



Wyoming
Department
of Health

Guidance for Control of
Carbapenem-Resistant
Enterobacteriaceae (CRE)

2017 Wyoming Toolkit

CONTENTS

Overview: 2017 Wyoming CRE Toolkit	2
Wyoming Department of Health CRE Definition	3
The resistance mechanism matters: Carbapenemase-producing CRE vs. non-carbapenemase-producing CRE	4
Carbapenemase-producing CRE (CP-CRE)	4
CRE which have acquired carbapenem resistance NOT due to carbapenemase production (non-CP-CRE)	4
CRE definition reference guide	5
Third generation Cephalosporins and CRE	5
Detection methods for CP-CRE	6
Recommendations for CRE Infection Control	7
Acute and Critical Access Hospitals	7
Part 1: General CRE prevention measures for Hospitals	7
Part 2: What to do when CRE are identified at your hospital	8
Recommendations after results of carbapenemase testing:	9
Skilled Nursing and Rehabilitation Facilities (SNFs)	12
Part 1: General CRE prevention measures for SNFs ³	12
Part 2: What to do when CRE is identified at your SNF	13
Additional recommendations based on the results of carbapenemase testing:	14
When and how to apply contact precautions ⁴ for CRE-positive residents in SNFs	16
Summary of recommendations for management of SNF residents with CRE	18
Ambulatory care, outpatient clinics, hemodialysis centers, ambulatory surgery centers, home health, hospice	19
Community-based care settings including assisted living facilities, residential care facilities, adult foster homes, memory care	21
Individuals colonized or infected with CRE living at home	23
Recommendations for Microbiology Laboratories	25
References	28
Appendix	30

OVERVIEW: 2017 WYOMING CRE TOOLKIT

The CRE Toolkit is designed to aid health care workers with carbapenem-resistant *Enterobacteriaceae* prevention, detection and treatment across the continuum of health care. This group would include physicians, infection preventionists, directors of nursing at skilled nursing facilities, nurses, microbiologists and health department personnel. Carbapenem-resistant *Enterobacteriaceae* (CRE) are an emerging threat to global health. Fortunately, these organisms remain rare in Wyoming. However, the potential for rapid spread and the difficulties confronted when treating CRE infections make it critically important for public health to maintain aggressive infection control measures.

As highlighted in the CDC Vital Signs, August 2015 issue titled, “Making health care safer: Stop spread of antibiotic resistance,” a coordinated, regional approach to prevent the spread of CRE is critical to reduce the impact of CRE on all of Wyoming’s facilities. Inappropriate antibiotic use and lack of infection prevention safeguards in one facility affects others because of shared health care providers and patient and resident transfers. (1)

Routine hand hygiene and ongoing monitoring of staff adherence to hand hygiene remains the single most important aspect of preventing CRE transmission and other MDROs! However, additional practices including appropriate antibiotic use, inter-facility communications and contact precautions are needed.

For any questions regarding this toolkit or CRE, please contact the Infectious Disease Epidemiology Unit of the Wyoming Department of Health at 1-877-996-9000.

Acknowledgement:

This toolkit was adapted from the *Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE) – 2016 Oregon Toolkit* produced by the Oregon Health Authority.(2) We thank them for giving us permission to adapt and reproduce much of their material. The original version can be found here: http://www.oregon.gov/oha/PH/DiseasesConditions/DiseasesAZ/CRE1/cre_toolkit.pdf

WYOMING DEPARTMENT OF HEALTH CRE DEFINITION

The Wyoming Department of Health defines CRE as any *Enterobacteriaceae*:

- That are resistant to at least one carbapenem (including imipenem¹, meropenem, doripenem, or ertapenem) using the current M100-S25 CLSI breakpoints²;
OR
- That test positive for carbapenemase production by the Carba NP test;
OR
- That test positive for a known carbapenemase gene by nucleic acid amplification testing.

Table: CLSI breakpoints, 2015 (3)

	Current MIC breakpoints (µg/mL)		
	MIC Interpretation ²		
Carbapenems	Susceptible	Intermediate	Resistant
Doripenem	≤1	2	≥4
Ertapenem	≤0.5	1	≥2
Imipenem	≤1	2	≥4
Meropenem	≤1	2	≥4
	Current disk diffusion zone diameters (mm)		
	Interpretation		
Carbapenems	Susceptible	Intermediate	Resistant
Doripenem	≥23	20-22	≤19
Ertapenem	≥22	19-21	≤18
Imipenem	≥23	20-22	≤19
Meropenem	≥23	20-22	≤19

¹ *Proteus* spp., *Providencia* spp. and *Morganella* spp., which are intrinsically resistant to imipenem, are excluded from this definition if only imipenem resistance is detected. To fit the CRE definition any of these genera must also demonstrate resistance to other carbapenems.

² Laboratories still using breakpoints before the June 2010 CLSI update should use the updated CLSI MIC cutoffs to determine reporting to public health, independent of the susceptibility interpretation (e. g., an isolate with an MIC of 8 to meropenem [“intermediate” by pre-2010 CLSI interpretation, but “resistant” by CLSI guidelines starting in 2011] should still be reported to WPHL and submitted for further evaluation).

THE RESISTANCE MECHANISM MATTERS: CARBAPENEMASE-PRODUCING CRE VS. NON-CARBAPENEMASE-PRODUCING CRE

We believe the CRE resistance mechanism should guide the prevention and control response. Microbiology laboratory susceptibility testing does not reliably differentiate resistance mechanisms; as a result, the Wyoming Public Health Laboratory (WPHL) has implemented a rapid mechanism for testing all Wyoming CRE isolates.

CARBAPENEMASE-PRODUCING CRE (CP-CRE)

CP-CRE are primarily responsible for the rapid worldwide spread of CRE. Since CRE was not reportable in Wyoming until 2017, we do not have prevalence data yet, but believe it is still rare. Potential for rapid spread, treatment difficulties and poor outcomes make it critically important for public health to maintain aggressive infection control measures. Resistance among CP-CRE is conferred by enzymes that directly break apart the carbapenem ring, inactivating the antibiotic.

When these carbapenemase enzymes are located on plasmids, this can facilitate transmission in and among bacterial species and contribute to rapid dissemination. Plasmid mediated carbapenemases are a reason for the rapid worldwide spread of CP-CRE.(4, 5) 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). KPC is the most widespread carbapenemase in the United States.(6)

We define CP-CRE as *Enterobacteriaceae* that are nucleic acid amplification testing (NAAT)-positive for carbapenemase production (e.g., KPC, NDM, VIM, IMP, OXA-48).

- For operational purposes, organisms are considered “presumptive CP-CRE” if testing is positive with Carba NP test.
- *Serratia marcescens* may produce a chromosomally-encoded carbapenemase called the *S. marcescens* enzyme (SME). Because it is located on the chromosome and not on a plasmid, it appears to have a limited potential for rapid global spread. The most aggressive control measures otherwise recommended for CP-CRE do not apply for SME-producing *S. marcescens* isolates.

CRE WHICH HAVE ACQUIRED CARBAPENEM RESISTANCE NOT DUE TO CARBAPENEMASE PRODUCTION (NON-CP-CRE)

Non-CP-CRE include *Enterobacteriaceae* that are resistant to at least one carbapenem through susceptibility testing, but test Carba-NP and PCR-negative for carbapenemases. Non-CP-CRE spread is less of a global threat, since these mechanisms of antibiotic resistance are not as easily transferable between species as compared to CP-CRE mechanisms, and are not typically sustained in the absence of antibiotic pressure. While non-CP-CRE are more common and less worrisome than CP-CRE, these organisms are typically highly drug-resistant, important to control at the facility level, and require intensified infection control measures, including contact precautions. Rather than direct carbapenem hydrolysis, non-CP-CRE resistance is mediated by a combination of mechanisms, typically through production of an extended

spectrum cephalosporinase (e.g., AmpC) or an extended spectrum β -lactamase (ESBL) plus decreased permeability of the bacterial cell wall (e.g., porin mutations).

CRE DEFINITION REFERENCE GUIDE

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

- Commonly encountered *Enterobacteriaceae* include: *E. coli*, *Klebsiella* spp., *Enterobacter* spp., *Proteus* spp., *Providencia* spp., *Morganella* spp., *Citrobacter* spp., *Serratia* spp. and *Salmonella* spp.
- *Pseudomonas* spp. and *Acinetobacter* spp. are NOT *Enterobacteriaceae*. However, carbapenem resistance in these species is 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 CRE screening carbapenem used. For laboratories still using the CLSI breakpoints predating the 2010 update, ertapenem non-susceptibility may be the only indicator of CP-CRE.
- *Proteus* spp., *Providencia* spp. and *Morganella* spp. are innately non-susceptible to imipenem. For laboratories using the updated CLSI breakpoints, it is common to encounter imipenem non-susceptible organisms (MICs 2–4 $\mu\text{g}/\text{mL}$). This specific resistance to imipenem is naturally occurring, is not usually associated with other acquired drug resistance, and is not a public health focus. Therefore, *Proteus* spp., *Providencia* spp. and *Morganella* spp. that are ONLY imipenem resistant and doripenem, ertapenem or meropenem susceptible are excluded from the Wyoming CRE case counts. However, isolates resistant to other carbapenems should be reported since resistance for these is not innate.

