vative figure in our calculations. We also recognize that the general inflation factor used may be an underestimate for "medical" inflation.

With increasing rates of travel and medical tourism, more patients are receiving OCMC. Although this point-prevalence study did not identify any CRE-colonized patients, ongoing surveillance and stringent infection control practices will be critical for identifying and limiting the spread of CRE among hospitalized patients in Canada. A preemptive isolation strategy has significant resource implications and is not economically practical at this time in our setting given the low prevalence of CRE colonization.

ACKNOWLEDGMENTS

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Nipunie Rajapakse, MD;[1] Joseph Vayalumkal, MD;[1,2] Debbie Lam-Li, BSc;[2] Craig Pearce, MSc;[2] Gwynne Rees, MSc;[2] Linda Kamhuka, MSc;[2] Gisele Peirano, PhD;[3] Corrinne Pidhorney, RN;[2] Donna Ledgerwood, MSc;[2] Nancy Alfieri, BSc;[2] Karen Hope, MSc;[2] Dan Gregson, MD;[3,4,5,7] Johann Pitout, MD;[3,4,6,7] Thomas Louie, MD;[2,5,6] John Conly, MD[2,3,4,5,6,7]

Affiliations: 1. Department of Pediatrics, Alberta Children's Hospital, Alberta Health Services, Calgary, Alberta, Canada; 2. Infection Prevention and Control, Alberta Health Services–Calgary Zone (Alberta Children's Hospital, Foothills Medical Centre, Peter Lougheed Centre, Rockyview General Hospital), Calgary, Alberta, Canada; 3. Calgary Lab Services, Calgary, Alberta, Canada; 4. Department of Laboratory Medicine and Pathology, University of Calgary, Calgary, Alberta, Canada; 5. Department of Medicine, University of Calgary, Calgary, Alberta, Canada; 6. Department of Microbiology, Immunology, and Infectious Diseases, University of Calgary, Calgary, Alberta, Canada; 7. Snyder Institute for Chronic Diseases, University of Calgary, Calgary, Alberta, Canada.

Address correspondence to John Conly, MD, AGW5, Foothills Medical Centre, 1403-29th Street NW, Calgary, Alberta T2N 2T9, Canada (jconly@ucalgary.ca).

Infect Control Hosp Epidemiol 2014;35(4):450-451

 0899-823X/2014/3504-0024$15.00. DOI: 10.1086/675616

REFERENCES

1. Kochar S, Sheard T, Sharma R, et al. Success of an infection control program to reduce the spread of carbapenem-resistant *Klebsiella pneumoniae*. *Infect Control Hosp Epidemiol* 2009;30:447–452.
2. Schwaber MJ, Lev B, Israeli A, et al. Containment of a country-wide outbreak of carbapenem-resistant *Klebsiella pneumoniae* in Israeli hospitals via a nationally implemented intervention. *Clin Infect Dis* 2011;52:848–855.
3. Won SY, Munoz-Price LS, Lolans K, Hota B, Weinstein RA, Hayden MK. Emergence and spread of *Klebsiella pneumoniae* carbapenemase-producing Enterobacteriaceae. *Clin Infect Dis* 2011:53:532–540.
4. Patel G, Huprikar S, Factor SH, Jenkins SG, Calfee DP. Outcomes of carbapenem-resistant *Klebsiella pneumoniae* infection and the impact of antimicrobial and adjunctive therapies. *Infect Control Hosp Epidemiol* 2008;29:1099–1106.
5. Jacob JT, Klein E, Laxminarayan R, et al. Vital signs: carbapenem-resistant Enterobacteriaceae. *MMWR Morb Mortal Wkly Rep* 62(09);165–170.
6. Brink A, Coetzee J, Clay C, et al. The spread of carbapenem-resistant Enterobacteriaceae in South Africa: risk factors for acquisition and prevention. *S Afr Med J* 2102;102(7):599–601.
7. Calgary Economic Development. Demographics. http://www.calgaryeconomicdevelopment.com/research/demographicspopulation/overview. Accessed August 8, 2013.
8. Government of Alberta. Tourism in Calgary area and tourism destination 2010: a summary of 2010 visitor numbers and characteristics. http://tpr.alberta.ca/tourism/statistics/docs/PersonvisitsCalgaryandArea2010.pdf. February 2012. Accessed October 8, 2013.
9. Conterno LO, Shymanski J, Ramotar K, Toye B, Zvonar R, Roth V. Impact and cost of infection control measures to reduce nosocomial transmission of extended spectrum B-lactamase-producing organisms in a non-outbreak setting. *J Hosp Inf* 2007;65:354–360.
10. Bank of Canada. Inflation calculator. http://www.bankofcanada.ca/rates/related/inflation-calculator/. Accessed April 28, 2013.

