Subject Category: Multidrug-Resistant (MDR) Organisms
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Multidrug-resistant organisms: Elevating issues identified by antimicrobial stewardship to improve infection control responses

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Objectives: Resistance to third-generation cephalosporins in *Escherichia coli* bacteremia is on the rise in Australia. Currently, laboratory definitions of multidrug-resistant organisms determine infection control responses. The incidence of particular extended-spectrum β-lactamase (ESBL) *E. coli* phenotype, with nonsusceptibility to both ciprofloxacin and trimethoprim-sulfamethoxazole, is increasing in the Australian Capital Territory, Australia. The increase was noted primarily through antimicrobial stewardship clinical care rather than standard infection control or microbiology processes. Clinically, patients are left with limited or no oral therapeutic options for treatment. Despite not necessarily meeting the laboratory definition of a multidrug-resistant organism, this phenotype is likely to be just as transmissible as other healthcare-associated pathogens. We sought to determine whether laboratory definitions of multidrug-resistant organisms adequately inform infection control responses. **Methods:** Using laboratory data from Australian Capital Territory (ACT) Pathology, we identified all ESBL *E. coli* bloodstream isolate episodes from 2016 to 2020. We then reviewed the antibiotic sensitivities of each isolate to identify isolates with nonsusceptibility to both ciprofloxacin and trimethoprim-sulfamethoxazole. We then compared these isolates with the multidrug-resistant organism definition used by ACT Pathology. **Results:** In total, 152 isolates were reviewed. ACT Pathology classified 35 (23.0%) of these isolates as a multidrug-resistant organisms. We identified 80 (52.6%) isolates with nonsusceptibility to both ciprofloxacin and trimethoprim-sulfamethoxazole. Of these 80 isolates, only 24 (30.0%) met the ACT Pathology definition of a multidrug-resistant organism. **Conclusions:** Multidrug-resistant organism definitions should encompass a broad range of healthcare considerations. When the laboratory defines what is important, it may not include the complete spectrum of clinical care concerns. To help combat the rise of multidrug-resistant organisms, definitions for organisms of resistance and transmissibility significance should be developed in conjunction with microbiology, infection control, and antimicrobial stewardship.

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Diagnostic and infection prevention and control (IPC) performance of rapid polymerase chain reaction (PCR) compared to conventional culture PCR methods for detecting carbapenemase-producing organisms (CPOs)

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Objectives: In this study, we compared the performance of a rapid polymerase chain reaction (PCR) method in detecting carbapenemase-producing organisms (CPOs) and its impact on infection prevention and control (IPC) measures compared with a culture PCR method. **Methods:** All patients requiring CPO screening were included. Rectal swabs were collected with double rayon swabs (Copan 139C). They were simultaneously analyzed for the presence of CPOs using rapid PCR assay (Xpert Carba-R assay, Cepheid, Sunnyvale, CA) and a culture–PCR method (ChromID CARBA-SMART, bioMerieux, Marcy-l'Etoile, France). For CARBA-SMART, only colored colonies (ie, Enterobacterales) were evaluated for CPOs according to the prevailing institutional protocol. We tracked time to CPO detection. Using CPO positivity from either the rapid PCR or the culture PCR method as the gold standard, we calculated the sensitivity and specificity of both tests. We calculated the number of epidemiologically linked contacts generated when the first test results were known. We prospectively followed the ward census to identify the putative additional number of contacts generated by the later known result. Contacts were patients who shared the same ward (with overlapping time) as the CPO patients. **Results:** Between April 2019 and June 2020, culture PCR method detected CPOs in 316 (1.3%) of 24,514 samples (*bla*OXA48, N = 211; *bla*NDM, N = 51; *bla*IMI, N = 21; *bla*IMP, N = 10; *bla*KPC, N = 9; mixed genotypes, N = 14). The rapid PCR test detected CPOs in 605(2.5%) of 24,514 samples (*bla*OXA48, N = 266; *bla*NDM, N = 161; *bla*IMP, N = 99; *bla*VIM, N = 29; *bla*KPC, N = 15; mixed genotypes, N = 35). The sensitivity of direct PCR and culture PCR methods were 94.2% (95% CI, 92.1%–95.8%) and 43.5% (95% CI, 39.6%–47.4%), respectively. Both tests had 100% specificity. The median times to detection for the rapid PCR and culture PCR methods were 3–4 hours and 4 days, respectively. Compared with rapid PCR, the culture PCR method generated additional 7,415 contacts when it also tested positive for CPOs and an additional 23,135 contacts when it tested negative for CPOs. **Conclusions:** In our study, the rapid PCR test was more sensitive, identified CPO faster, and generated fewer epidemiologically linked contacts than the culture PCR method.