THIRD GENERATION CEPHALOSPORINS AND CRE

We do not include third generation cephalosporin resistance in the Wyoming CRE definition for the reasons outlined below:

1. Per a recent CDC study, the third generation cephalosporin requirement did not substantially enhance the specificity of CP-CRE detection. Accordingly, CDC has dropped third generation cephalosporin-resistance from the CDC CRE definition.
2. OXA-48 carbapenemases, unless linked to other resistance mechanisms, are not innately cephalosporin-resistant and would potentially be missed using the prior CDC CRE definitions. To date, we have not identified any OXA-48-producing CRE in Wyoming.

DETECTION METHODS FOR CP-CRE

- **Carba NP Test:** A rapid, accurate technique for carbapenemase detection.(7-9) The test identifies the hydrolysis of the β -lactam ring of a carbapenem. A buffered suspension of the organism is combined with a solution of imipenem and phenol red; a positive test is defined as a color change from red to yellow. While accurate for the most commonly encountered carbapenemases in the U.S. (KPC and NDM), false negatives are known to occur when using the Carba NP test to detect OXA-48 carbapenemases and overall sensitivity is likely to be reduced when mucoid strains are tested. The Wyoming Public Health Laboratory uses a commercially available version of the Carba NP Test.
- **Nucleic acid amplification testing (NAAT):** NAAT is typically performed on pure colonies of a bacteria obtained by culture, which involves growing, isolating and identifying an organism from clinical samples. NAAT testing for resistance markers directly from positive blood culture bottles is also possible. Examples of NAAT include PCR and transcription-mediated amplification (TMA).
 - **NAAT: Isolated colonies. Testing CRE isolates for the presence of a carbapenemase gene is the most accurate way to detect CP-CRE.** While carbapenemase PCR testing of bacterial isolates is currently not performed by any Wyoming clinical labs, the Wyoming Public Health Laboratory (WPHL) has the capacity to perform PCR testing for the most commonly encountered global carbapenemases including KPC and NDM. WPHL works with the CDC Antibiotic Resistance Regional Laboratory in Texas to test for other carbapenemases and confirm isolates.
 - **NAAT: Positive blood cultures.** Several molecular platforms are FDA-cleared for identifying organisms and detecting antibiotic resistance markers, including carbapenemases directly from positive blood culture bottles. Example platforms include the FilmArray® Blood Culture Identification (BCID) Panel (BioFire, Salt Lake City, UT) and the Verigene® Gram-Negative Blood Culture Test (Nanosphere, Northbrook, IL).(10,11)
- **Modified Hodge test (MHT):** A laboratory test that relies on specific growth characteristics of the organism to indirectly assess carbapenemase production. While the MHT is accurate for detection of KPC-production in *E. coli* and *Klebsiella* spp., MHT is NOT accurate in AmpC cephalosporinase containing organisms (most frequently *Enterobacter* spp.) due to a high false-positive rate. Also, MHT has variable accuracy in detecting carbapenemases other than KPC. (9, 12-14) In the 2015 CLSI laboratory susceptibility testing standards update, the Carba NP test has replaced MHT as the recommended test to perform for carbapenemase detection.(3)

RECOMMENDATIONS FOR CRE INFECTION CONTROL

ACUTE AND CRITICAL ACCESS HOSPITALS

In summary, act “NICE” to prevent the spread of CRE:

Notify the Wyoming Department of Health and pertinent clinician groups when any type of CRE are identified. Additionally, for carbapenemase-producing CRE (CP-CRE), notify hospital administration

Intervene on all cases with core infection prevention and control strategies including hand hygiene, contact precautions, private rooms and optimized environmental cleaning. Reduce unnecessary antibiotics and invasive devices.

Additionally, for CP-CRE:

- Cohort patients – monitor adherence to hand hygiene, contact precautions;
- Environmental cleaning – use chlorhexidine to bathe the affected patients; and
- Screen high-risk patient contacts

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

Educate residents, staff and visitors about CRE.

PART 1: GENERAL CRE PREVENTION MEASURES FOR HOSPITALS

1. **Align your facility’s CRE definition with the WDH definition.** Know and verify the accuracy of CLSI criteria your microbiology laboratory uses to detect CRE.
2. **Ensure adequate processes to facilitate rapid notification of clinical and infection prevention and control (IPC) staff** when CRE are identified in the microbiology laboratory.
3. **Have a plan for notifying other healthcare facilities upon patient transfer.**
 - a. Do not assume that just because it is in their chart, the receiving facility knows the patient has CRE.
 - b. When a referring health care facility transfers or discharges a patient who is infected or colonized with a multi-drug-resistant organism (MDRO) or pathogen that warrants

Transmission-based Precautions, consider including written notification of the infection or colonization to the receiving facility in transfer documents.

- c. The referring facility should ensure that the documentation is readily accessible to all parties involved in patient transfer (for example, referring facility, medical transport, emergency department, receiving facility).
- d. Consider communicating MDRO status on transfer for one year following the last positive CRE test.

Sample inter-facility transfer forms can be found in the appendix and at the following website:

<https://health.wyo.gov/publichealth/infectious-disease-epidemiology-unit/disease/cre/>

4. **Educate the staff about CRE.** Consider giving an in-service to staff about CRE and other multi-drug-resistant Gram-negative organisms (MDROs). Sample CRE educational materials are attached as appendices; further materials are available at: <https://www.cdc.gov/hai/organisms/cre/index.html> and <https://health.wyo.gov/publichealth/lab/ast/>
5. **Consider reviewing microbiology laboratory records** for the past 12 months to identify any previously unrecognized CRE cases in consultation with laboratory personnel.
 - a. Report any new cases discovered to WDH.
6. **Consider implementing perirectal active surveillance cultures** for patients who are at high-risk for CRE colonization upon hospital admission.
 - a. Given the current epidemiology of CP-CRE, one suggested approach is to screen newly admitted patients who have been hospitalized overnight internationally or outside of the Mountain West within the past six months. For basic assistance on determining global and national CP-CRE epidemiology, we recommend the following links:
 - i. www.cdc.gov/hai/organisms/cre/TrackingCRE.html
 - ii. wwwnc.cdc.gov/eid/article/17/10/pdfs/11-0655.pdf
 - iii. www.ncbi.nlm.nih.gov/pubmed/24930781
 - iv. CDC's Antibiotic Resistance Patient Safety Atlas. This website is a freely available dashboard that includes CRE prevalence by state:
<https://www.cdc.gov/hai/surveillance/ar-patient-safety-atlas.html>

PART 2: WHAT TO DO WHEN CRE ARE IDENTIFIED AT YOUR HOSPITAL

Initial recommendations before carbapenemase testing:

1. **Notify the Wyoming Department of Health** within one business day of identification of a patient isolate meeting the CRE case definition. Report any new cases or known cases transferred from out-of-state. Both laboratories and clinicians are required to report cases. Information on how to report: <https://health.wyo.gov/publichealth/infectious-disease-epidemiology-unit/reporting/> If your facility identifies a CRE, a further requirement is to submit an isolate to the WPHL for confirmatory testing. The WPHL submission form can be found at: https://health.wyo.gov/wp-content/uploads/2016/04/35-18353_testrequestfillable2016.pdf

2. **Upon patient transfer to another health care facility, notify the receiving facility the patient has CRE in a readily available written manner in addition to verbal communication.** An example transfer form is provided in the appendix. Be sure the individuals directly caring for the patient and those responsible for infection prevention at the receiving facility are aware of the patient’s CRE status.
3. **Place CRE-infected and CRE-colonized patients in contact precautions.** Empower staff to monitor and enforce contact precautions.
 - a. Continue contact precautions for hospitalization duration.
 - b. “Flag” the chart of a CRE-positive patient so they can be identified and placed in contact precautions immediately if re-admitted.
4. **Place CRE-infected and CRE-colonized patients in private rooms.** If the number of single patient rooms is limited, prioritize single rooms for CRE-positive patients with higher transmission risk such as stool incontinence. Cohort CRE-positive patients if private rooms are unavailable.
5. **Educate staff, affected patients and their visitors about CRE.** Education helps reduce the spread of CRE.
6. **Reinforce the importance of adherence to core infection prevention measures of hand hygiene, contact precautions and environmental cleaning through periodic audits and observations.** Consider monitoring adherence to all core MDRO prevention measures.
7. **Notify pertinent clinician groups (infectious diseases, critical care, pharmacy, antibiotic stewardship program [ASP], etc.) of CRE in the facility.**
 - a. Consider initiating a formal ASP if your facility does not have one already. See CDC website www.cdc.gov/getsmart/healthcare/inpatient-stewardship.html and/or contact WDH to find out how to start your program.
8. **Directly interface with clinicians caring for the CRE-infected or CRE-colonized patient.** Encourage limiting antibiotics and invasive devices.

RECOMMENDATIONS AFTER RESULTS OF CARBAPENEMASE TESTING:

For non-CP-CRE: continue contact precautions per recent CDC guidance; no additional measures are required. (2,15)

For CP-CRE: implement the following additional measures:

1. **Notify the Wyoming Department of Health in addition to receiving facility upon patient transfer.** A copy of the transfer notification should be faxed to the local health department where the person resides.

