MY BUGABOO

Carbapenem-resistant Enterobacteriaceae (CRE)

A microbiological overview of carbapenem-resistant Enterobacteriaceae.

BY IRENA KENNELEY, PHD, APRN-BC, CIC

This agar culture plate grew colonies of *Enterobacter cloacae* that were both characteristically rough and smooth in appearance.

PHOTO COURTESY OF CDC.

GREETINGS, FELLOW INFECTION PREVENTIONISTS!

THE SCIENCE OF infectious diseases involves hundreds of bacteria, viruses, fungi, and protozoa. The amount of information available about microbial organisms poses a special problem to infection preventionists. Obviously, the impact of microbial disease cannot be overstated. Traditionally the teaching of microbiology has been based mostly on memorization of facts (the "bug parade"). Too much information makes it difficult to tease out what is important and directly applicable to practice. This quarter's My Bugaboo column will feature details on the CRE family of bacteria. The intention is to convey succinct information to busy infection preventionists for common etiologic agents of healthcare-associated infections.

MULTIDRUG-RESISTANT GRAM-NEGATIVE ROD ALERT: THE CDC SAYS WE MUST ACT NOW!

Carbapenem-resistant Enterobacteriaceae (CRE) infections come from bacteria normally found in a healthy person's digestive tract. CRE bacteria have been associated with the use of medical devices such as: intravenous catheters, ventilators, urinary catheters, and through wounds caused by injury or surgery. Because these bacteria have become resistant to antibiotics, CRE infections are very difficult to treat.

The Enterobacteriaceae are among the most common etiologic agents that cause healthcare-associated infections (HAIs). Multidrug-resistant Gram-negative rods are becoming an increasingly difficult problem in U.S. hospitals and long-term care facilities.[1] Resistance to the carbapenem antibiotics has been uncommon until now. The family of bacteria known as the carbapenem-resistant Enterobacteriaceae is an emerging group of Gram-negative bacilli that have become resistant to all or nearly all antibiotics and are causing infections with significant morbidity and mortality.

The Centers for Disease Control and Prevention (CDC) defines multidrug-resistant Gram-negative rods as those organisms that are resistant to three or more classes of antimicrobials. The classes of antimicrobials are: (1) beta-lactams, (2) fluoroquinolones, (3) aminoglycosides, and (4) carbapenems. The designation extra drug-resistant is applied to those organisms susceptible to fewer than two antimicrobials.

The Enterobacteriaceae have become resistant to third-generation cephalosporins due to the production of extended spectrum beta-lactamase (ESBL), leading to difficulty in treatment. The resultant increased use of broader spectrum agents and carbapenems contributed to resistance due to selection and amplified the production of increasingly resistant organisms. Thus, the CRE bacteria have emerged. Organisms capable of producing the enzymes beta-lactamase and carbapenemase include: *Klebsiella pneumoniae,* other *Klebsiella* species, *Enterobacter* species, *Escherichia coli,* and *Serratia* species. Table 1 lists the CRE bacteria that have been isolated.

TABLE 1: CRE BACTERIA

ENTEROBACTERIACEAE	*NON-ENTEROBACTERIACEAE*
Citrobacter freundii	*Pseudomonas aeruginosa*
Escherichia coli	*Pseudomonas putida*
Enterobacter aerogenes	*Acinetobacter spp.*
Enterobacter cloacae	
Enterobacter gergoviae	
Klebsiella pneumonia	
Klebsiella oxytoca	
Proteus mirabilis	
Salmonella enterica	
Serratia marcescens	

After initial outbreaks in the northeastern U.S., CRE bacteria have emerged in multiple species of Gram-negative rods worldwide. They have created significant clinical challenges for clinicians because they are not consistently identified by routine screening methods and are highly drug-resistant, resulting in delays in effective treatment and a high rate of clinical failures.

WHY WE MUST ACT NOW

- CRE bacteria are able to give their antibiotic resistance to any neighboring bacteria—they can easily spread resistance, making many more bacterial types potentially untreatable as well.
- Antibiotic resistance is not only a problem for the person with the infection; it is a problem for all of us because it directly impacts how effective the treatment will be tomorrow or in another patient.
- Antibiotics are a shared resource.
- Some CRE bacteria have become resistant to all or nearly all antibiotics, including last-resort drugs called carbapenems.
- CRE bacteria are spreading and urgent action is needed to stop them.

