533. Impact of Different Definitions on Reported Rates of Carbapenem-Resistant *Enterobacteriaceae* (CRE)

Catherine Passaretti, MD[1]; Anupama Neelakanta, MD, MPH[2];
Jessica Layell, CIC[3]; Eileen Campbell, CIC[3] and Shelley Kester, CIC, MHA[3];
[1]Carolinas HealthCare Systems, Charlotte, North Carolina; [2]Carolinas HealthCare System, Charlotte, North Carolina; [3]Atrium Health, Charlotte, North Carolina

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Background. Different definitions exist for tracking and trending rates of hospital-acquired Carbapenem-resistant Enterobacteriaceae (CRE). National Health Safety Network (NHSN) allows for Laboratory Identified Event (LabID) and Healthcare-associated infection (HAI) surveillance reporting for CRE. Our facility developed an internal definition for CRE prior to release of the NHSN modules that differs from the CDC definitions in that patients colonized or infected with CRE identified on hospital day 1 or 2 who had a hospitalization within the past four weeks are considered community-onset healthcare facility acquired (COHCFA) and are included in our HA definition. In addition, by our definition once a patient develops CRE any subsequent positive cultures for the same organism are not considered new events.

Methods. All CRE cultures at our facility were reviewed by an infection preventionist and hospital epidemiologist who categorized each culture as hospital acquired by our internal HA definition, NHSN LabID definition and NHSN HAI definition. Results from each method of surveillance were compiled and compared as were trends of HA CRE over time by each definition.

Results. 590 patients with 975 clinical cultures for Carbapenem-resistant *Klebsiella* spp., Enterobacter spp and *E. coli* were reviewed from January 2012 to March 2019. 297 cultures met our internal definition for HA CRE compared with 302 by NHSN LabID and 189 by NHSN HAI surveillance. Sixty-one (21%) of HA cases by our definition were COHCFA. 259 patients had multiple CRE cultures and 1 patient had 22 cultures with the same CRE organism between 2014 and 2019 and met for 5 lab ID events and 5 NHSN HAI events. All 3 tests agreed that a culture was HA in 140 instances (14%) and all 3 agreed that a culture was not HA in 589 instances (60%). At least one definition yielded a discordant result in 246 cultures (25%). Trends over time were compared between the definitions. While the number of HA cases varied based on the definition used, overall trends over time were similar regardless of the definition utilized. (Figure 2)

Conclusion. Regardless of the definition used for surveillance of CRE, trends over time are similar. Consideration should be given to monitoring COHCFA cases in addition to those acquired on or after hospital day 3.

Figure 2: Hospital Acquired CRE by LabID, HAI CDC and Internal Definition
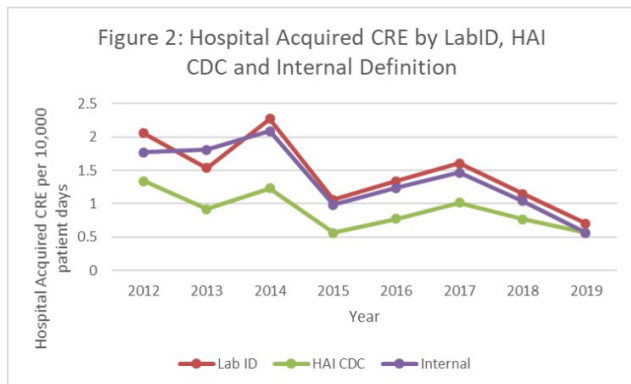
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534. Active Screening for Carbapenemase Producing *Enterobacteriaceae*: Yield and Cost Considerations

Jorge A. Ramos-Castaneda, PhD Student[1]; Allison Reeme, PhD, CIC[2];
Blake W. Buchan, PhD[3]; Nathan A. Ledeboer, PhD[3];
Mary Beth Graham, MD[3];
Paula Pintar, MSN, RN, ACNS-BC, CIC, FAPIC[4]; Siddhartha Singh, MD, MS[4] and
L Silvia Munoz-Price, MD, PhD [3]; [1]Universidad CES, Medellin, Antioquia, Colombia; [2]Froedtert Hospital, Milwaukee, Wisconsin; [3]Medical College of Wisconsin, Milwaukee, Wisconsin; [4]Froedtert and Medical College of Wisconsin, Racine, Wisconsin

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Background. During 2016, our hospital experienced an outbreak with carbapenemase-producing *Enterobacteriaceae* (CPE) in our solid-organ transplant (SOT) population. Since this outbreak and until now, our hospital has implemented active CPE screening of patients admitted to SOT units and point prevalence surveillances in any unit with a known CPE patient. The present study evaluates the yield of these screening tests and their cost since implementation.

