Characterizing Antibiotic Resistance Mechanisms in a Hospital Setting Using BioFire PCR Testing: A Quality Improvement Initiative

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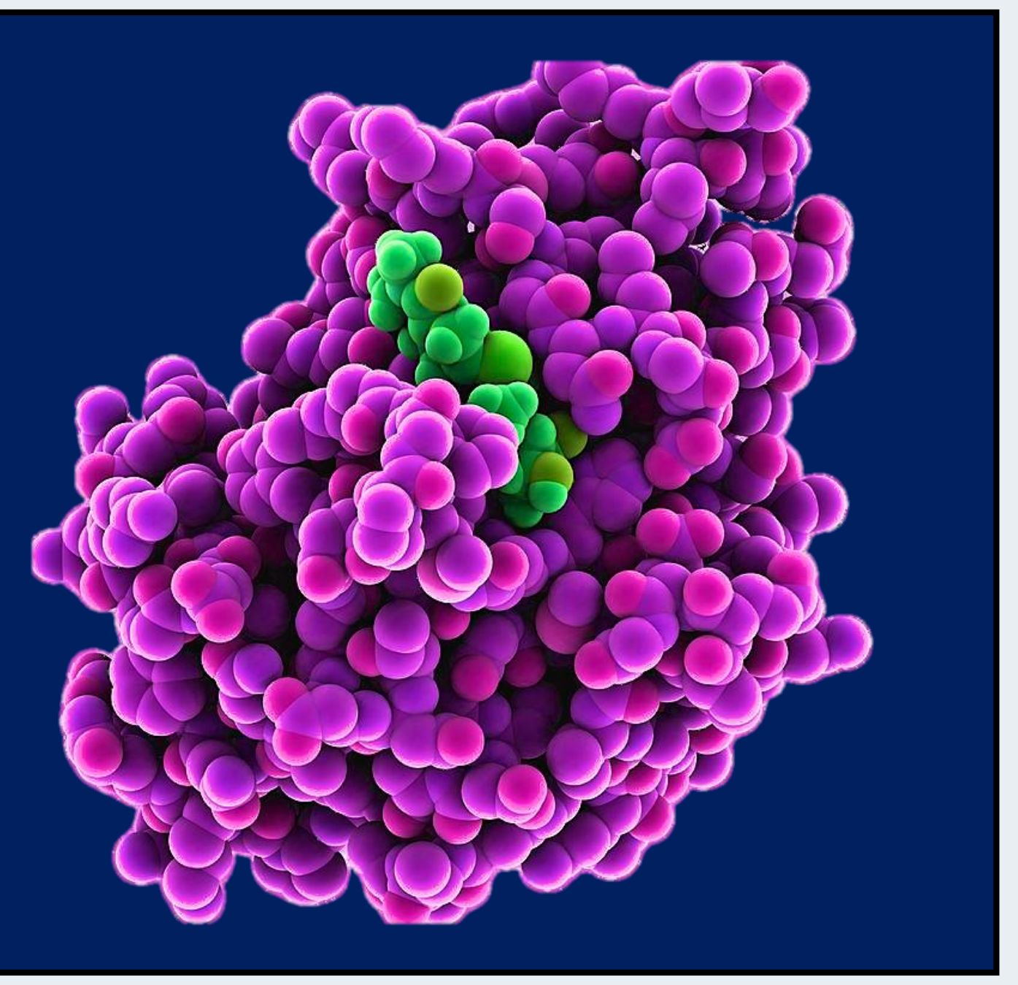


Introduction

- Carbapenem-resistant Enterobacterales (CRE) pose a critical public health challenge, particularly in bloodstream infections (BSIs) where treatment delays contribute to high mortality.
- Resistance in CRE typically results from carbapenemase enzymes, including Klebsiella pneumoniae carbapenemase (KPC), Verona integron–encoded metallo-β-lactamase (VIM), Oxacillinase (OXA-48–like), Imipenemase (IMP), and New Delhi metallo-β-lactamase (NDM). While KPC has historically predominated in the United States (U.S.), the distribution of resistance genes is shifting.
- Surveillance across U.S. hospitals reveals a decrease in KPC-positive CRE and a rise in metallo-β-lactamases, such as NDM. Because these enzymes are poorly inhibited by current β-lactam/β-lactamase inhibitor agents, therapeutic options remain limited. Ongoing, localized monitoring of resistance genes is essential to guide therapeutic decisions and infection control practices.

Objective

The objective of this study is to report the incidence and types of resistance genes identified from BSI at AtlantiCare Regional Medical Center (ARMC). With this information, we aim to identify emerging resistance trends using quarterly BCID2 reports to inform the Antibiotic Stewardship Program (ASP) and guide physician antibiotic selection as new patterns arise.

