Table 1

ST type (No. isolates)	Allele distance		Countries (No. isolates)	Major beta-lactamases detected (No. isolates)	
	Within ST	Between STs (compared to)		Carbapenemases[a]	ESBL
258[b] (45)	160	660 (ST11)	USA (23), Brazil (10), Greece (8), Argentina (4)	KPC-2 (24), KPC-3 (15)	CTX-M-14 (10), CTX-M-15 (1), OXA-10 (2)
11 (57)	519	631 (ST437)	Brazil (15), Poland (9), USA (6), Greece, Korea, Russia & Taiwan (4 each), Argentina & Chile (3 each), Spain (2), Mexico, Panama & Thailand (1 each)	KPC-2 (19), NDM-1 (10), OXA-48-like (4)	CTX-M-14 (3), CTX-M-15 (30), OXA-10 (1)
512[c] (12) Clustered within ST258	41	56 (ST258)	Italy (10), Russia (2)	KPC-3 (12)	OXA-10 (1)
437 (6)	107	631 (ST11)	Brazil (3) and Costa Rica, Poland, USA (1 each)	KPC-2 (3), OXA-48-like (1)	CTX-M-15 (5)
395 (6)	236	1336 (CC258)	Russia (5), Spain (1)	NDM-1 (1), OXA-48-like (5)	CTX-M-15 (6)
2856 (1)	NA	2909 (all other STs)	Mexico (1)	None	CTX-M-15
307 (10; non-CC258)	63	2763 (CC258)	USA (2) and Australia, Brazil, Costa Rica, Germany, Ireland, Italy, Mexico, Spain (1 each)	KPC-2 (1), KPC-3 (1)	CTX-M-15 (10; CTX-M-15 +OXA-1/-30 [8])

a. OXA-48-like included OXA-48, OXA-181 or OXA-232
b. One ST418 isolate clustered within ST258
c. One ST3498 isolate clustered within ST512
ESBL, extended-spectrum β-lactamase

Disclosures. Fredrik Dyrkell, n/a, 1928 Diagnostics (Employee) Dimitrios Arnellos, n/a, 1928 Diagnostics (Employee) Mariana Castanheira, PhD, 1928 Diagnostics (Research Grant or Support)A. Menarini Industrie Farmaceutiche Riunite S.R.L. (Research Grant or Support)Allergan (Research Grant or Support) Allergan (Research Grant or Support)Amplyx Pharmaceuticals (Research Grant or Support)Cidara Therapeutics (Research Grant or Support)Cidara Therapeutics (Research Grant or Support)Cipla Ltd. (Research Grant or Support)Cipla Ltd. (Research Grant or Support)Fox Chase Chemical Diversity Center (Research Grant or Support)GlaxoSmithKline (Research Grant or Support)Melinta Therapeutics, Inc. (Research Grant or Support)Melinta Therapeutics, Inc. (Research Grant or Support) Melinta Therapeutics, Inc. (Research Grant or Support)Merck (Research Grant or Support)Merck (Research Grant or Support)Merck & Co, Inc. (Research Grant or Support)Merck & Co, Inc. (Research Grant or Support)Paratek Pharma, LLC (Research Grant or Support)Pfizer (Research Grant or Support)Qpex Biopharma (Research Grant or Support)

832. Assessment of Risk Factors Associated with Wide-resistance Gram-negative Bacteria Infections

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Session: P-36. HAI: Gram-negatives (MDR-GNR)

Background. Enterobacteria and multidrug-resistant non-fermenting Gram-negative bacilli present a challenge in the management of invasive infections, leading to mortality rates due to their limited therapeutic arsenal. The objective of this work was to analyze risk factors that may be associated with these infections, for a better situational mapping and assertive decision-making in a university hospital in Brazil.

Methods. The study was conducted between January and September 2019, with 167 patients in contact isolation at a university hospital in Brazil. Potential outcome-related variables for wide-resistance Gram-negative bacteria (BGN) infections were evaluated. Risk factors were identified from univariate statistical analysis using Fisher's test.

