Predicting carbapenem resistance among gram-negative pathogens in complicated urinary tract infections

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Disclosures

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Consulting & Advisory Boards
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Background

- In the US, UTI hospitalizations rose by 50% over the 2000s
  - over 3 million UTI admissions in 2009\(^1\)
- Pathogens\(^2\)
  - Enterobacteriaceae -- common
  - *P. aeruginosa* -- common
  - *A. baumannii* – rare, but often resistant
- Carbapenem resistance (CR) has grown rapidly
  - over 3% of Enterobacteriaceae carbapenem non-susceptible\(^2-4\)
  - CR among PA and AB substantially higher\(^1\)
- Resistance associated with inappropriate empiric therapy (IET)\(^5-6\)
- IET associated with worsened outcomes
Study aim

• To develop and validate a predictive score to be used at the bedside to identify hospitalized patients with complicated UTI (cUTI) who are at risk for a CR pathogen
Methods

- Design: multi-center retrospective cohort
- Population: adult patients admitted to a US hospital with cUTI
- Data source: Premier Research database, years 2009-2016
- Modeling: Split cohort method
  - 60% training
  - 40% validation
  - Limited to \( \leq 10 \) predictors
  - Score weighted to each predictor’s regression coefficient
Definitions

• cUTI defined through an algorithm using ICD-9-CM codes
  – CAUTI analyzed as a subgroup of cUTI
• Appropriate empiric treatment: patient received coverage that
  – Included corresponding organism
  – Within two days of the culture being obtained
• IET: All other regimens
• Predictors: baseline factors, hospital characteristics, processes prior to infection onset
Organisms of interest

- Pseudomonas aeruginosa
- Acinetobacter baumannii
- Stenotrophomonas maltophilia
- Escherichia coli
- Klebsiella pneumoniae
- Klebsiella oxytoca
- Enterobacter cloacae
- Enterobacter aerogenes
- Proteus mirabilis
- Proteus spp.
- Serratia marcescens
- Citrobacter freundii
- Morganella morganii
- Providencia spp.
Results

<table>
<thead>
<tr>
<th></th>
<th>CR</th>
<th>CS</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>64.1 (17.9)</td>
<td>64.0 (18.7)</td>
<td>0.86</td>
</tr>
<tr>
<td>Mean Charlson</td>
<td>2.9 (2.2)</td>
<td>2.3 (2.2)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

cUTI N=25,285, 92% CO

- CR 13.2% 18.1% 8.7% 36.3% 63.0% 76.0% 50.3% 11.8%
- CS  7.6% 10.5% 5.5% 35.5% 44.0% 46.8% 26.1% 0.9%
Model and prediction score

- **C-statistic**
  - Training 0.746
  - Validation 0.721
- **Performed better among hospitals with lower prevalence of CR**
  - tertile 1 – 0.752 [CR prevalence 2.1%]
  - tertile 2 – 0.725 [CR prevalence 4.7%]
  - tertile 3 – 0.703 [CR prevalence 9.2%]

NPV is high (99%) for score \(<3\)
Conclusions

• CR is prevalent in 5% of hospitalized patients with cUTI
• Our simple bedside score was able to identify cUTI patients at low risk for CR
• Using our score may help reduce overuse of broad-spectrum antibiotics in patients with cUTI
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References