agent), we identified a trend toward increasing prevalence of polymyxin-resistant nCP-MDR isolates (6.1% ± 4.0), which made the selective pressure evident, even with a reduction in the overall prevalence (5.6% ± 1.3) of these nCP-MDR organisms during the same study period (Figure 2).

Carbapenem-resistant *K. pneumoniae* BSIs have been associated with higher morbidity and mortality rates than BSIs due to carbapenem-susceptible isolates.[7] This finding may be due to the presence of any carbapenemase gene, especially bla_{KPC}, which is highly endemic in Brazilian hospitals, and to the virulence and competitive fitness of *K. pneumoniae* regardless of its susceptibility profile.[2]

In this survey, KPC production by *K. pneumoniae* seems to be responsible for increasing the prevalence rate of this pathogen over the study period, compared with the prevalence rates of "wild-type" *K. pneumoniae* and multidrug-resistant organisms with any other mechanism (eg, ESBL, *amp*C, or efflux pumps). Importantly, this superior prevalence seems to be driven by the acquisition of adaptive PMB resistance, which is found mainly in KPC-Kp but also in the nCP-MDR group.

Although the impact of the PMB-resistant KPC-Kp recovery on patient outcome was not evaluated in this study, the results reported here are important, particularly concerning multidrug-resistant pathogens, because KPC producers are important in the effort to reduce rates of infection, especially in a clinical site as notable as the bloodstream.

In conclusion, an increase in the prevalence of KPC-Kp recovered from the bloodstream was observed during the study period. Apart from that, KPC production probably contributes to this increased rate. A notorious emergence of polymyxin resistance among nCP-MDR isolates is worrying and may be attributed to strong selective pressure. The optimization of polymyxin use in treating BSIs must be further investigated to minimize the overall resistance development.

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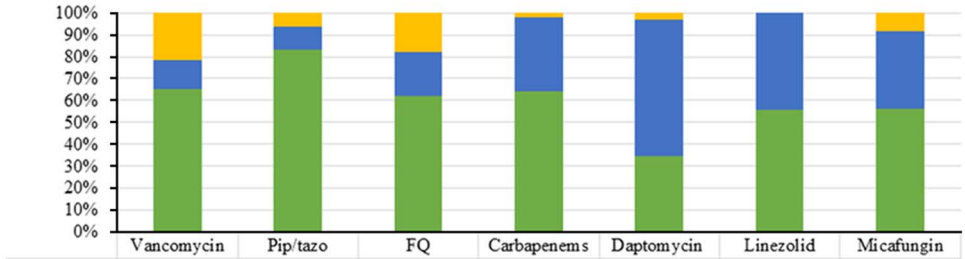
REFERENCES

1. Tamma PD, Goodman KE, Harris AD, et al. Comparing the outcomes of patients with carbapenemase-producing and non-carbapenemase-producing carbapenem-resistant Enterobacteriaceae bacteremia. *Clin Infect Dis* 2016;64:257–264.
2. Rodrigues Perez LR. Carbapenem-resistant Enterobacteriaceae: a major prevalence difference due to the high performance of carbapenemase producers when compared to the nonproducers. *Infect Control Hosp Epidemiol* 2015;36:1480–1482.
3. Giacobbe DR, Del Bono V, Trecarichi EM, et al. Risk factors for bloodstream infections due to colistin-resistant KPC-producing *Klebsiella pneumoniae*: results from a multicenter case-control-control study. *Clin Microbiol Infect* 2015;21:1106.e1–1106.e8.
4. Tumbarello M, Trecarichi EM, De Rosa FG, et al. Infections caused by KPC-producing *Klebsiella pneumoniae*: differences in therapy and mortality in a multicentric study. *J Antimicrob Chemother* 2015;70:2133–2143.
5. Perez LR. Know thy self, know thy enemy: a current survey and a forecast for KPC-producing *Klebsiella pneumoniae* resistance among inpatients in southern Brazil. *Infect Control Hosp Epidemiol* 2017;38:754–755.
6. Perez LR. Epidemiology of adaptive and intrinsic polymyxin resistance mechanisms by comparing polymyxin-resistant pathogens prevalence in a one-year follow-up survey. *Infect Control Hosp Epidemiol* 2017;38:1121–1123.
7. Tumbarello M, Viale P, Viscoli C, et al. Predictors of mortality in bloodstream infections caused by *Klebsiella pneumoniae* carbapenemase-producing *Klebsiella pneumoniae*: importance of combination therapy. *Clin Infect Dis* 2012;55:943–950.

