516. Social Network Analysis to Study MDRO Transmission in VA Community Living Centers and Spinal Cord Injury Units

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Session: 55. HAI: MDRO – GNR Transmission
Thursday, October 3, 2019: 12:15 PM

Background. Residents of V A Community Living Centers (CLC) and Spinal Cord Injury units (SCI) are commonly colonized or infected with multidrug-resistant organisms (MDROs). The mechanisms by which MDROs are spread between residents in CLC/SCI settings remain poorly understood. Our objective was to develop methods to better understand how MDROs are spread in VA CLC/SCIs.

Methods. Preliminary data from two of the four VA medical centers participating in an ongoing study are included in these analyses. A structured sociometric survey was employed to collect data on interactions between residents, staff, and environmental surfaces in study units. UCINET was used to construct a sociogram and calculate network characteristics (density, centrality) using responses to the surveys administered in one of the participating facilities.

Results. A total of 136 surveys were completed by 49 staff and 45 residents at the two VA sites. Staff reported more interactions with residents than with other staff. Residents reported more interactions with staff than with other residents, the latter tending to only occur during group activities. Sociograms generated from preliminary surveys collected at one site suggest a four-core-person social network pattern connecting two staff with two specific residents and showed that the dining room was the most common social contact setting (figure). Challenges in identifying contact patterns include recall bias and inability of some residents to identify names of individuals with whom they interacted. Residents were still able to reliably identify staff roles.

Conclusion. This preliminary work shows heterogeneous contact patterns between persons and surfaces in VA CLC/SCIs. Characterizing this heterogeneity and its influence on MDRO spread via this type of social network analysis is feasible in the VA CLC/SCI setting, albeit with some limitations. Next steps in our studies include adding data from two additional sites and using observation techniques supplemented with microbiological sampling of targeted environmental surfaces to further understand potential transmission patterns.

517. Treatment Patterns of Hospitalized Adults with Infections Due to Carbapenem Non-Susceptible Gram-Negative Organisms in a Large Electronic Health Record Database in the United States

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Background. Infections caused by carbapenem non-susceptible (C-NS) Gram-negative (GN) organisms pose a major threat, due in part to limited treatment options. The aim of this study was to assess treatment patterns for these infections in a large US electronic health record database.

Methods. A retrospective cohort study of hospitalized adults with complicated intra-abdominal infection (cIAI), complicated urinary tract infection (cUTI), bacterial pneumonia (BP), or bacteremia (BAC) due to C-NS (resistant/intermediate susceptibility to carbapenem) GN organisms from January 2013 to March 2018. Patients with inherently C-NS organisms (e.g., Pseudomonas aeruginosa toertapenem) were only included if resistance to another carbapenem was identified. The index date was the date of first C-NS culture in a qualifying hospitalization (±3 days from admission/discharge). Clinical characteristics and administered treatments were assessed from admission to discharge with variables summarized descriptively and stratified by infection type.

Results. 7,072 patients met inclusion criteria: 31% cUTI ± BAC, 24% BP ± BAC, 21% cUTI + BP ± BAC, 17% cIAI ± BAC, cUTI, or BP, 7% BAC only. The median age was 66 years, ranging from 60 (BAC) to 69 (cUTI) years; male, 57%. The most common pathogens were Pseudomonas aeruginosa (64%) and Klebsiella pneumoniae (15%). Antibiotics were administered to the majority of patients (87%); of which, 79% received combination therapy (median classes: 3; maximum: 7), the remainder received monotherapy. For antibiotic-treated patients, 93% initiated an antibiotic before the non-susceptibility status of the underlying organism was known. The most common classes given during the index hospitalization were: penicillin (49%), fluoroquinolone (44%), carbapenem (40%), cephalosporin (39%), amoxicillin (28%) (by infection type, figure). Eleven percent of patients received colistin/polymyxin B.

Conclusion. Varied antibiotic use was observed in this cohort, with carbapenem frequently detected despite the C-NS nature of the underlying GN organisms. The use of antibiotics to which organisms are non-susceptible could lead to poor health outcomes, supporting the need for new targeted therapies to treat C-NS infections.

518. Comparing the Mortality of Carbapenemase-Producing and Non-Carbapenemase-Producing Carbapenem-Resistant Enterobacteriaceae Bacteremia

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Background. Carbapenem-resistant Enterobacteriaceae (CRE) infection is an emerging clinical issue. One of the mechanisms of carbapenem-resistance is carbapenem production. This study aimed to identify whether clinical outcomes differ by CRE resistance mechanism and to evaluate risk factors for mortality in patients with CRE bacteremia.

Methods. We conducted a retrospective cohort study comparing 14-day mortality between patients with carbapenemase-producing (CP)-CRE and non-CP-CRE bacteremia during January 2011 to October 2018. Only monomicrobial Escherichia coli or Klebsiella pneumoniae bacteremia were included in the study. A modified
carbapenem inactivation method was used for phenotypic detection of carbapenemase production. The presence of a variety of carbapenemases was evaluated by PCR with specific primers.

Results. Of 134 patients with monomicrobial CRE bacteremia, 48 (35.8%) were infected with CP-CRE, and 86 (64.1%) were infected with non-CP-CRE. The most common carbapenemase in non-CP-CRE isolates was KPC (66.7%), followed by NDM-1 (18.8%), OXA-48-like (10.4%), and VIM (4.1%). Baseline characteristics were similar between the two groups (Table 1). However, the CP-CRE group was significantly more likely to undergo removal of eradicable foci and to have meropenem MIC >8 µg/mL. A total of 33 (24.6%) patients died within 14 days, including 9 (18.8%) in the CP-CRE group and 24 (27.9%) in the non-CP-CRE group. Deceased patients were more likely to have a higher Pitt bacteremia score, nosocomial acquisition, ineradicable or not-eradicated foci, immunosuppressant use, inappropriate definitive treatment (Table 2). Combination therapy for definitive treatment was associated with decreased mortality. In a multivariate analysis including carbapenemase production, a higher Pitt bacteremia score (aOR, 5.15), ineradicable or not-eradicated foci (aOR, 4.05) and combination therapy for definitive treatment (aOR, 0.35) were independent risk factors for mortality.