Methods

- The BioFire Blood Culture Identification 2 (BCID2) panel, a multiplex PCR assay, was used to rapidly detect pathogens. Antimicrobial resistance genes from positive blood cultures collected over a 2-year period (Jan 2024 – Dec 2025), were retrospectively analyzed.
- Inclusion criteria were gram-negative BSIs with at least one resistance gene. Samples with only gram-positive organisms were excluded.
- Resistance genes were categorized by type, including Cefotaximase from Munich (CTX-M), a common extended-spectrum β-lactamase (ESBL). Incidence rates were calculated using observational statistics and normalized to the hospital census (inpatient days).
- This study did not use patient identifiers or access to electronic medical records; Institutional Review Board approval was not required.

Results

Table 1: Gram-negative organism totals and associated resistance gene counts (BCID2 panel, 2-year period).

BCID2 Resistance Marker Counts							
Organism	**Total**	**CTX-M**	**IMP**	**KPC**	**NDM**	**OXA-48-like**	**VIM**
E. coli	271	57	0	1	0	2	0
K. pneumonia	114	33	0	4	0	1	0
P. mirabilis	10	3	0	0	0	0	0
Ps. aeruginosa	4	1	0	0	0	0	0

Incidence of gram-negative resistance genes in BSIs: 0.5 cases per 1000 inpatient days annually.

Figure 1: Composition of resistance genes detected using the BCID2 panel.

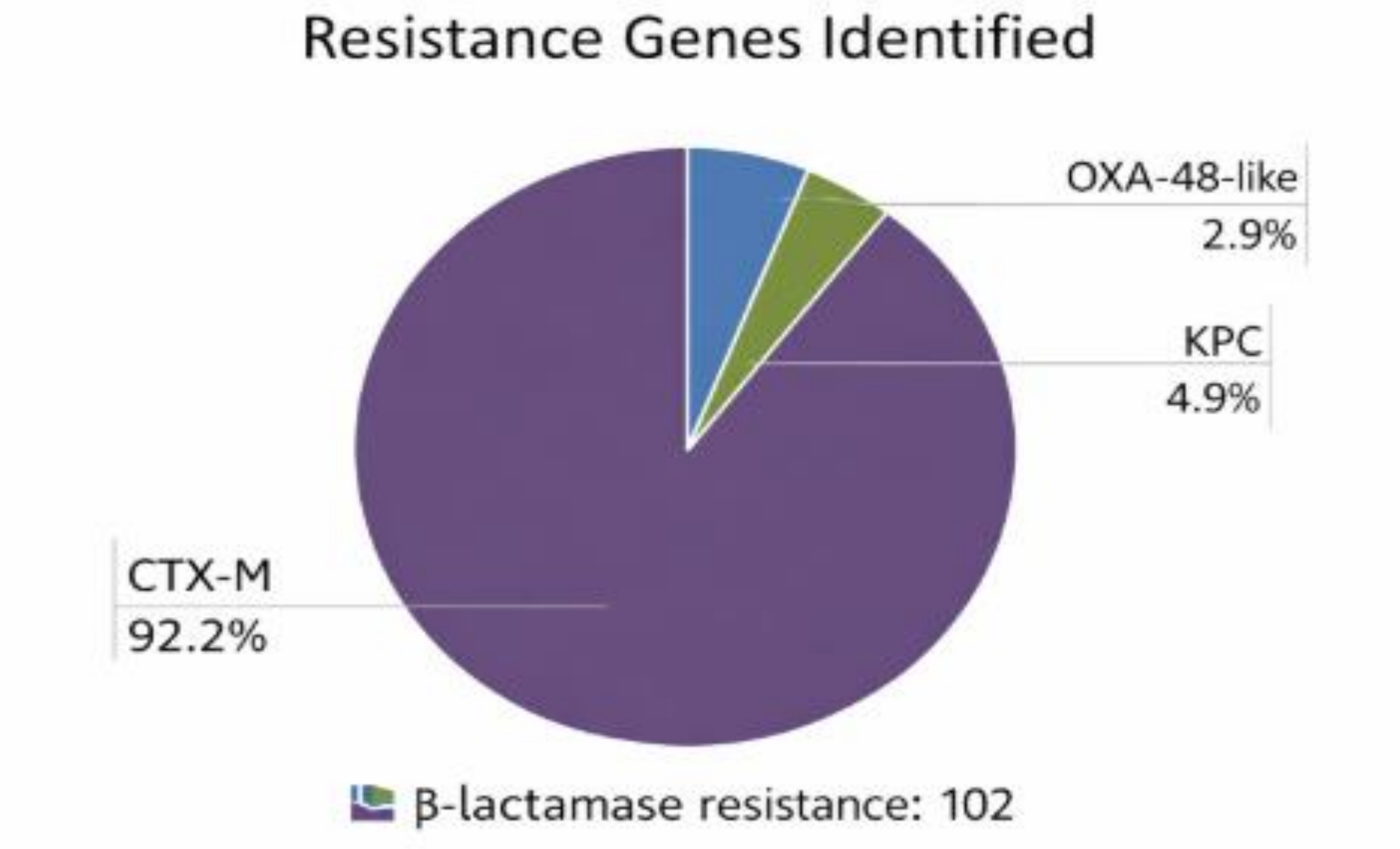
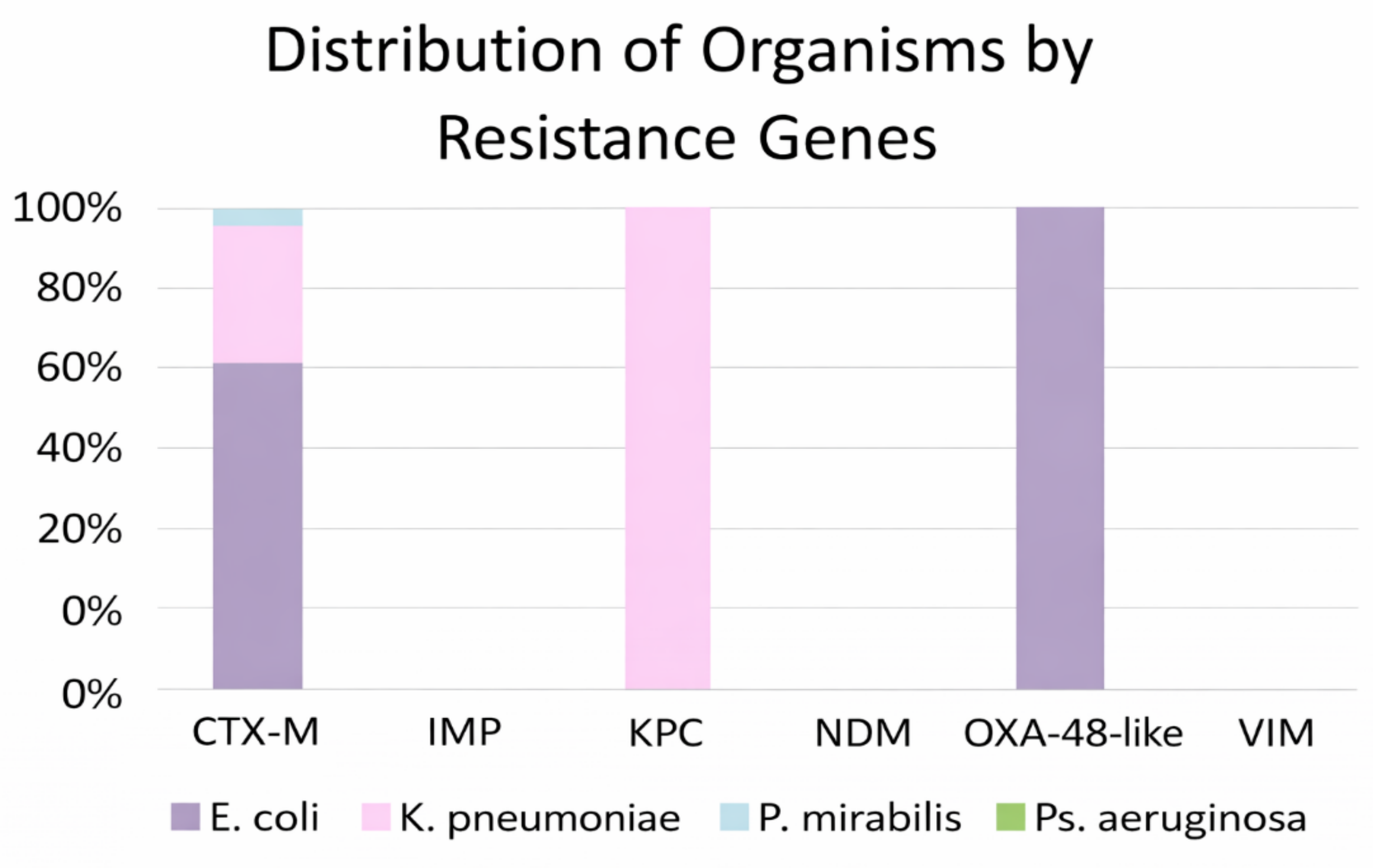


