2. Conraths FJ, Peters M, Beer M. Schmallenberg virus, a novel orthobunyavirus infection in ruminants in Europe: potential global impact and preventive measures. N Z Vet J. 2013;61:63–7. http://dx.doi.org/10.1080/00480169.2012.738403

3. Müller U, Steinhoff U, Reis LF, Hemmi S, Pavlovic J, Zinkernagel RM, et al. Functional role of type I and type II interferons in antiviral defense. Science. 1994;264:1918–21. http://dx.doi.org/10.1126/science.809221

4. Bilk S, Schulze C, Fischer M, Beer M, Hlinak A, Hofmann B. Organ distribution of Schmallenberg virus RNA in malformed newborns. Vet Microbiol. 2012;159:236–8. http://dx.doi.org/10.1016/j.vetmic.2012.03.035

5. Wernike K, Eschaumier M, Schirrmacher H, Blohm U, Breithaupt A, Hofmann B, et al. Oral exposure, reinfection and cellular immunity to Schmallenberg virus in cattle. Vet Microbiol. 2013;165:155–9. http://dx.doi.org/10.1016/j.vetmic.2013.01.040

6. Hofmann B, Scheuch M, Höper D, Jungblut R, Holsteg M, Schirrmacher H, et al. Novel orthobunyavirus in cattle, Europe, 2011. Emerg Infect Dis. 2012;18:469–72. http://dx.doi.org/10.3201/eid1803.111905

7. Wernike K, Eschaumier M, Breithaupt A, Hofmann B, Beer M. Schmallenberg virus challenge models in cattle: infectious serum or culture-grown virus? Vet Res. 2012;43:84. http://dx.doi.org/10.1186/1297-9975-43-84

8. Wernike K, Kohn M, Conraths FJ, Werner D, Kameke D, Hechinger S, et al. Transmission of Schmallenberg virus during winter, Germany. Emerg Infect Dis. 2013;19:1701–3. http://dx.doi.org/10.3201/eid1910.130622

9. Parsonson IM, Della-Porta AJ, Snowdon WA, O’Halloran ML. The consequences of infection of cattle with Akabane virus at the time of insemination. J Comp Pathol. 1981;91:611–9. http://dx.doi.org/10.1016/0021-9975(81)90090-6

10. van Oirschot JT. Bovine herpesvirus 1 in semen of bulls and the risk of transmission: a brief review. Vet Q. 1995;17:29–33. http://dx.doi.org/10.1080/01652176.1995.9694526

Address for correspondence: Martin Beer, Institute of Diagnostic Virology, Friedrich-Loeffler-Institut, Federal Research Institute for Animal Health, Süderau 10, 17493 Greifswald-Insel Riems, Germany; email: martin.beer@fli.bund.de

Search past issues of EID at wwwnc.cdc.gov/eid

NDM-1–producing Strains, Family Enterobacteriaceae, in Hospital, Beijing, China

To the Editor: The prevalence of New Delhi metallo-β-lactamase-1 (NDM-1)–producing strains (family Enterobacteriaceae) in China remains unclear. Recently, to clarify the prevalence of blaNDM-1 in Enterobacteriaceae strains, we carried out retrospective surveillance for blaNDM-1 among carbapenem-resistant enterobacterial strains isolated from patients at the Chinese PLA General Hospital in Beijing. This tertiary teaching hospital has 4,000 beds and 12,000 daily outpatient visits. More than 50% of patients admitted to the hospital are from areas outside Beijing. During January 2009–June 2013, a total of 8,586 enterobacterial isolates were obtained from routine clinical samples that had been passively sent to the microbiology department. Of these, 242 (2.8%) strains exhibited resistance to carbapenems.

In this study, we used PCR amplification to screen the carbapenem-resistant strains for the blaNDM-1 gene and other common resistance determinants. The MICs of various antimicrobial drugs were measured by E-test (AB bioMérieux, Solna, Sweden). S1 nuclease pulsed-field gel electrophoresis and Southern blot analysis showed that the blaNDM-1 gene was located on plasmids of various sizes belonging to different Inc groups. The K. pneumoniae isolate was defined as a novel ST1240 with the allelic profile 2–1–1–1–3–24, and the E. coli isolate was identified as ST167.