Methods. This retrospective cohort was performed in a 600-bed hospital in Milwaukee, WI. CPE screening tests were retrieved from the clinical microbiology laboratory dataset from January 2016 to April 2019. CPE tests are performed on rectal swabs or stool samples using the CDC broth enrichment method followed by MIC confirmation using Etest. CPE patients were placed on enhanced precautions (gowns, gloves, booties) and were cohorted geographically and to 1:1 nursing and nurse aid staff.

Results. A total of 6,684 samples belonging to 3,383 patients were processed (1.9 samples/patient). Two hundred thirty (3.44%) had carbapenem-resistant *Enterobacteriaceae*, although only 33 isolates (0.49%) were confirmed as either KPC ($n = 31$) or NDM ($n = 2$) positive. Out of the 3,383 patients tested, 121 were identified as carriers of carbapenem-resistant isolates but only 11 (0.32%) were CPE (KPC = 11; NDM = 2). The incidence of new CPE patients during 2016 was 0.82% but decreased to 0.28% and 0.33% in 2017 and 2018, respectively. The units with the highest number of CPE patients were the transplant intensive care unit ($n = 6$) and the step-down SOT unit ($n = 3$). Negative cultures were quoted at $8.49 per sample but culture plates with colonies increased the cost per test to $28.44. The total cost for all the 6,684 screening tests was calculated at $61,335. The cost of CPE screening per positive CPE patient identified comes up to $5,575 (not including RN collection time).

Conclusion. In an institution with staff and CPE patient cohorting, active screening of CPE positive patients was relatively expensive given our low -level of transmission. In the near future, we plan to stop staff and patient cohorting due to the high stress that these interventions place on our hospital staff. This might ensue in increase transmission, which will be detected by CPE screening tests.

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535. Multicenter Study of the Prevalence of Rectal Colonization by Carbapenem-Resistant Enterobacteriaceae in Patients Admitted to the Intensive Care Units of 7 Major Hospitals in Kuwait

Amani Al Fadhli, BSc, MSc; Wafaa Y. Jamal, MD, PhD and
Vincent O. Rotimi, MD, PhD; Faculty of Medicine, Kuwait University, Jabriya, Hawalli, Kuwait

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Background. The emergence of carbapenem-resistant Enterobacteriaceae (CRE) has become an important epidemiological change in infectious diseases in the last 10 years. The gut is an important reservoir for these isolates thereby creating an opportunity for dissemination in a hospital setting especially the intensive care units (ICUs). The objective of this study was to investigate the colonization rates of patients, by CRE, admitted to the ICUs of 7 teaching hospitals.

Methods. Rectal swabs were collected during July 2017 to November 2018 from all patients on the day of ICU admission and 1 week after in each hospital. The samples were screened by direct plating on MacConkey agar containing 10-μg meropenem. Bacterial species identification was performed using the VITEK-2 system. The minimum inhibitory concentrations (MICs) of 14 antibiotics were determined by using Etest. Genes encoding carbapenem resistance was detected by PCR and sequencing. Their clonal relationship was determined by pulsed-field gel electrophoresis (PFGE).

