

Epidemiology of Carbapenem-Resistant Organisms in Alameda County, California (July 2019 - June 2021)

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Background

- Carbapenem-resistant *Enterobacterales* (CREs) and some Carbapenem-resistant organisms (CROs) are considered urgent threats by the CDC¹.
- Since 2017, the Alameda County Public Health Department (ACPHD) has mandated the reporting of CREs (specifically *Escherichia coli*, *Klebsiella* spp., and *Enterobacter* spp.) and encouraged voluntary reporting of non-CRE CROs². Specimen submittal to Alameda County Public Health Laboratory (ACPHL) was mandated for the given CRE species and encouraged for other CREs and CROs.
- Surveillance data from these cases were analyzed to describe the epidemiology of infections and to target local public health interventions.

Methods

- Healthcare providers and labs in Alameda County report cases of CROs to ACPHD directly or through electronic laboratory reporting.
- Data were entered into the California Reportable Disease Information Exchange (CalREDIE) for reporting to the California Department of Public Health.
- Clinical labs submitted isolates to ACPHL to test for carbapenemase genes by whole genome sequencing using the Illumina MiSeq platform.
- Active surveillance was also performed through the Antibiotic Resistance Lab Network (ARLN) for long term care facilities experiencing a CRO outbreak using Cepheid to detect for carbapenemases.
- Surveillance data were accessed from CalREDIE and analyzed for cases July 2019 – June 2021.
- Cases included in analysis were identified by the clinical laboratory as resistant to one or more carbapenems.

References

- Centers for Disease Control and Prevention (U.S.). *Antibiotic Resistance Threats in the United States, 2019*. Centers for Disease Control and Prevention (U.S.); 2019. doi:10.15620/cdc:82532
- Alameda County Public Health Department. Alameda County Health Officer Order for Reporting Carbapenem-Resistant Enterobacteriaceae. <https://acphd.org/health-alerts/advisory/alameda-county-health-officer-order-for-reporting-carbapenem-resistant-enterobacteriaceae-jun-13-2017>. Accessed May 3, 2022.
- Livorsi DJ, Chorazy ML, Schweizer ML, et al. A systematic review of the epidemiology of carbapenem-resistant Enterobacteriaceae in the United States. *Antimicrobial Resistance & Infection Control*. 2018;7(1):55. doi:10.1186/s13756-018-0346-9

Results

From July 2019 – June 2021, 442 cases of CROs were reported to ACPHD from 408 patients; 651 bacterial isolates were submitted to ACPHL from these patients.

The county case rate for CROs over the two-year period was 29 cases per 100,000 population. Of the cases, 107 (24%) were carbapenemase-producing.

Table 1. Characteristics of the 408 Patients Diagnosed with Carbapenem-Resistant Organisms

Patient Characteristic	N = 408 ¹
Age Group	
<18	5 (1.2%)
18-30	22 (5.4%)
31-40	36 (8.8%)
41-50	31 (7.6%)
51-60	69 (17%)
61-70	98 (24%)
71-80	91 (22%)
81+	56 (14%)
Race/Ethnicity	
African American or Black	51 (12%)
Asian	37 (9.1%)
Hispanic or Latino/a/x	54 (13%)
White	80 (20%)
Other/Multiple Races	42 (10%)
Unknown	144 (35%)
Gender	
Female	165 (40%)
Male	227 (56%)
Other or Unknown	16 (4.0%)
Facility Type ²	
Long Term Acute Care Hospital (LTACH)	91 (22%)
Short Term Acute Care Hospital (STACH)	206 (50%)
Skilled Nursing Facility (SNF)	14 (3.4%)
Ventilator equipped SNF (vSNF/SNF)	59 (14%)
Outpatient	20 (4.9%)
Other ³	18 (17%)

¹n (%)

²Facility where patient resided or visited when organism was first identified, or reporting facility