2. **Notify hospital administration.** Prevention of spread needs to be an institutional priority, which requires leadership and monetary support.
3. **Review microbiology records** to identify any other CP-CRE cases at the facility within the past 12 months. Review of microbiology records can detect outbreaks of CRE such as those reported in association with contaminated medical equipment.(16)
4. **Educate staff, patients and visitors about CP-CRE.**
5. **Monitor adherence to hand hygiene and contact precautions for the room(s) of CP-CRE-positive patients.**
 - a. Strongly consider a hand-hygiene campaign on affected units.
 - b. Review with and evaluate staff on use of contact precautions.
6. **Alert housekeeping and monitor environmental cleaning.** Encourage frequent thorough cleaning of high-touch surfaces, particularly those near the patient, and common areas outside the room. Evaluate terminal cleaning using visual inspection plus quantitative strategies such as UV fluorescence marker or ATP monitor before placing another patient in that room. If available, supplement manual cleaning with UV light, hydrogen peroxide vapor or another “no touch” modality. See the CDC environmental cleaning monitoring tool in the appendix.
7. **Give the patient daily chlorhexidine (CHG) baths, if no contraindications are present.** Also, consider unit-wide CHG bathing, particularly if >1 CRE case in an area is identified. CHG bathing reduces CRE skin contamination and has been a component of several successful CRE-eradication bundles.(17,18)
8. **Verify and audit decontamination, disinfection, reprocessing, and sterilization (when needed) of reusable medical equipment used by CP-CRE patients.**
9. **In consultation with WDH, obtain CP-CRE screening cultures for high-risk health care facility contacts.** Expand the screening pool if initial testing reveals additional cases. Considerations for contacts at highest risk include factors related to duration and intensity of exposure to the case patient including:
 - a. Proximity to case patient;
 - b. Shared nurses, physicians, and other health care providers;
 - c. The intensity of nursing required;
 - d. Stool and urine incontinence;
 - e. Shared medical equipment or procedures; and
 - f. Length of stay.

For example, it is important to screen roommates, even if already discharged. Other local factors may be considered; each situation is unique, and the final approach will be based on discussions between WDH and the hospital.

Pertinent screening culture details include:

- See the microbiology laboratory section for the recommended screening protocol.
 - If MRSA, VRE or other multidrug-resistant organism (MDRO) screening is performed in your facility, a similar consent process may be used. Either verbal or written consent, depending on your facility's policies and procedures, could be appropriate. See the appendix for a sample consent form.
 - Specimens for screening cultures may be obtained by anyone who is qualified (see appendix).
 - The recommended screening sites are either rectal or perirectal swabs. Enhanced sensitivity may be achieved by screening both wounds and urine, if catheters are in place. The cost-benefit ratio of screening additional sites is uncertain and therefore not routinely recommended.
 - Generally, screening cultures should not be billed to the patient; discuss billing with the microbiology laboratory, facility leadership and WDH. If approved by the WDH Infectious Disease Epidemiology Unit, WPHL does not charge for testing CRE screening cultures.
 - Keep a record of screening culture results and “flag” any CRE-colonized patient for appropriate infection control.
10. **Cohort nursing staff that care for CP-CRE-positive patients as resources allow.** This is most important and more feasible in the situation of ≥ 2 CP-CRE-positive patients. Cohorted nursing to ratios as low as 1:1 has been key to preventing further transmission in several outbreaks.
11. **In the event >1 case is detected, cohort patients to one hospital ward when technically feasible.** Private rooms for each patient are still recommended.
12. **In the event of a cluster of cases, consider active surveillance cultures.** Unlike screening cultures for high-risk contacts, which is routinely recommended for CP-CRE cases, this approach is the systematic screening of a predefined patient population, such as all ICU admissions or patients having stool samples already obtained for *C. difficile* testing.⁽¹⁹⁾ Typically surveillance cultures are performed on admission and periodically for affected wards or areas. Surveillance cultures are another strategy successfully used as part of an intervention bundle to control outbreaks.^(17,18)

SKILLED NURSING AND REHABILITATION FACILITIES (SNFS)

In summary, act “NICE” to prevent the spread of CRE:

Notify the Wyoming Department of Health and pertinent clinician groups when any type of CRE are identified. Additionally, for carbapenemase-producing CRE (CP-CRE), notify facility administration

Intervene on all cases with improved facility-wide hand hygiene and environmental cleaning while reducing unnecessary antibiotics and use of invasive devices. Place residents with CP-CRE in private rooms, if available, and use contact precautions for in-room care.

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

Educate residents, staff and visitors about CRE.

PART 1: GENERAL CRE PREVENTION MEASURES FOR SNFS³

1. **Align your facility’s CRE definition with the WDH definition.**
2. **Ensure adequate processes are in place for rapid notification of pertinent staff** when CRE and other MDROs are identified by the microbiology laboratory. This should include requesting the laboratory to call and notify the facility when CRE are identified.
3. **Ensure routine adherence to hand hygiene:**
 - Before touching a resident, even if gloves will be worn;
 - Before exiting the resident’s care area after touching the resident or the resident’s immediate environment;
 - After contact with blood, body fluids or excretions, or wound dressings;
 - Before performing an aseptic task such as capillary blood glucose (CBG) testing or giving a subcutaneous injection (must wear gloves);
 - If hands move from contaminated body sites to clean body sites during resident care; and
 - After glove removal.

4. **Ensure sufficient and appropriate PPE (gloves and gowns) is available and readily accessible, and caregivers understand and are trained on when and how to use it.**
5. **When transferring a patient with CRE, consider providing written notification of the condition on an inter-facility transfer form.** When a referring health care facility transfers or discharges a patient who is infected or colonized with a multi-drug-resistant organism (MDRO) or pathogen which warrants Transmission-based Precautions, it should include written notification of the infection or colonization to the receiving facility in transfer documents. The referring facility should ensure the documentation is readily accessible to all parties involved in patient transfer (for example, referring facility, medical transport, emergency department, receiving facility). MDRO status should be communicated on transfer for one year following the last positive CRE test. Sample inter-facility transfer forms can be found at the following website:
<https://health.wyo.gov/publichealth/infectious-disease-epidemiology-unit/disease/cre/>
6. **Educate staff about CRE.** Consider giving an in-service to staff about CRE and other multidrug-resistant Gram-negative organisms (MDROs). Sample CRE educational materials are attached as appendices.
7. **Review general infection prevention and control policies and ensure appropriate training, competencies and audits are in place.** Examples of important basic issues are standard precautions including hand hygiene, contact precautions, linen reprocessing and environmental cleaning. For environmental cleaning, ensure housekeeping is properly using an EPA-registered disinfectant labeled for use in health care.
8. **Familiarize your staff with infection criteria and surveillance definitions in long term care settings.**(20)

³ Skilled nursing facility (SNF) means a licensed long-term care facility providing care for persons with severe and/or unstable health problems that cannot be managed at the intermediate care level, requiring the availability of a registered nurse 24 hours daily, seven days a week, but not requiring the levels of nursing, physician and specialized services available in a hospital.

PART 2: WHAT TO DO WHEN CRE IS IDENTIFIED AT YOUR SNF

1. **Promote hand hygiene and monitor staff adherence to hand hygiene: this is the single most important aspect of preventing CRE transmission!** A long-term care facility hand hygiene observation tool developed by the Oregon Patient Safety Commission (OPSC) can be found in the appendix or the OPSC website at <http://oregonpatientsafety.org>.
2. **Notify the Wyoming Department of Health** within one business day of identification of a patient isolate meeting the CRE case definition. Report any new cases or known cases transferred from out-of-state. Laboratories and clinicians are required to report cases and submit and isolate for confirmatory testing at the WPHL.
3. **Work with public health to develop the appropriate infection prevention plan for the resident including the need for contact precautions,** based on the resident's clinical status and other

medical and social needs. Refer to “When and how to apply contact precautions to residents” below.

4. **Upon resident transfer to another health care facility, inform the receiving facility, in writing, that the resident has CRE.** An example transfer form is provided as an appendix. Be sure people directly caring for the patient and responsible for infection prevention are aware the resident has CRE.
5. **Review the importance of meticulous environmental cleaning with the housekeepers.** This includes at a minimum, daily room and bathroom cleaning and attention to “high-touch” surfaces such as light switches, door knobs and bathroom handrails. Two long-term care facility environmental cleaning checklists, one for resident rooms and one for common areas, can be found in the appendix.
6. **If a CRE-infected or CRE-colonized resident is discharged home, ensure they are aware of their CRE colonization 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.
7. **Educate staff, affected residents and their visitors about CRE.** Education helps reduce the spread of CRE.
8. **Notify pertinent clinicians (medical director, director of nursing, contracted pharmacist, etc.) of CRE in the facility.** Specific goals:
 - Limit use of catheters, tubes and other invasive devices in all residents.
 - Stop unnecessary antibiotic use in all residents, especially those who are CRE-positive.
 - Review monthly antibiotic use and culture orders and susceptibility patterns to evaluate appropriate antibiotic use and identify if unnecessary antibiotics and cultures were ordered. If interested, contact WDH for information on antimicrobial stewardship programs in long-term care facilities.

ADDITIONAL RECOMMENDATIONS BASED ON THE RESULTS OF CARBAPENEMASE TESTING:

For non-CP-CRE, no additional measures are required. Refer to the section titled “When and how to apply contact precautions for CRE-positive residents in SNFs” for a discussion of how to determine whether contact precautions should be used.

For CP-CRE, implement the following additional measures:

1. **Notify Wyoming Department of Health, in addition to the receiving facility, upon resident transfer.**
2. **Notify facility administration. Prevention of spread needs to be an institutional priority,** which requires leadership and monetary support.

