computed $W(i, j)$ for all room pairs i, j for parameters t1 = 30 seconds and t2 = 1,800 and 3,600 seconds. For nurses, there was a strong negative correlation of between pairwise room distance and the weights $W(i, j)$ (−0.768 for t2 = 1,800; −0.711 for t2 = 3,600), The more distant 2 rooms were, the less they shared nurse traffic. This was not true for physicians (correlation = −0.027 for t2 = 1,800; −0.014 for t2 = 3,600). Figure 1 shows a weight versus distance scatter plot for nurses for t1 = 30 and t2 = 1,800. This spatial correlation has positive implications for disease spread; the base simulation, which preserves these spatial correlations, has between 12% and 55% fewer mean infected patients (>100 replicates) for different simulation parameters compared to the perturbed simulation. **Conclusions:** Our results, based on fine-grained data, show a "naturally emerging" cohorting behavior of nurses, where nurses are more likely to visit rooms close to each other within a 30–60 minute time window, than rooms further away. Through simulations, this behavior provides substantial protection against disease spread.

Funding: None
Disclosures: None
Doi:10.1017/ice.2020.932

Presentation Type:
Poster Presentation

New Approaches to Colonization Screening in Response to Emerging Antimicrobial Resistance

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Background: The capacity to monitor the emergence of carbapenemase-producing organisms (CPO) is critical in limiting transmission. CPO-colonized patients can be identified by screening rectal specimens for carbapenemase genes and the Cepheid GeneXpert Carba-R (XCR), the only FDA-approved test, is limited to 5 carbapenemase genes and cannot identify the bacterial species. **Objective:** We describe the development and validation of culture-based methods for the detection of CPO in rectal cultures (RCs) and nonrectal cultures (NRCs) of tracheal aspirate and axilla-groin swabs. **Methods:** Colonization screening was performed at 3 US healthcare facilities; specimens of RC swabs and NRC ESwabs were collected. Each specimen was inoculated to a MacConkey broth enrichment tube for overnight incubation then were subcultured to MacConkey agar with meropenem and ertapenem 10 µg disks (BEMA) and CHROMagar KPC (KCHR) or CHROMagar *Acinetobacter* (ACHR). All media were evaluated for the presence of carbapenem-resistant organisms; suspect colonies were screened by real-time PCR for the most common carbapenemase genes. MALDI-TOF was performed for species identification. BEMA, a previously validated method, was the comparator for 52 RCs; clinical culture (CC) served as the comparator method for 66 NRCs. Select CPO-positive and -negative specimens underwent reproducibility testing. **Results:** Among 56 patients undergoing colonization screening, 12 (21%) carried a CPO. Only 1 patient had CPO solely from RC. Also, 6 patients had both CPO-positive RC and NRC, and 5 patients only had a CPO-positive NRC. Of the latter, 4 had a CPO-positive tracheal specimen, and 1 had a positive culture from both tracheal and axilla-groin specimens. Sensitivity of BEMA (70%) for NRC was lower than for KCHR (96%) and ACHR (88 %) for all specimens. All methods showed a specificity of 100% and reproducibility of 92%. The detected CPO included OXA-23–positive *Acinetobacter baumannii*, NDM-positive *Escherichia coli*, KPC-positive *Pseudomonas aeruginosa* and 4 genera of KPC-positive Enterobacteriaceae. **Conclusions:** The addition of nonrectal specimens and use of selective media contributed to increased sensitivity and enhanced identification of CPO-colonized patients. Positive cultures were equally distributed among the 3 specimen types. The addition of the nonrectal specimens resulted in the identification of more colonized patients. The culture-based method was successful in detecting an array of different CPOs and target genes, including genes not detected by the Carba-R assay (eg, blaOXA-23-like). Enhanced isolation and characterization of CPOs will be key in aiding epidemiologic investigations and strengthening targeted guidance for containment strategies.

