

Association of Race and Ethnicity with Antibiotic Resistance

Deepali Tailor¹; Matthew Sims, MD, PhD, FACP, FIDSA^{2,3}

¹ Oakland University William Beaumont School of Medicine, ² Corewell Health William Beaumont University Hospital, Dept of Medicine, Section of Infectious Diseases and International Medicine,

³ Oakland University William Beaumont School of Medicine, Depts of Internal Medicine and Foundational Medical Studies.

Background

- Antibiotic resistance is a major global health concern that complicates the effective treatment of bacterial infections¹
- The development of antibiotic resistance in gut flora is multifactorial and influenced by antibiotic use in food production, food preparation practices, and ethnic dietary traditions¹
- Antibiotics are commonly used in livestock to promote growth and prevent infections, creating selective pressure that favors antibiotic-resistant bacteria in animal gut flora²
- Consumption of food products derived from animals treated with antibiotics can introduce resistant bacteria into the human gut²
- Prior research by our group has shown associations between specific racial and ethnic groups and ESBL-producing Gram-negative urinary infections, with Asian race and Arab/Middle Eastern ethnicity showing increased odds³
- Other than that study, there has been little to no prior research on the association of race or ethnicity with Gram-negative antibiotic resistance

Objectives

- Identify if there is a more generalized association, outside of the previous shown association with ESBLs in urine, between Gram-negative antibiotic resistance and patient race or ethnicity.

Methods

- Retrospective analysis of adult patients (≥18 years old) with unique positive Gram-negative isolates from blood, urine, wound and respiratory cultures in the inpatient and outpatient setting from our clinical microbiology laboratory in the year 2019
- Demographic data (age, gender, race, ethnicity, encounter type) and culture data (identification and sensitivities) were extracted from the EMR; patients with missing data were excluded, patients who answered that they prefer not to answer for race or ethnicity were included in the total but were not considered a separate category.
- Statistical analysis using Fisher's Exact test was performed to calculate statistical significance of differences in resistance.

References

- McEwen SA, Collignon PJ. Antimicrobial Resistance: a One Health Perspective. Microbiol Spectr. 2018;6(2):10.1128/microbiolspec.ARBA-0009-2017. doi:10.1128/microbiolspec.ARBA-0009-2017
- Torki Baghbaderani Z, Shakerian A, Rahimi E. Phenotypic and Genotypic Assessment of Antibiotic Resistance of *Staphylococcus aureus* Bacteria Isolated from Retail Meat. Infect Drug Resist. 2020;13:1339-1349. Published 2020 May 7. doi:10.2147/IDR.S241189
- Herkness J and Sims M. Social Determinants of Health in Extended Spectrum Beta-Lactamase Carriage in the Urine – The Influence of Race, Ethnicity and Sex in the Outpatient Setting. Open Forum Infect Dis. 2023 Dec;10(Suppl 2): ofad500.1668. doi:10.1093/ofid/ofad500.1668.

