Predictive Patient-specific Antibiograms Could Improve Precision of Empiric Antibiotic Therapy: A Performance Evaluation in an Academic Health System

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Background

- Empiric treatment for patients with bacteremia or UTI caused by MDROs accurately covers the index pathogen in ~50% of patients[1-3]
- Appropriate empirical antibiotic treatment in septic patients is associated with a significant reduction in all-cause mortality[4]
- An institution antibiogram (ABG) summarizes hospital resistance and incidence of organisms, predicts likelihood of successful antibiotic treatment, and assists clinicians with empiric antibiotic prescribing
- There may be room to improve the accuracy of institution ABGs to inform antibiotic prescribing with inclusion of patient-specific factors
- Patient-specific antibiograms (PS-ABGs) were developed with the University of Pennsylvania Health System (UPHS) using 8 years of clinical data and logistic regression
- Logistic regression factors included inpatient status, prior antibiotic exposure, and prior microbiological susceptibility
- One model was produced for each organism-antibiotic pair in the institution ABG (n=248)

Objective

- Evaluate the performance of predictive patient-specific ABGs against the institutional ABG in an academic health system

Methods

- PS-ABG susceptibilities were calculated for all positive microbiology specimens from 8/2016 to 12/2016 at UPHS
- Exclusion Criteria: (1) PS-ABG organism-antibiotic pairs with n <10; (2) Pairs with institution ABG susceptibilities ≥98% or ≤2%
- The evaluation metric was the Brier score, a measure of error for probabilistic predictions with binary results
- Paired *t*-test was used to compare performance of PS-ABG to institution ABG
- Mean Brier score difference assessed for each organism-antibiotic pair with 95% confidence level

References

1. Linsenmeyer K, et al. *Antimicrob Agents Chemother*. 2015;59(12):7593-7596.
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3. Ortega M, et al. *J Antimicrob Chemother*. 2009;63(3):568-574.
4. Paul M, et al. *Antimicrob Agents Chemother*. 2010;54(11):4851-4863.

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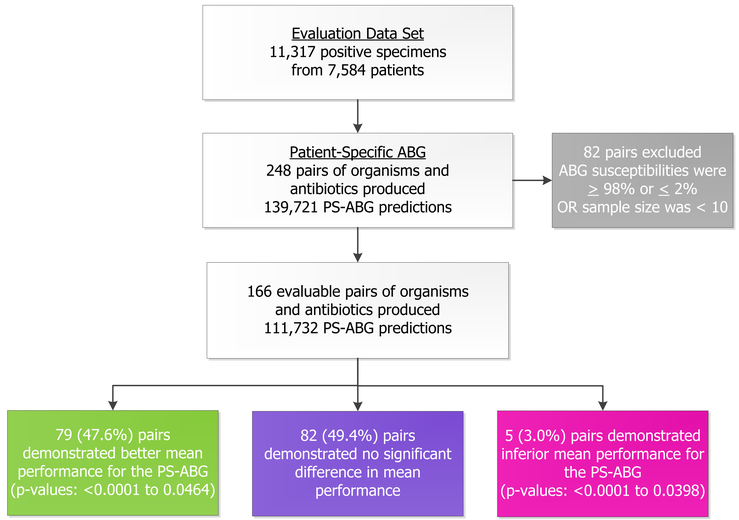
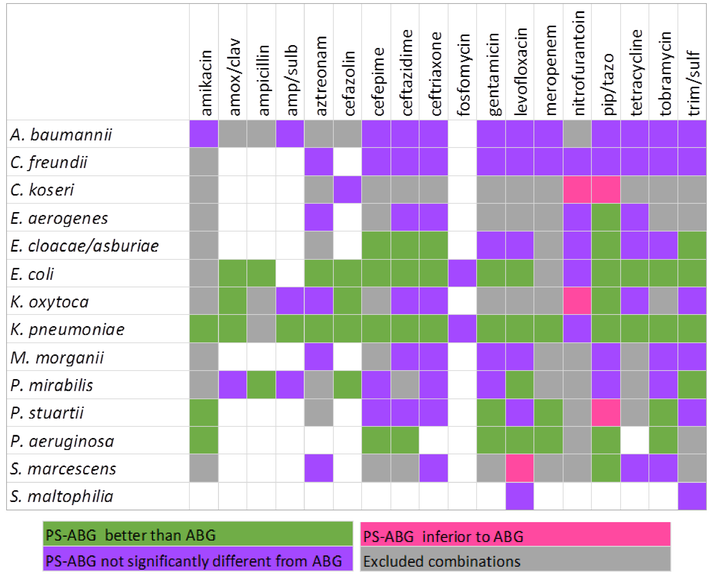
Results

Study Population and Results

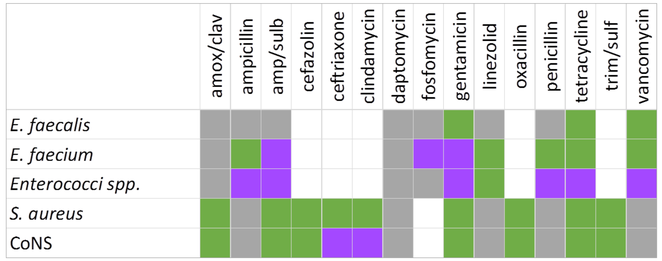


Antibiogram Performance Comparison: Gram Negative

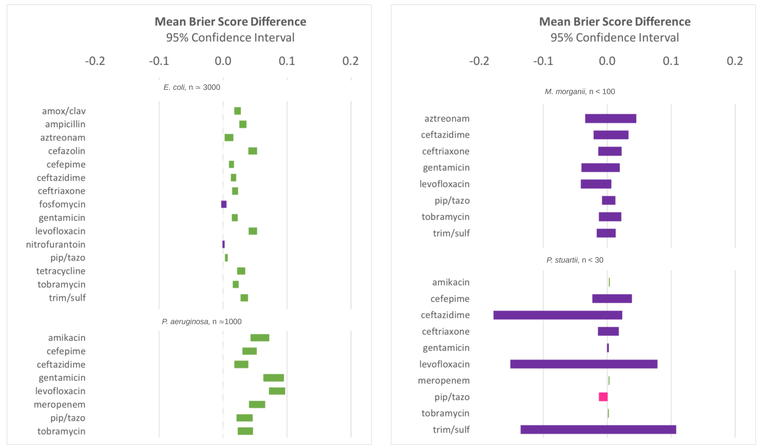


Results (continued)

Antibiogram Performance Comparison: Gram Positive



Antibiogram Performance Comparison: Confidence Intervals with Low/High Sample Sizes



Conclusions

- Incorporation of historic patient data can improve predictions of susceptibility
- Patient-specific ABGs can extend the value of institutional ABGs
- Organism-antibiotic pairs with higher incidence, and therefore more data, generate models with better performance
- Further research is required to evaluate the impact of these predictions on clinical outcomes, the optimal delivery method to clinicians, and generalizability to other settings