3. **Review your facility's microbiology records** within the past 12 months to identify any other recent CP-CRE cases.
4. **Educate staff, affected residents and their visitors about CP-CRE.**
5. **Monitor facility-wide hand hygiene adherence, particularly for the room(s) of CP-CRE-positive residents.** Use the case as an opportunity to initiate a facility-wide hand hygiene campaign.
6. **We strongly encourage private single bed rooms for all residents infected or colonized with CP-CRE.** This will decrease the chance of CP-CRE transmission within the facility. Note: this recommendation is separate from and does not mean "isolation," which would typically be reserved for residents with active CRE infection with high transmission risk due to their inability to contain their body fluids or wound drainage. Isolation is considered an adjunct method to contact precautions focused on decreasing transmission from an actively ill person to others. See below for details.
7. **If feasible, when >1 CP-CRE case is identified at the facility, cohort the residents by housing them in same wing, even if they are in single-bed rooms.**
8. **Alert housekeeping and monitor adequacy of environmental cleaning.** Encourage frequent, thorough cleaning of high-touch surfaces in and outside the room. Use the long-term care facility environmental cleaning checklists, one for resident rooms and one for common areas provided in the appendix. Determine and fix any gaps in the adequacy of room cleaning on discharge or transfer before placing another resident in the room. If available, use additional strategies to check cleaning adequacy, such as UV fluorescence markers or ATP monitors.
9. **Verify and audit decontamination, disinfection, reprocessing, and sterilization (when needed) of reusable medical equipment used by CP-CRE residents.**
10. **In consultation with WDH, obtain CRE screening cultures for high-risk health care facility contacts.** Expand the screening pool if initial testing reveals additional cases. Considerations for contacts at highest risk include factors related to duration and intensity of exposure to the known CRE-positive resident, including the following:
 - a. Proximity to CRE-positive resident;
 - b. Shared health care providers;
 - c. Intensity of nursing required;
 - d. Stool or urine incontinence;
 - e. Shared medical equipment or procedures; and
 - f. Length of stay.

For example, it is important to screen roommates, even if already discharged. Other local factors should be considered; each situation is unique, and the final approach will be based on discussions between public health and the facility.

Pertinent screening culture details include:

- See the microbiology laboratory section for the recommended screening protocol. WDH is available for consultation and assistance throughout the process.
 - If MRSA, VRE or other multidrug-resistant organism (MDRO) screening is performed in your facility, a similar consent process may be used. Either verbal or written consent, depending on your facility's policies and procedures, could be appropriate. See the appendix for a sample consent form.
 - Specimens for screening cultures may be obtained by anyone who is qualified (see appendix).
 - The recommended screening sites are either rectal or perirectal swabs. Enhanced sensitivity may be achieved by screening both wounds and urine, if catheters are in place. The cost-benefit ratio of screening additional sites is uncertain and therefore not routinely recommended.
 - Generally, screening cultures should not be billed to the patient; discuss billing with the microbiology laboratory, facility leadership and WDH. If approved by the WDH Infectious Disease Epidemiology Unit, WPHL does not charge for testing CRE screening cultures.
 - Keep a record of screening culture results and "flag" any CRE-colonized residents for appropriate infection control. 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.
11. **Cohort staff that care for CP-CRE-positive residents as resources allow.** In long-term care, this generally means assigning the same group of caregivers to the resident instead of assigning caregivers who may float to other wards or wings of the facility.
12. In the rare event of an outbreak, consult with WDH regarding the need for supplemental measures including chlorhexidine (CHG) bathing and active surveillance cultures.

WHEN AND HOW TO APPLY CONTACT PRECAUTIONS⁴ FOR CRE-POSITIVE RESIDENTS IN SNFS

For whom:

- CP-CRE-infected or colonized residents;
- Residents infected with non-CP-CRE or other target MDROs; and
- Residents colonized with non-CP-CRE or other target multidrug-resistant organisms (MDROs) who are at a higher-risk for transmission.

How to apply: Staff must use gowns and gloves for all in-room resident care.

Important details:

1. **Room restriction:** CRE-positive residents should not be discouraged from participating in daily community meals and activities outside of their room, provided their source of CRE is covered and contained.
2. **Do not forget hand hygiene** is KEY to preventing CRE transmission, and the appropriate use of in-room care contact precautions provides an additional measure of protection. Staff should be reminded to perform hand hygiene before donning and after doffing gloves and gowns.
3. **Standard precautions should be employed for all residents.**(21) This includes the use of gowns and gloves for anticipated contact with body fluid or potential splashes and when changing soiled bed linens. Refer to the “Standard precautions” section in the “Ambulatory care” section of the CRE toolkit for additional information.

Working definition of residents at “higher-risk for transmission” based on CDC guidance (21):

- Ventilator-dependent;
- Uncontained incontinence of stool;
- Uncontained incontinence of urine; and/or
- Wounds with difficult to control drainage.

Consult public health for individualized case recommendations when the need for contact precautions is uncertain.

⁴ Contact precautions are a part of transmission-based precautions, where the type of personal protective equipment (PPE) is chosen to fit the clinical situation. For example, contact precautions involve using gown and gloves when administering care to a resident or contacting their room environment. Droplet precautions means using a facemask and face-shield to prevent contact with respiratory droplets. “Precautions” DO NOT mean “isolation.” Isolation is a selective adjunct to transmission-based precautions when additional separation of an ill person is necessary to prevent transmission of the infectious diseases. For example, a person with active symptoms of Influenza or norovirus should be isolated to their room until symptoms resolve, and caregivers must use certain transmission-based precautions when administering care.

When can contact precautions for residents with CP-CRE be discontinued?

Discontinue contact precautions when the resident has at least three negative screening cultures per the following algorithm:

- Three negative screening cultures that are:
 - At least three months after the last positive culture; AND
 - At least three months after last course of antibiotics; AND
 - Each culture obtained ≥ 1 week apart.
- The recommended screening sites are either rectal or perirectal swabs. If the original site of infection is still present such as a wound that hasn’t healed or urine from a chronically catheterized patient, at least one culture from such sites should be added to the screening from the GI tract.

SUMMARY OF RECOMMENDATIONS FOR MANAGEMENT OF SNF RESIDENTS WITH CRE

Measure	CP-CRE Infection	CP-CRE Colonization	Non-CP-CRE Infection	Non-CP-CRE Colonization ^{††}
Notify Receiving facility	Yes	Yes	Yes	Yes
Notify WDH upon transfer or death	Yes	Yes	No	No
Standard Precautions	Yes	Yes	Yes	Yes
Contact Precautions [†] Gown/gloves for in-room resident care	Yes	Yes	Yes	For residents at higher risk of CRE transmission
Door Signage	Yes	Yes	Yes	For residents at higher risk of CRE transmission
Private Room	Yes (strongly encouraged)	Yes (strongly encouraged)	Yes	No
Restricted to room	Yes	No**	No**	No**
Enhanced Environmental Cleaning	Yes	Yes	Yes	No
Designated or disposable equipment	Yes	Yes	Yes	No
If >1 case, cohort staff if feasible	Yes	Yes	Optional	Optional
If >1 case, cohort residents if feasible	Yes	Yes	Optional	Optional
Consult with WDH regarding screening cultures	Yes	Yes	No	No
Visitor recommendations:				
<ul style="list-style-type: none"> Perform hand hygiene often, particularly after leaving the resident's room. 	Yes	Yes	Yes	Yes
<ul style="list-style-type: none"> Gown/gloves if contact with body fluids is anticipated. 	Yes	Yes	Yes	Yes
<ul style="list-style-type: none"> Gown/gloves if no contact with body fluids is anticipated. 	No	No	No	No

* Report MDRO on transfer communication form for one year following the most recent positive CRE test.

† Contact precautions means using a gown and gloves for any in-room resident care. Residents colonized with non-CPCRE require contact precautions if they are at higher risk for CRE transmission (see text).

** Restricted to room. Residents should be restricted to their rooms if they are not able to contain their secretions and excretions. Residents for whom secretions and excretions can be contained may leave their rooms. Upon leaving their rooms, all residents should be clean, fluids contained, able to follow instructions with assistance and should wash their hands.

†† Colonization with CRE means the organism is present on the body but is not causing symptoms of disease. Colonizing CRE can go on to cause infections of various body sites such as blood, urinary tract, or lungs. (Source: Centers for Disease Control and Prevention. Carbapenem-resistant *Enterobacteriaceae* (CRE) Infection: Clinician FAQs. <http://www.cdc.gov/hai/organisms/cre/cre-clinicianFAQ.html>; accessed Nov 17, 2015)

AMBULATORY CARE, OUTPATIENT CLINICS, HEMODIALYSIS CENTERS, AMBULATORY SURGERY CENTERS, HOME HEALTH, HOSPICE

We recommend employing standard precautions.

Refer to the 2011 CDC booklet titled the “**Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care**,” available here: <http://www.cdc.gov/HAI/settings/outpatient/outpatient-care-guidelines.html> (22) The most pertinent infection prevention and control measures for preventing the transmission of CRE, MDROs, norovirus and many other infections in ambulatory care setting are **adherence to hand hygiene and 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:**

- a. Before touching a patient, even if gloves will be worn;
- b. Before exiting the patient’s care area after touching the patient or the patient’s immediate environment;
- c. After contact with blood, body fluids or excretions, or wound dressings;
- d. Before performing an aseptic task such as placing an IV, preparing an injection;
- e. If hands move from contaminated body sites to clean-body sites in patient care; and
- f. After glove removal

2. **The preferred method of hand decontamination is with an alcohol-based hand rub.**

- a. **Exception:** use soap and water when hands are visibly soiled or after caring for patients with known or suspected infectious diarrhea such as *Clostridium difficile* or norovirus, or after using the restroom.

