Figure 1. *P. aeruginosa* Bacteremia Total Cases and 30-Day Mortality Rate by Year

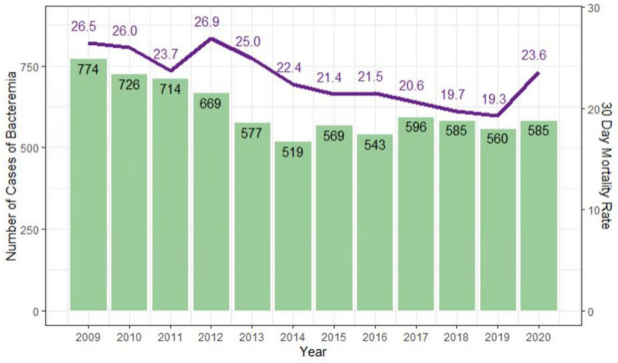
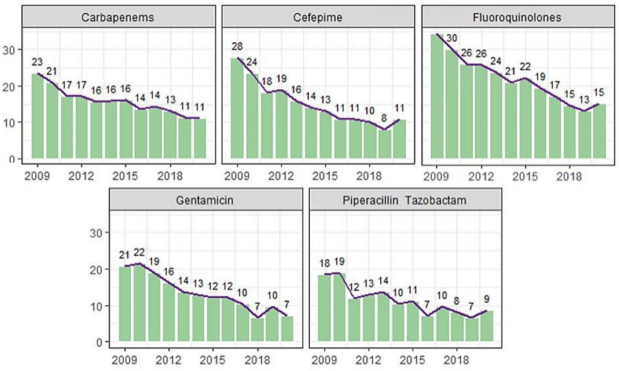


Figure 2. Percentage of *P. aeruginosa* Isolates with Resistance to Selected Classes/Agents by Year



Additionally, we determined rates of resistance to antipseudomonal agents. **Results:** In total, 7,480 cases of *P. aeruginosa* bacteremia were identified. The total case count of *P. aeruginosa* bacteremia decreased from 774 in 2009 to 519 in 2014, then remained relatively stable. The 30-day mortality rate decreased from 26.5 in 2009 to 19.3 in 2019, but this rate increased to 23.6 in 2020 (Fig. 1). The fluoroquinolone class had the highest resistance rate at 23%, followed by ceftazidime, cefepime, and the carbapenem class with rates of ~15%–16%. All classes were noted to have decreased resistance over time (Fig. 2). **Conclusions:** Occurrences, mortality rate, and associated resistance of *P. aeruginosa* bacteremia across the VHA system generally decreased during the study period. Potential explanations for these observations include improved infection control measures, more effective therapeutic agents, and enhanced antimicrobial stewardship efforts. The increased mortality in 2020 could be related to concomitant COVID-19 or the result of delayed medical care in the pandemic setting. Limitations of this study include inability to identify causative factors for observed trends and potential variability between labs affecting the rates of observed resistance. Additionally, VHA data may not be representative of entire adult population. Future studies could explore the relationship between *P. aeruginosa* bacteremia and infection prevention and antimicrobial stewardship efforts and could describe associations between *P. aeruginosa* and COVID-19 and identify risk factors associated with *P. aeruginosa* bacteremia and mortality.

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Characterization of carbapenem-resistant gram-negative bacteria collected in the Sentinel Surveillance Program, 2018–2019

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Background: Carbapenem resistance in gram-negative organisms is an important public health problem. The CDC conducted Sentinel surveillance in 2018–2019 to characterize these organisms from 9 facilities in 9 different states. **Methods:** Carbapenem-resistant Enterobacterales (CRE), *Pseudomonas aeruginosa* (CRPA), and *Acinetobacter* spp (CRA) obtained from clinical samples of patients in acute-care or long-term care facilities were submitted to the CDC. Identification was confirmed using matrix-assisted laser desorption ionization time-of-flight (MALDI-TOF), and antimicrobial susceptibility testing (AST) was performed via broth microdilution for 27 antibiotics. All confirmed CRE and CRPA were tested for carbapenemase production (CP) using the modified carbapenem inactivation method (mCIM). The isolates that were mCIM-positive were assessed by real-time PCR for presence of *bla*KPC, *bla*NDM, *bla*VIM, and *bla*IMP. CP-CRE were also assessed for *bla*OXA-48-like. All confirmed CRA were tested for the same genes as CRPA and *bla*OXA-23–like, *bla*OXA-24/40-like, *bla*OXA-58–like, and *bla*OXA-235–like genes. Difficult-to-treat resistance (DTR) was defined as resistance to all β-lactams (excluding newer β-lactam combination agents) and quinolones tested. **Results:** The CDC confirmed 208 CRE, 161 CRPA, and 94 CRA. Table 1 summarizes AST results for a selection of drugs. We identified 112 (53.8%) mCIM-positive CRE and 6 (3.7%) mCIM-positive CRPA. The PCR results are summarized in Table 2. One mCIM-positive and PCR-negative isolate was positive in a metallo-β-lactamase screen. **Conclusions:** Resistance among CRE and CRPA to newer β-lactam combination agents was detected. Options for treating CRA are limited. Of 112 CP-CRE, 85.7% harbored *bla*KPC; CP-CRPA were rare (3.7%); and most CRA harbored *bla*OXA-23-like (55.3%) or *bla*OXA-24/40-like (30.9%). Whole-genome sequencing is planned to better understand gene variants, sequence types, and additional resistance markers present among the isolates.

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Table 1. Frequency of resistance to key drugs

	n	CZA %R	MVB %R	I-R* %R	C/T %R	COL %R	TGC %R	DTR %	Pan-NS
CRE	208	4.3%	2.9%	6.5%	91.3%	17.4%	3.4%	43.3%	0%
CRPA	161	17.4%		8.8%	11.8%	4.3%		34.2%	3.1%
CRA	94			96.7%		20.2%		80.9%	21.3%

CZA: ceftazidime-avibactam; %R: percentage of resistant isolates; MVB: meropenem-vaborbactam; I-R: imipenem-relebactam; C/T: ceftolozane-tazobactam; COL: colistin; TGC: tigecycline; Pan-NS: number of isolates intermediate or resistant to all tested antibiotics
*Not all isolates were tested against I-R

Table 2: PCR Results

	n	*bla*KPC	*bla*NDM	*bla*OXA-48-like	*bla*IMP	*bla*VIM	*bla*OXA-23-like	*bla*OXA-24/40-like	*bla*OXA-58-like	*bla*OXA-235-like	mCIM +/PCR -
CRE	112	85.7%	4.5%	4.5%	0%	0%					5.4%
CRPA	6	33.3%	16.7%		0%	16.7%					33.3%
CRA	94	0%	0%		0%	0%	55.3%	30.9%	1.1%	3.2%	

bla: β-lactamase gene; +: positive; -: negative