Results. A total of 2580 Enterobacteriaceae were isolated from all patients. Seventy-four (2.9%) were confirmed as CRE most of which were from patients in Adan (AH: 36.5%) and Mubarak (MH: 46%) hospitals. Sixty (81.1%) harbored one or more of the tested carbapenemases genes. Forty-six (62.2%) carried $bla_{OXA-181}$, 9 (12.2%) bla_{OXA-48}, one bla_{KPC-2}, while 14 (18.9%) carried 2 genes. Combinations of bla_{KPC-2} and $bla_{OXA-181}$ genes were found in 5 (6.8%), bla_{VIM-1} and $bla_{OXA-181}$ in 4 (5.4%), bla_{NDM-5} and $bla_{OXA-181}$ in 3 (4.1%) and bla_{NDM-1} and $bla_{OXA-181}$ in 2 (3.3%). The *XbaI* PFGE profile-based Dendrogram, at 85% similarity criterion, resolved 7 pulsotypes among isolates carrying $bla_{OXA-181}$ in AH and MH designated A, B, C, D, E, F, and G. Further analysis revealed that 7 subpulsotypes A1, A2, A5, A6, C1, C2, and E1 were from unit D in the medical ICU of MH and A3, A4, B1, B3, D1, D2, D3, D4, F1, F2, F3, G1, and G2 were from surgical/medical ICUs in AH. 100% similarity was demonstrated among 8 isolates from AH and 2 from MH.

Conclusion. The prevalence of rectal colonization by CRE in the ICU patients was lower than expected. Detection of $bla_{OXA-181}$ variety and bla_{NDM-5} is new to the milieu of genes so far described in isolates from Kuwait.

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536. Challenges in Using MALDI-TOF Technology to Assess for KPC Resistance in *Klebsiella pneumoniae* isolates in America

Michael Christopher. Thompson, DO[1]; David Banach, MD[2];
Christina Nishimura, MPH[3] and Anthony Muyombwe, PhD[3]; [1]UCONN, Farmington, Connecticut; [2]UConn Health, Farmington, Connecticut; [3]Connecticut Department of Public Health, Farmington, Connecticut

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Background. The emergence of *Klebsiella pneumoniae* Carbapenemase-producing Enterobacteriaceae (KPC-E) has created a major public health concern. In clinical practice, rapid identification of KPC-KP has important implications for clinical management and infection control. In some settings matrix-assisted laser desorption ionization time of flight (MALDI-TOF) software has been used for rapid detection of KPC producing *K. pneumoniae* with high sensitivity and specificity. Genomic sequencing has determined that the 11.09 m/z peak is related to protein expression from the P109 gene found mostly in Tna4401a isoform among KPC-E. In our study, we evaluated the use of MALDI-TOF automated detection software to evaluate for KPC detection among a diverse group of KPC-E isolates.

Methods. We tested 52 KPC-E isolates from various hospitals in Connecticut and the Centers for Disease Control and Prevention (CDC) Antibiotic Resistance (AR) Bank. All specimens were verified as KPC-producing strains by detection of the bla_{KPC} gene through polymerase chain reaction. Protein extraction using the standard extraction method was performed on sub-cultured isolates. Each isolate was tested three times on MALDI-TOF MS with the incorporated bio-subtype KPC module. An organism confidence or log score value of 2 or higher was considered valid.

Results. Among 52 tested KPC-*K. pneumoniae* isolates, 44 (85%) were from various hospitals in Connecticut, eight (15%) came from the AR Bank. Only 15 (25.1%) of the isolates were detected as KPC-producing using the MALDI-TOF KPC module. Further investigation by peak analysis confirmed all 15 isolates detected positive demonstrated a peak at 11.09 m/z. The 11.09 m/z peak was not found in the 37 specimens that were not detected.

Conclusion. The results from our study suggest low sensitivity using this software and contradicts results seen in previous European studies. The Tna4401a isoform is often seen in KPC-2 strains, which may be less prevalent in our sample of isolates, explaining the poor sensitivity of MALDI-TOF. Further study is needed to explore this finding and potential opportunities for MALDI-TOF for rapid identification of KPC-KP.