Acknowledgements

Figure 1A: Association of Race to Gentamicin Sensitivity

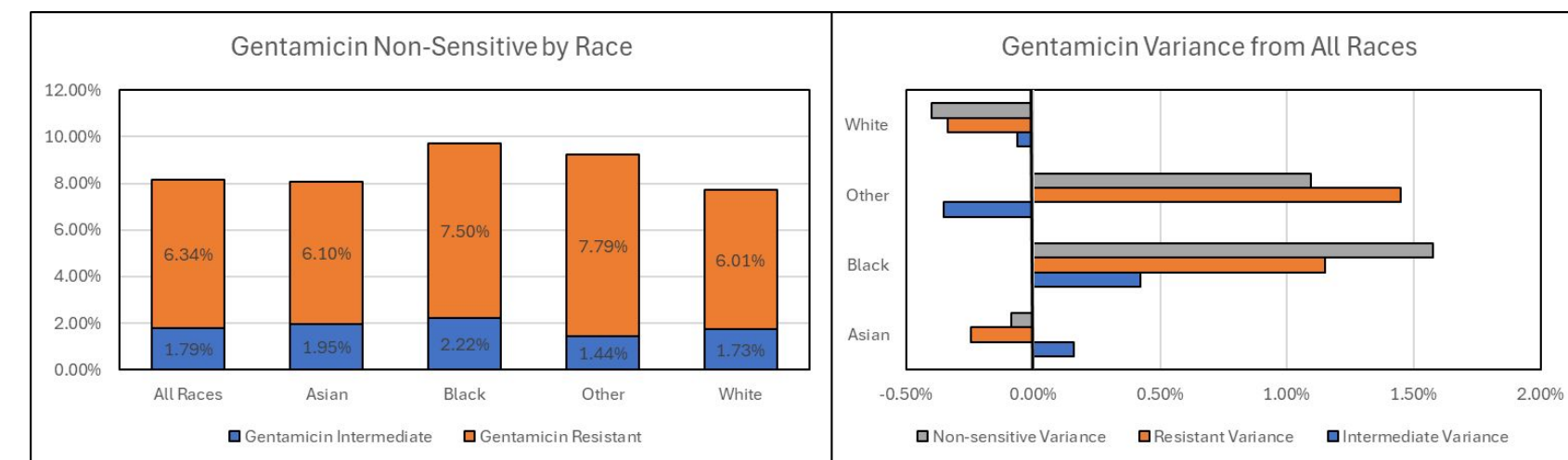


Figure 2A: Association of Race to Tobramycin Sensitivity

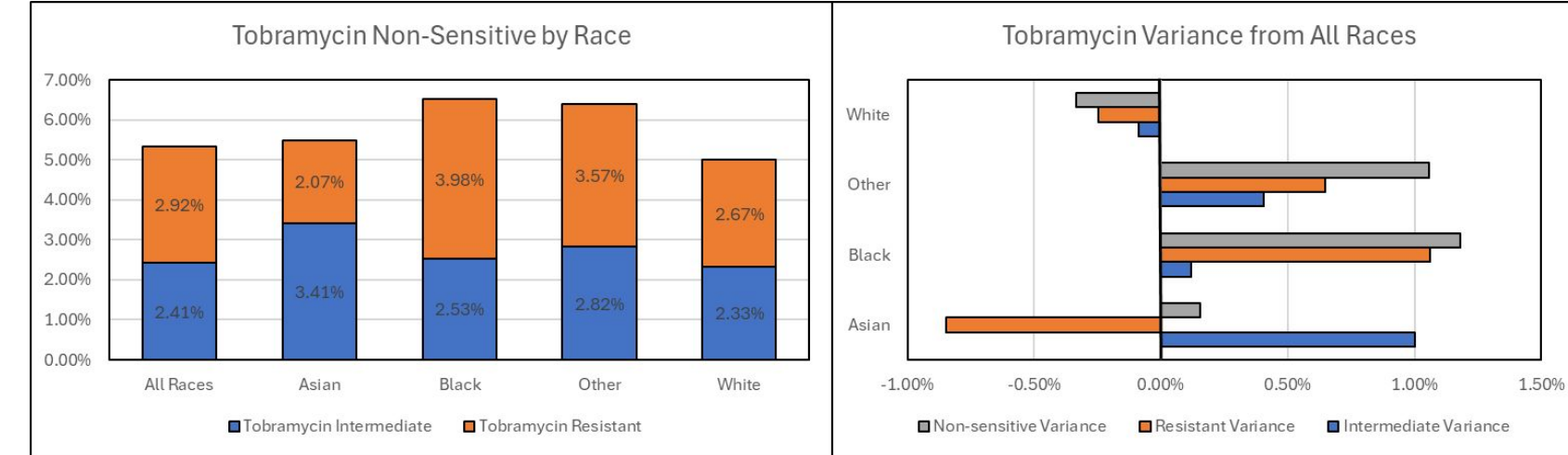