Funding: None
Disclosures: We discuss the drug combination aztreonam-avibactam and acknowledge that this drug combination is not currently FDA approved.
Doi:10.1017/ice.2020.933

Presentation Type:
Poster Presentation

Nonsusceptibility to Ceftazidime or Cefepime Can Predict Carbapenemase-Production Among Carbapenem-Resistant *Pseudomonas aeruginosaa*

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Background: In the United States, carbapenemases are rarely the cause of carbapenem resistance in *Pseudomonas aeruginosa*. Detection of carbapenemase production (CP) in carbapenem-resistant *P. aeruginosa* (CRPA) is critical for preventing its spread, but testing of many isolates is required to detect a single CP-CRPA. The CDC evaluates CRPA for CP through (1) the Antibiotic Resistance Laboratory Network (ARLN), in which CRPA are submitted from participating clinical laboratories to public health

Definition#	Total N for which AST data was available for drugs evaluated in the definition	True positive: Meets definition and CP gene present	False positive: Meets definition and CP gene absent	False Negative: Does not meet definition and CP gene present	True Negative: Does not meet definition and CP gene absent	Sensitivity	Specificity
R to 2 or more carbapenems (excluding ertapenem)	5445	175	3371	8	1891	96%	36%
R to Imipenem, Meropenem, or Doripenem AND:							
R Cefepime	6211	131	1480	70	4530	65%	75%
NS to Cefepime	6211	166	2805	35	3205	83%	53%
R Ceftazidime	5338	110	1544	42	3642	72%	70%
NS to Ceftazidime	5338	142	2041	10	3145	93%	61%
NS to Cefepime or Ceftazidime	6444	183	3046	20	3195	90%	51%
R to Aztreonam	6138	99	2947	90	3002	52%	50%
NS to Aztreonam	6138	124	4126	65	1823	66%	31%
R to Levofloxacin or Ciprofloxacin	1989*	153	981	6	849	96%	46%
NS to Levofloxacin or Ciprofloxacin	1989*	153	1111	6	719	96%	39%
R to Piperacillin/tazobactam	1989*	75	684	84	1146	47%	57%
NS to Piperacillin/tazobactam	1989*	129	1013	30	817	81%	41%
R to Gentamicin	1989*	77	377	82	1453	48%	73%
NS to Gentamicin	1989*	88	518	71	1312	55%	66%

CLSI interpretative criteria were applied to designate isolates as susceptible (S), intermediate (I), or resistant (R); Non-susceptible isolates (NS) include isolates designated as I or R.

*Only isolates from New York and Texas were included in this analysis because susceptibility data for these drugs was only available from these two states.

laboratories for carbapenemase testing and antimicrobial susceptibility testing (AST) and (2) laboratory and population-based surveillance for CRPA in 8 sites through the Emerging Infection Program (EIP). **Objective:** We used data from ARLN and EIP to identify AST phenotypes that can help detect CP-CRPA. **Methods:** We defined CRPA as *P. aeruginosa* resistant to meropenem, imipenem, or doripenem, and we defined CP-CRPA as CRPA with molecular identification of carbapenemase genes (*bla*KPC, *bla*IMP, *bla*NDM, or *bla*VIM). We applied CLSI break points to 2018 ARLN CRPA AST data to categorize isolates as resistant, intermediate, or susceptible, and we evaluated the sensitivity and specificity of AST phenotypes to detect CP among CRPA; isolates that were intermediate or resistant were called nonsusceptible. Using EIP data, we assessed the proportion of isolates tested for a given drug in clinical laboratories, and we applied definitions to evaluate performance and number needed to test to identify a CP-CRPA. **Results:** Only 203 of 6,444 of CRPA isolates (3%) tested through AR Lab Network were CP-CRPA harboring *bla*VIM (n = 123), *bla*KPC (n = 53), *bla*IMP (n = 16), or *bla*NDM (n = 13) genes. Definitions with the best performance were resistant to ≥1 carbapenem AND were (1) nonsusceptible to ceftazidime (sensitivity, 93%; specificity, 61%) (Table 1) or (2) nonsusceptible to cefepime (sensitivity, 83%; specificity, 53%). Most isolates not identified by definition 2 were sequence type 111 from a single-state *bla*VIM CP-CRPA outbreak. Among 4,209 CRPA isolates identified through EIP, 80% had clinical laboratory AST data for ceftazidime and 96% had clinical laboratory AST data for cefepime. Of 967 CRPA isolates that underwent molecular testing at the CDC, 7 were CP-CRPA; both definitions would have detected all 7. Based on EIP data, the number needed to test to identify 1 CP-CRPA would decrease from 135 to 42 for definition 1 and to 50 using definition 2. **Conclusions:** AST-based definitions using carbapenem resistance combined with ceftazidime or cefepime nonsusceptibility would rarely miss a CP-CRPA and would reduce the number needed to test to identify CP-CRPA by >60%. These definitions could be considered for use in laboratories to decrease the testing burden to detect CP-CRPA.