Key recommendations for use of PPE in ambulatory care settings:

1. **Facilities should ensure sufficient and appropriate PPE is available and readily accessible.**

2. **Educate all health care providers on proper selection and use of PPE.**

3. **Remove and discard PPE before leaving the patient’s room or area; and**

4. **Wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment:**

- a. Do not wear the same pair of gloves for the care of more than one patient;
- b. Do not wash gloves for the purpose of reuse; and
- c. 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:**

- a. 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 and when injecting material into these spaces.**

We strongly recommend outpatient settings use the checklist included with the “Guide to Infection Prevention for Outpatient Settings” document to review current policies and practices. Topics include transmission-based precautions, safe injection practices and safe medication storage.

COMMUNITY-BASED CARE SETTINGS INCLUDING ASSISTED LIVING FACILITIES, RESIDENTIAL CARE FACILITIES, ADULT FOSTER HOMES, MEMORY CARE

Standard precautions are recommended.

The most important infection prevention and control measures for CRE and other MDROs in the community based care setting are similar to those in outpatient and ambulatory care. Refer to the 2011 CDC booklet titled the “**Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care,**” available here: www.cdc.gov/HAI/settings/outpatient/outpatient-care-guidelines.html.(21) The most important infection prevention and control measures to prevent transmission of CRE, MDROs, norovirus and many other infections in community-based care settings are **adherence to hand hygiene and proper use of personal protective equipment (PPE) when handling bodily fluids.**

Key recommendations for hand hygiene in community-based care settings:

1. **Key situations where hand hygiene should be performed include:**
 - a. Before touching the colonized or infected person, even if gloves will be worn;
 - b. Before exiting the care area after touching the colonized or infected person or their immediate environment;
 - c. After contact with blood, body fluids or excretions, or wound dressings;
 - d. Before performing an aseptic task such as placing an IV, blood glucose monitoring, preparing an injection;
 - e. If hands move from contaminated body sites to clean body sites during care; and
 - f. After glove removal.

2. **The preferred method of hand decontamination is with an alcohol-based hand rub.**
 - a. **Exception:** use soap and water when hands are visibly soiled or after caring for residents with known or suspected infectious diarrhea such as *Clostridium difficile* or norovirus, or after using the restroom.

Key recommendations for use of PPE in community-based care settings:

1. **Facilities should ensure sufficient and appropriate PPE is available and readily accessible.**
2. **Educate all health care providers on proper selection and use of PPE.**
3. **Remove and discard PPE before leaving the resident’s room or area.**
4. **Wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment:**
 - a. Do not wear the same pair of gloves for the care of more than one resident;
 - b. Do not wash gloves for the purpose of reuse; and
 - c. 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:**
 - a. Do not wear the same gown for the care of more than one resident.
6. **Wear mouth, nose and eye protection during procedures that are likely to generate splashes or sprays of blood or other body fluids.**

We strongly recommend community-based care settings use the checklist included with the “Guide to Infection Prevention for Outpatient Settings” document to review current policies and practices. Topics include transmission-based precautions, safe injection practices and safe medication storage.

INDIVIDUALS COLONIZED OR INFECTED WITH CRE LIVING AT HOME

We recommend good hand hygiene and CRE education.

The most important message for persons living at home who are colonized or infected with CRE and other MDROs is adherence to good hand hygiene. CRE education is also important; CRE-positive persons should be informed that if they are hospitalized, additional precautions will be taken when they receive care and they should inform their health care providers of their history of CRE.

Family members or health care employees providing patient care in the home setting should use standard precautions and adhere to hand hygiene guidelines:

Key recommendations for hand hygiene in home settings:

- 1. Key situations where hand hygiene should be performed include:**
 - a. Before touching the colonized or infected person, even if gloves will be worn;
 - b. Before exiting the care area after touching the colonized or infected person or their immediate environment;
 - c. After contact with blood, body fluids or excretions, or wound dressings;
 - d. Before performing an aseptic task such as placing an IV, blood glucose monitoring, preparing an injection;
 - e. If hands move from contaminated body sites to clean body sites during care; and
 - f. After glove removal.

- 2. The preferred method of hand decontamination is with an alcohol-based hand rub**
 - a. **Exception:** use soap and water when hands are visibly soiled or after caring for persons with known or suspected infectious diarrhea such as *Clostridium difficile* or norovirus, or after using the restroom.

Key recommendations for use of PPE in home settings:

- 1. Home care agencies should ensure sufficient and appropriate PPE is available and readily accessible.**
- 2. Educate all health care providers on proper selection and use of PPE.**
- 3. Remove and discard PPE before leaving the room or area.**
- 4. Wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment:**
 - a. Do not wear the same pair of gloves for the care of more than one person;
 - b. Do not wash gloves for the purpose of reuse; and
 - c. 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:**

a. Do not wear the same gown for the care of more than one person.

6. Wear mouth, nose and eye protection during procedures that are likely to generate splashes or sprays of blood or other body fluids

For additional information on infection prevention in your home, please refer to the Association for Professionals in Infection Control and Epidemiology (APIC) resources: <http://consumers.site.apic.org/infection-prevention-in/your-home/>

RECOMMENDATIONS FOR MICROBIOLOGY LABORATORIES

1. Determine carbapenem susceptibility using updated CLSI-recommended procedures and interpretive criteria. In 2010, CLSI lowered the carbapenem susceptibility breakpoints for testing *Enterobacteriaceae*. In 2012, the ertapenem breakpoint was increased by a one-fold dilution. Breakpoints for the carbapenems have not changed since 2012. The updated breakpoints increased the sensitivity for carbapenemase detection.
 - a. We request laboratories using pre-2010 breakpoints send all isolates meeting the new definition to WPHL independent of clinical interpretation. For example, if an isolate of *Klebsiella pneumoniae* has an MIC of 8 µg/mL for meropenem and the interpretation is “intermediate” using the pre-2010 breakpoint but “resistant” by CLSI guidelines starting in 2011, this should be reported and the isolate sent to WPHL for further evaluation.
 - b. We recommend laboratories discontinue performing the Modified Hodge test, as it is more expedient to send the isolate directly to WPHL for carbapenemase testing. This recommendation is in response to poor performance of the test and is in agreement with the 2015 CLSI update.

The pre-2010 breakpoints are summarized in the following table:

	Breakpoints predating 2010 update (µg/mL)(23)		
	(through Jan. 2010; M100-S19)		
	Susceptible	Intermediate	Resistant
Doripenem	n/a	n/a	n/a
Ertapenem	≤2	4	≥8
Imipenem ⁵	≤4	8	≥16
Meropenem	≤4	8	≥16

2. **Report CRE to the Wyoming Department of Health within one business day.** Use the WDH case definition. Wyoming defines CRE as any *Enterobacteriaceae*:
 - That are resistant to at least one carbapenem (including imipenem⁵, meropenem, doripenem, or ertapenem) using the current M100-S25 CLSI breakpoints⁶;
 - OR
 - That test positive for carbapenemase production by the Carba NP test;
 - OR
 - That test positive for a known carbapenemase gene by nucleic acid amplification testing.

Table: CLSI breakpoints, 2015(3) C

	Current MIC breakpoints (µg/mL)		
	MIC Interpretation ⁶		
Carbapenems	Susceptible	Intermediate	Resistant
Doripenem	≤1	2	≥4
Ertapenem	≤0.5	1	≥2
Imipenem	≤1	2	≥4
Meropenem	≤1	2	≥4
	Current disk diffusion zone diameters (mm)		
	Interpretation		
Carbapenems	Susceptible	Intermediate	Resistant
Doripenem	≥23	20-22	≤19
Ertapenem	≥22	19-21	≤18
Imipenem	≥23	20-22	≤19
Meropenem	≥23	20-22	≤19

3. **Send *Enterobacteriaceae* isolates that meet the WPHL CRE case definition to the Wyoming State Public Health Laboratory (WPHL) for further testing.**

WPHL does testing using a commercially available version of the Carba NP Test and PCR for KPC and NDM, the most common carbapenemases. When appropriate, the WPHL will arrange for further testing via the Antibiotic Resistance Laboratory Network. WPHL will provide results to your laboratory once available.

- Use the Laboratory Requisition Form. Available online: <https://health.wyo.gov/publichealth/lab/forms/>
- Complete the Submitter Information, Patient Information and Specimen Type sections.
- In “Tests Request,” check “CRE/CRPA ” under “Culture/ID” and please indicate genus and species.
- Send the susceptibilities along with the isolate.
- Send isolate preferably on a slant; a plate is also acceptable.
- Send via the WPHL courier. If unable to send through the courier, contact the WPHL to facilitate shipping via FedEx. Ship according to regulations for infectious substances.
 - Send to:
Wyoming Public Health Laboratory
208 South College Drive
Cheyenne, WY 82002

4. CRE screening cultures for case contacts should be performed as recommended by local facility infection prevention and control staff, in consultation with WDH. The number of surveillance cultures requested is based on pertinent epidemiology.
 - a. The recommended protocol for screening cultures is attached as an appendix. If your laboratory does not have ertapenem or meropenem disks, contact WPHL. Confirm candidate CRE organisms through routine identification and susceptibility; send all confirmed CRE isolates to WPHL.
 - b. Generally, screening cultures should not be billed to the patient; discuss billing with the microbiology laboratory, facility leadership and WDH. If approved by the WDH Infectious Disease Epidemiology Unit, WPHL does not charge for testing CRE screening cultures.
 - c. Discuss how results of screening cultures will be reported with infection prevention and control.