Figure 3A: Association of Race to Cefepime Sensitivity

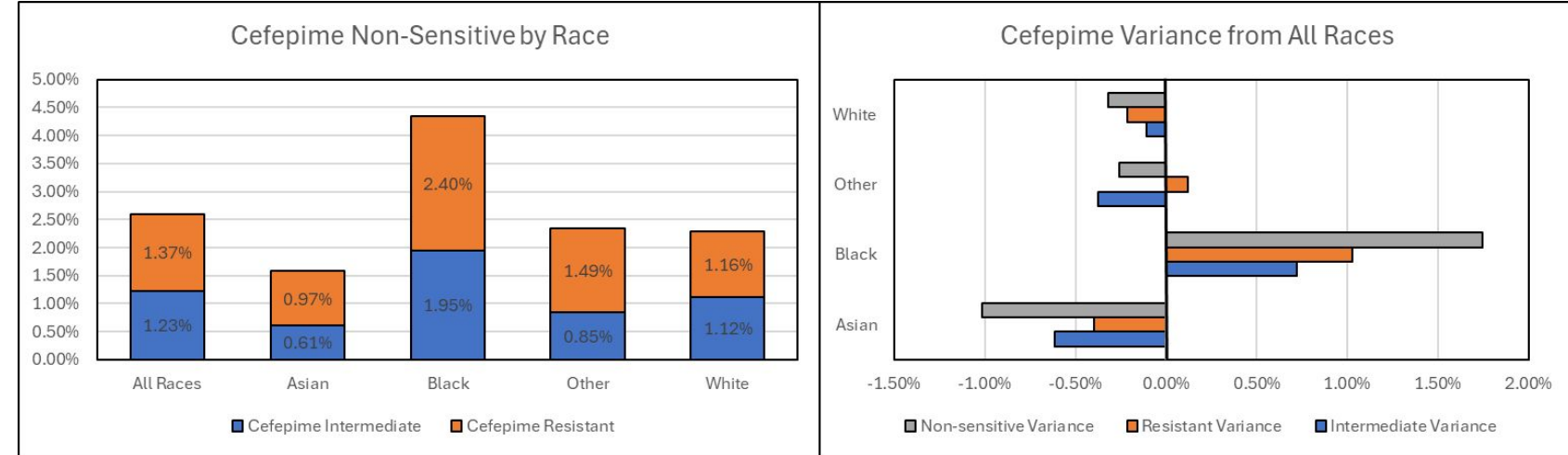


Figure 4A: Association of Race to Piperacillin-Tazobactam Sensitivity

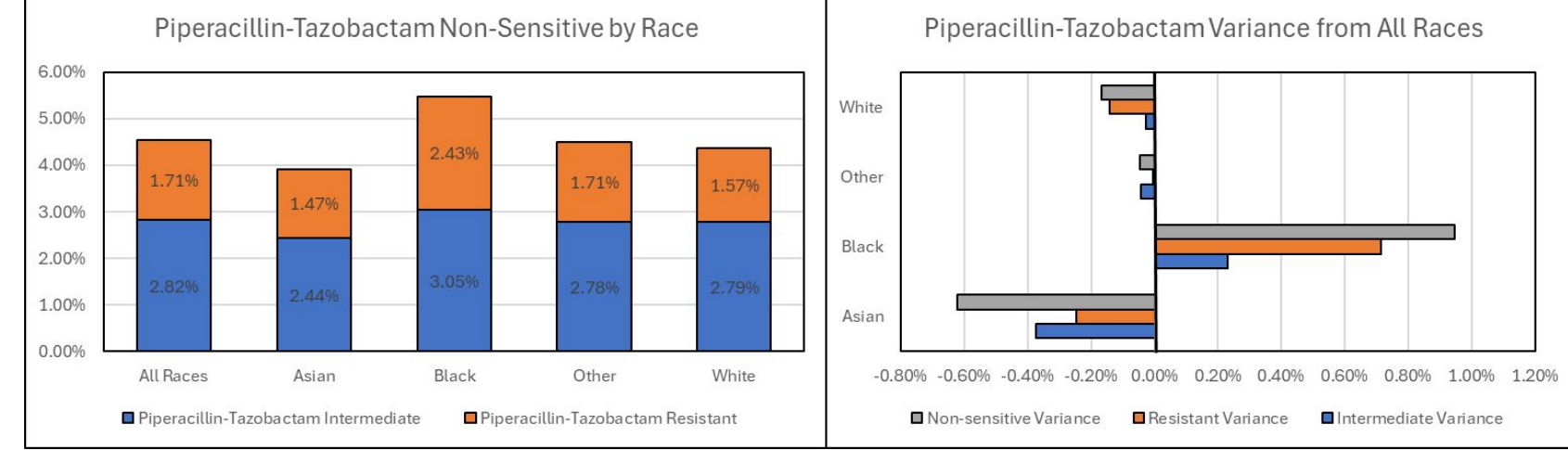