Funding: None

Disclosures: In the presentation we will discuss the drug combination aztreonam-avibactam and acknowledge that this drug combination is not currently FDA approved.

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Doi:10.1017/ice.2020.934

Presentation Type:
Poster Presentation

Nosocomial Rabies Encephalitis: Lessons Learned From Exposures in a Large Healthcare System

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Background: In October 2018 a patient presented to hospital A's emergency department (ED) for a work injury, arm spasms, and inability to drink liquids. He developed rapid neurologic decline and was transferred to hospital B for neurocritical care. He developed a fever, was intubated, and had an unrevealing infectious diseases (ID) consultation. He became comatose, had refractory seizures, and was transferred to hospital C. A second ID consultation revealed that he had many bats in his home, and his symptoms were consistent with rabies encephalitis. Antemortem specimens of serum, CSF, skin biopsy, and saliva were all positive for rabies virus PCR, and/or rabies serologies. **Objective:** We describe the response of a multihospital system to the exposure of employees across 3 facilities to rabies-infected body fluids. **Methods:** Three hospitals in 1 system (222 caregivers) cared for the index patient (hospital A, n = 8; hospital B, n = 107; hospital C, n = 107; 19 students and residents), as did 2 additional facilities outside the system. These included physicians (n = 21), registered nurses (n = 57), respiratory therapists (n = 29), imaging technicians (n = 24), phlebotomists (n = 12), laboratorians (n = 8) and others (n = 71). Infection prevention, employee health, and pharmacy leadership created a centralized team to ensure that all exposed caregivers were screened, and if exposed, were vaccinated. An electronic screening tool developed and administered by the Utah Department of Health via Research Electronic Data Capture (Redcap), rapidly assessed caregiver body fluid exposure risks (saliva, tears, neurologic tissue), and use of personal protective equipment in patient care. After completion, caregivers received notification that he or she (1) had no exposure (no further action), (2) had exposure and should report to employee health for vaccination, or (3) had unclear exposure and should contact the employee health department. **Results:** Caregivers feared that the tool underestimated exposure risk. Many caregivers (n = 48), repeated the assessment more than once, changing answers. The most common reasons cited were incomplete forms (n = 21), caregiver did not recall using personal protective equipment with contact with saliva (n = 8) or did not understand rabies transmission (n = 3). All vaccinations were initiated by 11 of 26 care givers, 18 days after initial deployment of the tool. All exposed caregivers completed the course. No caregivers developed symptoms of rabies encephalitis. **Conclusions:** An online tool can safely assess large healthcare exposure such as rabies. A team comprising infection preventionists, employee health representatives, pharmacists, and public health department representatives made the assessment of many geographically dispersed caregivers rapid and effective. Caregivers should employ the basic tenets of standard precautions in the daily care of patients to avoid unknown exposures to common bodily fluids.