Figure 2: 100% stacked column chart detailing organism and resistance gene.



Discussion

⟶ Over the study period, 399 gram-negative BSI were identified, with 102 (25.6%) carrying a β-lactamase resistance gene. CTX-M (n=94, 92.2%) predominated, while KPC (n=5, 4.9%) and OXA-48–like (n=3, 2.9%) were rare. No metallo-β-lactamases (NDM, VIM, IMP) were detected. This pattern indicates that ESBLs remain the primary resistance mechanism at our institution.

⟶ Unlike regional data from New York City, where NDM-producing CRE increased from 5.8% in 2019 to 28.2% in 2024, ARMC has not seen similar emergence. Ongoing local molecular surveillance is essential to detect early shifts in resistance patterns.

⟶ As part of a quality improvement initiative, quarterly BCID2 resistance reports will be incorporated into the ASP. Monitoring regional resistance trends will help guide empiric prescribing, standardize treatment of resistant BSIs, and enhance patient outcomes.

Conclusion

CTX-M remains the predominant resistance gene in gram-negative BSIs at ARMC, with no detection metallo-β-lactamases. Implementation of this quarterly surveillance program supports informed antibiotic selection, updated hospital guidelines, and increased awareness of emerging resistance to improve overall patient care.

References

Disclosure panel: The authors have nothing to disclose concerning financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter.