Are Community-Based Hospitals Safe from Carbapenem-Resistant Enterobacteriaceae in Korea?

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Carbapenems are used with increasing frequency to treat multidrug-resistant isolates, especially strains producing extended-spectrum β-lactamas [1, 2]. Resistance to carbapenems has been uncommon among Enterobacteriaceae. However, the emergence of β-lactamas with direct carbapenem-hydrolyzing activity has contributed to an increased prevalence of carbapenem-resistant Enterobacteriaceae (CRE) [3]. CRE are particularly problematic given the high mortality associated with infections caused by CRE, and the potential for widespread transmission of carbapenem resistance via mobile genetic elements [3, 4].

We should recall 2 outbreaks in New York City [5]. At hospital A, 2 patients with carbapenem-resistant Klebsiella pneumoniae (CRKP) were identified. During the next 6 months, a total of 30 additional patients were identified as having CRKP. Thirty of 32 isolates were considered to be acquired nosocomially, with median length of hospital stay before a positive culture result of 18.5 days. At hospital B, an initial case of CRKP was recognized, followed by 2 more cases within 2 months. In the ensuing 3 months, another 24 cases were identified. All isolates were considered to be acquired nosocomially. We assume that horizontal transmission of carbapenem-resistant organisms occurred at these 2 hospitals.

The emergence of carbapenem-resistant Gram-negative bacteria has been increasingly reported, especially Pseudomonas aeruginosa, Acinetobacter baumannii, and Enterobacter spp. in Korea [6]. Among Gram-negative bacteria, the proportion of CRE has been very low, compared with that of P. aeruginosa and A. baumannii [1, 6]. However, the trend is increasing [6].

Lee et al. [7] investigated the prevalence and risk factors of CRE in a single community-based hospital in Korea. Until now, most research on carbapenem-resistant Gram-negative bacteria including CRE was performed in tertiary acute care hospitals in Korea. However, Lee et al. conducted their study at a mid-sized community-based hospital, including not only the intensive care unit but also the general wards. Many patients had been transferred from long-term care facilities (LTCFs). In this study, a total of 41 (1.6%) CRE isolates were identified, including 13 of Enterobacter aerogenes, 8 of K. pneumoniae, 5 of Enterobacter cloacae, and 15 others. They reported that risk factors for CRE included vascular catheters,
high comorbidity score, and regular visits to the outpatient clinic.

CRE carriage has been described in a number of investigations involving those in LTCFs. In one study, 9 carbapenem-resistant *Escherichia coli* isolates harboring *K. pneumoniae* carbapenemase were identified in patients residing in 7 different LTCFs [8]. In other reports, about 60% of patients with CRKP were admitted from post-acute care facilities [9]. These results suggest that LTCFs can be important reservoirs for the transmission and dissemination of these organisms. Well-known risk factors for CRE acquisition or infection include recent organ or stem-cell transplantation, mechanical ventilation, exposure to antimicrobials, and longer length of stay [3, 10]. In one study, the risk factors for CRKP included previous use of carbapenems, cephalosporins, and fluoroquinolones [4, 10]. In other reports, poor functional status and intensive care unit stay were risk factors for CRKP [4].

In conclusion, CRE is threatening not only tertiary acute care hospitals but also mid-sized community hospitals in Korea. LTCFs are possible reservoirs for the threat of CRE. Because of high mortality rates and the possibility of outbreaks, each hospital must detect CRE as soon as possible and aggressively perform infection control to perfection.

For CRE prevention, we recommend active surveillance in high-risk groups admitted to the hospital, whether in a tertiary acute care or mid-sized community-based hospital. In addition, we should apply antimicrobial stewardship to decrease carbapenem consumption in hospitals and to minimize device usage in clinical settings. We absolutely should perform appropriate infection control procedures, including use of personal protective equipment and good hand hygiene following exposure to patient environments.

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**Conflicts of Interest**

No conflicts of interest.

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**References**

1. Kim BM, Jeon EJ, Jang JY, Chung JW, Park J, Choi JC, Shin JW, Park IW, Choi BW, Kim JY. Four year trend of carbapenem-resistance in newly opened ICUs of a university-affiliated hospital of South Korea. Tuberc Respir Dis (Seoul) 2012;72:360-6.

2. Yoon YK, Park GC, An H, Chun BC, Sohn JW, Kim MJ. Trends of antibiotic consumption in Korea according to national reimbursement data (2008-2012): a population-based epidemiologic study. Medicine (Baltimore) 2015;94:e2100.

3. Gupta N, Limbago BM, Patel JB, Kallen AJ. Carbapenem-resistant *Enterobacteriaceae* epidemiology and prevention. Clin Infect Dis 2011;53:60-7.

4. Schwaber MJ, Klafeld-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;52:1028-33.

5. Bratu S, Landman D, Haag R, Recco R, Eramo A, Alam M, Quale J. Rapid spread of carbapenem-resistant *Klebsiella pneumoniae* in New York City: a new threat to our antibiotic armamentarium. Arch Intern Med 2005;165:1430-5.

6. Huh K, Kim J, Cho SY, Ha YE, Joo EJ, Kang CI, Chung DR, Lee NY, Song JH, Peck KR; Korean Network for Study on Infectious Diseases (KONSID). Continuous increase of the antimicrobial resistance among gram-negative pathogens causing bacteremia: a nationwide surveillance study by the Korean Network for Study on Infectious Diseases (KONSID). Diagn Microbiol Infect Dis 2013;76:477-82.

7. Lee HJ, Choi JK, Cho SY, Kim SH, Park SH, Choi SM, Lee DG, Choi JH, Yoo JH. Carbapenem-resistant *Enterobacteriaceae*: prevalence and risk factors in a single community-based hospital in Korea. Infect Chemother 2016;48:166-73.

8. Urban C, Bradford PA, Tuckman M, Segal-Maurer S, Wehbeh W, Grenner L, Colon-Urban R, Mariano N, Rahal JJ. Carbapenem-resistant *Escherichia coli* harboring *Klebsiella pneumoniae* carbapenemase beta-lactamases associated with long-term care facilities. Clin Infect Dis 2008;46:e127-30.

9. Perez F, Endimiani A, Ray AJ, Decker BK, Wallace CJ, Hujer KM, Ecker DJ, Adams MD, Tolzis P, Dul MJ, Windau A, Bajaksouzian S, Jacobs MR, Salata RA, Bonomo RA. Carbapenem-resistant *Acinetobacter baumannii* and *Klebsiella pneumoniae* across a hospital system: impact of
post-acute care facilities on dissemination. J Antimicrob Chemother 2010;65:1807-18.
10. 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;29:1099-106.