



Carbapenem-resistant Enterobacteriaceae (CRE)



General Information

CRE, which stands for *carbapenem-resistant Enterobacteriaceae*, are a family of Gram-negative bacteria that are difficult to treat because they have high levels of resistance to antibiotics. *Klebsiella* species and *Escherichia coli* (*E. coli*) are examples of *Enterobacteriaceae*, a normal part of the human gut bacteria that can become carbapenem-resistant.

Healthy people usually do not get CRE infections. In healthcare settings, CRE infections most commonly occur among patients who are receiving treatment for other conditions. Patients whose care requires devices like ventilators (breathing machines), urinary (bladder) catheters, or intravenous (vein) catheters, and patients who are taking long courses of certain antibiotics are most at risk for CRE infections. Some CRE bacteria have become resistant to most available antibiotics. Infections with these germs are very difficult to treat, and can be deadly—one report cites they can contribute to death in 40% of patients who become infected.

Significance

CRE are important for a number of reasons. First, these organisms are often resistant to multiple classes of antimicrobials substantially limiting treatment options. Second, infections caused by these organisms are associated with high mortality rates, 40% to 50% in some studies. Third, many *CRE* possess carbapenemases which can be transmitted from one *Enterobacteriaceae* to another potentially facilitating transmission of resistance. Fourth, *Enterobacteriaceae* are a common cause of infections in both community and healthcare settings. Carbapenem resistance among these organisms could therefore have far-reaching impact.



How do Enterobacteriaceae become resistant to carbapenems?

Unlike other multi-drug resistant organisms (MDRO) like MRSA for which a single mechanism leads to methicillin resistance, CRE can become nonsusceptible to carbapenems due to a number of mechanisms. Before the recent emergence of carbapenemases like KPC (*Klebsiella pneumoniae* carbapenemase), most CRE in the United States likely were resistant to carbapenems through a combination of mechanisms (e.g., a beta-lactamase combined with a porin mutation that limited the ability of carbapenems to get into the bacteria). In 2001, a *K. pneumoniae* isolate that possessed a novel carbapenemase called KPC was recognized in the United States. The genes that code for KPC are on a highly mobile genetic element that can be transmitted from one bacterium to another thereby spreading resistance. KPC-producing bacteria have spread widely across the United States.

In addition to KPC, a number of other carbapenemases exist that can lead to carbapenem resistance; examples of these include New Delhi Metallo-beta-lactamase (NDM), Verona Integron-Encoded Metallo-beta-lactamase (VIM), and Imipenemase Metallo-beta-lactamase (IMP). These metallo-beta-lactamases are more common outside the United States but have been identified rarely in North America, most commonly in patients with exposure to healthcare in endemic countries. Of note, some Enterobacteriaceae are intrinsically nonsusceptible to the carbapenem imipenem, such as *Morganella morganii*, *Proteus* species, and *Providencia* species.

Symptoms

CRE can cause infections in almost any part of the body including bloodstream infections, ventilator-associated pneumonia, and intra-abdominal abscesses. Based on information from a CDC pilot surveillance system most CRE infections involve the urinary tract, often in people who have a urinary catheter or have urinary retention.



Transmission

In healthcare settings, CRE are usually transmitted from person to person often via the hands of healthcare personnel or via contaminated medical equipment. As *Enterobacteriaceae* can commonly be found in stool or wounds, contact with these might be particularly concerning. Ensuring the use of personal protective equipment during and good hand hygiene following exposure to the patient's immediate environment, especially when cleaning up stool or changing wound dressings, is very important. The role of transmission directly from the environment to patients is controversial and requires further investigation.

Core Measures for All Acute and Long-term Care Facilities

There are **8 core** measures facilities should follow.

- 1) Hand Hygiene
- 2) Contact Precautions
- 3) Healthcare Personnel Education
- 4) Minimal use of Devices
- 5) Patient and Staff Cohorting
- 6) Laboratory Notification
- 7) Antimicrobial Stewardship
- 8) CRE Screening












Guidelines and Recommendations

Guidance for Control of Carbapenem-resistant *Enterobacteriaceae* (CRE) 2012 CRE Toolkit (<http://www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf>)



Cleaning and Disinfection

Enterobacteriaceae, such as *Klebsiella* and *Escherichia coli* (*E. coli*) are of Gram negative bacillii that are susceptible to the following Diversey disinfectants:

Product	Oxivir® 1 RTU / Wipes	Oxivir® Tb RTU / Wipes	Oxivir® Five 16	Alpha® HP Multisurface Disinfectant Cleaner	Avert™ Sporidical Disinfectant Cleaner/Wipes	Virex® II 256	Virex® Tb	Virex® Plus	Expose® II 256	MoonBeam®3 UV Disinfection
Contact Time (Min)	1	1	5	5	1	5	3	3	10	3
										
Product	Oxivir® Tb RTU / Wipes	Oxivir® Plus (Concentrate)	Virox® 5 Concentrate	Virox® 5 (RTU & Wipes)	Percept™ (M/MC) (Concentrate, RTU & Wipes)	Virex® II 256	Avert™ Disinfectant Cleaner			
Contact Time (Min)	1	5	5	5	5	5	1			