In the March 2013 *Vital Signs* report, the CDC states that we now have a small window of opportunity to stop the spread of CRE, but we must act now.

According to the CDC, the U.S. is at a critical time in which CRE infections could be controlled—that's the good news. However, there must be a rapid and consistent effort by doctors, nurses, lab staff, medical facility leadership, health departments/states, policy makers, and the federal government, and YOU as a leader in infection prevention.

WHAT INFECTION PREVENTIONISTS CAN DO

1. 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.

2. Protect your patients from CRE.

- Follow contact precautions and hand hygiene recommendations for patients with CRE.
  - This is a great time for educating front-line clinicians about CRE and how to keep themselves safe.
  - Evaluate the effectiveness of education programs and/or whether staff is appropriately using contact precautions, personal protective equipment, and hand hygiene.
- Dedicate rooms, staff, and equipment to patients with CRE.
- Practice antibiotic stewardship to assure antibiotics are being used wisely (visit **www.cdc.gov/getsmart/healthcare** for more information).
- Timed protocols for orders should be instituted to remove temporary medical devices such as catheters and ventilators as soon as possible.

3. Follow CDC guidelines for active surveillance for CRE.

- Know which patients need to be screened to determine whether they are carrying CRE.
- Because CRE can be carried from one healthcare setting to another, facilities are urged to work together regionally to implement CRE prevention programs.

The CDC's 2012 CRE Toolkit (**www.cdc.gov/hai/organisms/cre/cre-toolkit/index.html**) provides CRE prevention guidelines for doctors, nurses, hospitals, long-term acute care hospitals, nursing homes, and health departments. It gives step-by-step instructions for facilities that have patients with CRE infections.

View the archived APIC webinar on CRE, recorded May 1, 2013, by visiting **http://webinars.apic.org**.

SUMMARY

CRE infections can be prevented.

- Require and strictly enforce CDC guidelines for CRE detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify CRE, and ensure proper protocols are in place to alert clinical and infection prevention staff when CRE are present.
- Know CRE trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about infections, including CRE.

CRE infection prevention programs have been successful.

- Medical facilities in several states have reduced CRE infection rates by following the CDC's prevention guidelines.
- In one year, Israel decreased CRE infection rates in all of its 27 hospitals by more than 70 percent with a coordinated prevention program.[1]
- The U.S. is at a critical time in which CRE infections could be controlled if addressed in a rapid, coordinated, and consistent effort by informed infection preventionists, doctors, nurses, lab staff, medical facility leadership, health departments/states, policy makers, and the federal government. PS

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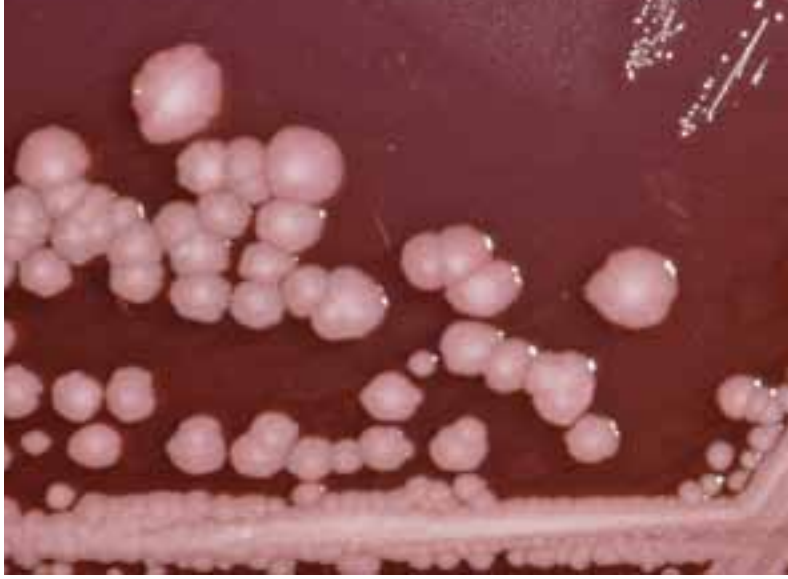

This photograph depicts the colonies of *Proteus mirabilis* bacteria grown on a Xylose Lysine Sodium Deoxycholate (XLD) agar plate. PHOTO COURTESY OF CDC.