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Evaluation of a pooling strategy using Xpert Carba-R assay for screening for carbapenemase-producing organisms in rectal swabs

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Objectives: Rapid and accurate screening for carbapenemase-producing organism (CPOs) in hospitalized patients is critical for infection control and prevention. The Xpert Carba-R assay is designed for rapid detection of CPOs, but 1 assay is usually conducted for only 1 sample. We evaluated a pooling strategy for CPO screening using the Xpert Carba-R assay. **Methods:** Swab sets containing 2 swabs were collected from 415 unique patients at Peking University People's Hospital. One swab was used for the pooling test, in which 5 swabs from different patients were mixed in 1 sample treatment solution. The prevalence of CPOs in the hospital (5.3%) predicted that 5:1 pooling was most economical. As the reference method, the other swab was tested by culture using sequencing. **Results:** Of 415 samples, 383 were CPO negative using the pooling test strategy and 31 were positive. All samples that were negative by pooling were negative by culture and sequencing. Among the 31 positive samples identified by the pooling strategy, 26 were positive by culture and sequencing (including 24

samples with 1 targeted gene and 2 samples with double targeted genes, 1 NDM+/IMP+ and 1 VIM+/IMP+), and 5 were negative. Overall, 198 tests were conducted in the study, and 217 were saved compared with testing individually. The efficiency of the pooling strategy was 215%. The overall sensitivity was 1 (95% CI, 0.840–1), the specificity was 0.987 (95% CI, 0.968–0.995), the accuracy was 0.987 (95% CI, 0.970–0.996), positive predictive value was 0.838 (95% CI, 0.655–0.939), and the negative predictive value was 1 (95% CI, 0.988–1). **Conclusions:** The pooling strategy using the Xpert Carba-R assay showed good potential in screening CPO with good sensitivity and a significantly lower cost.

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Healthcare cost of antibiotic resistant infections: A hospital-based study in Vietnam
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Objectives: Antimicrobial resistance is a serious threat to health and economic well-being worldwide. The impact of antibiotic-resistant infections is reflected by higher mortality, increased lengths of hospital stay (LOS), and increased healthcare costs. We analyzed the direct healthcare costs attributable to treating patients infected with methicillin-resistant *Staphylococcus aureus* (MRSA) and carbapenem-resistant Enterobacterales (CRE) in a tertiary-care referral hospital in Vietnam. **Methods:** A retrospective descriptive cross-sectional study was conducted in an intensive care unit (ICU) in the University Medical Center in Ho Chi Minh City from June 2018 to September 2019. Participants were ICU patients diagnosed with either MRSA or CRE infection, and patients infected with non–multidrug-resistant organisms (non-MDROs) were used as the comparison group. Medical records were obtained to collect data on medical services expenditures such as medications, diagnostic testing, medical procedures, and hospital rooms. Statistical significance was determined using the Mann-Whitney and Kruskal-Wallis tests for comparing the average costs and the χ^2 test for comparing the proportions. **Results:** In total, 227 patients, including 37 MRSA-infected patients, 97 CRE-infected patients, and 93 non–MDRO-infected patients, were included in the study. The additional average healthcare costs for a treatment episode of a CRE infection case (367.7 million VND or ~US $16,000) and of a MRSA infection case (139.1 million VND or ~US $6,043) were 3.8 times higher ($P < .001$) and 1.5 times higher ($P < .001$), respectively, than the average cost for a non-MDRO case (94.8 million VND or ~US $4,121). Resource use for a CRE infection was higher than that for MRSA infection, with longer antibiotic treatment (13.4 additional days), greater LOS (15.8 additional days), and higher costs (additional 228.6 million VND or ~US $9,939). **Conclusions:** Multidrug-resistant infections create a heavy economic burden in a low- to middle-income country like Vietnam. The elevated cost was mainly due to longer antibiotic treatment and increased LOS.