Establishing Surveillance for Carbapenem-Resistant Enterobacteriaceae in Minnesota, 2012

To the Editor—Carbapenem-resistant Enterobacteriaceae (CRE) have emerged as a public health threat; Enterobacteriaceae harboring carbapenemase-encoded genes often carry resistance to multiple antibiotic classes, rendering the bacteria resistant to almost all available antibiotics. Invasive CRE infections are associated with a high mortality rate (38%–48%),[1-3] and intra- and interfacility spread in a variety of healthcare settings has occurred.[4,5] A standardized approach to CRE surveillance and a clearer description of the evolving epidemiology are needed to understand the health burden and evaluate the impact of control measures.

In 2009, the Minnesota Department of Health (MDH) Public Health Laboratory (PHL) first confirmed *Klebsiella pneumoniae* carbapenemase in a clinical Enterobacteriaceae isolate. The MDH immediately initiated statewide voluntary reporting of CRE with isolate submission to the PHL (clinical cultures from all sources and Enterobacteriaceae species). In collaboration with the Centers for Disease Control and Prevention (CDC) Emerging Infections Program (EIP) Multisite resistant Gram-negative Surveillance Initiative (MuGSI),

the MDH began active, laboratory-based surveillance in Minnesota's 2 most populous counties, Hennepin and Ramsey, using a standardized case definition. The CRE definition includes the species *Enterobacter cloacae, Enterobacter aerogenes, Escherichia coli, K. pneumoniae,* and *Klebsiella oxytoca*; culture specimens from sterile sites and urine; and intermediate resistance to all tested third-generation cephalosporins.[6] Data from 2012 represent the first full year of MuGSI surveillance.

Antibiotic susceptibility testing (AST) results from automated testing instruments (ATIs) and results of additional testing (eg, modified Hodge test) performed by the submitting laboratory are sent to the PHL with isolates, and minimum inhibitory concentrations reviewed by MDH staff to confirm case status, because variable interpretive criteria are used by clinical laboratories. Isolates submitted to the PHL are tested by polymerase chain reaction for the bla_{KPC} and bla_{NDM} genes. Medical records of CRE cases meeting MuGSI criteria are reviewed.

During 2012, the PHL received and tested 154 Enterobacteriaceae, including isolates not meeting the MuGSI definition, from 151 unique patients (multiple species in a single patient are reported). Isolates were submitted by 20 clinical laboratories statewide, including 115 (75%) from 9 of 11 clinical laboratories participating in active surveillance. Submitted isolates included *Enterobacter* species (75 isolates), *Klebsiella* species (32), *E. coli* (23), *Citrobacter* species (15), *Serratia marcescens* (4), *Proteus mirabilis* (3), and *Providencia rettgeri* (2). Thirty-six (23%) of the isolates were bla_{KPC} positive, and 3 (2%) were bla_{NDM} positive. Species of bla_{KPC}-positive isolates were *Klebsiella* species (20), *Enterobacter* species (15), and *E. coli* (1). Notably, 2 (6%) of the bla_{KPC}-positive isolates were resistant to ertapenem only and therefore did not meet the established CRE definition; both had a positive modified Hodge test result reported by the submitting laboratory. Additional characterization of the isolates may provide insight into why these isolates carry the bla_{KPC} gene but had test results that indicated susceptibility to imipenem and/or meropenem. The bla_{NDM}-positive isolates included 2 *K. pneumoniae* and 1 *E. coli* from 2 patients (1 patient with 2 species); both patients had previous healthcare exposure outside of the United States.

Thirty-two cases that met the MuGSI CRE definition were identified during 2012. Isolates for 5 of the 32 cases were not available or were repeat isolates from the same patient. Twenty-seven isolates were submitted to the CDC for additional testing; 12 were unexpectedly susceptible to all carbapenems (excluding ertapenem) when tested by broth microdilution at the CDC. Of note, all 12 isolates (9 *E. aerogenes* and 3 *E. coli*) were negative for bla_{KPC} and bla_{NDM}. The 5 cases without isolate testing at the CDC and 12 cases whose isolates had test results indicating susceptibility at the CDC were excluded from further review. Of the remaining 15 cases, 10 (67%) were bla_{KPC} positive; species are reported in Table 1. The source for all 15 CRE isolates was urine samples. Ten case patients were hospitalized at the time of or within 30 days of culture specimen collection. Three others were in an outpatient setting at the time of culture specimen collection, and 1 each were in a long-term care facility and a long-term acute care hospital. Two cases had recurrent isolates submitted within 30 days of initial culture.

TABLE 1. Multi-site resistant Gram-negative Surveillance Initiative (MuGSI) Carbapenem-Resistant Enterobacteriaceae (CRE) Isolates by Species and bla_{KPC} Polymerase Chain Reaction Results, Minnesota, 2012

CRE species	No. of isolates	No. (%) of bla_{KPC}-positive isolates
Enterobacter cloacae	7	6 (86)
Klebsiella pneumoniae	4	3 (75)
Escherichia coli	2	1 (50)
Enterobacter aerogenes	2	0 (0)
Total	15	10 (67)

CRE control can be impacted by early detection and implementation of appropriate infection prevention measures and communication of CRE status when a patient is transferred.[7] Similar to other reports, we found that CRE cases came from healthcare facilities across the continuum of care.[8] Regional evaluation of CRE and a coordinated approach to CRE prevention is recommended by the CDC and has been fundamental to controlling CRE in areas with a high prevalence of CRE infection.[9,10] Although many states are establishing CRE surveillance, defining CRE has been difficult because of the nuances of CRE detection methods used in clinical laboratories, including variations and complexities of ATIs and differences in the interpretation criteria used. The emergence of novel resistance mechanisms (eg, OXA-48) adds to the challenge of developing a standardized definition. Additional study is needed to evaluate the discrepancy in AST results that we observed with different methods and in different laboratories. Despite these challenges, it remains important to establish a common national CRE definition.

