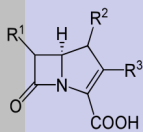


Carbapenem-Resistant Organisms Background for Providers

Organisms that have developed resistance to carbapenems are known as carbapenem-resistant organisms (CROs). They are commonly in the Enterobacteriaceae family, but there are also non-Enterobacteriaceae organisms that can develop carbapenem-resistance. The most concerning types of CROs are those that have resistance by producing carbapenemases.

What to Know about Carbapenems and Enterobacteriaceae

Carbapenems



- ◆ Class of broad-spectrum antibiotics reserved to treat serious multidrug-resistant infections
- ◆ Often considered the last-line antibiotics to treat an infection
- ◆ Includes the following: doripenem, ertapenem, imipenem, and meropenem



Enterobacteriaceae

- ◆ Large family of more than 70 gram-negative bacteria that often inhabit or colonize the gastrointestinal (GI) tract of healthy humans or animals
- ◆ Examples are *Enterobacter* spp., *E. coli*, and *Klebsiella* spp.

Danger of CROs

Often, CROs are resistant to other classes of antibiotics besides carbapenems, and treatment options for these infections can be severely limited. In extremely rare situations, CROs might be resistant to all available classes of antibiotics (pan-resistant), leaving no treatment options. The CDC considers these types of antibiotic-resistant infections an urgent threat in the United States. CROs may cause a variety of infections ranging from gastrointestinal illness and pneumonia, to invasive infections of the bloodstream or organs.

Common Types of CROs

- ◆ CRE: Carbapenem-resistant Enterobacteriaceae
 - ◆ CRPA: Carbapenem-resistant *Pseudomonas aeruginosa**
 - ◆ CRAB: Carbapenem-resistant *Acinetobacter baumannii**
- *Non-Enterobacteriaceae gram-negative bacteria

CROs are classified into 2 categories based on their ability to produce carbapenemases

Carbapenemases are enzymes that directly break apart the carbapenem ring to inactivate the antibiotic.

Those that do not produce carbapenemases

- ◆ Denoted with “non-CP” (e.g., non-CP-CRE)

Those that produce carbapenemases

- ◆ Denoted with “CP” for “carbapenemase-producing” (e.g., CP-CRE)
- ◆ Because carbapenemase genes are often located on mobile genetic elements (e.g., plasmids), transfer of resistance to Enterobacteriaceae or other gram-negative organisms is enhanced, resulting in the potential for widespread transmission. Carbapenemase genes that have been identified are presented in Table 1.

Table 1: Carbapenemase Genes

Carbapenemase	Comments
Imipenemase metallo-β-lactamase (IMP)	Endemic to areas outside of the United States
Klebsiella pneumoniae carbapenemase (KPC)	Most widespread in the United States; more commonly seen in Enterobacteriaceae compared to other gram-negative organisms
New Delhi metallo-β-lactamase (NDM)	Endemic to areas outside of the United States; increasing reports of United States residents without international healthcare exposure
Oxacillinase-type carbapenemases (OXA)	Different subtypes such as OXA-48 or OXA-23
Verona Integron-encoded metallo-β-lactamase (VIM)	Endemic to areas outside of the United States; more commonly seen in CP-CRPA

Disease Characteristics

Period of communicability

CROs are communicable as long as the infection or carrier state (colonization) persists. People colonized with CRE can carry the bacteria for a long period of time.

Mode of Transmission

- Direct contact with bodily tissues or fluids, particularly contaminated wounds or stool, from an infected or colonized person.
- Indirect contact via the hands of healthcare workers or contact with contaminated objects, surfaces, or equipment.

Incubation Period

The incubation period is variable and not well defined.

Risk Factors

Healthy people usually do not get CRO infections. Patients whose care requires devices like ventilators (breathing machines), urinary (bladder) catheters, or intravenous (vein) catheters; patients who are taking long courses of certain antibiotics; patients who are immunocompromised; and patients who have received international healthcare are most at risk for CRO infections.