



Healthcare Happenings: Infection Prevention and Control Highlight

Carbapenem-resistant Enterobacteriales (CRE)

WHAT IS IT?

Enterobacteriales is an order of bacteria commonly found in the human gastrointestinal tract that can cause infections both in healthcare and community settings. Enterobacteriales that test resistant to at least one carbapenem antibiotic (i.e., ertapenem, meropenem, doripenem, or imipenem) are called CRE. All CRE are likely multidrug-resistant organisms, and interventions may be required in healthcare settings to prevent transmission. The most common CRE species in healthcare settings are *Klebsiella pneumoniae* and *Escherichia coli*.

CRE can carry mobile genetic elements that produce carbapenemase enzymes, which are easily transferred between bacteria. **Approximately 30% of CRE are carbapenemase-producing (CP-CRE)**. CP-CRE are believed to be primarily responsible for the increasing spread of CRE in the United States and have therefore been targeted for aggressive prevention.

There are a number of carbapenemase genes associated with [mobile genetic elements](#), including:

- *Klebsiella pneumoniae* carbapenemase (KPC)
- New Delhi Metallo- β -lactamase (NDM)
- Verona Integron-Encoded Metallo- β -lactamase (VIM)
- Imipenemase (IMP)
- Oxacillinase-48 (OXA-48)

Infections with CRE are difficult to treat and have been associated with **mortality rates of up to 50%** for hospitalized patients. Due to patient movement throughout the healthcare system, if CRE is present in one facility, then it is typically present in other facilities in the region as well.

Surveillance criteria for CRE in Philadelphia can be found on the [second page of the CRE report form](#).

TRANSMISSION

In healthcare settings, CRE is transmitted from person to person, often via the hands of healthcare personnel or through contaminated medical equipment or environmental surfaces. Sink drains and toilets are increasingly recognized as an environmental reservoir and source of CRE transmission.

Healthcare-related risk factors include:

- Multiple/frequent healthcare stays
- Invasive medical devices, such as catheters and mechanical ventilation
- Exposure to an ICU
- Recent/previous treatment with antibiotics including carbapenems, cephalosporins, fluoroquinolones, and vancomycin
- Requiring assistance with most activities of daily living (i.e., toileting/bathing)

TESTING AND DIAGNOSIS

CRE infection is diagnosed through culture of the affected body site and antimicrobial susceptibility testing (AST). Healthcare providers should base treatment decisions on the susceptibility profile for the organism and reevaluate empiric regimens as soon as AST results are available. Extended AST, which provides susceptibility testing to newer antibiotics, is available through CDC's Antibiotic Resistance Lab Network (ARLN) for pandrug-resistant CRE isolates. Please email (hai.pdph@phila.gov) or call the HAI/AR team at (215) 685-4501 to coordinate isolate submission for extended AST testing.

CRE colonization is primarily identified through culture or a PCR-based test from a rectal swab. Patients colonized with CRE who are not showing active signs of infection do not need to be treated. **Improper antibiotic use drives the development of resistance – judicious antibiotic use is essential to prevent further resistance!**

Table 1. Antibigram for Philadelphia Confirmed CRE cultured from various body sites, 2020–2021

	Antibiogram for Confirmed CRE (n=437)												
	Pip+Tazo	Cefazolin	Ceftriaxone	Cefepime	Ertapenem	Meropenem	Levofloxacin	Gentamicin	Tobramycin	Nitrofurantoin	Tetracycline	Tigecycline	Trime+Sulfa
Isolates Tested	399	411	402	427	375	409	398	433	412	208	291	161	418
% Susceptible	6.5	1.5	5.0	12.6	3.2	20.5	34.2	69.7	50.2	34.6	60.1	93.2	40.9
Percent Susceptibility by Carbapenem-Producing (CP) Status													
Non-CP (n=90)	14.8	3.4	10.6	22.7	7.4	40.0	63.8	86.5	84.9	36.4	62.7	93.9	68.6
CP (n=256)	0.4	0	0	5.2	0.5	9.4	22.6	64.8	39.2	38.3	61.9	95.9	30.5
Percent Susceptibility for Three Most Frequently Reported CRE Species													
<i>Klebsiella pneumoniae</i> (n=208)	2.7	0.5	2.0	6.4	1.7	8.9	17.9	56.8	30.2	7.8	54.7	91.9	26.3
<i>Enterobacter cloacae</i> (n=76)	6.9	0	1.5	16.2	0	45.1	56.5	80.3	72.2	34.5	71.2	90.0	61.6
<i>Escherichia coli</i> (n=71)	9.2	3.1	8.3	18.8	1.7	24.6	26.6	83.8	55.9	80.9	54.0	100	37.7

Not all isolates were tested for all antibiotics

REPORTING

Report all CRE cases (colonization or infection) **within 5 days** to the Philadelphia Department of Public Health by completing and faxing [the CRE patient report form](#) to 215-238-6947 or calling 215-685-6748 during business hours.

IPC RECOMMENDATIONS

TRANSMISSION-BASED PRECAUTIONS:

- CRE patients should be placed on **contact precautions** or **enhanced barrier precautions** (nursing homes/SNFs only) and in a **private room** for the duration of all current and future healthcare stays. Patients can be cohorted if they have the same organism and same resistance mechanism (if known).
- Patients may remain colonized for more than one year - **do not discontinue precautions when the infection has been treated.**
- Inter-facility transfer: Prior to patient transfer, the transferring facility should notify the receiving facility of CRE colonization or infection using [the PDPH inter-facility transfer form](#) or another established method that captures the same information.

DISINFECTION GUIDANCE:

- Reusable equipment should be dedicated to the colonized or infected patient whenever possible
- Shared reusable medical equipment should be disinfected **immediately** after use
- Disinfect with products that are effective against CRE
- Disinfect areas in close proximity to the patient, high-touch surfaces in the room, and surfaces around sinks and toilets daily
- Immediately clean and disinfect equipment or surfaces contaminated with blood, urine, feces, and other bodily fluids or infectious materials
- Terminal cleaning should consist of thorough wet cleaning and disinfection

References:

Carbapenem-resistant Enterobacterales (CRE). Centers for Disease Control and Prevention. <https://www.cdc.gov/hai/organisms/cre/index.html>
 CARBAPENEM-RESISTANT ENTEROBACTERIACEAE. <https://www.cdc.gov/drugresistance/pdf/threats-report/CRE-508.pdf>
 Healthcare Facilities: Information about CRE. <https://www.cdc.gov/hai/organisms/cre/cre-facilities.html>