⁵ *Proteus* spp., *Providencia* spp. and *Morganella* spp., which are intrinsically resistant to imipenem, are excluded from this definition if only imipenem resistance is detected. To fit the CRE definition any of these genera must also demonstrate resistance to other carbapenems.

⁶ Laboratories still using breakpoints before the June 2010 CLSI update should use the updated CLSI MIC cutoffs to determine reporting to public health, independent of the susceptibility interpretation (e.g., an isolate with an MIC of 8 to meropenem [“intermediate” by pre-2010 CLSI interpretation, but “resistant” by CLSI guidelines starting in 2011] should still be reported to WDH and submitted for further evaluation).

REFERENCES

1. Centers for Disease Control and Prevention. Vital Signs Aug 4, 2015. Making Health Care Safer: Stop Spread of Antibiotic Resistance. www.cdc.gov/vitalsigns/stop-spread/index.html; accessed Aug 23, 2015.
2. Oregon Health Authority. Guidance for Control of Carbapenem-resistant *Enterobacteriaceae* (CRE): 2016 Oregon Toolkit. Available at: http://www.oregon.gov/oha/PH/DiseasesConditions/DiseasesAZ/CRE1/cre_toolkit.pdf; accessed June 26, 2017.
3. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing. Twenty-fifth informational supplement. CLSI Document M100-S25. Wayne, PA, 2015.
4. Nordmann P, Naas T, Poirel L. Global spread of Carbapenemase-producing *Enterobacteriaceae*. *Emerg Infect Dis*. 2011;17(10):1791-8.
5. Tzouveleakis LS, Markogiannakis A, Psychogiou M, Tassios PT, Daikos GL. Carbapenemases in *Klebsiella pneumoniae* and other *Enterobacteriaceae*: an evolving crisis of global dimensions. *Clin Microbiol Rev*. 2012;25(4):682-707.
6. Centers for Disease Control and Prevention. Tracking CRE. www.cdc.gov/hai/organisms/cre/TrackingCRE.html; accessed July 13, 2015.
7. Nordmann P, Poirel L, Dortet L. Rapid detection of carbapenemase-producing *Enterobacteriaceae*. *Emerg Infect Dis*. 2012;18(9):1503-7.
8. Tijet N, Boyd D, Patel SN, Mulvey MR, Melano RG. Evaluation of the Carba NP test for rapid detection of carbapenemase-producing *Enterobacteriaceae* and *Pseudomonas aeruginosa*. *Antimicrob Agents Chemother*. 2013;57(9):4578-80.
9. Vasoo S, Cunningham SA, Kohner PC, Simner PJ, Mandrekar JN, Lolans K, et al. Comparison of a novel, rapid chromogenic biochemical assay, the Carba NP test, with the modified Hodge test for detection of carbapenemase-producing Gram-negative bacilli. *J Clin Microbiol*. 2013;51(9):3097-101.
10. Verigene® Gram-Negative Blood Culture Test (BC-GN). www.nanosphere.us/products/gram-negative-blood-culture-test; accessed July 13, 2015.
11. FilmArray Blood Culture Identification Panel. <http://filmarray.com/assets/pdf/Info-Sheet-BCID-Panel-FLM1-PRT-0069-03.pdf>; accessed July 13, 2015.
12. Carvalhaes CG, Picao RC, Nicoletti AG, Xavier DE, Gales AC. Cloverleaf test (modified Hodge test) for detecting carbapenemase production in *Klebsiella pneumoniae*: be aware of false positive results. *J Antimicrob Chemother*. 2010;65(2):249-51.
13. Girlich D, Poirel L, Nordmann P. Value of the modified Hodge test for detection of emerging carbapenemases in *Enterobacteriaceae*. *J Clin Microbiol*. 2012;50(2):477-9.

14. Mathers AJ, Carroll J, Sifri CD, Hazen KC. Modified Hodge test versus indirect carbapenemase test: prospective evaluation of a phenotypic assay for detection of *Klebsiella pneumoniae* carbapenemase (KPC) in *Enterobacteriaceae*. *J Clin Microbiol*. 2013;51(4):1291-3.
15. Centers for Disease Control and Prevention. FAQs about Choosing and Implementing a CRE Definition. www.cdc.gov/hai/organisms/cre/definition.html; accessed July 9, 2015.
16. Epstein L, Hunter JC, Arwady MA, Tsai V, Stein L, Gribogiannis M, et al. New Delhi metallo-beta-lactamase-producing carbapenem-resistant *Escherichia coli* associated with exposure to duodenoscopes. *JAMA*. 2014;312(14):1447-55.
17. Hayden MK, Lin MY, Lolans K, Weiner S, Blom D, Moore NM, et al. Prevention of colonization and infection by *Klebsiella pneumoniae* carbapenemase-producing *Enterobacteriaceae* in long-term acute-care hospitals. *Clin Infect Dis*. 2015;60(8):1153-61.
18. Munoz-Price LS, Hayden MK, Lolans K, Won S, Calvert K, Lin M, et al. Successful control of an outbreak of *Klebsiella pneumoniae* carbapenemase-producing *K. pneumoniae* at a long-term acute care hospital. *Infect Control Hosp Epidemiol*. 2010;31(4):341-7.
19. Banach DB, Francois J, Blash S, Patel G, Jenkins SG, LaBombardi V, et al. Active surveillance for carbapenem-resistant *Enterobacteriaceae* using stool specimens submitted for testing for *Clostridium difficile*. *Infect Control Hosp Epidemiol*. 2014;35(1):82-4.
20. Source: Stone ND, Ashraf MS, Calder J, Crnich C, Crossley K et al. Surveillance Definitions of Infections in Long-Term Care Facilities: Revisiting the McGeer Criteria. *Infect Control Hosp Epidemiol*. 2012; 33(10): 965–977.
21. Centers for Disease Control and Prevention. Management of Multi-drug-Resistant Organisms in Health Care Settings, 2006. www.cdc.gov/hicpac/pdf/MDRO/MDROGuideline2006.pdf; accessed July 9, 2015.
22. Centers for Disease Control and Prevention. Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care, May 2011. www.cdc.gov/HAI/settings/outpatient/outpatient-care-guidelines.html; accessed July 9, 2015.
23. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing. Nineteenth informational supplement. CLSI document M100-S19. Wayne, PA, 2009.

APPENDIX

CRE PROTOCOLS AND OTHER TOOLS

Patient/Resident infection control transfer form	31
CRE rectal screening specimen collection protocol.....	32
Example verbal consent for collection of rectal swabs	34
CRE screening culture sample letter for staff.....	35
CRE screening culture sample letter and consent for patients	36
Laboratory protocol for CRE screening cultures from rectal swabs.....	37
Healthcare facility environmental cleaning check list for terminal cleaning	43
Long-term care facility environmental cleaning checklist for resident rooms.....	44
Long-term care facility environmental cleaning checklist for common areas	45
Hand hygiene observation tool	46

CRE EDUCATIONAL MATERIALS

CDC Vital Signs: Making Healthcare Safer (2013).....	47
CDC Vital Signs: Making Healthcare Safer (2015).....	48
CRE Screening FAQ	49
Basic CRE FAQs	51
Detailed CRE FAQs	52
CDC What Patients Can Do to Prevent Healthcare associated infections.....	54

Inter-Facility Infection Control Transfer Form

SENDING FACILITY TO COMPLETE FORM and COMMUNICATE TO ACCEPTING FACILITY

Please attach copies of latest culture reports with susceptibilities, if available.

Sending Healthcare Facility:

Patient/Resident Last Name	First Name	Date of Birth	Medial Record Number
		___/___/___	

Name/Address of Sending Facility	Sending Unit	Sending Facility Phone

Sending Facility Contacts	NAME	PHONE	E-mail
Case Manager/Admin/SW			
Infection Prevention			

Is the patient/resident currently on antibiotics? NO YES **DX:** _____

Does the patient/resident have pending cultures? NO YES

Is the patient/resident currently on precautions? NO YES

Type of Precautions (check all that apply) Contact Droplet Airborne Other: _____

Does patient currently have an infection, colonization OR a history of positive culture of a multidrug-resistant organism (MDRO)?	Colonization or history <i>Check if YES</i>	Active infection on Treatment <i>Check if YES</i>
Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA)		
Vancomycin-resistant <i>Enterococcus</i> (VRE)		
<i>Clostridium difficile</i> (C. Diff, CDI)		
<i>Acinetobacter</i> spp., multidrug-resistant*		
<i>E coli</i> , <i>Klebsiella</i> , <i>Proteus</i> etc. w/Extended Spectrum B-Lactamase (ESBL)*		
Carbapenemase resistant <i>Enterobacteriaceae</i> (CRE)*		
Other:		

Does the patient/resident currently have any of the following?

