Modeling Likelihood of Coverage for Narrow Spectrum Antibiotics in Patients Hospitalized with Urinary Tract Infections

Authors: Courtney Hebert, MD[1], Erinn M. Hade, PhD[1], Protiva Rahman[1], Yuan Gao[1], Mark Lustberg, MD, PhD[1], and Kurt Stevenson, MD[1], Preeti Pancholi, PhD[1]
Institutions: Department of Biomedical Informatics, Department of Internal Medicine, The Ohio State University

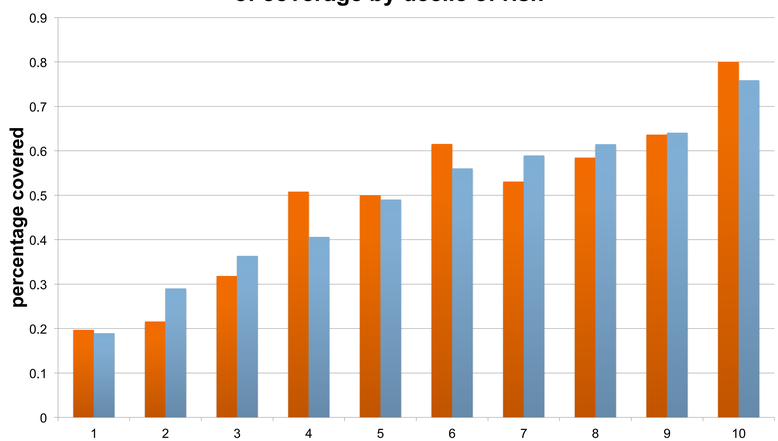
Background

- When prescribing empiric antibiotics, providers try to choose the narrowest spectrum antibiotic that will cover a patient's infection.
- To do this they must assess the likelihood of coverage of different regimens.
- As a test of feasibility, we developed a predictive model for cefazolin/cephalexin coverage for patients admitted to the hospital with urinary tract infections (UTI) to identify a group of patients with a high likelihood of coverage by this first-line, narrow spectrum antibiotic.
- We also investigated how cefazolin/cephalexin treatment would compare to the actual empiric antibiotic treatment given in terms of breadth of coverage and number of antimicrobials given

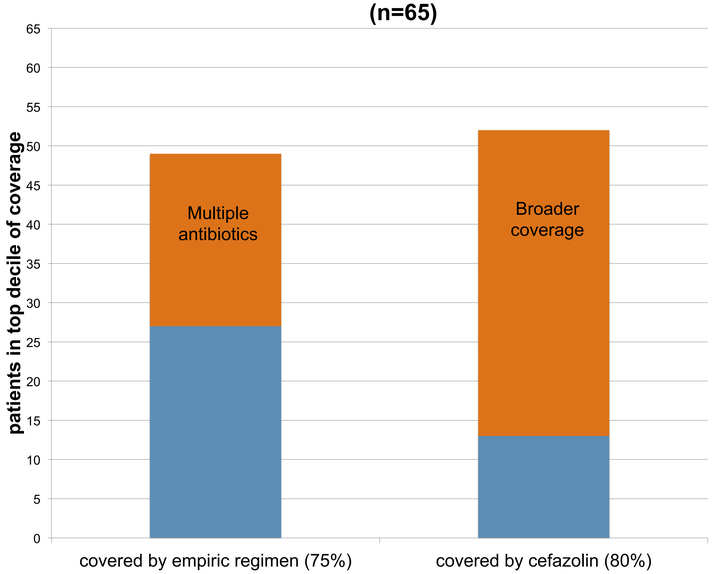
Methods

- Patients admitted from 11/1/11 to 1/1/14 with a positive urine culture in the first 48 hours and a discharge diagnosis of UTI were included.
- Data extracted from our information warehouse included empiric antibiotic administration data, demographics, comorbidities, and past antibiotic use.
- Only the first eligible admission for each patient was included.
- A 20% random sample of patients was selected as the test/ validation set.
- Logistic regression models estimated the predicted probability of cefazolin coverage
- Models were built on the training set using two methods
  - Stepwise variable selection
  - 10 fold cross validation with LASSO penalized logistic regression, with and without interactions included

Comparison of actual % covered to estimated probability of coverage by decile of risk

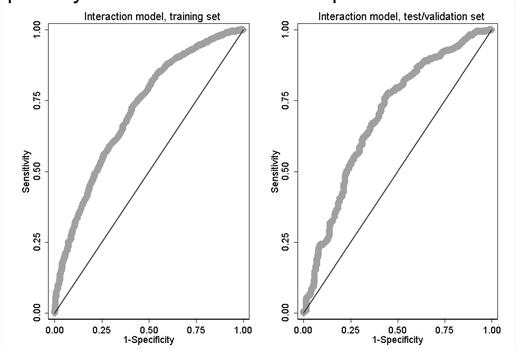


Patients in top decile of probability of cefazolin coverage (n=65)



Results

- 3,456 patients with an eligible UTI were included. 691 were held out for validation. 49% of the UTIs were covered by cefazolin.
- The final stepwise model had an area under the receiver operating curve (AUC) of 69% (95% CI: 67%, 71%) in the training and 70%, (66%, 74%) in the test/validation set.
- The final penalized model (with interaction effects included) had an AUC 72% (70%, 74%) in the training and 70% (66%, 74%) in the test/validation set.
- 80% (52/65) in the highest estimated decile of cefazolin coverage had a UTI that would have been covered by cefazolin; only 13/66 (20%) in the lowest decile would have been covered by cefazolin.
- 49/65 (75%) of patients in the highest decile of cefazolin coverage were covered by the actual empiric regimen given, however 22/49 (45%) of those regimens consisted of multiple antibiotics.
- Of those that would have been covered by cefazolin 39/52(75%) were empirically treated with a broader spectrum antibiotic.



Conclusion

- This preliminary model can reasonably identify patients whose infections would be likely to be covered by cefazolin.
- If this model were used to guide clinical decision making, our analysis suggests that a majority of patients would have been covered by more narrow spectrum antibiotics than what they received.

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