Results. 51 (30.5%) out of 167 patients in contact isolation evolved with wide-resistance BGN infection. Risk factors in univariate analysis were age, hospital unit and previous use of invasive devices. Patients aged up to 59 years were more likely to progress to infection than those aged over 60 years (p 0.0274, OR 2.2, 95% CI 1.1-4.5). Those admitted to the oncohematology (p < 0.001, OR 32.5, Cl 9.1-116.3) and intensive care unit (p < 0.001, OR 28.0, Cl 3.5-225.9) units were more likely to develop this type of infection. The least likely were those admitted to a kidney transplant unit (p 0.0034, OR 15.33, Cl 1.8-131.0). Prior use of mechanical ventilation (p 0.0058, OR 12.2, Cl 2.0-76.1) and delayed bladder catheter (p 0.0266, OR 5.0, Cl 1.2-20.1) in patients with respiratory and urinary tract infection, respectively, were also reported as risk factors related to these infections. The gender of the patients was not significant for the study.

Conclusion. This study determined that variables such as age, hospitalization unit, use of mechanical ventilation and delayed bladder catheter could be considered important risk factors in triggering the infectious process by wide-resistant gram-negative bacteria. Thus, the analysis of these factors becomes a great foundation to prevent the development of multiresistant pathogens through prevention strategies, prophylaxis management and more targeted empirical therapies.

Disclosures. **All Authors**: No reported disclosures

833. Characteristics and Utilization Patterns of Colistin Compared with Newer Agents in Gram-Negative Infections

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Session: P-36. HAI: Gram-negatives (MDR-GNR)

Background. Colistin has resurfaced in light of Gram-negative (GN) resistance. New antibiotics to treat antibiotic resistant GN infections (eg, ceftazidime-avibactam, ceftolozane-tazobactam, meropenem-vaborbactam [new agents]), have recently been approved but their use vs colistin is unclear. We compared the overall use of colistin and new agents from 2014 to 2018 in patient days on therapy (PDOT).

Methods. Data on non-cystic fibrosis patients from the Premier Healthcare Database was used. PDOT was tabulated quarterly for Premier hospitals and projected to the US population. A subset of data from 2016 to 2018 with microbiologically confirmed GN (MCGN) infections was selected for adult inpatients receiving ≥3 days of therapy with colistin, new agents, carbapenems, or extended-spectrum cephalosporins. The index infection was defined either as the first carbapenem-resistant (CR) or -sensitive infection if no CR infection occurred. Patients could be treated with ≥1 antibiotic per infection. Utilization was examined by pathogen and patient characteristics.

Results. PDOT with colistin decreased from 2015 to 2018, while new agents have increased (Figure). During 2015–2018, colistin and any of 3 new agents were used by 3,320 and 5,781 inpatients, respectively, of whom, 649 (20%) and 1,284 (22%) had MCGN pathogens. Colistin-treated patients were sicker than patients treated with new agents (Table), underlying renal disease was present in 34.5% vs 36.3 %, and median length of stay of 17 vs 15 days, respectively. Mean total hospital cost was $93,815 vs $84,013 for colistin and new agents, respectively. Mortality was greater in colistin patients (18% vs 12%; p< 0.0001). CR infections constituted similar proportions of colistin and new agent use (79% vs 75%). Colistin accounted for 15.2% of CR *Acinetobacter* treatments and 9.7% of CR Enterobacterales (CRE) treatments compared with 4.5% and 12.8%, respectively, for new agents.

Figure. Projected Inpatient PDOT

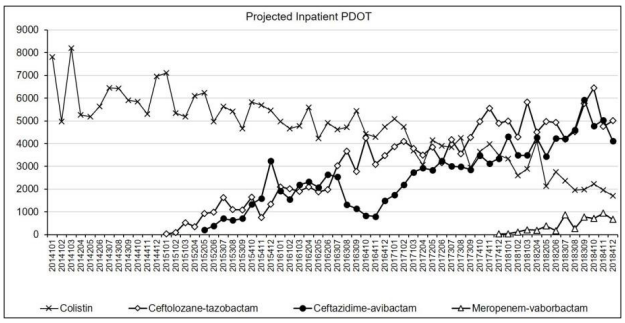

Table.

Table		
Baseline Characteristics	Colistin	New Agents
Sex (male), n (%)	1,930 (58%)	3,349 (58%)
Age (years), mean	59.8	61.0
Charlson Comorbidity Index, mean	3.3	3.4
Chronic renal disease, n (%)	1,145 (34%)	2,099 (36%)
Healthcare utilization prior 6 mo (days, LOS), mean	18.9	15.4
Hospital Course Characteristics		
Sepsis/septic shock present on admission, n (%)	1,781 (54%)	2,845 (49%)
ICU during hospital, n (%)	2,117 (64%)	3,131 (54%)
Mechanical ventilation, n (%)	1,992 (60%)	2,435 (42%)
Length of stay (days), median	17	15
Patient charges (US$), mean	$400,888	$333,643
Inpatient mortality, n (%)	594 (18%)	712 (12%)

Conclusion. Colistin use has decreased simultaneously with the introduction and increased use of new agents in the USA. Colistin was used more frequently in sicker patients and for *Acinetobacter* spp. infections than for CRE infections. Patients on colistin have worse outcomes, probably due to baseline differences in their health status.

Disclosures. Stephen Marcella, MD, Shionogi Inc. (Employee) Casey Doremus, MS, Shionogi Inc. (Employee) Roger Echols, MD, Shionogi Inc. (Consultant)

834. Clinical Outcomes with Carbapenem-Resistant *Pseudomonas aeruginosa* that Retain Susceptibility to Traditional Antipseudomonal β-lactams: Atlanta, 2016-2018

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Session: P-36. HAI: Gram-negatives (MDR-GNR)

Background. Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) often results from multiple mechanisms, creating unique phenotypic patterns of resistance including retaining susceptibility to traditional antipseudomonal β-lactams: cefepime

(FEP), ceftazidime (CAZ) and piperacillin-tazobactam (TZP). Outcomes of patients with CRPA susceptible to FEP, CAZ and TZP are unclear.

Methods. The Georgia Emerging Infections Programed performs active, population-based surveillance for CRPA (minimum inhibitory concentration [MIC] ≥ 8 μg/mL for doripenem, imipenem or meropenem) isolated from sterile sites, urine, lower respiratory tracts and wounds in metropolitan Atlanta. We created a retrospective cohort of adults without cystic fibrosis with their first episode of CRPA while hospitalized or hospitalized within 1 week, from 8/2016 – 7/2018. We compared patients with CRPA that remained susceptible to FEP, CAZ and TZP ("susceptible CRPA") to those that were not ("resistant CRPA") including multivariable logistic regression for 30-day mortality.

Results. Among 643 patients, 638 had susceptibility results available for FEP, CAZ or TZP. 60% were male, median age was 65 years, and median Charlson comorbidity index was 2 (Table 1). Most (66%) resided in a hospital or long-term care facility 4 days prior to culture. The most common source was urine (38%). Non-susceptibility to multiple antibiotic classes was common: 523 (81%) for 3 classes and 214 (33%) for 5 classes (Table 2). 220 (34%) patients had susceptible CRPA and compared to patients with resistant CRPA, were more likely to have lived in a private residence, have a community-associated infection, and less likely to be in the ICU previously (Table 1). Patients with susceptible CRPA had a similar crude 30-day mortality (16% vs 12%, p = 0.15) to those with resistant CRPA, but in a multivariable analysis had an increased 30-day mortality (OR 1.9; 95% CI 1.1–3.2).

Table 1 (Part 1/2): Characteristics and outcomes of hospitalized patients with carbapenem-resistant Pseudomonas aeruginosa (CRPA) in metropolitan Atlanta, stratified by antipseudomonal β-lactam susceptibility

Table 1: Characteristics and outcomes of hospitalized patients with carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) in metropolitan Atlanta, stratified by antipseudomonal β-lactam susceptibility