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537. Impact of Active Surveillance Testing (AST) on Rates of Hospital-acquired Carbapenem-Resistant *Enterobacteriaceae* (CRE)

Eileen Campbell, CIC[1]; Shelley Kester, CIC, MHA[1]; Jessica Layell, CIC[1]; Anupama Neelakanta, MD, MPH[2]; Gerald A. Capraro, PhD, D(ABMM)[1] and Catherine Passaretti, MD[1]; [1]Atrium Health, Charlotte, North Carolina; [2]Carolinas HealthCare System, Charlotte, North Carolina

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Background. Active surveillance testing (AST) for Carbapenem-resistant *Enterobacteriaceae* (CRE) to identify and isolate asymptomatic carriers has been recommended to help prevent patient to patient transmission. Optimal screening population, frequency, and testing method remain a subject of debate.
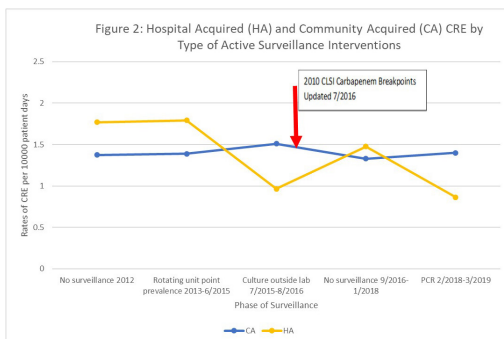
Methods. Beginning in 2012, all clinical cultures yielding a CRE isolate in an 898-bed teaching hospital were reviewed to determine whether the isolate was hospital-acquired (HA). HA CRE rates per 10,000 patient-days were calculated. From 1/2013 to 6/2015, in-house, culture-based point prevalence surveys were performed on rectal swabs from rotating units using the CDC recommended method. 7/2015 through 8/2016, culture-based AST was outsourced to a reference laboratory and AST was expanded to include high-risk patients on admission with weekly sweeps on high-risk units. Of note, revised CLSI breakpoints were implemented by our laboratory in 7/2016, which resulted in an increase in CRE detections. Surveillance was suspended from September 2016 to January 2018 when we resumed AST utilizing in-house PCR for KPC, NDM, OXA48, IMP and VIM mechanisms. Rates of HA CRE were compared between surveillance periods. Cohorting of patients in select units, focus on hand hygiene and isolation, antibiotic stewardship, and CHG bathing were ongoing throughout all time periods.

Results. 510 rectal swabs in 424 patients were positive for CRE. Additional clinical cultures yielding CRE were absent in 83% of those patients, so would otherwise have gone undetected. Of those patients with both positive AST and clinical culture, 70% had a positive AST result prior to their clinical culture (range 0–997 days, average 94 days, median 14.5 days prior to clinical culture). Compared with preceding periods with no surveillance, on admission and weekly CRE AST, whether utilizing culture based or PCR based screening, was associated with significantly lower rates of HA CRE. (See Table 1). Rates of HA CRE during the initial point prevalence AST period were unchanged compared with periods with no surveillance. Community-onset CRE did not significantly change in any of the time periods monitored (Figure 2).

Conclusion. On admission and weekly AST was associated with a significant decrease in HA CRE in a large teaching hospital.

Table 1: Risk ratio comparing time periods with on admission/weekly CRE AST vs no or limited surveillance

	Risk Ratio	95% Confidence Interval	p value
Rotating unit AST vs no surveillance 2012	1.01	0.73, 1.4	0.95
Outside culture on admission/weekly screening vs no surveillance 2012	**0.53**	**0.33, 0.83**	**0.005**
PCR AST on admission/weekly vs no surveillance 2017	0.61	0.39, 0.93	0.02

Figure 2: Hospital Acquired (HA) and Community Acquired (CA) CRE by Type of Active Surveillance Interventions

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538. Extended-Spectrum β-Lactamase (ESBL): Producing Enterobacteriaceae Surveillance Pilot, New Mexico, 2017

Erin C. Phipps, DVM, MPH; Kristina Flores, PhD and Emily B. Hancock, MS; University of New Mexico, Albuquerque, New Mexico

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Background. Extended-spectrum β-lactamase – producing (ESBL) Enterobacteriaceae pose a serious antibiotic resistance threat, yet gaps remain in our understanding of their epidemiology. New Mexico was one of five Emerging Infection Program (EIP) sites to participate in a surveillance pilot from October 1 to December 31, 2017.

