Results. Out of 2,576 articles, 9 clinical studies (8 retrospective case series and 1 prospective single-center trial) met the eligibility criteria. In total, 221 out of 265 (83.4%) evaluated adult patients received a minocycline-based antimicrobial regimen and 44 out of 265 (16.6%) received other antimicrobial agents (most frequently aminoglycosides); 198 out of 216 (91.7%) patients with available data, received minocycline as part of an antimicrobial combination regimen (most frequently colistin and carbapenems). Pneumonia was the most prevalent infection (81.5% with 50.4% ventilator associated pneumonias). Clinical and microbiological success rates in the minocycline group were 72.4% and 59.7%, respectively. Mortality rate was 21.2% among 165 patients in the BMD group and 23.5% in the non-minocycline group, clinical and microbiological cure rates were 45.5% and 18.2%, respectively.

Conclusion. This systematic review, minocycline demonstrated promising activity against MDR-AB isolates. This study could set the grounds for further research with large randomized, controlled trials that would explore and define the role of minocycline in the treatment of MDR-AB-associated infections.

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2414. Real-World Evaluation of Patient Characteristics and Outcomes of Patients Treated With Ceftolozane/Tazobactam Across 253 US Hospitals
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Background. Treatment of patients with Gram negative infections is increasingly difficult due to rising resistance to commonly used agents. Ceftolozane/tazobactam (C/T) is an agent with a pseudomonal activity with broad Gram-negative coverage, that is indicated for cUTI and cIAI and currently being studied for ventilated nosocomial pneumonia. This study evaluates C/T in a large database of US hospitals to better understand treatment patterns and associated outcomes.

Methods. This retrospective cohort of adult hospitalized patients in the Premier Healthcare Database (PHD) from January 1, 2015 to June 30, 2017, who received ≥2 consecutive days of C/T. The PHD contains demographic, clinical and healthcare resource utilization. Microbiology data are available from a subset of PHD hospitals. Multidrug resistance (MDR) was resistance to intermediate or to 1 or more agents in at least 3 classes. Outcomes included hospital length of stay (LOS), 30-day mortality, and readmissions (all cause and infection-related).

Results. A total of 1490 patients across 253 hospitals met study criteria. Mean age was 59.1 ± 17.5 years, 57% were male, and 65% were Caucasian. The most common comorbidities were chronic pulmonary disease (36%), renal disease (34%), and congestive heart failure (25%). 27% of patients had a prior hospitalization within 30 days. The mean Charlson score was 3 ± 2.4. Over half (55%) of patients were in the ICU, 49% were mechanically ventilated and 15% were on dialysis. Within the 229 patients with microbiology data, the most prevalent pathogen was Pseudomonas aeruginosa (78%). The median (IQR) number of days from admission to first day of C/T was 6 (2–15). Patients received a median (IQR) 7 (4–11) days of C/T. The median (IQR) LOS after the first day of C/T was 10 (6–18) days. The 30-day mortality rate was 9%. All cause and infection related readmissions were 17% and 9%, respectively.

Conclusion. Most of C/T usage was among critically ill, complex patients treated in the intensive care unit with P. aeruginosa. In spite of the complex nature of these patients, the outcomes among patients treated with C/T were positive and provides needed real world evidence. Further studies with a comparator group will allow further interpretation.

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2415. Comparison of Minocycline MICs Obtained by Etest to Those Obtained by broth Microdilution in a Bank of Isolates of Acinetobacter baumannii Collected in Southeastern Michigan
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Background. Minocycline is an important antibacterial for the management of AB infections. Discordance in tigecycline susceptibilities between BMD and ET has been as high as 43% (a 2-log 2 dilution higher MIC by ET). As many automated susceptibility panels do not include minocycline clinicians must rely on ET results. This analysis assesses the discordance between methodologies for minocycline and compares the performance of minocycline and tigecycline against a clinical set of AB isolates from Southeast Michigan.

Methods. Testing using BMD and ET were done on 386 isolates of AB from 5 hospitals. Results were compared using FDA breakpoints with BMD considered the gold standard. Correlations were defined as: (i) essential agreement (EA) if the ET MIC was identical to or 1 doubling dilution from the BMD MIC, (ii) categorical agreement (CA) if results via BMD and ET were the same susceptibility category, (iii) minor error if the isolate was intermediate by either test, but either susceptible or resistant by the other test, (iv) a major error if the isolate was false resistant by ET, and (v) a very major error if ET was false susceptible. Comparative BMD susceptibility between tigecycline and minocycline was also assessed.