Figure 5A: Association of Race to Meropenem Sensitivity

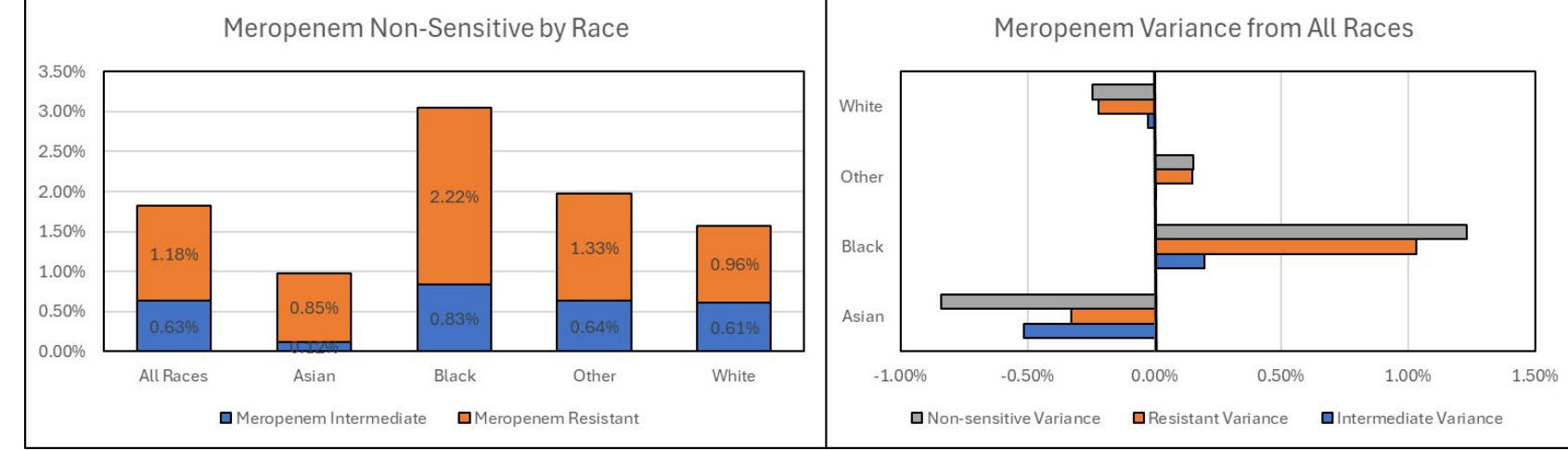


Figure 6A: Association of Race to Ciprofloxacin Sensitivity

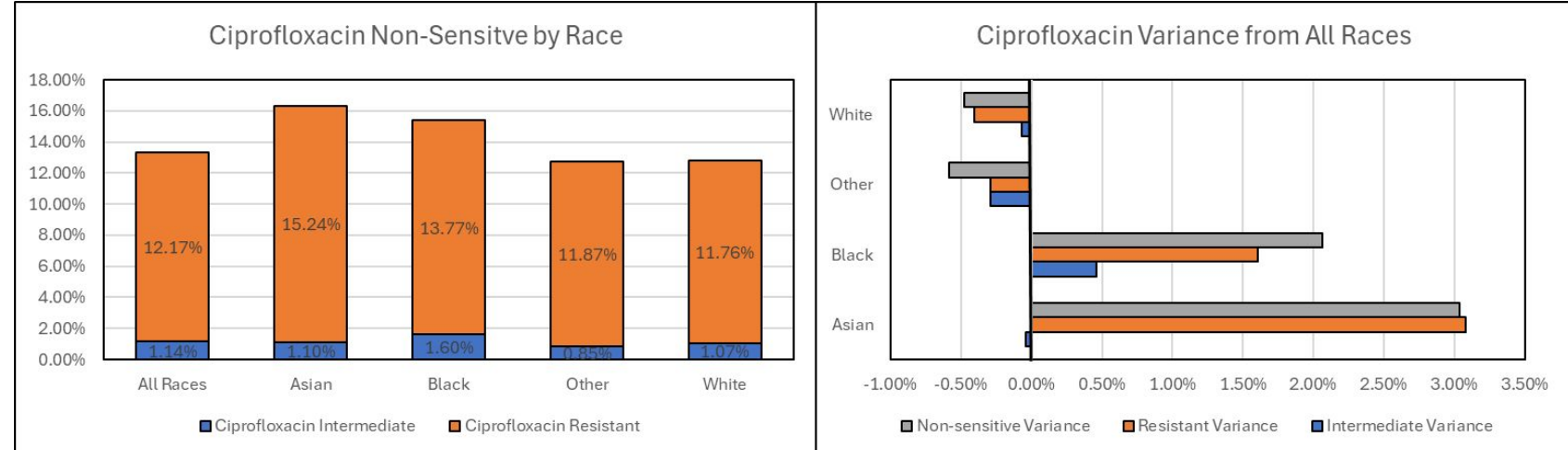


Figure 1B: Association of Ethnicity to Gentamicin Sensitivity

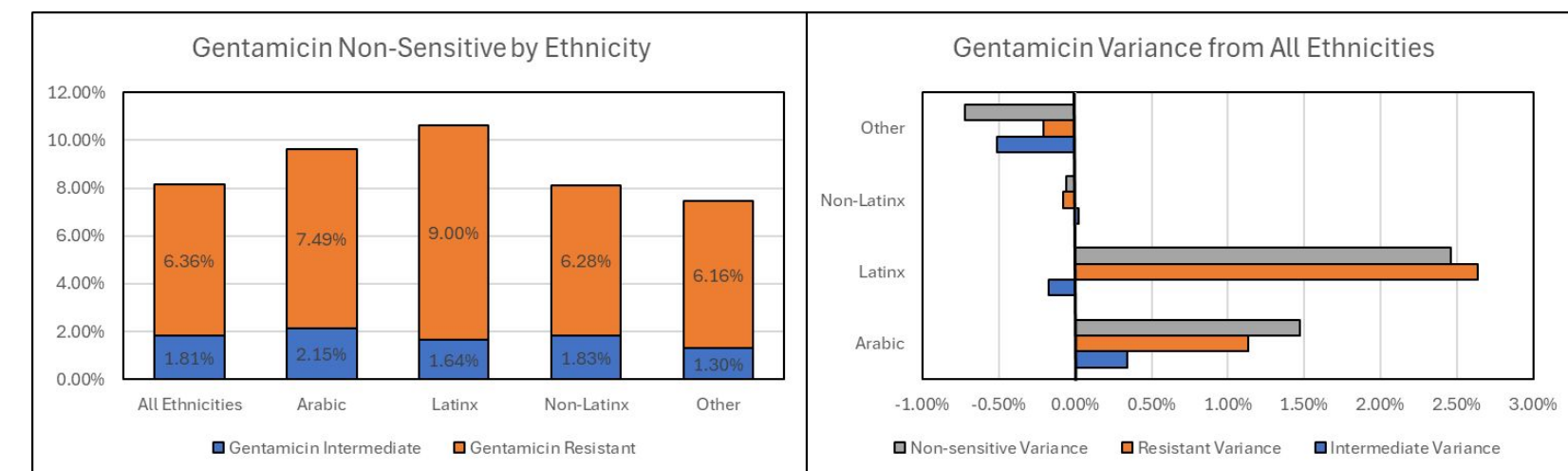


Figure 2B: Association of Ethnicity to Tobramycin Sensitivity

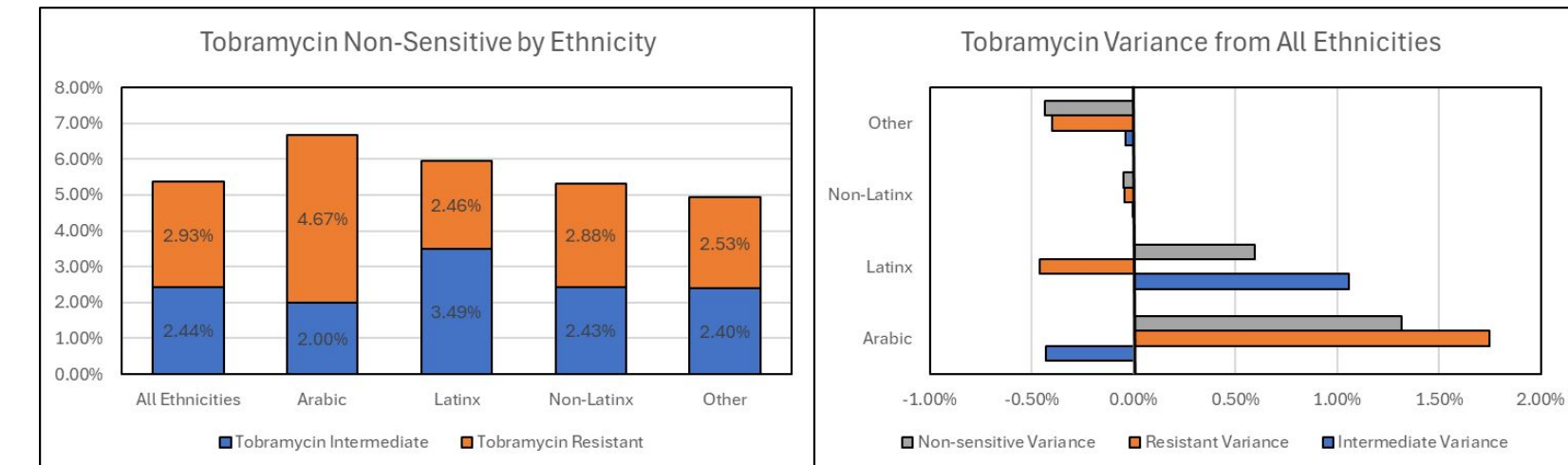


Figure 3B: Association of Ethnicity to Cefepime Sensitivity

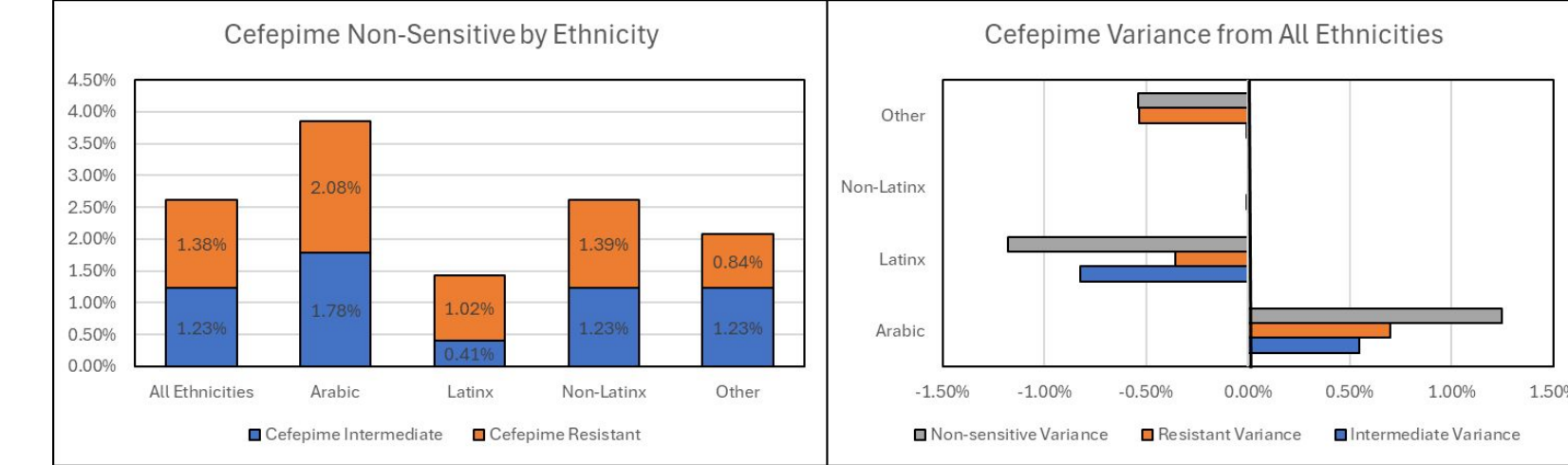


Figure 4B: Association of Ethnicity to Piperacillin-Tazobactam Sensitivity

