Prediction of the Microbial Origin of Presumed Sepsis in PICU Encounters

Joseph Boen1, Shiker Nair1, Hao Tong1, Jason Werenski1
Luis Ahumada2, Jules Bergmann2, James Fackler2, Joseph Greenstein1, Casey Overby Taylor1

1 Department of Biomedical Engineering, Johns Hopkins University Whiting School of Engineering, Baltimore, Maryland, USA
2 Department of Anesthesiology and Critical Care Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Introduction & Background

- Sepsis is an extreme bodily reaction caused from an infection, accounts for ~30% of all hospital mortality.
- Standard treatment is broad-spectrum antibiotics, however, 50% of all sepsis cases are not bacterial in origin, leading to antibiotic overuse.

Objective

To build statistical models for predicting the microbial origin of presumed sepsis in PICU patients by using physiological time series data.

Methods

- Patient data from the JHU ACCM PMAP Database.
- Include if unstable temperature (≤36°C or ≥38.5°C)
- Include if physiological time series (heart rate, blood pressure, respiratory rate, blood oxygenation) present.
- Patient labels: Bacterial (n = 99) if positive blood test, Non-Bacterial (n = 642) if negative blood test, Not Infected (n = 1,187) if no test is taken.

Results

<table>
<thead>
<tr>
<th>Rank</th>
<th>Class 0</th>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NIBP Minimum 6</td>
<td>HR Std 9</td>
<td>HR Std 10</td>
</tr>
<tr>
<td>2</td>
<td>HR Mean 10</td>
<td>HR Std 10</td>
<td>RR Mean 5</td>
</tr>
<tr>
<td>3</td>
<td>RR Mean 10</td>
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<td>4</td>
<td>RR Minimum 7</td>
<td>RR Mean 7</td>
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<tr>
<td>5</td>
<td>RR Minimum 5</td>
<td>HR Std 7</td>
<td>RR Mean 10</td>
</tr>
</tbody>
</table>

Table 1. Top five features for each One Vs. Rest Random Forest classifier calculated across 10-folds. Top features are presented by signal name, metric, and hour before temperature instability. NIBP = non-invasive blood pressure, HR = heart rate, RR = respiratory rate.

Discussion & Conclusion

- Based on the ROC curves and PR curves, our model showed promising predictive power for differentiating infections.
- Heart rate and respiratory rate derived features were the top features in predicting the source of infection.
- Future work will be focused on the extraction of additional clinical features from physiological signals and model refinement.