³Includes sub-acute rehab, in-home care, and lab facilities

Figure 1. Epidemiologic Curve of Cases by Month and Carbapenemase-Producing Status

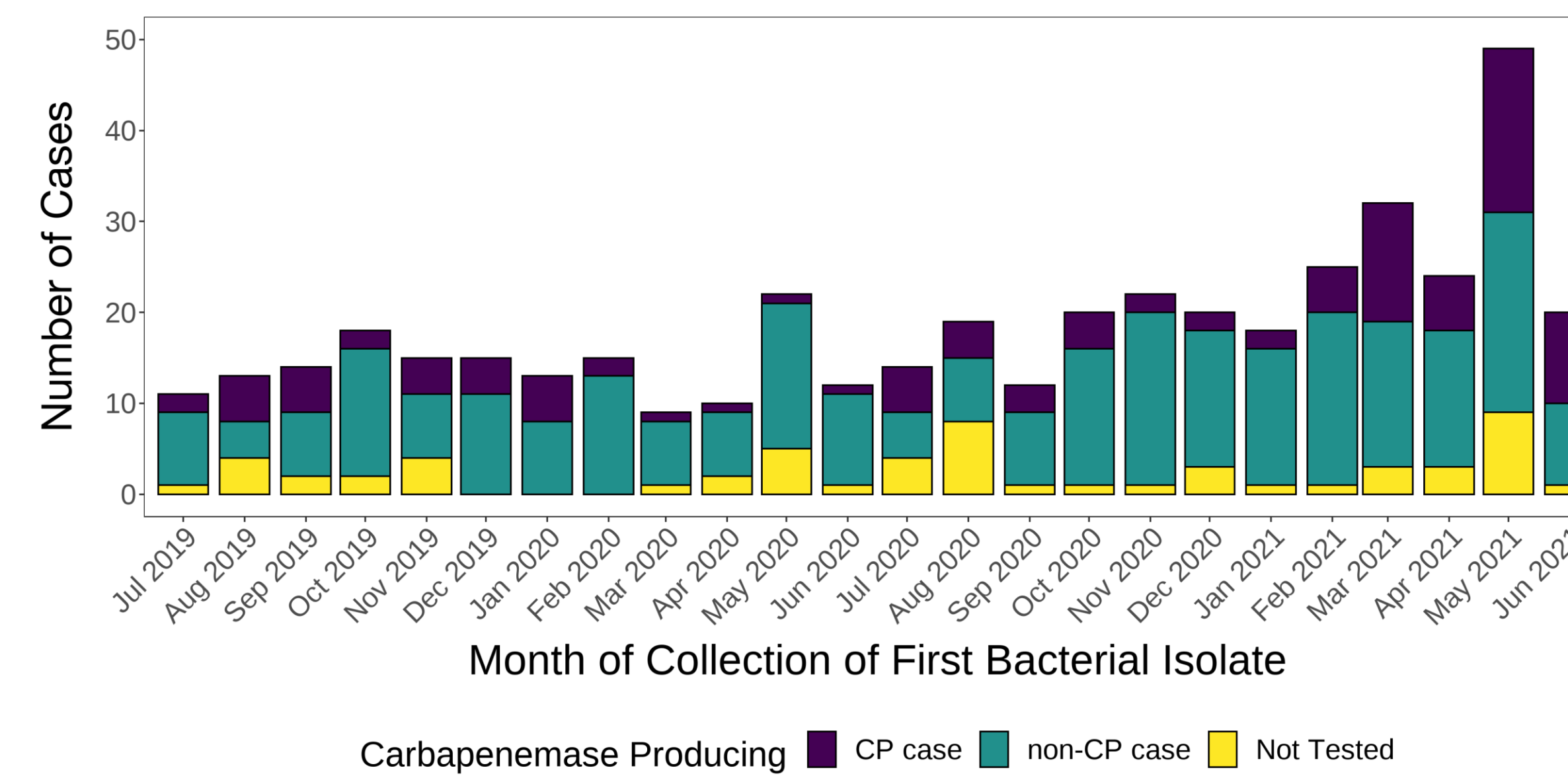


Table 2. Carbapenem-Resistant Organism Species by Carbapenemase-Producing Status Among Cases (n=442), Alameda County, California, July 2019 - June 2021