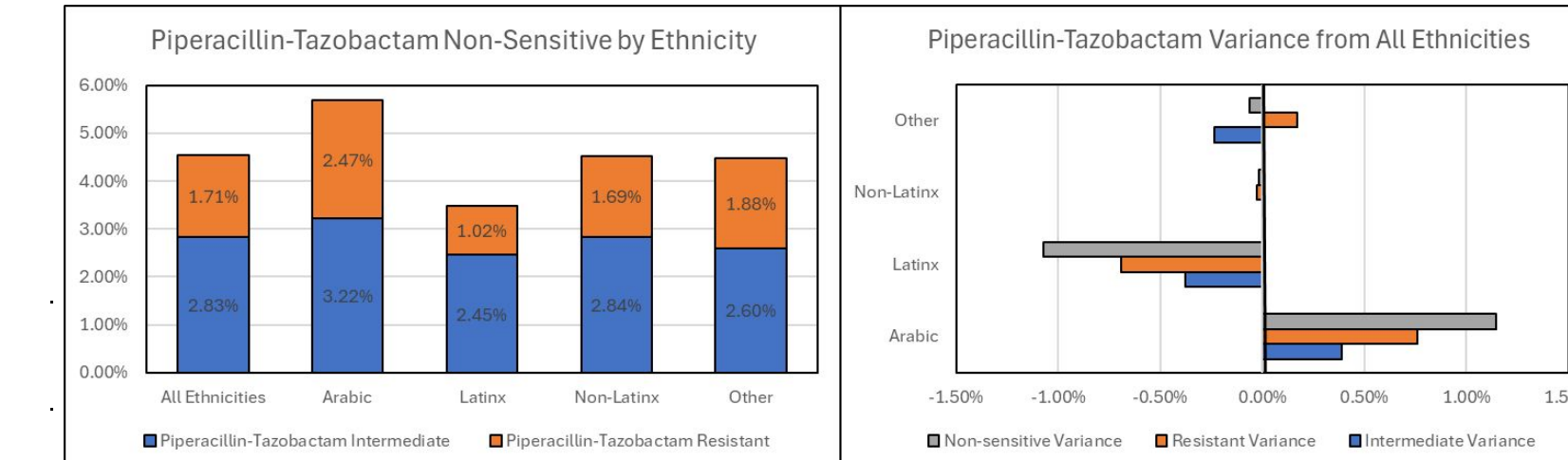


Figure 5B: Association of Ethnicity to Meropenem Sensitivity

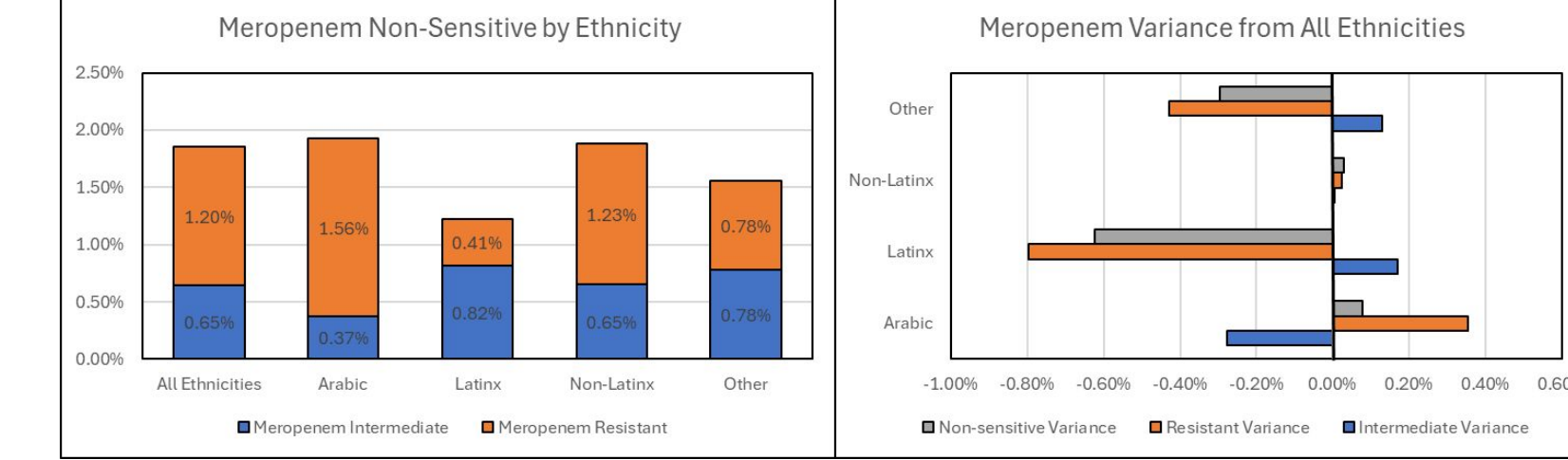
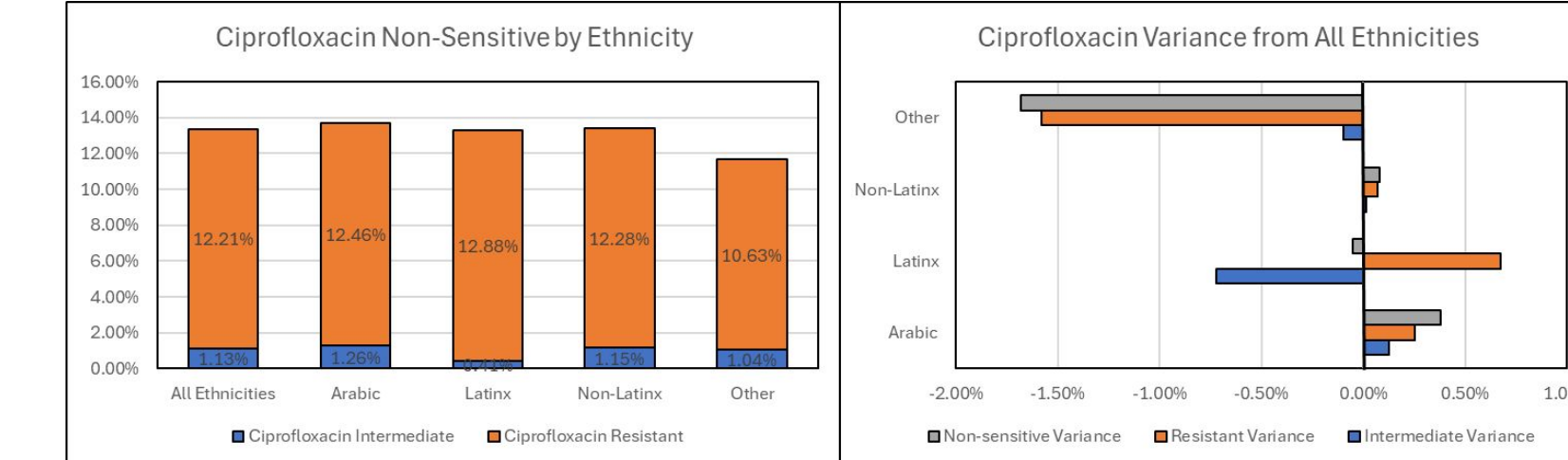
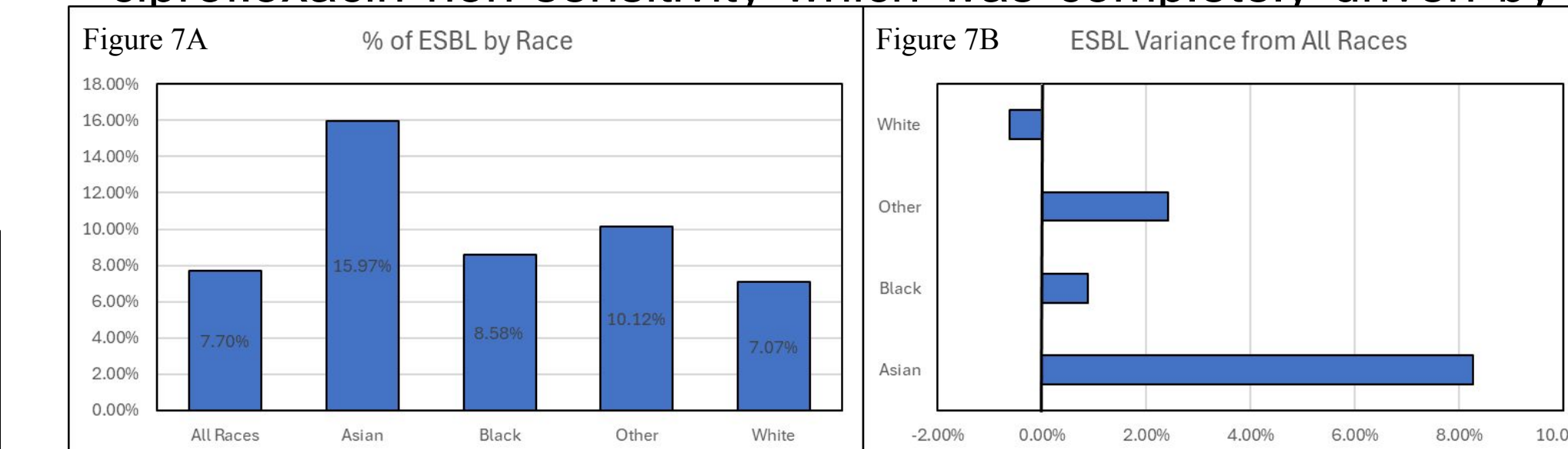