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Prevalence and classification of carbapenemase-producing gram-negative bacilli at a medical center in Ho Chi Minh City, Vietnam
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Objectives: The identification and classification of carbapenemases are meaningful in clinical treatment, epidemiology, and multidrug-resistant bacteria control. We sought to identify the proportion of carbapenemase-producing and carbapenemase classifications in gram-negative bacilli in our hospital. **Methods:** Isolates of gram-negative bacilli were extracted from sputum, blood, and urine samples in a medical center in Ho Chi Minh City. The identification of gram-negative bacilli was performed using the Phoenix M50 automated system (Becton Dickinson, Franklin Lakes, NJ). An antibiogram was conducted using the disk-diffusion method to detect meropenem-resistant gram-negative bacteria. Carbapenemase confirmation and classification of isolates resistant or intermediately resistant to meropenem were performed using the NMIC500 CPO kit on the Phoenix M50 system. **Results:** Among 599 isolates of gram-negative bacilli, 108 isolates were resistant or intermediately resistant to carbapenem (meropenem). Of these108 isolates, 107 (99.1%) were resistant due to the carbapenemase-producing mechanism. The proportions of resistant or intermediately resistant isolates to carbapenem were as follows: 73.8% for *Acinetobacter baumannii*, 26.4% for *Klebsiella pneumoniae*, 25.9% for *Pseudomonas aeruginosa*, and 2.8% for *Escherichia coli*. Class D carbapenemase accounted for the highest proportion, with 53 (49.5%) of 107 isolates, followed by class B with 31 isolates (29%), and class A with the lowest proportion of 2 isolates (1.9%). Also, 44.4% of *Acinetobacter baumannii* isolates and 74.4% of *Klebsiella pneumoniae* isolates produced class D carbapenemase. **Conclusions:** Gram-negative bacilli are resistant to carbapenem primarily due to the carbapenemase-secreting mechanism. D-class carbapenemase accounted for the highest percentage, followed by B-class type, and A-class carbapenemase in gram-negative bacilli.

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Subject Category: Multidrug-Resistant (MDR) Organisms
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Control of hospital-acquired carbapenemase-producing carbapenem-resistant Enterobacteriaceae colonization: A descriptive study
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Objectives: Carbapenemase-producing carbapenem-resistant Enterobacteriaceae (CP-CRE) are nosocomial pathogens, and control of CP-CRE transmission is one of the most important infection control issues healthcare organizations face today. Increasing colonization acquisition and clinical infections of CP-CRE occurred in our institution in 2019. In this observational study, we monitored CP-CRE acquisition following implementation of multimodal control measures, and we describe the impact of this intervention on clinical infections. **Methods:** Increased hospital-acquired CP-CRE colonization and clinical infections were observed in early 2019. Increased CP-CRE surveillance was implemented to include CP-CRE contacts, patients with lengths of stay >7 days, patients with a recent history of hospitalization in other hospitals, and renal dialysis patients. The following interventions were also implemented**:** (1) isolation or placing CP-CRE patients in cohorts in a designated multidrug-resistant organism (MDRO) ward; (2) emphasis on hand hygiene and contact precautions; (3) mandatory use of gown and gloves for predefined 'high-risk' nursing activities, including diaper changing, toilet assistance, wound dressing, and handling urine or stool; (4) enhanced environmental and equipment cleaning; (5) regular audit and feedback regarding compliance; and (6) weekly feedback on ward-level CP-CRE acquisition. CP-CRE colonization cases and clinical infections were tracked by infection prevention and control nurses. **Results:** The hospital-acquired CP-CRE colonization rate was 4.39 per 10,000 patient days in 2019; it decreased slightly to 3.61 in 2020 and remained steady at 3.77 in 2021. The predominant CP-CRE genes were NDM, OXA-48–like, and KPC. There were 12 hospital-acquired CP-CRE infections in 2019, a rate of 0.37 per 10,000 patient days. This incidence decreased to 6 infections in 2020 and 3 infections in 2021, with corresponding