	All CRPA (n = 638)[1]	Susceptible CRPA[2] (n = 220)	Resistant CRPA[3] (n = 418)	P-value[4]
Age category (years)				0.09
19 – 49	125 (20)	37 (17)	88 (21)	
50 – 64	187 (29)	64 (29)	123 (29)	
65 – 79	231 (36)	76 (35)	155 (37)	
>79	95 (15)	43 (20)	52 (12)	
Male (n = 637)	385 (60)	127 (58)	258 (62)	0.36
Race				0.01
Black	335 (56)	98 (48)	237 (60)	
White	249 (42)	101 (49)	148 (38)	
Multiracial, other or unknown	54 (8)	21 (10)	33 (8)	
Charlson comorbidity index > 2	310 (49)	99 (45)	211 (50)	0.19
Residence 4 days prior to culture				<0.01
Inpatient	279 (44)	81 (37)	198 (47)	
Long-term facility (LTCF or LTACH)	145 (23)	42 (19)	103 (25)	
Private residence	214 (34)	97 (44)	117 (28)	
Epidemiologic class[5]				<0.01
Community associated	20 (3)	11 (5)	9 (2)	
Healthcare associated, community onset	332 (52)	128 (58)	204 (48)	
Hospital onset	286 (45)	81 (37)	205 (49)	
ICU in 7 days prior to culture	203 (32)	51 (23)	152 (36)	<0.01
Culture source				
Sterile site	52 (8)	17 (8)	35 (8)	0.09
Lower respiratory tract	226 (35)	64 (29)	162 (39)	
Urine	243 (38)	94 (43)	149 (36)	
Wound	117 (18)	45 (20)	72 (17)	
Location where culture was collected				0.14
Outpatient or ER	134 (21)	50 (22)	84 (20)	
Hospital inpatient (excluding ICU)	278 (44)	105 (48)	173 (41)	
ICU	209 (33)	59 (27)	150 (36)	
Long-term facility (LTCF or LTACH)	17 (3)	6 (3)	11 (3)	
Outcome at 30 days:				
Death	87 (14)	36 (16)	51 (12)	0.15
Alive and remained hospitalized	95 (15)	22 (10)	73 (17)	0.01
Alive and discharged to:	456 (71)	162 (74)	294 (70)	0.11
LTACH	58 (13)	21 (13)	37 (13)	
LTCF	145 (32)	41 (25)	104 (35)	
Private residence	233 (51)	94 (58)	139 (47)	
Other or Unknown	20 (4)	6 (4)	14 (5)	

Table 1 (Part 2/2): Characteristics and outcomes of hospitalized patients with carbapenem-resistant Pseudomonas aeruginosa (CRPA) in metropolitan Atlanta, stratified by antipseudomonal β-lactam susceptibility

Table 1 (continued)

All values are presented as number (%) unless otherwise stated

1. Had susceptibility results available for cefepime, ceftazidime or piperacillin-tazobactam
2. Susceptible to cefepime, ceftazidime and piperacillin-tazobactam (if tested)
3. Resistant to at least one of: cefepime, ceftazidime, and piperacillin-tazobactam
4. Compared susceptible versus resistant CRPA with Chi-square or Fisher's exact test as appropriate
5. Hospital onset is defined as the incident culture being obtained after hospital day 3; Healthcare associated, community onset is defined as not meeting criteria for hospital onset but having at least one of the following risk factors: Hospitalization, surgery, residence in LTCF or LTACH within the last year, chronic dialysis, or presence of a urinary catheter, central venous catheter or other indwelling device at the time of culture or within the 2 prior calendar days. Community onset is defined as not meeting criteria for hospital onset or healthcare associated, community onset

Abbreviations: CRPA, carbapenem-resistant *Pseudomonas aeruginosa*; LTCF, long term care facility; LTACH, long term acute care hospital; ICU, intensive care unit

Table 2: Antibacterial susceptibility results for hospitalized patients with carbapenem-resistant Pseudomonas aeruginosa in metropolitan Atlanta

Table 2: Antibacterial susceptibility results for hospitalized patients with carbapenem-resistant *Pseudomonas aeruginosa* in metropolitan Atlanta

Antibiotic (n = number tested)	Number susceptible (%)[1]
Amikacin (n = 543)	467 (86)
Gentamicin (n = 635)	373 (59)
Tobramycin (n = 610)	428 (70)
Ciprofloxacin (n = 555)	61 (11)
Levofloxacin (n = 496)	41 (8)
Cefepime (n = 623)	318 (51)
Ceftazidime (n = 570)	327 (57)
Piperacillin-tazobactam (n = 572)	264 (46)
Ceftazidime-avibactam (n = 38)	28 (74)
Ceftolozane-tazobactam (n = 47)	42 (89)
Aztreonam (n = 424)	141 (33)
Colistin (n = 85)[2]	66 (78)
Polymyxin B (n = 60)[2]	55 (92)
Meropenem (n = 598)	25 (4)
Doripenem (n = 66)	10 (15)
Imipenem (n = 296)	3 (1)

1. Antibiotic susceptibility was determined by automated testing instruments or through chart review. An isolate was non-susceptible if the MIC exceeded the Clinical and Laboratory Standards Institute 2020 susceptible breakpoint on any testing modality.
2. Based off medical record documentation or E-test only

Conclusion. Over 1/3 of hospitalized patients with CRPA retained susceptibility to other antipseudomonal β-lactams, but had an increased mortality compared to CRPA resistant to other β-lactams. Further research into mechanisms of resistance or antibiotics received might help explain this unexpected finding.