In China, various blaNDM-1–carrying strains of the Enterobacteriaceae have been sporadically identified, including K. pneumoniae, K. oxytoca, Escherichia coli, Enterobacter cloacae, Enterobacter aerogenes, and Citrobacter freundii (1–4). We identified a P. rettgeri isolate and an R. ornithinolytica isolate that produced NDM-1. The blaNDM-1–positive P. rettgeri isolates have also been identified in Pakistan, India, Canada, and Mexico, whereas the NDM-1-producing R. ornithinolytica strain has only been detected in India (5–9). In this study, 5 NDM-1–producing strains were isolated only once, and no dissemination of NDM-1–producing strains of Enterobacteriaceae has been found. Two strains (K. pneumoniae and Enterobacter cloacae) were isolated within 48 hours of the patient’s hospital admission.
indicating the infections were imported (from Shandong and Hebei Provinces, respectively). *Escherichia coli*, *P. rettgeri*, and *R. ornithinolytica* were isolated 48 hours after admission of patients (from Henan and Hebei Provinces). Therefore, the patients might have acquired the NDM-1–producing *Enterobacteriaceae* strains at the hospital.

However, the source of the bla<sub>NDM-1</sub> determinant remains unclear. The possibility that the strains were imported cannot be excluded for the several reasons. First, examination to determine the infectious agent had not been performed for a considerable number of patients within 48 hours of their admission. Second, NDM-1–producing *Enterobacteriaceae* species have not spread in this hospital. Third, their admission. Second, NDM-1–producing enterobacteria in the hospital. Sequencing analysis (data not shown) indicated that the bla<sub>NDM-1</sub>-carrying plasmid carried by *K. pneumoniae* (~50 kb, IncX3) was different from the plasmid found in the *Acinetobacter pittii* isolate that was disseminated in an intensive care unit of the Chinese PLA General Hospital in 2008 (10). This finding suggests that the 2 plasmids had a different evolutionary origin. The IncX3 plasmid that we found was highly homologous (~99%) to the plasmid pNDM-HN380 (GenBank accession no. JX104760), which has been identified in several *Enterobacteriaceae* strains isolated from patients in southern China (1). This finding showed that the IncX3 plasmid that was 50 kb in size acted as the main factor mediating the transmission of the bla<sub>NDM-1</sub> gene across China. IncA/C plasmids are the leading group of bla<sub>NDM-1</sub>-carrying plasmids and have been detected in *E. coli* isolated from China (1). In this study, *E. coli* (IR5028) and *P. rettgeri* (IR5337) carried IncA/C plasmids. However, these 2 strains exhibited diverse resistant determinants on these plasmids (Table). This observation suggested that the 2 plasmids have different integrating processes. For *R. ornithinolytica*, the bla<sub>NDM-1</sub> gene was located on an IncN plasmid of ~70 kb, which is very different from other plasmids.

In conclusion, we identified various NDM-1–producing enterobacterial isolates at the Chinese PLA Hospital in Beijing and the emergence of novel bla<sub>NDM-1</sub>-carrying clones among common species of *Enterobacteriaceae*, such as *K. pneumoniae* ST1240 and *E. coli* ST167. There is an urgent need for monitoring and surveillance of epidemiologic and genotypic profiles of NDM-1–producing *Enterobacteriaceae* species in China.

Acknowledgment

We thank the team of curators at the Institute Pasteur MLST system (Paris, France) for providing novel isolates.

This study was supported by the China Mega-Project on Infectious Disease Prevention (grant no. 2013ZX10004202-002-002).

