Epidemiology of Resistant Gram-Negative Bacterial Colonization in Michigan Nursing Facilities

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Background

- Drug-resistant gram-negative bacteria (R-GNB) infections are common and increasing in nursing homes (NHs)
- R-GNB colonization ranges from 11.2%-59.1%, and is significantly higher in United States (38%) than other countries (14%)[1]
- *Klebsiella pneumoniae* (~40% mortality rate), *Acinetobacter baumannii* (~57%), and *Pseudomonas aeruginosa* (~31%) are classified as *critical* priority in the WHO bacterial priority pathogens list (BPPL) [2,3]

Objectives

- Characterize R-GNB colonization patterns among NH residents and environmental surfaces
- Evaluate potential interspecies transmission of resistance among co-colonizing isolates
- Gain helpful insights for R-GNB infection prevention and control in NHs

Methods

- Secondary data analysis of a cohort of patients admitted to 6 Michigan nursing homes
- 896 patients, 2412 visits, 31575 anatomic site and room surface samples collected at enrollment, day 14 and 30, and monthly thereafter for up to 6 months
- Comparison of resistance rates in strains co-colonizing with another resistant versus susceptible strain ($P < 0.05$ = statistically significant) (Pearson test, Fisher exact test, logistic regression)

Results

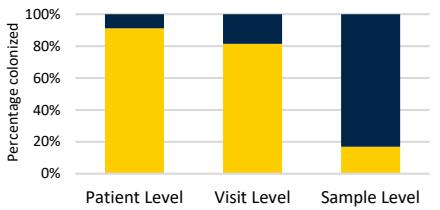


Figure 1. Colonization with gram-negative bacteria

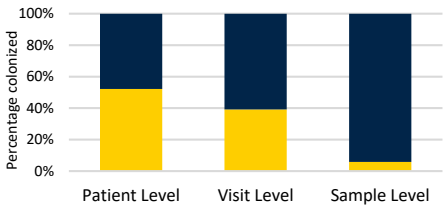


Figure 2. Colonization with resistant gram-negative bacteria

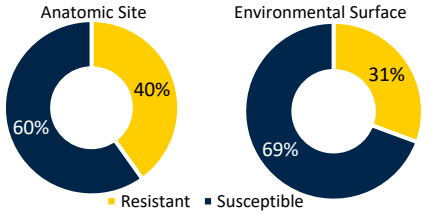


Figure 3. Resistance rates at sample level: Anatomic Site vs. Environmental Surface

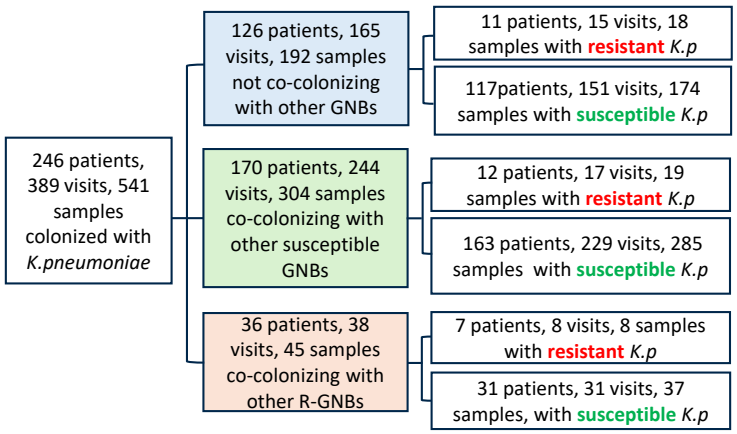


Figure 4. Patient classification based on their colonization of *K. pneumoniae* and resistance of Cephalosporins.

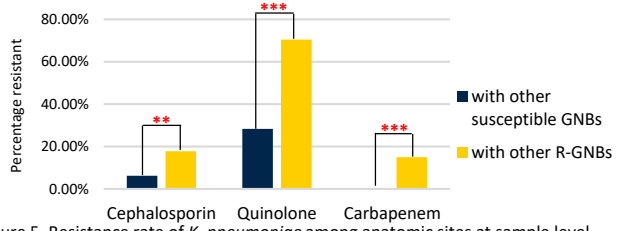


Figure 5. Resistance rate of *K. pneumoniae* among anatomic sites at sample level.

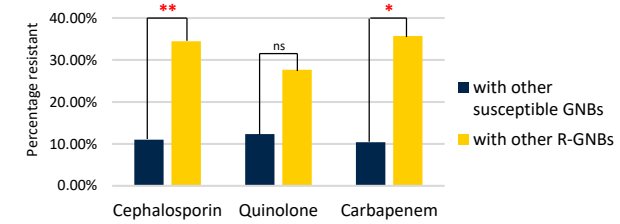


Figure 6. Resistance rate of *A. baumanii* among environmental surfaces at sample level.

Table 1. Odds Ratios of antibiotic resistance according to co-colonization status and patient antibiotic exposure.

	Adjusted OR (95% CI), P value		
	Cephalosporins	**Quinolones**	**Carbapenems**
Single isolate, no antibiotics	1 [Reference]	1 [Reference]	1 [Reference]
Isolate co-colonizing with other R-GNBs	2.56 (1.97, 3.31), <0.001	3.61 (3.14, 4,16), <0.001	3.15 (1.20, 4.96), <0.001
Isolate exposed to that antibiotic	2.24 (1.92, 2.60), <0.001	2.26 (1.94, 2.62), <0.001	4.90 (3.62, 6.65), <0.001

References & Acknowledgments

1. Aliyu, S., et al. 2017. *Infection Control*
2. WHO. 2024. *Bacterial Priority Pathogens List*
3. Lodise, T.P., et al. 2020. *Expert Review of Anti-Infective Therapy*
Thank you to Dr. Mody Research Team, Center for Research and Innovation in Infection Prevention among Susceptible Populations (CRIISP) Research Group, and Certificate in Healthcare Infection Prevention and Control (CHIP) Program

Conclusions & Future Directions

- R-GNB colonization rates are high among nursing home residents and their surrounding environment
- Co-colonization with another resistant species and antibiotic exposure are associated with significantly higher resistance rates
- Sequencing could be used to verify antibiotic resistance genes transfer among co-colonizing bacterial species
- Other classes of antimicrobials and their potential interaction effects on resistance could be explored