Validation and Evaluation of Antimicrobial Orders Indication for Use

To the Editor—Tracking and monitoring antimicrobial prescribing, which includes documentation of the indication for use, is 1 of the 7 Core Elements of Antimicrobial Stewardship Programs set forth by the Centers for Disease Control and Prevention (CDC).[1] Requiring a question for indication in the computerized physician order entry (CPOE) allows for increased transparency and communication among patients and all members of the healthcare team; it also enhances mindful prescribing, medication safety, and understanding of antimicrobial use.[2] Thus, on September 20, 2016, a mandatory selection of antimicrobial indication as an empiric or pathogen-directed therapy or as a prophylaxis was implemented for all prescribers within the Cleveland Clinic Health System (CCHS), which comprises an academic medical center, 8 community hospitals in Northeast Ohio, and 1 community hospital in Florida. Given the role of antimicrobial indication as a measurement of prescribing patterns and a guide for future stewardship activities, validation is important and necessary to ensure accurate selection of indications by the end users of the electronic medical record (EMR). We sought to describe the accuracy of prescriber-entered antimicrobial



	Vancomycin	Pip/tazo	FQ	Carbapenems	Daptomycin	Linezolid	Micafungin
Prophylaxis	1111	219	682	20	5	0	11
Pathogen	673	384	752	303	99	42	45
Empiric	3342	2973	2357	581	55	53	72

FIGURE 1. Prevalence of indications of selected antimicrobials across CCHS.

indications at CCHS and to describe the prevalence of indications for antimicrobial use on both a health-system and hospital levels.

Through retrospective chart review, data were collected to validate indications of non–order-set antimicrobials administered to patients over a 24-hour period on October 19, 2016, and to describe the prevalence of indications for antimicrobial use over a 1-month period in October 2016. Antimicrobials in order sets had preselected indications in the EMR. Empiric indications consisted of orders to treat possible infection syndrome with unknown pathogen, pathogen-directed indications for treatment of known infection and pathogen, and prophylaxis to prevent infection. The accuracy of prescriber-entered indications was evaluated using information in the EMR available to the prescriber at the time of order entry, including identification of a pathogen by in-house microbiology lab or as described in transfer records, if applicable, and review of physician progress notes describing an intention to prescribe the antimicrobial for prevention of an infection.

Between October 1 and October 31, a total of 39,312 antimicrobials were ordered at CCHS: 20,843 for empiric therapy (53%), 12,338 as prophylaxis (31%), and 6,131 for pathogen-directed therapy (16%). On October 19, there were 899 non–order-set antimicrobial orders: 567 for empiric therapy (63%), 150 as prophylaxis (17%), and 182 as pathogen-directed therapy (20%). During this 24-hour validation period, prescriber-entered indications for antimicrobial orders were validated for 728 of 899 (81%) of all orders, including for 87% of empiric, 91% of prophylaxis, and 52% of pathogen-directed indication. The largest discrepancy in the selection of indications was noted in pathogen-directed orders; 82 of 182 orders classified as pathogen-directed (45%) were validated as empiric therapy, according to the predetermined definitions. No significant difference in proportion of validated indications was detected among the academic medical center and community hospitals, with the exception of 2 outliers, for which the majority of discrepancies arose from antimicrobials ordered in the emergency department. When stratified by prescriber type, the proportion of validated indications was 82% for physicians (394 of 479), 80% pharmacists (69 of 86), and 78% advanced practice providers (166 of 212). The prevalence of indications varied by agent (Figure 1). A significant percentage of vancomycin and piperacillin/tazobactam was used empirically across CCHS as well as on a hospital-specific level.

Validation is needed to reliably assess the impact of stewardship activities targeted to optimize antimicrobial use. The accuracy of prescriber-entered antimicrobial indications was evaluated previously in a retrospective study that analyzed a random sample of 50 orders, of which the indications of 100% of prophylaxis orders were accurate and the indications of 86% of treatment orders were accurate.[3] Through an expanded sample size of 899 non–order-set antimicrobial orders from hospitals in the academic and community settings, we also found that most prescriber-entered indications were accurate and that accuracy was comparable among different prescriber types and hospital settings. Using antimicrobial order indications, we further characterized the epidemiology of antimicrobial prescribing within CCHS over 1 month, during which empiric antimicrobial use was the most prevalent, followed by prophylaxis and pathogen-directed, a trend consistent with national level data.[4] Given its overall high accuracy, prescriber-entered antimicrobial indication for use will continue to be utilized as an important data point for the design, direction, and monitoring of future stewardship initiatives. Additional education on accurate documentation of indication will be provided at select facilities to ensure the quality and integrity of data used to track and monitor antimicrobial use.