Disclosures. **Jessica Howard-Anderson, MD**, **Antibacterial Resistance Leadership Group (ARLG)** (Other Financial or Material Support, The ARLG fellowship provides salary support for ID fellowship and mentored research training)

835. Comparison of the outcomes of patients with KPC and NDM-1-producing *Enterobacteriaceae*

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Session: P-36. HAI: Gram-negatives (MDR-GNR)

Background. Carbapenemase-producing *Enterobacteriaceae* infections are associated with high mortality. We aimed to compare the clinical outcomes of patients with *Klebsiella pneumoniae* carbapenemase (KPC)-producing *Enterobacteriaceae* and those with New-Delhi-Metallo-beta-lactamase-1 (NDM-1)-producing *Enterobacteriaceae*.

Methods. We performed a retrospective cohort study of all adult patients (> 16 years old) with KPC or NDM-1-producing *Enterobacteriaceae* isolates in a 2,700-bed tertiary referral hospital in Seoul, South Korea between 2010 and 2019. Primary outcomes were infection within 30 days and 30-day mortality after the first isolation of KPC or NDM-1-producing *Enterobacteriaceae*.

Results. A total of 859 patients were identified during the study period. Of them, 475 (55%) were KPC group and 384 (45%) were NDM-1 group. KPC group tended to develop infection within 30 days after first isolation more frequently than NDM-1 group (31% vs. 26%; $P = 0.07$). Thirty-day mortality was significantly higher in KPC group compared to NDM-1 group (KPC, 17% (81/475) versus NDM-1, 9% (33/384), $P < 0.001$). Multivariate analysis revealed that APACHE II score (adjusted odds ratio [aOR], 1.12; $P < 0.001$), solid cancer (aOR, 2.56; $P < 0.001$), previous carbapenem therapy (aOR, 1.93; $P = 0.004$), development of infection of KPC or NDM-1-producing *Enterobacteriaceae* within 30 days (aOR, 2.63; $P < 0.001$), and KPC-producing *Enterobacteriaceae* (aOR, 1.62; $P = 0.045$) were independent risk factors for 30-day mortality.

Table 1. Results of analyses of risk factors for 30-day mortality from initial positive culture date in patients with KPC or NDM-1- producing Enterobacteriaceae

Table 1. Results of analyses of risk factors for 30-day mortality from initial positive culture date in patients with KPC or NDM-1- producing *Enterobacteriaceae*

	Univariate analysis		Multivariate analysis[a]	
Risk factor	**OR (95% CI)**	***P* value**	**Adjusted OR (95% CI)**	***P* value**
Age	1.03 (1.01–1.05)	< 0.001		
Male gender	0.73 (0.47–1.15)	0.17		
Healthcare-associated acquisition	1.04 (0.60–1.78)	0.89		
APACHE II score	1.13 (1.10–1.16)	< 0.001	1.12 (1.09–1.16)	< 0.001
Diabetes mellitus	0.83 (0.54–1.27)	0.39		
End-stage renal disease	1.52 (0.99–2.33)	0.06		
Solid cancer	1.87 (1.26–2.78)	0.002	2.56 (1.62–4.05)	< 0.001
Neutropenia	1.74(0.87–3.49)	0.12		
Indwelling device	1.73 (0.99–3.02)	0.054		
Previous carbapenem use within 3 months	2.56 (1.72–3.82)	< 0.001	1.93 (1.24–3.00)	0.004
Carbapenemase type (KPC)	2.19 (1.42–3.36)	< 0.001	1.62 (1.01–2.60)	0.045
Development of KPC or NDM-1-producing *Enterobacteriaceae* infection within 30 days	2.48 (1.62–3.81)	< 0.001	2.63 (1.69–4.10)	< 0.001

Abbreviations: CI, confidence interval; APACHE II, Acute Physiology and Chronic Health Evaluation II; KPC, *Klebsiella pneumoniae* carbapenemase; NDM-1, New-Delhi-Metallo-beta-lactamase-1

[a] Potential confounders identified to include in the multivariate analysis were age, male gender, APACHE II score, end-stage renal disease, solid cancer, neutropenia, indwelling device, previous carbapenem use within 3 months, development of KPC or NDM-1-producing *Enterobacteriaceae* infection within 30 days and carbapenemase type.