Sepsis predictive model roll out for providers
How we approach Sepsis Improvement

Monitor  Alert  Treat  Measure
Sepsis Predictive model

• Epic built tool that uses Lasso penalized logistic regression function to predict risk of sepsis

• The model uses 68 variables in following categories
  • Demographics
  • Vitals- temp, RR, HR, NOT BP
  • Recent lab results (last 24 hrs)
  • Counts of medication orders
  • Comorbidities- from Problem List and Past Medical History
  • Active lines/ drains/ airways as documented
Performance of Risk Scores for predicting In-Hospital Mortality

<table>
<thead>
<tr>
<th>Risk Score</th>
<th>Area Under the Curve (AUC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPIC PREDICTIVE MODEL*</td>
<td>0.76</td>
</tr>
<tr>
<td>NEWS</td>
<td>0.77</td>
</tr>
<tr>
<td>MEWS</td>
<td>0.74</td>
</tr>
<tr>
<td>QSOFA</td>
<td>0.69</td>
</tr>
<tr>
<td>SIRS</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Churpek et al. (2017) non-ICU patients, n=30,677
*Epic Model White Paper, AUC 0.76 - 0.83, 500,000+ encounters
Sepsis model results from UMMHC data

Adjusted Predictive model based on UMMHC data produced ROC curve with AUC of 0.952.

UMMHC has decided to select model cutoff threshold of 0.07
Sepsis model results from UMMHC data

Model's performance based on the cutoff threshold of 0.07

<table>
<thead>
<tr>
<th>Confusion Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted Outcome</td>
</tr>
<tr>
<td>True</td>
</tr>
<tr>
<td>True</td>
</tr>
<tr>
<td>False</td>
</tr>
</tbody>
</table>

What does this mean?

**Performance Measures**

- **Accuracy**: The number of patients correctly identified divided by the total number of patients.
  - 0.950
- **True Positive Rate**: The number of patients that had sepsis and a risk greater than the threshold / total number of patients with sepsis. Higher is better.
  - 0.803
- **False Positive Rate**: The number of patients who did not have sepsis and had a risk above the threshold / total number of patients who did not have sepsis. Lower is better.
  - 0.047
- **Positive Predictive Value**: The number of patients that had sepsis and a risk greater than the threshold / total number of patients with a risk above the threshold. Higher is better.
  - 0.239
- **Negative Predictive Value**: The number of patients who did not have sepsis with a risk lower than the threshold / total number of patients with a risk lower than the threshold. Higher is better.
  - 0.996
- **C-Statistic**: Also known as AUC, this is the area under the ROC curve. A C-statistic of 0.5 is no better than chance, while a C-statistic of 1.0 represents perfect accuracy.
  - 0.952

Additional info: Specificity - 0.953
Implications of the Sepsis score of 7 or greater for nurses and care providers

• This is a predictive score. Higher the score, greater is the probability of a patient having sepsis.

**With the current threshold of 7-**

• We can miss 20 % of sepsis cases, so clinical judgement is very important.

• When the model fires, there is 75% chance that this may not be true sepsis. Again, clinical judgement is still very important.

• When the model does not fire, it is reassuring that the patient may not be in sepsis but does not completely rule out sepsis.

• Remember- If the patient looks septic, think of sepsis even if the probability score is less than 7.
How can care providers access patient’s sepsis risk predictive score?

• Through PatientList as a PatientList column
• Through Summary Overview- sepsis – (for score trend)
• Through BPA’s
PatientList
Score Trend - Summary/Overview/ Sepsis
Sent to PCAs, Nurses, MD/AP
PCA alert- Acknowledgement suppresses alert for 12 hrs
SEPSIS ALERT: Patient has an increased chance of sepsis and sepsis is not on the hospital problem list. Please notify the provider.

Current Risk of Sepsis
Predictive Model Details
4
Factors Contributing to Score
17% Number of active cephalosporin orders is 2
15% Age is 67
15% Number of incisions is 2
11% Diagnosis of hypertension is present
7% Diagnosis of diabetes mellitus is present
7% Diagnosis of chronic kidney disease is present
5% Diagnosis of HIV is present
4% Diagnosis of chronic liver disease is present

Vitals
Recent Patient Data
7/13/2018 1300
Pulse: 111 (Abnormal)
Temp: 39.4 °C (103 °F) (Abnormal)
Resp: 25 (Abnormal)

Current Antibiotics
• penicillin G benzathine

MOST RECENT LAB RESULT WITHIN 72 HOURS
No results found for: WBC, PLT, INR, LACTICACID, TROPONINI, CREATININE, ALKPHOS, AST, ALT

Acknowledge Reason
Provider has been/will be notified
Provider BPA features

Will not fire for patients on CMO

Will not fire for 36 hours post op

Will not fire if sepsis/ severe sepsis/ septic shock on problem list

Shuts off for 24 hours if select treating separate illness or already started treatment

Dismiss shuts off alert for 2 hours, you may consider using this option if you want to get labs back before deciding on diagnosis.

Only fires on opening the chart but is score is visible on patient list if wrenched in
Proposed Sepsis Workflow Overview

PCA alert → Nurse alert → MD/AP alert → Sepsis intervention → Monitoring

Sepsis Data feed to the system

Time zero

Nurse Eval Documentation

MD/ AP Eval documentation

Time
Thank You