- | | |
|--|--|
| <input type="checkbox"/> Cough or requires suctioning | <input type="checkbox"/> Central line/PICC (Approx. date inserted ___/___/___) |
| <input type="checkbox"/> Diarrhea | <input type="checkbox"/> Hemodialysis catheter |
| <input type="checkbox"/> Vomiting | <input type="checkbox"/> Urinary catheter (Approx. date inserted ___/___/___) |
| <input type="checkbox"/> Incontinent of urine or stool | <input type="checkbox"/> Suprapubic catheter |
| <input type="checkbox"/> Open wounds or wounds requiring dressing change | <input type="checkbox"/> Percutaneous gastrostomy tube |
| <input type="checkbox"/> Drainage (source)_____ | <input type="checkbox"/> Tracheostomy |

Notes:

Printed Name of Person Completing Form	Signature	Date	If information communicated prior to transfer: Name and phone of individual at receiving facility

Background:

Following isolation of a carbapenemase-producing *Enterobacteriaceae* (CRE), screening cultures may be recommended in consultation with the Wyoming Department of Health (WDH). 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. If approved by the WDH Infectious Disease Epidemiology Unit, WPHL does not charge for testing CRE screening cultures.
2. Collaborate with the laboratory and WDH regarding supplies:
 - a. WDH 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 or perirectal sites, but it is applicable to pre-moistened "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 WDH, identify high-risk contacts to undergo surveillance cultures.
2. Pre-moisten 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.

Screening Protocol 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.

EXAMPLE VERBAL CONSENT FOR COLLECTION OF RECTAL SWAB TO ASSESS COLONIZATION WITH CRE

Hi, my name is *[insert name]* and I work for *[insert organization]*. I'm here to talk to you about some screening the *[insert healthcare facility e.g., hospital or nursing home]* is doing to check for a rare germ. Recently, we identified this germ that is rare in the U.S. in a patient who was cared for at this facility. The germ is called carbapenem-resistant *Enterobacteriaceae*, or "CRE" for short.

We are screening patients for this germ because some people can carry this germ in the gut without knowing it and they can spread the germ to others without knowing it.

The chance that you carry this germ is very low, and fortunately, most people who do carry it never get sick from it. But to make sure this germ has not spread, the health department would like us to screen patients to make sure they don't have it.

If you agree to be screened, the process is very simple and takes just a few seconds. We would need to swab inside your rectum. To do that, we would gently insert just the tip of a soft swab, which looks like a Q-tip, into your rectum, gently rotate it, and then remove it. The process is not painful and there shouldn't be any side effects. If you're not comfortable with us doing this, you can use the swab yourself to gently wipe a few times around your anus. The downside to swabbing yourself is that it may decrease our ability to find the bacteria than if we collect it.

The swab will be sent to a lab to test for the bacteria, which will take a few days. If they find the germ, someone will contact you to discuss what to do. The results of the test will be kept confidential to the extent allowed by law.

Providing a swab is completely voluntary and you can choose not to.

Do you have any questions? *[pause for questions]*

Is it OK if we collect the swab?

CRE SCREENING CULTURE SAMPLE LETTER FOR STAFF

<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 *Enterobacteriaceae* (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 *Enterobacteriaceae* (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 Wyoming Department of Health; [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

Patient Sticker



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 carbapenemase-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).

- 1 -

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
SAFER • HEALTHIER • PEOPLE™



Reagents

5 ml Trypticase Soy Broth
10- μ g carbapenem disks
MacConkey agar

Equipment

Vortex
35 \pm $^{\circ}$ C, ambient air

Supplies

100 μ l calibrated pipettes
Forceps
Sterile loops

Specimen

Rectal swab or perianal swab specimen in suitable transport media

Special safety precautions

Biosafety 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 the 10- μ g/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- μ g 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 $35 \pm 2^{\circ}\text{C}$, ambient air
Step 2 Day Two	Vortex and subculture 100 μ l of the incubated broth culture onto a MacConkey agar plate (see procedure note 2) Streak for isolation Incubate overnight at $35 \pm 2^{\circ}\text{C}$, ambient air
Step 3 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 1×10^5 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 1×10^2 CFU/ mL to 1×10^6 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- μ g 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- μ g 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

- 4 -

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
SAFER • HEALTHIER • PEOPLE™



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 1×10^4 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 1×10^8 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 1×10^5 CFU/mL), suspension to the 5 ml TSB for a final concentration of approximately 1×10^4 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 -

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
SAFER • HEALTHIER • PEOPLE™



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

CDC Environmental Checklist for Monitoring Terminal Cleaning¹

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

¹Selection of detergents and disinfectants should be according to institutional policies and procedures

²Hospitals may choose to include identifiers of individual environmental services staff for feedback purposes.

³Sites most frequently contaminated and touched by patients and/or healthcare workers





LTCF GENERAL ROOM ENVIRONMENTAL CLEANING CHECKLIST

Date: _____

Unit or Ward: _____

Room Number: _____

Initials of environmental services staff (optional):¹ _____

Evaluate the following priority sites for each resident room:

High-touch Room Surfaces²	Cleaned	Not Cleaned	Not Present in Room
Bed rails			
Tray table			
Call button			
Remote Controls			
Bedside table			
Bedside Chair			
Telephone			
Room light switch			
Room inner door knob/door pull			
Closet door knob/door pull			
Bathroom inner door knob/pull			
Bathroom light switch			
Bathroom handrails by toilet			
Bathroom sink/faucet handles			
Toilet seat			
Toilet flush handle			
Toilet bedpan cleaner			
Shower hand holds			

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

High-touch Room Surfaces²	Cleaned	Not Cleaned	Not Present in Room
IV /tube feeding pump control panel			
Wound Vacuum Control panel			
Wheelchair-especially handles			
Walker /Cane handles			

¹ Facilities may choose to include identifiers of individual environmental services staff for feedback purposes

² Sites most frequently contaminated and touched by residents and/or healthcare workers



LTCF COMMON AREAS ENVIRONMENTAL CLEANING CHECKLIST

Date: _____

Unit or Ward: _____

Initials of environmental services staff (optional):¹

Evaluate the following priority sites for each resident room:

High-touch Common Surfaces ²	Cleaned	Not Cleaned	Not Present in Room
Common Light Switch			
Common Call Button			
TV Remote Controls			
Common Chair			
Common Telephone			
Mechanical Lift			
Hall Hand Rails			
Door Pulls			
Common Closet Door Knobs/Pull			
Microwave Control Panel			
Refrigerator/Freezer Handles			
Bathroom inner door knob/pull			
Bathroom light switch			
Bathroom handrails by toilet			
Bathroom sink/faucet handles			
Bathroom toilet seat			
Toilet flush handle			
Common Tub Faucet Handles			
Common Shower hand holds			
Common Bench			

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

High-touch Surfaces ²	Cleaned	Not Cleaned	Not Present in Room
Beauty Salon Chair			
PT/OT Support Bars			
Washer/Dryer Knobs			
Activity Room Tables			

REFERENCE: Guh, A., Carling, P., and the Environmental Evaluation Workgroup. (2010). [Options for Evaluating Environmental Cleaning](#). Centers for Disease Control and Prevention.

DISCLAIMER: All data and information provided by the Oregon Patient Safety Commission is for informational purposes only. The Oregon Patient Safety Commission makes no representations that the patient safety recommendations will protect you from litigation or regulatory action if the recommendations are followed. The Oregon Patient Safety Commission is not liable for any errors, omissions, losses, injuries, or damages arising from the use of these recommendations.

HAND HYGIENE OBSERVATION TOOL

Hand Hygiene Observation Tool


Unit: _____ Date: _____ Observer Name: _____

- **DIRECTIONS** - If you believe you observed 'no hand hygiene' or are unsure, please confirm with staff privately; remind if applicable. (Some staff members carry their own hand sanitizer. Remember to observe 'hands full' process in its entirety).
- **FORM UPDATES:**
 - 'Nursing' is now 'Nursing (RN)', Nursing (CNA) and Nursing (Tech) 'Students' are now 'Student (Nursing)', 'Student (CNA)', 'Student (Medical)', 'Student (Other)'. The 'OTHER' section is alphabetized and 'Cath Lab' (personnel) has been added.
 - Surgeons and Medical Providers are divided by specialty – record by #.

	Observed Person													Observed Behavior																						
	Nursing (RN)	Nursing (CNA)	Nursing (Tech)	Surgeon 1 Cardiac 2 General 3 Neuro 4 OB/Gyn 5 Orthopedic 6 Plastics 7 Urology 8 Other 9 Unknown	Prov (Medical) 1 Cardiology 2 Emergency 3 Fam Practice 4 GI 5 Internal Med 6 Nephrology 7 Neurology 8 Oncology 9 Pediatrics 10 Psychiatry 11 Radiology 12 Other 13 Unknown	Provider (Hospitalist)	Provider (Anesthesia)	Provider (PA/NP)	Provider (CNM)	Provider (Resident/Fellow)	Provider (Unknown)	Student (Nursing)	Student (CNA)	Student (Medical)	Student (Other)	OTHER – use # 1 Admitting 2 Cath Lab 3 Clergy 4 Engineering 5 EVS 6 Imaging 7 Lab 8 Nutr Services 9 Pharmacy 10 PT-OT-ST 11 Resp Therapy 12 SS/Case Mgmt 13 Transport 14 Unknown	Circle ONE	Blocked view/ unsure	Used hand sanitizer	Hand washing w/ soap and water	No hand hygiene – ask remind	Comments – record name of observed staff member, feedback given, response, etc.														
1																		IN OUT																		
2																		IN OUT																		
3																		IN OUT																		
4																		IN OUT																		
5																		IN OUT																		
6																		IN OUT																		
7																		IN OUT																		
8																		IN OUT																		
9																		IN OUT																		
10																		IN OUT																		
11																		IN OUT																		
12																		IN OUT																		
13																		IN OUT																		
14																		IN OUT																		
15																		IN OUT																		
16																		IN OUT																		

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 !\[\]\(4b7a79268f6ba26c1471d4232fffa85a_img.jpg\) http://www.cdc.gov/vitalsigns](http://www.cdc.gov/vitalsigns)

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



Making Health Care Safer

Stop Spread of Antibiotic Resistance

We're at a tipping point: an increasing number of germs no longer respond to the drugs designed to kill them. Inappropriate prescribing of antibiotics and lack of infection control actions can contribute to drug resistance and put patients at risk for deadly diarrhea (caused by *C. difficile*). Even if one facility is following recommended infection controls, germs can be spread inside of and between health care facilities when patients are transferred from one health care facility to another without appropriate actions to stop spread. Lack of coordination between facilities can put patients at increased risk. Now more than ever is the time for public health authorities and health care facilities to work together, sharing experiences and connecting patient safety efforts happening across the state.