References

1. Centers for Disease Control and Prevention. *Vital Signs*: Carbapenem-Resistant Enterobacteriaceae. *MMWR* 2013 March. 62(09);165-170. Accessed March 22, 2013. Available at: http://www.cdc.gov/mmwr/pdf/wk/mm6209.pdf.

2. Centers for Disease Control and Prevention. Patients Face More Untreatable Infections from CRE. Accessed March 22, 2013. Available at: http://www.cdc.gov/features/vitalsigns/HAI/CRE.

DID YOU KNOW?

- Antibiotic resistance is one of the world's most pressing public health threats.
- Nearly 50 percent of patients with CRE bloodstream infections die.[1]
- In 2012, the CDC documented that people in 42 states had been infected with CRE bacteria.[2]
- Even the antibiotics known as the last resort medications no longer work and have made some infections impossible to cure.
- Antibiotic overuse increases the development of drug-resistant bacteria.

AJIC American Journal of Infection Control

ACCESS PEER-REVIEWED ARTICLES ABOUT CRE IN THE *AMERICAN JOURNAL OF INFECTION CONTROL*

The carbapenem-resistant Enterobacteriaceae score: A bedside score to rule out infection with carbapenem-resistant Enterobacteriaceae among hospitalized patients. Emily T. Martin, Ryan Tansek, Vicki Collins, Kayoko Hayakawa, Odaliz Abreu-Lanfranco, Teena Chopra, Paul R. Lephart, Jason M. Pogue, Keith S. Kaye, Dror Marchaim [February 2013 (volume 41 issue 2 Pages 180-182 DOI: 10.1016/j.ajic.2012.02.036)]

Swimming in resistance: Co-colonization with carbapenem-resistant Enterobacteriaceae and *Acinetobacter baumannii* or *Pseudomonas aeruginosa*. Dror Marchaim, Federico Perez, Jiha Lee, Suchitha Bheemreddy, Andrea M. Hujer, Susan Rudin, Kayoko Hayakawa, Paul R. Lephart, Christopher Blunden, Maryann Shango, Michelle L. Campbell, Jastin Varkey, Palaniappan Manickam, Diixa Patel, Jason M. Pogue, Teena Chopra, Emily T. Martin, Sorabh Dhar, Robert A. Bonomo, Keith S. Kaye [November 2012 (volume 40 issue 9 Pages 830-835 DOI: 10.1016/j.ajic.2011.10.013)]

Duration of carriage of carbapenem-resistant Enterobacteriaceae following hospital discharge. Frederic S. Zimmerman, Marc V. Assous, Tali Bdolah-Abram, Tamar Lachish, Amos M. Yinnon, Yonit Wiener-Well [March 2013 (volume 41 issue 3 Pages 190-194 DOI: 10.1016/j.ajic.2012.09.020)]

Disparity in infection control practices for multidrug-resistant Enterobacteriaceae. Christopher Lowe, Kevin Katz, Allison McGeer, Matthew P. Muller [November 2012 (volume 40 issue 9 Pages 836-839 DOI: 10.1016/j.ajic.2011.11.008)]

Retrospective evaluation of colistin versus tigecycline for the treatment of *Acinetobacter baumannii* and/or carbapenem-resistant Enterobacteriaceae infections. Kimberly Ku, Jason M. Pogue, Judy Moshos, Suchitha Bheemreddy, Yujing Wang, Ashish Bhargava, Michelle Campbell, Namir Khandker, Paul R. Lephart, Teena Chopra, Kayoko Hayakawa, Emily T. Martin, Odaliz Abreu-Lanfranco, Sorabh Dhar, Keith S. Kaye, Dror Marchaim [December 2012 (volume 40 issue 10 Pages 983-987 DOI: 10.1016/j.ajic.2011.12.014)]

40th Annual CONFERENCE APIC 2013 FT. LAUDERDALE, FL JUNE 8–10

Are you looking for more CRE prevention education? Check out these sessions at the APIC 2013 Annual Conference, June 8-10 in Fort Lauderdale:

- #2502: **Control Strategies for CRE:** June 9, 2013, 3–4 p.m.
- #3202: **Alphabet Soup: From KPC to NDM and Beyond—Updates from the Expanding World of Carbapenem-Resistant Enterobacteriaceae (CRE):** June 10, 2013, 9:30–10:30 a.m.

Visit www.apic.org/ac2013 to learn more.