Methods. A case was defined as a resident of Bernalillo County, NM with *E. coli*, *Klebsiella pneumoniae*, or *Klebsiella oxytoca* cultured from urine or normally sterile body sites resistant to at least one extended-spectrum cephalosporin and nonresistant to all carbapenem antibiotics tested. EIP staff assessed prior healthcare exposures, risk factors, and outcomes through medical record review.

Results. NM EIP identified 309 incident cases among 288 individuals; 263 medical records were reviewed. Cases ranged in age from 3–95 years, with a median age of 63 years. Most isolates were *E. coli* (*n* = 270, 87.4%); 35 (11.3%) were *K. pneumoniae* and 4 (1.3%) were *K. oxytoca*. The majority of isolates were cultured from urine (297, 96.1%). Blood cultures comprised 11 cases (3.6%). The majority of ESBL cultures were collected in an outpatient setting; 15% were collected from hospital inpatients and fewer than 5% from residents of a long-term care facility (LTCF) or long-term acute care hospital (LTACH). However, 21% of those collected in an outpatient setting, primarily the ED, were hospitalized within 30 days.

Over 60% of the cases had at least one relevant risk factor documented in their medical record. One-third had documented antimicrobial use in the prior month, 39% had been hospitalized in the year prior, and 19% had a urinary catheter in place in the 2 days prior to culture collection. Interestingly, while only 2% had documentation of international travel in the two months prior to culture, 18% had either documented international travel outside of that timeframe, or required the use of language interpretation, possibly indicating extensive time living internationally in the past.

Conclusion. Among residents of Bernalillo County, NM, ESBL isolates were predominantly *E. coli*, cultured from urine in outpatient settings. Over half had documentation of recognized risk factors, including prior hospitalizations, recent antibiotic use, or presence of indwelling devices.

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539. Canaries in a Coal Mine?: Early Identification of Regional Spread of Novel Multidrug-resistant Organisms (MDROs) Using Sentinel Surveillance in Skilled Nursing Facilities Caring For Ventilated Patients (vSNFs)

Prabasaj Paul, PhD, MPH[1]; Rachel Slayton, PhD, MPH[1]; Maroya S. Walters, PhD[2] and John A. Jernigan, MD, MS[1]; [1]Centers for Disease Control and Prevention, Atlanta, Georgia; [2]Division of Healthcare Quality Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia

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Background. Regional containment of novel or targeted MDROs depends on detecting their presence as soon as possible following their introduction. Prior modeling studies suggest that after importation to a region, novel MDROs appear relatively quickly in certain high-risk post-acute long-term care facilities via patient movement. Sentinel surveillance in such facilities might facilitate early detection of emergent MDROs, thereby enhancing the effectiveness of containment efforts.

Methods. We simulated the introduction and spread of carbapenem-resistant Enterobacteriaceae (CRE) in a region using an adaptation of a previously described susceptible-infectious-susceptible model (Clin Infect Dis. 2019 March 28 doi: 10.1093/cid/ciz248). The model includes the patient sharing network among healthcare facilities in an exemplar US state, using claims data and the Minimum Data Set from the Centers for Medicare & Medicaid Services for 2015. Disease progression, transmission and testing rates were estimated for CRE using data from the literature. Each simulated outbreak was initiated with a single importation to a Dartmouth Atlas of Health Care hospital referral region. The predicted timing of first CRE detection using two different data sources was compared: (1) real-time monitoring of clinical microbiology test results, or (2) results from quarterly point prevalence colonization surveys (PPSs). For each data source, the timing of earliest detection was compared according to availability of data from: (a) all healthcare facilities statewide, (b) only long-term acute care hospitals, (c) only vSNFs, or (d) only the largest acute care hospitals in the state (*n* = 23).

Results. Compared with real-time monitoring of clinical microbiology testing results from all facilities statewide, quarterly PPSs at all facilities detected CRE 446 days (median; range 312–608 days) earlier, while PPSs at only vSNFs (representing 4.4% of inpatient beds statewide) detected CRE 385 days (range 194–553 days) earlier (figures).

Conclusion. Regular point prevalence surveys in vSNFs may detect new MDROs in a region approximately one year sooner than real-time monitoring of clinical microbiology results, and may be an efficient strategy for early regional detection and subsequent containment.