Guang Zhou,† Si Guo,† Yanping Luo, Liyan Ye, Yang Song, Guangwei Sun, Ling Guo, Yong Chen, Li Han, and Jiyoung Yang

Author affiliations: Chinese PLA General Hospital, Beijing, China (G. Zhou, Y. Luo, L. Ye, Y. Song, G. Sun, L. Guo, J. Yang); Henan Provincial People’s Hospital, Zhengzhou, China (S. Guo); and Chinese PLA Institute for Disease Control and Prevention, Academy of Military Medical Sciences, Beijing (Y. Chen, L. Han)

DOI: http://dx.doi.org/10.3201/eid2002.131263

*NDM-1, New Delhi metallo-β-lactamase-1–producing; ST, sequence type; RDs, resistance determinants; CTX, cefotaxime; FEP, ceftazidime; TZP, piperacillin-tazobactam; IMP, imipenem; MEM, meropenem; ETP, ertapenem; AK, amikacin; LVX, levofloxacin; NA, not applicable.
†The alleles at each of the multi-locus ST loci for a given isolate are combined into an allelic profile and assigned an ST designation.
‡Shown to be transferred by conjugation experiments.
References

1. Ho PL, Li Z, Lo WU, Cheung YY, Lin CH, Sham PC, et al. Identification and characterization of a novel incompatibility group X3 plasmid carrying blaNDM-1 in Enterobacteriaceae isolates with epidemiological links to multiple geographical areas in China. Emerging Microbes & Infections. 2012;1(e39). http://dx.doi.org/10.1038/emi.2012.37.

2. Ho PL, Li Z, Lai EL, Chiu SS, Cheng VC. Emergence of NDM-1–producing Enterobacteriaceae in China. J Antimicrob Chemother. 2012;67:1553–5. http://dx.doi.org/10.1093/jac/dks095

3. Hu L, Zhong Q, Tu J, Xu Y, QinZ, Parsons C, et al. Emergence of blaNDM-1 among Klebsiella pneumoniae ST15 and novel ST1031 clinical isolates in China. Diagn Microbiol Infect Dis. 2013;75:373–6. http://dx.doi.org/10.1016/j.diagmicrobio.2013.01.006

4. Wang SJ, Chiu SH, Lin YC, Tsai YC, Mu JJ. Carbapenem resistant Enterobacteriaceae carrying New Delhi metallo-β-lactamase gene (NDM-1) in Taiwan. Diagn Microbiol Infect Dis. 2013;76:248–9. http://dx.doi.org/10.1016/j.diagmicrobio.2013.02.003

5. Perry JD, Naqvi SH, Mirza IA, Alizai SA, Hussain A, Ghiardi S, et al. Prevalence of faecal carriage of Enterobacteriaceae with NDM-1 carbapenemase at military hospitals in Pakistan, and evaluation of two chromogenic media. J Antimicrob Chemother. 2011;66:2288–94. http://dx.doi.org/10.1093/jac/dkr299

6. Lascols C, Hackel M, Marshall SH, Hujer AM, Bouchillon S, Badal R, et al. Increasing prevalence and dissemination of NDM-1 metallo-β-lactamase in India: data from the SMART study (2009). J Antimicrob Chemother. 2011;66:1992–7.

7. Kus JV, Tadros M, Simor A, Low DE, McGee AJ, Willey BM, et al. New Delhi metallo-beta-lactamase-1: local acquisition in Ontario, Canada, and challenges in detection. CMAJ. 2011;183:1257–61. http://dx.doi.org/10.1503/cmaj.110477

8. Barrios H, Garza-Ramos U, Reyna-Flores F, Sanchez-Perez A, Rojas-Moreno T, Garza-Gonzalez E, et al. Isolation of carbapenem-resistant NDM-1-positive Providencia rettgeri in Mexico. J Antimicrob Chemother. 2013;68:1934–6. http://dx.doi.org/10.1093/jac/dkt124

9. Khajuria A, Praharaj AK, Grover N, Kumar M. First report of blaNDM-1 in Raoultella ornithinolytica. Antimicrob Agents Chemother. 2013;57:1093–2. http://dx.doi.org/10.1128/AAC.02147-12

10. Chen Y, Cui Y, Pu F, Jiang G, Zhao X, Yuan Y, et al. Draft genome sequence of an Acinetobacter genomic species 3 strain harboring a blaNDM-1 gene. J Bacteriol. 2012;194:204–5. http://dx.doi.org/10.1128/JB.06202-11

Address for correspondence: Jiyong Yang, Microbiology Department, 301 Hospital, 28# Fuxing Rd, Beijing 100853, China; email: yangjy301@hotmail.com