We found this surveillance useful, because it highlights that it is possible to detect carbapenemase-producing organisms even in regions with a low incidence of infection, like Minnesota. This provides an opportunity to control the spread and proliferation of CRE through infection prevention activities and antimicrobial stewardship. Detection of bla_{NDM}-positive isolates serves as a reminder that these organisms may return with travelers who receive health care in countries where these resistance mechanisms are endemic.

ACKNOWLEDGMENTS

We thank Alexander Kallen, Sandra Bulens, and Brandi Limbago at the Centers for Disease Control and Prevention (CDC) for guidance and assistance establishing Multi-site resistant Gram-negative Surveillance Initiative (MuGSI) surveillance and characterizing the MuGSI carbapenem-resistant Enterobacteriaceae (CRE) isolates. We also thank Jesse Jacobs and Janine Scott of Georgia Emerging Infections Program (EIP) for guidance in sur-

veillance, Kelly Gall and Kate Klammer with the Minnesota Department of Health Public Health Laboratory for their contributions to isolate characterization, Edwin Pereira for his work on the CRE pilot surveillance project, Minnesota clinical microbiology laboratories and infection preventionists for their participation in CRE surveillance, and CDC EIP for funding the MuGSI project.

Financial support. CDC cooperative agreement 5U50CK000204.

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

Kristin M. Shaw, MPH, CIC;[1]
Jane E. Harper, BSN, MS, CIC;[1]
Paula Snippes Vagnone, MT(ASCP);[1] Ruth Lynfield, MD[1]

Affiliation: 1. Minnesota Department of Health, Saint Paul, Minnesota.

Address correspondence to Kristin M. Shaw, MPH, 625 Robert Street North, St. Paul, MN 55155 (kristin.shaw@state.mn.us).

Infect Control Hosp Epidemiol 2014;35(4):451-453

 0899-823X/2014/3504-0025$15.00. DOI: 10.1086/675615

REFERENCES

1. Ben-David D, Kordevani R, Keller N, et al. Outcome of carbapenem resistant *Klebsiella pneumoniae* bloodstream infections. *Clin Microbiol Infect* 2012;18(1):54–60.
2. Patel G, Huprikar S, Factor SH, Jenkins SG, Calfee DP. Outcomes of carbapenem-resistant *Klebsiella pneumoniae* infection and the impact of antimicrobial and adjunctive therapies. *Infect Control Hosp Epidemiol* 2008;29(12):1099–1106.
3. Schwaber MJ, Klarfeld-Lidji S, Navon-Venezia S, Schwartz D, Leavitt A, Carmeli Y. Predictors of carbapenem-resistant *Klebsiella pneumoniae* acquisition among hospitalized adults and effect of acquisition on mortality. *Antimicrob Agents Chemother* 2008;52(3):1028–1033.
4. Munoz-Price LS, Hayden MK, Lolans K, 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):341–347.
5. Won SY, Munoz-Price LS, Lolans K, et al. Emergence and rapid regional spread of *Klebsiella pneumoniae* carbapenemase-producing *Enterobacteriaceae. Clin Infect Dis* 2011;53(6):532–540.
6. Clinical and Laboratory Standards Institute (CLSI). *Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Second Informational Supplement.* Wayne, PA: CLSI, 2012. CLSI document: M100-S22.
7. Kochar S, Sheard T, Sharma R, et al. Success of an infection control program to reduce the spread of carbapenem-resistant *Klebsiella pneumoniae. Infect Control Hosp Epidemiol* 2009;30(5):447–452.
8. Marquez P, Terashita D, Dassey D, Mascola L. Population-based incidence of carbapenem-resistant *Klebsiella pneumoniae* along the continuum of care, Los Angeles County. *Infect Control Hosp Epidemiol* 2013;34(2):144–150.
9. Centers for Disease Control and Prevention. *Guidance for Control of Carbapenem-Resistant Enterobacteriaceae (CRE): 2012 CRE Toolkit.* http://www.cdc.gov/hai/pdfs/cre/CRE-guidance-508.pdf. 2012. Accessed August 19, 2013.
10. Schwaber MJ, Lev B, Israeli A, et al. Containment of a country-wide outbreak of carbapenem-reisstant *Klebsiella pneumoniae* in Israeli hospitals via a nationally implemented intervention. *Clin Infect Dis* 2011;52(7):848–855.