Isolated Species	Carbapenemase -Producing, n (%)	Non-Carbapenemase-Producing, n (%)	Not Tested, n (%)
Reportable Carbapenem-resistant <i>Enterobacterales</i> ¹ , n = 216	61 (28%)	133 (62%)	22 (10%)
Carbapenem-resistant <i>E. Coli</i> , n = 55	18 (33%)	31 (56%)	6 (11%)
Carbapenem-resistant <i>Enterobacter</i> spp., n = 73	7 (10%)	59 (80%)	7 (10%)
Carbapenem-resistant <i>Klebsiella</i> spp., n = 88	36 (41%)	43 (49%)	9 (10%)
Carbapenem-resistant <i>Acinetobacter baumannii</i> , n = 46	27 (59%)	4 (9%)	15 (33%)
Carbapenem-resistant <i>Pseudomonas aeruginosa</i> , n = 157	15 (10%)	129 (82%)	13 (8%)
Other CRO, n = 23	4 (17%)	11 (48%)	8 (35%)
Overall	107 (24%)	277 (63%)	58 (13%)

¹*E. coli*, *Klebsiella* spp., and *Enterobacter* spp.

Figure 2. Number of CRO Isolates Sent to Alameda County Public Health Lab by Month

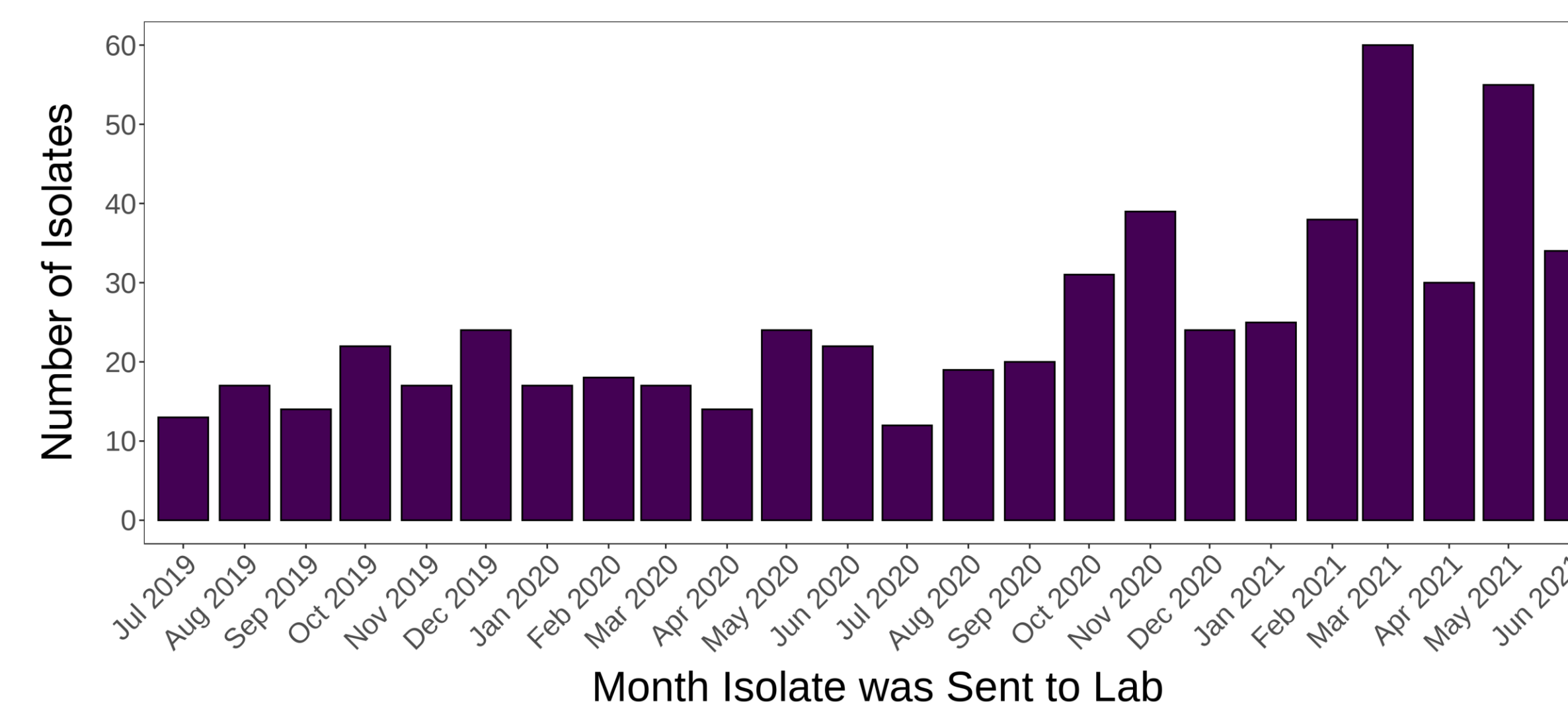


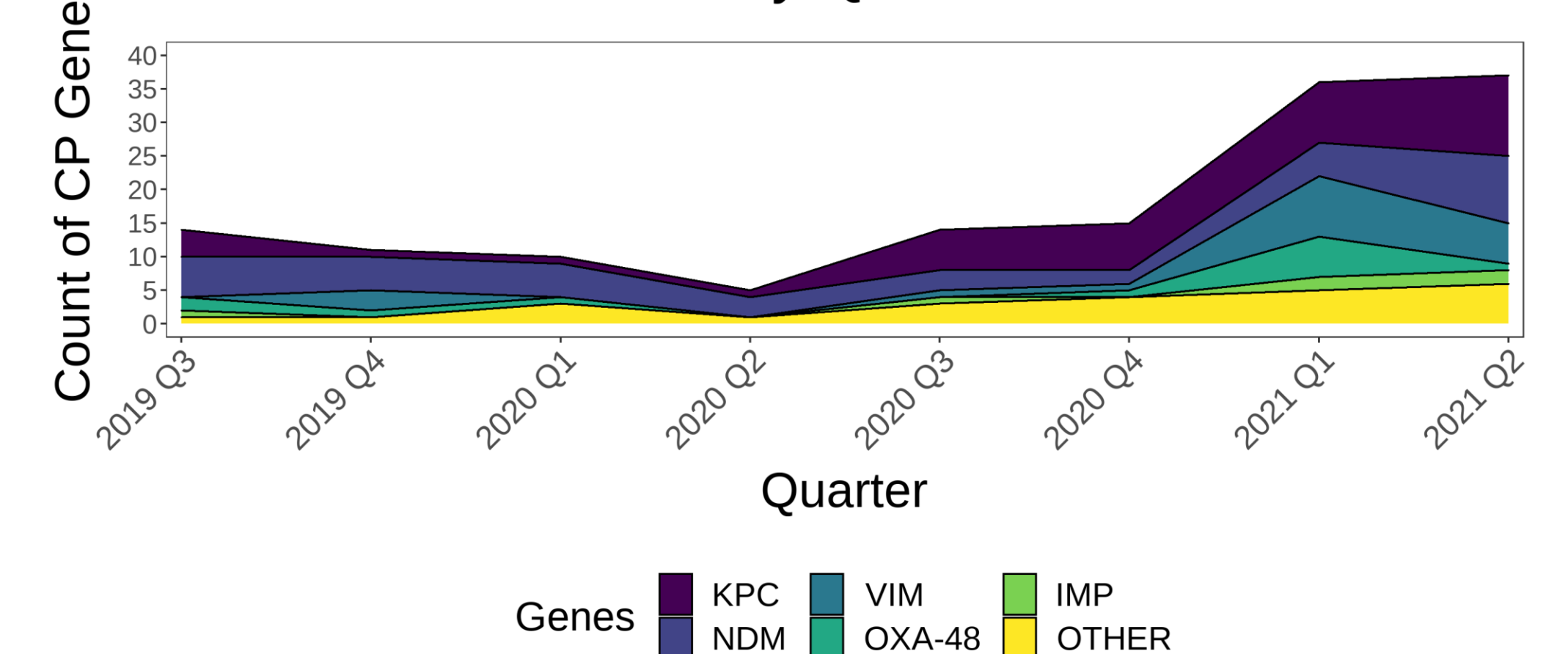
Table 3. Genes, Specimen Sources, and Species for the 651 Bacterial Isolates Collected from 442 Cases