Health care facility CEOs/administrators can:

- Implement systems to alert receiving facilities when transferring patients who have drug-resistant germs.
- Review and perfect infection control actions within your facility.
- Get leadership commitment to join healthcare-associated infection (HAI)/antibiotic resistance prevention activities in the area.
- Connect with the public health department to share data about antibiotic resistance and other HAIs.
- Make sure clinical staff have access to prompt and accurate laboratory testing for antibiotic-resistant germs.

Want to learn more? www.cdc.gov/vitalsigns/stop-spread



Centers for Disease
Control and Prevention
National Center for Emerging and
Zoonotic Infectious Diseases

2
Million

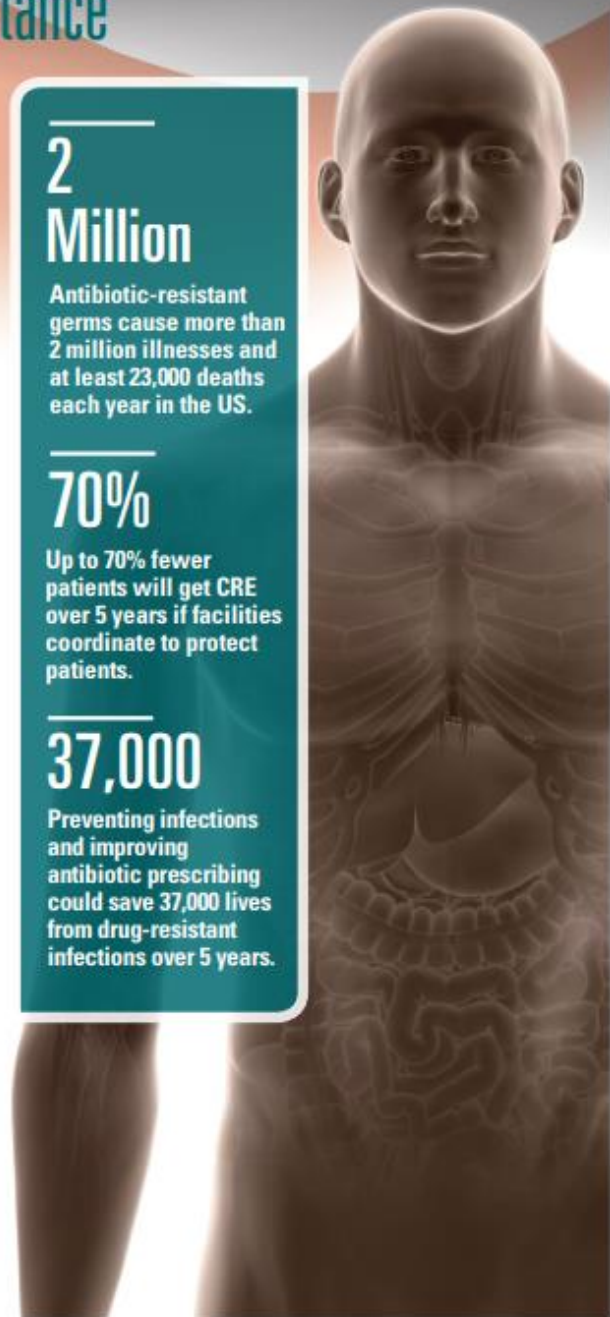
Antibiotic-resistant germs cause more than 2 million illnesses and at least 23,000 deaths each year in the US.

70%

Up to 70% fewer patients will get CRE over 5 years if facilities coordinate to protect patients.

37,000

Preventing infections and improving antibiotic prescribing could save 37,000 lives from drug-resistant infections over 5 years.



FREQUENTLY ASKED QUESTIONS ABOUT SCREENING TESTS FOR CARBAPENEM-RESISTANT ENTEROBACTERIACEAE (CRE)

Your [*insert healthcare facility e.g., hospital or nursing home*] has identified a person with a type of bacteria (a kind of germ) that is resistant to important antibiotics drugs that are used to treat infections. When bacteria are resistant to an antibiotic, it means that the drug will not work to treat infections caused by those bacteria.

Why have I been contacted?

To make sure this type of resistant bacteria does not spread further, the healthcare facility or health department is contacting people who might have had contact with this bacteria. They are requesting that these people get a screening test to make sure they are not also carrying the bacteria.

Why is it important for me to be tested for this bacteria?

It is important for you to be tested for this germ so that the healthcare facility and health department can prevent it from spreading. Preventing the spread of these bacteria is very important so that these resistant bacteria don't become common in your community.

What happens if these bacteria are found in or on me?

The results of the test will be kept confidential to the extent allowed by law. The results will be shared with you and your healthcare providers and might be shared with the health department.

The risk to you from this germ is low. Most people carry these bacteria and never get sick from them. However, if you do get sick, it can help your doctor to know you carry these bacteria when making treatment decisions. If you receive medical care, your healthcare providers may take extra steps to protect you and make sure they do not spread the bacteria to other patients.

How can I be tested for this germ?

People carry this kind of germ in their gut or stool, so the best way to test for these bacteria is to swab your rectum. If you agree to be tested, a healthcare provider will gently insert just the tip of a soft swab that looks like a Q-tip into your rectum, gently rotate it, and then remove the swab. The procedure is not painful and there should be no side effects. The swab will be sent to a lab and, within a few days, the lab will report the result to your healthcare provider.

Do I have a choice to be tested?

Yes, providing a swab is voluntary. You can choose to decline testing. However, if you decline testing and you receive medical care, your healthcare providers might take extra precautions, such as wearing a gown and gloves when caring for you, since they will not know if you have this germ. If you do get sick, knowing whether you carry the bacteria can help your doctor make better treatment decisions for you.

I want to be tested, but I am not comfortable having a rectal swab collected. Is there an alternative test?

We can give you the swab for you to swab a few times around your anus or you can provide a stool sample, but these alternative tests may decrease our ability to find these bacteria in your body if they are present.

If my test is positive, what will I need to do?

The risk of spreading this germ to your family and friends is very low, but family and visitors should wash their hands well after caring for you or visiting you to decrease the chance of getting the germ. You should also wash your hands frequently, especially after using the bathroom and before eating or preparing food.

If you receive medical care at a healthcare facility such as a hospital or nursing home, be sure to let your healthcare providers know about the results so that they can make the best treatment decisions for you and take steps to prevent spreading the germ to others.

If my test is positive, will I need treatment?

If the test is positive, it means you are carrying the germs in your gut. Since they are not making you sick (causing infection), you will not need antibiotics. Many people stop carrying these bacteria over time, but this depends on many factors. Taking antibiotics can increase the time these germs are carried in your gut. So, in consultation with your doctor, antibiotics should be used appropriately and should be taken exactly as prescribed.

Your healthcare providers might recommend you get an additional test at a later time to see if the germ is gone. However, a follow-up test will not be recommended for everyone.

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.

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:
 - Before preparing or eating food
 - Before and after changing wound dressings or bandages
 - After using the bathroom
 - 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:

Wyoming Department of Health Resources: <https://health.wyo.gov/publichealth/infectious-disease-epidemiology-unit/disease/cre/>

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 July 13, 2017.

BE INFORMED. BE EMPOWERED. BE PREPARED.

6 WAYS TO BE A SAFE PATIENT

1

SPEAK UP.

Talk to your doctor about all questions or worries you have. Ask them what they are doing to protect you.

- ▶ If you have a catheter, ask each day if it is necessary.
- ▶ Ask your doctor how he/she prevents surgical site infections. Also ask how you can prepare for surgery to reduce your infection risk.



2

KEEP HANDS CLEAN.

Be sure everyone cleans their hands before touching you.



3

GET SMART ABOUT ANTIBIOTICS.

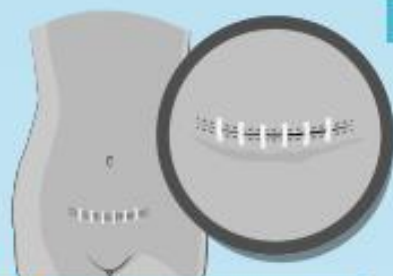
Ask if tests will be done to make sure the right antibiotic is prescribed.



4

KNOW THE SIGNS AND SYMPTOMS OF INFECTION.

Some skin infections, such as MRSA, appear as redness, pain, or drainage at an IV catheter site or surgery site. Often these symptoms come with a fever. Tell your doctor if you have these symptoms.



5

WATCH OUT FOR DEADLY DIARRHEA. (AKA *C. difficile*)

Tell your doctor if you have 3 or more diarrhea episodes in 24 hours, especially if you have been taking an antibiotic.



6

PROTECT YOURSELF.

Get vaccinated against flu and other infections to avoid complications.



245525-E