Figure 6B: Association of Ethnicity to Ciprofloxacin Sensitivity



Results

- We identified 36,544 unique, unrelated organisms from 29,836 patients with positive cultures for Gram negative organisms tested in our clinical microbiology laboratory in 2019 for whom data on race was available. Of these 35,599 had ethnicity data also available.
- We analyzed the relative level of resistance and non-sensitivity (resistant + intermediate) to gentamicin, tobramycin, cefepime, piperacillin-tazobactam, meropenem, and ciprofloxacin by race and ethnicity of the patient
- The Black population had significantly higher levels of non-sensitivity to all 6 antibiotics. This was primarily driven by increased resistance in all antibiotics except cefepime which was had increases in both resistant and intermediate isolates.
- The Asian population had was neutral with respect to aminoglycosides though in part this was due to lower levels of resistant isolates being balanced by higher levels of intermediate isolates. The Asian population had lower levels of resistance to the three beta-lactams tested, which is somewhat surprising as Asian race was associated with the highest levels of ESBL producing organisms (Figure 2). Asian race was also associated with the highest levels of ciprofloxacin non-sensitivity which was completely driven by



- The Latinx ethnicity was associated with higher levels of non-sensitivity to the aminoglycosides, lower levels of non-sensitivity to the beta-lactams, and higher resistance but lower intermediate sensitivity to ciprofloxacin.
- The Arabic ethnicity had higher rates of antibiotic resistance for all 6 antibiotics analyzed, often having the highest rates of resistance among all ethnicities

Discussion

- We have demonstrated clear associations between race, ethnicity, and antibiotic resistance.
- It is likely these differences are more related to cultural differences, such as food preferences, rather than biological ones
- This study only includes participants within 3 counties in Southeast Michigan over a single year. Additional studies must be conducted to determine whether these results are generalizable