Characteristic	Reportable CRE ¹ N = 274 ²	<i>Acinetobacter baumannii</i> , N = 57 ²	<i>Pseudomonas aeruginosa</i> , N = 292 ²	Other CRE/CRO, N = 28 ²	Total, N = 651 ²
Carbapenemase-Producing Gene					
KPC	39 (14%)	0 (0%)	1 (0.3%)	1 (3.6%)	41 (6.3%)
NDM	26 (9.5%)	10 (18%)	2 (0.7%)	1 (3.6%)	39 (6.0%)
VIM	0 (0%)	0 (0%)	20 (6.8%)	0 (0%)	20 (3.1%)
OXA-48	11 (4.0%)	1 (1.8%)	0 (0%)	0 (0%)	12 (1.8%)
IMP	0 (0%)	0 (0%)	3 (1.0%)	3 (11%)	6 (0.9%)
Other genes	3 (1.1%)	21 (37%)	0 (0%)	1 (3.6%)	25 (3.8%)
No Genes Detected	146 (66%)	4 (12%)	197 (90%)	10 (62%)	357 (73%)
Isolate Not Tested	54 (20%)	25 (44%)	73 (25%)	12 (43%)	164 (25%)
Specimen Source					
Blood	24 (8.8%)	0 (0%)	1 (0.3%)	4 (14%)	29 (4.5%)
Not Specified	5 (1.8%)	2 (3.5%)	4 (1.4%)	1 (3.6%)	12 (1.8%)
Other	19 (6.9%)	2 (3.5%)	6 (2.1%)	2 (7.1%)	29 (4.5%)
Perirectal/rectal/fecal swab	39 (14%)	6 (11%)	14 (4.8%)	3 (11%)	62 (9.5%)
Respiratory	39 (14%)	32 (56%)	213 (73%)	7 (25%)	291 (45%)
Urine	136 (50%)	5 (8.8%)	41 (14%)	9 (32%)	191 (29%)
Wound	12 (4.4%)	10 (18%)	13 (4.5%)	2 (7.1%)	37 (5.7%)

¹*E. coli*, *Enterobacter* spp., *Klebsiella* spp.

²n (%)

Figure 3. Counts of Carbapenemase-Producing Genes from Isolates by Quarter



Conclusions

- The high burden of CROs in Alameda County highlights the need for continued partnership on reporting and testing, and the necessity of targeted public health guidance including improved infection prevention measures and enhanced environmental cleaning to limit the spread of resistant organisms³.
- Cases of reported CROs have increased in Alameda County over the past two years along with the number of specimens requiring testing at ACPHL.
- One hundred and four (24%) cases were identified as carbapenemase-producing, with a high percentage among carbapenem-resistant *Acinetobacter baumannii* isolates, informing future targeted public health interventions.
- A large proportion of cases were identified in vulnerable long-term care (vSNF and LTACH) residents, and many residents of these facilities were identified at STACHs.