Results. Of the 386 isolates of AB, 87% were susceptible to minocycline by BMD and 77% by ET (9.6% difference, P = 0.001). MIC comparisons are shown in Table 1. EA occurred in 80% of isolates and CA in 87%. Discordant results included 47 minor errors, 11 major errors, and 0 very major errors. 14% of isolates had ≥1 double dilution difference in the two methodologies and 4% had ≥2 double dilution differences. Susceptibility rates to tigecycline and minocycline were both 87%, with 11% of tigecycline nonsusceptible isolates susceptible to minocycline and 4% of minocycline nonsusceptible isolates susceptible to tigecycline.

Conclusion. Minocycline provides excellent activity against AB. ET provides reliable susceptibility results in comparison to BMD.

Table 1: Minocycline Susceptibility Comparing ET vs. BMD

| MIC (µg/mL) | BMD (%) | ET (%) |
|------------|---------|--------|
| N/A        | >8      | >8     |
| 0.5        | 0       | 0      |
| 1          | 0       | 0      |
| 2          | 0       | 0      |
| 4          | 0       | 0      |
| 8          | 0       | 0      |

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2416. Risk Factors and Outcomes of Bacteria Caused by Carbapenem-Resistant Enterobacteriaceae Compared With Carbapenem Susceptible Enterobacteriaceae
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Background. Due to shrinking therapeutic options, infections due to Carbapenem-resistant enterobacteriaceae (CRE) are an urgent threat in healthcare systems across the world. While the CRE phenotype is determined by a number a different genes, the metallo-β-lactamases such as the NDM, are particularly prevalent in the South Asian region. Data regarding infections with CRE caused by these strains is relatively limited. Our objective was to compare the risk factors and outcomes (mortality and length of hospitalization) of bacteremia secondary to CRE with bacteria secondary to carbapenem susceptible enterobacteriaceae (CSE).

Methods. We conducted a cross-sectional study on patients admitted between 2013 and 2016, to a large tertiary care hospital in Karachi, Pakistan. Patients with CRE bacteremia were matched for the same year with patients with bacteremia due to CSE. Patients with polymicrobial blood cultures were excluded. Clinical data of these patients were obtained using a structured performa.

Results. A total of 131 patients enrolled (65 CRE and 66 CSE). The mean age was similar in both groups (51.8 years and 57.1 years in CRE and CSE patients respectively). Compared with CSE, CRE bacteremia was more likely to occur in patients with Diabetes Mellitus or those with a tracheostomy (P = 0.002 and 0.014, respectively) and the most common CRE bacteremia was central line associated (24.6% of all cases) as opposed to urinary tract infections in those with CSE bacteremia (62.1% of all cases). Fewer patients with CRE bacteremia received appropriate antibiotics (72.3% vs. 81.8%). Mortality was over three times higher in patients with CRE (41.5% vs. 12.1%, P = 0.001). The mortality remained higher when adjusted for the severity of illness using the Pitt bacteremia score. Increased mortality was also associated with central venous catheterization in both CRE and CSE bacteremia, while urinary catheterization and hemodialysis were associated with mortality in patients in CSE bacteremia only. While length of ICU stay was similar between the two groups, the median length of hospital stay was longer in patients with CRE (median of 8 days vs. 6 days, P = 0.021).

Conclusion. CRE bacteremia was more likely associated with central lines and led to significantly higher mortality and length of stay.

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2417. Risk Factors, Response to Empiric Therapy, and Healthcare Utilization Among Children With UTI Due to Extended Spectrum β-Lactamase-Producing Enterobacteriaceae
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Background. There are few data on risk factors, chosen therapy and healthcare utilization among US children with extended spectrum β-lactamase-positive urinary tract infection (ESBL UTI). We performed a multicenter case–control study on childhood ESBL UTI from November 2014 to February 2017; herein we present preliminary data from a single Los Angeles County hospital.

Methods. We defined UTI per 2011 AAP guidelines and ESBL per CLSI specifications. ESBL(−) UTI controls were matched by sex and age. Descriptive and matched univariate analyses on medical record data (up to 6 months after index culture) were performed.

Results. Among 893 urinary Enterobacteriaceae isolates, 28 were ESBL(+), of which 23 were included: 13 girls, 0–5 year olds; 4 girls, 6–26 year olds; and 6 boys, 0–5 year olds. Prior hospitalization (55 vs. 78% for cases vs. controls, respectively), prior receipt of systemic antibiotics (53 vs. 38%), index hospitalization (39 vs. 20%), mean length of stay (3.8 vs. 3.6 days), and medical comorbidity (44 vs. 56%) did not differ significantly between groups. As well, several biosocial risk factors were similar in both groups, including: race, ethnicity, non-English-speaker, access to public benefits, international travel, non-US-born, domestic violence/child abuse/neglect, and housing insecurity. Of cases and controls receiving any therapy, 16% and 96%, respectively, got empiric antibiotics to which the isolate was susceptible (P = 0.001). After culture results were available, only 39% of cases and 96% of controls received effective agents (P = 0.00002). Forty-two percent of cases had clinical improvement (within a mean of 2–3 days), vs. 43% of controls. Total treatment duration did not differ, and no deaths were recorded. In the 6 months after index UTI, groups did not differ in number of clinical encounters, proportion with documented follow-up, repeat urine tests, receipt of additional therapy, or prophylactic antibiotics. The proportions undergoing any of these specific interventions were similar (42 vs. 47%), but this imaging included modalities with ionizing radiation in 4 cases vs. none of the controls (P < 0.05).

Conclusion. Our data suggest that clinical improvement occurs with (initial and potentially ineffective) empiric regimens, regardless of ESBL phenotype. The finding of more ionizing radiation exposure warrants additional study.

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2418. Management of Carbapenem-Resistant Enterobacteriaceae Infections in a Long-term Acute Care Hospital

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Background. Long-term acute care hospital (LTACH) systematically selects a unique patient population with multiple risk factors for Carbapenem-resistant Enterobacteriaceae (CRE) colonization and infection leading to an increase CRE prevalence at these facilities. This selection bias creates a fertile ground to harness scientific data and test hypotheses. We performed a retrospective analysis of patients with CRE infections diagnosed and treated in one LTACH.

Methods. Baseline data, antimicrobial treatment, and outcomes were collected in patients with bacteremia, healthcare-associated pneumonia (HCAP), and complicated urinary tract infection (cUTI/acute pyelonephritis (AP) due to CRE diagnosed between January 2017 and December 2017.

Results. 57 cases of CRE infections were identified over the study period; 12 bacteremias, 20 HCAP and 25 cUTI/ AP. The proportion of patient with significant comorbidities included: 31%; diabetes, 40.4% heart failure, 29.8% kidney disease and 10% with solid tumors. 89.5% of patients presented with sepsis and 33.3% had septic shock. Among 57 patients, majority (56) received empiric antibiotics known to have activity against Gram negative but only 38.6% had in vitro activity against the CRE organism recovered from cultured specimen. 85% of index CRE isolate was Klebsiella pneumoniae, 8.7% Enterobacter cloacae, 3.5% Proteus mirabilis, and 1.8% Escherichia coli. Treatment regimen varied; however, 78.9% received monotherapy. Overall outcome was poor with 28-day mortality of 17.5% across all infection sites but up to 25% in patients with bacteremia.

Conclusion. In this study, we report our clinical experience treating CRE infections in LTACH. We proved that CRE infections occurred in patients with substantial co-morbidities. Even though clinical outcome remain of great concern, 28-day mortality and rate of eradication of CRE in the study were comparatively better than other national estimates. Inappropriate empiric treatment may be one of the many factors leading to overall poor treatment outcomes.

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2419. Standard vs. Alternative Therapy for Stenotrophomonas maltophilia Infections: Focus on Trimethoprim–Sulfamethoxazole, Minocycline, and Moxifloxacin Monotherapy

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Background. Stenotrophomonas maltophilia is a Gram-negative bacilli associated with nosocomial infections. TMP-SMX is often considered the first-line agent; however, use may be limited due to adverse effects or resistance. Both minocycline and moxifloxacin have historically been used based on in vitro data; however, there is limited data assessing clinical utility. The purpose of this study was to compare the efficacy of TMP-SMX, minocycline, or moxifloxacin monotherapy for treatment of S. maltophilia infections.