Conclusion. Our study suggests that carbapenem production is not a mortality risk factor in CRE bacteremia and provides additional evidence for early source control and combination therapy.

Table 1. Baseline and clinical characteristics of patients with carbapenem-resistant Enterobacteriaceae (CP-CRE) and non-CRE bacteremia

| Characteristic/outcome | CP-CRE (n=48) | Non-CRE (n=86) | P-value |
|------------------------|-------------|--------------|--------|
| Age (yr), median (IQR)  | 62.3 (53.5-64.8) | 59 (46-64.6) | 0.01 |
| Male                   | 37 (77.1%) | 66 (77.9%) | 0.63 |
| Previous hospitalization | 46 (95.8%) | 83 (96.5) | 0.64 |
| Healthcare-associated | 18 (37.5) | 13 (15.1) | <0.001 |
| Nosocomial             | 30 (62.5) | 73 (84.9) | 0.30 |
| McAb and Jackson classification | 4 (8.5) | 65 (75.6) | 0.77 |
| Charcoal comorbidity index, median (IQR) | 7 (6.9) | 6 (4.0) | 0.10 |
| Precipitating medical condition | 21 (43.8) | 21 (24.4) | 0.06 |
| Diabetes mellitus      | 17 (35.4) | 27 (31.4) | 0.64 |
| End-stage liver disease | 14 (29.2) | 18 (20.9) | 0.28 |
| Severe organ failure | 22 (45.8) | 38 (44.2) | 0.55 |
| Hematologic malignancy | 9 (18.8) | 22 (25.6) | 0.37 |
| Immunosuppressant use  | 15 (31.3) | 18 (20.9) | 0.18 |
| Immunosuppressant use  | 22 (45.8) | 38 (44.2) | 0.85 |
| Prior surgery within 3 months | 21 (43.8) | 21 (24.4) | 0.14 |
| Recent chemotherapy within 6 months | 19 (39.6) | 29 (33.7) | 0.50 |
| APACHE II score, median (IQR) | 16 (12.2-23.75) | 16 (11.7-25.25) | 0.64 |
| Septic shock           | 14 (29.2) | 29 (33.7) | 0.16 |
| Site of infection       | 13 (27.1) | 29 (33.7) | 0.43 |
| Bilateral infection     | 13 (27.1) | 14 (16.3) | 0.14 |
| Intrabdominal infection | 7 (14.6) | 22 (25.6) | 0.14 |
| Primary bacteremia      | 7 (14.6) | 4 (4.4) | 0.06 |
| Urinary tract infection | 5 (10.4) | 12 (14.0) | 0.56 |
| Pneumonia              | 4 (8.3) | 5 (6.0) | 1.00 |
| Culture-related infection | 4 (8.3) | 5 (6.0) | 1.00 |
| Removal of eradicable foci within 7 days | 20 (41.7) | 20 (41.7) | 1.00 |
| Days to initiation of antibiotics, median (IQR) | 2 (1.4) | 2.5 (0.5-3.3) | 0.33 |
| Inappropriate empirical treatment | 37 (77.1) | 57 (66.3) | 0.19 |
| Monotherapy for definitive treatment | 10 (20.8) | 24 (27.9) | 0.37 |
| Combination therapy for definitive treatment | 30 (62.5) | 52 (60.5) | 0.82 |
| Carbapenem-containing regimen | 19 (39.6) | 28 (32.6) | 0.41 |
| Tigecycline-containing regimen | 10 (20.8) | 25 (28.6) | 0.64 |
| Antimicrobial combination | 8 (16.7) | 25 (28.6) | 0.11 |
| Carbapenem-containing regimen | 18 (37.5) | 23 (26.7) | 0.30 |
| Inappropriate definitive treatment | 8 (16.7) | 13 (15.1) | 0.81 |
| Meropenem minimum inhibitory concentration | 2.0 µg/mL | 5.0 µg/mL | 0.004 |
| 8 µg/mL                | 7 (14.6) | 16 (18.6) | 0.25 |
| >25 µg/mL              | 26 (55.0) | 42 (49.0) | 0.10 |
| 7-day mortality        | 4 (8.3) | 18 (20.9) | 0.09 |
| 14-day mortality       | 9 (18.8) | 34 (39.5) | 0.04 |

Table 2. Results of analyses of risk factors for 14-day mortality in CRE bacteremia

| Risk factor | Univariate analysis | Multivariate analysis |
|-------------|---------------------|----------------------|
| OR (95% CI) | P-value             | OR (95% CI)          | P-value |
| Carbapenem-producing strain | 0.596 (0.251-1.415) | 0.24 | |
| Age          | 1.027 (0.9991-1.05) | 0.06 |
| Pitt bacteremia score ≥4   | 5.496 (2.358-12.011) | <0.001 | 5.151 (2.065-9.925) | <0.001 |
| Ineffective or not-eradicated foci | 5.241 (0.3-20.29) | 0.01 | 4.048 (0.49-15.94) | 0.03 |
| Combination therapy for definitive treatment | 0.625 (0.199-5.941) | 0.60 | 0.347 (0.140-0.939) | 0.02 |
| Imipenem resistance | 2.316 (0.58-8.353) | 0.43 | |

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