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REFERENCES

1. Core elements of hospital antibiotic stewardship programs, 2014. Centers for Disease Control and Prevention website. http://www.cdc.gov/getsmart/healthcare/implementation/core-elements.pdf. Published 2014. Accessed November 14, 2016.
2. Schiff GD, Seoane-Vazquez E, Wright A. Incorporating indications into medication ordering—time to enter the age of reason. *N Engl J Med* 2016;375:306–309.
3. Patel JA, Esterly JS, Scheetz MH, Postelnick MJ. An analysis of the accuracy of physician-entered indications on computerized antimicrobial orders. *Infect Control Hosp Epidemiol* 2012;33:1066–1067.
4. Kelesidis T, Braykov N, Uslan DZ, et al. Indications and types of antibiotic agents used in 6 acute care hospitals, 2009–2010: a pragmatic retrospective observational study. *Infect Control Hosp Epidemiol* 2016;37:70–79.

The Impact of Isolation Precautions on Hand Hygiene Frequency by Healthcare Workers

To the Editor— New systems to monitor hand hygiene (HH) can promote good practice and increase the adherence and frequency of HH.[1,2] Isolation precautions are used to reduce the risk of transmission of pathogens from known or unknown sources and to reduce the risk of direct contact with secretions or bodily fluids of patients with suspected or confirmed transmissible infections or contact with contaminated objects in the patient's environment.[3,4] This study evaluated the frequency of HH episodes among multidisciplinary team members in rooms of patients with and without isolation precautions located in 3 step-down units (SDUs).

The study was carried out from February 1, 2016, to July 31, 2016, in a private, tertiary-care hospital with 664 beds in São Paulo, Brazil. The hospital has 3 SDUs: a mixed medical surgical unit, a cardiology unit, and a neurology unit. All rooms have a single bed. The Ethics and Research Committee of the Hospital Israelita Albert Einstein approved the study.

To assess HH frequency, we used an electronic monitoring system (i-HealthSys, São Carlos, São Paulo, Brazil) that employs radiofrequency devices with sensors. One sensor is located in each employee's identification (ID) badge, another is installed in the alcohol-based hand sanitizer dispenser, and another is installed above the patient's bed. Identification data from the badge of the HCW who cleaned his or her hands are sent to the fixed sensor above the patient's bed. Using a light in the sensor above the patient's bed (green for clean hands and red for unclean hands), the HCW is notified in real time about whether HH has been done when approaching the patient's bed.

Integrated software with a database enables the generation of detailed reports with information on the presence or absence of HH events (date and time where HH occurred), duration of HCW time at the patient's bedside, the number of times the HCW cleaned his or her hands, and the manner in which and places through which the HCW passed during a certain date and time interval. If the HCW is not using the ID badge, the system records the HH event but does not identify the ID badge; therefore, the system is still able to register all HH events using the alcohol-based sanitizer.[5]

We analyzed the HH data from rooms of patients who were hospitalized for >48 hours and stratified the findings by isolation status. For isolated patients, we included patients that were on contact, airborne, and droplet precautions. During the study period, we used Charlson comorbidity index[6] data, and the Simplified Acute Physiology (SAPS 3) admission score,[7] collected upon admission to the SDU.

Isolated and nonisolated patient populations were compared. Categorical variables were described by absolute and relative frequencies, and groups were compared using a χ^2 or Fisher exact test. Numerical variables are described as medians and interquartile ranges because the data are not normally distributed. We used the Mann-Whitney test to compare numerical measures by groups.

To determine factors associated with the number of HH episodes per patient day, we analyzed simple and multiple linear regression models. The statistical package R, version 3.1.3 (R Foundation for Statistical Computing, Vienna, Austria) was used, and a $P < .05$ significance level was adopted.

In this 6-month study, 768 patients participated. We excluded 13 patients because of equipment technical failure. Therefore, we analyzed 755 patients: 561 patients with no isolation precautions (74.3%) and 194 (25.7%) patients on isolation precautions. The number of HH episodes with alcohol sanitizer per patient day ranged from 0.45 to 177.6; the median was 63.7 HH episodes per patient day.

Regarding heterogeneity between patient profiles and isolation status, patients in isolation had a shorter length of stay in the SDU ($P = .027$) but a longer total length of stay in the hospital ($P = .001$). Patients in isolation also had a higher Charlson comorbidity index ($P = .046$) and a higher probability of death according to SAPS 3 ($P < .001$). Isolated patients had more devices ($P < .001$). The median number of HH episodes per patient day was 70 for patients in isolation rooms and 62 for those without isolation precautions ($P = .040$).

Table 1 shows the estimated effects of the factors studied on the mean number of HH episodes per patient day by simple