Methods. This was a single-center, retrospective chart review from January 2006 to September 2017. Subjects were selected by cross-referencing pharmacy billing and culture data. Patients ≥18 years of age were included if they had isolated S. maltophilia in at least one culture and were treated for at least five days. Patients were excluded due to pregnancy, incarceration, cystic fibrosis, receipt of combination therapy, or having prior case of treated S. maltophilia infection. Complete success was defined as meeting all three of the following: (1) resolution of signs/symptoms, (2) no repeat isolation 30 days after end of therapy, and (3) no switch or addition of alternative agents that cover S. maltophilia. Partial success was defined as meeting at least two out of the three criteria.

Results. A total of 109 patients were included in this study. No statistically significant difference in complete clinical success was identified: TMP-SMX 14/32 (43.8%) vs. minocycline 17/37 (45.9%) vs. moxifloxacin 16/40 (40%), P = 0.8674. There was also no significant difference when including those that achieved partial clinical success: TMP-SMX 29/32 (90.6%) vs. minocycline 35/37 (94.6%) vs. moxifloxin 34/40 (85%), P = 0.3724. Moxifloxacin use was associated with a significantly longer median LOS of 41.5 days compared with 24.5 days for TMP-SMX and 10 days for minocycline (P = 0.0340). Resistance development within 30 days post-treatment only occurred in 4 patients who received moxifloxacin (P = 0.0028). There was no difference in mortality nor treatment duration.

Conclusion. Clinical success achievement was found to be similar in patients treated with TMP-SMX, minocycline, or moxifloxacin monotherapy for S. maltophilia infections.

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2420. A Real-World Perspective on the Efficacy of Fosfomycin for Treatment of Multidrug-Resistant Pathogens Causing Urinary Tract Infections

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Background. Urinary tract infections (UTI) are the most common infection associated with multidrug-resistant (MDR) pathogens. With limited treatment options, there has been an increasing interest in the efficacy of fosfomycin (FOS); however, real-world clinical data are limited. Our objective was to assess the outcomes of hospitalized patients with MDR UTIs treated with FOS.

Methods. Retrospective review of patients with carbapenem-resistant (CRE) or extended spectrum β-lactamase producing (ESBL) Enterobacteriaceae, or vancomycin-resistant Enterococcus (VRE) UTIs who received ≥1 dose of FOS. UTI was defined as a urine culture with ≥10^5 CFU/mL among patients with dysuria, increased urinary frequency, suprapubic or flank pain or tenderness, fevers, or altered mental status without an alternative etiology. We defined cure as resolution of symptoms within 7 days without recurrence within 30 days. Microbiological failure was defined as a positive urine culture within 14 days.

Results. 49 patients with MDR UTIs (17 ESBL, 17 VRE, 15 CRE) were included. Median age was 69 (range: 20–95), 18% were male, 14% were immunosuppressed and the median Charlson score was 4 (0–12). 33% had indwelling catheters and 10% of patients had neurogenic bladder. Increased frequency (29%) and fever (27%) were the most common symptoms. 51% of cases were healthcare associated and 64% met the CDC/NHSN definition of UTI. UTIs were complicated by pyelonephritis in 2 patients, but none had concomitant bacteremia. FOS was administered as empiric or definitive treatment in 39% and 61%, respectively. Only 12% of patients received ≥1 dose. CRE occurred in 88% of patients, and did not vary by infecting pathogen (Figure 1, Table 2), or the number of FOS doses received. Patients with relapsing symptoms were infected by ESBL (n = 3), CRE (n = 1), and VRE (n = 3); all but one received ≥1 dose of FOS. Microbiologic failures occurred in 18% due to ESBL (n = 1), CRE (n = 4), and VRE (n = 4). 4% of patients died in hospital, but only 1 death was related to UTI. Overall, FOS was well-tolerated with vomiting recorded in one patient.

Conclusion. Across a range of MDR pathogens causing UTIs, FOS was well-tolerated and effective for hospitalized patients. FOS represents an attractive oral option to preserve alternative agents for systemic infections. Future studies are needed to evaluate the benefit of repeated dosing.

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