Making ‘Meaningful Use’ more meaningful

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From 2008 to 2014, hospitals with EHRs rose to 75% from 9%, and in doctors’ offices rose to 51% from 17%.
$32+ billion effort went into digitization. Benefits?

Sutherland, a family physician in Tennessee, made the shift to computerized patient records from paper in the last few years. There are benefits to using electronic health records, Dr. Sutherland says, but grappling with the software and new reporting requirements has slowed him down. He sees fewer patients, and his income has slipped.
Example: Septicemia is the 11th leading cause of death in the US

3.9 times higher mortality rate
2.4 times longer mean Length of Stay (LOS)
2.7 times higher mean cost

SEPSIS CLAIMS

“The Greatest”
We mourn Mohammad Ali
1942 - 2016

Image credit: The Rory Staunton Foundation
Mortality and length of stay decreased with timely treatment [Kumar et al. 2011].

For every hour that antibiotic treatments were delayed, risk of mortality went up by 7-8%.

Can we detect those at risk of this adverse event early?
Surprising finding: Using routinely collected data, the majority of patients were identified as high risk a median time of 25 hours prior to shock onset.

Mortality and length of stay decreased with timely treatment [Kumar et al. 2011]. For every hour that antibiotic treatments were delayed, risk of mortality went up by 7.6%.
Scleroderma - an example

- Systemic autoimmune disease
  Main symptom: **skin** fibrosis
  Affects **many visceral organs**—lungs, heart, GI tract, kidney, vasculature, and muscles
  Affects 300K individuals; 80 other autoimmune diseases — lupus, multiple sclerosis, diabetes, Crohn’s — many of which are systemic & highly multiphenotypic.
Individualize Prognosis of Disease Activity Trajectory. Why?

- Will this individual continue to decline?
- Should we administer immunosuppressants, which can be toxic?
Models for Individualizing Prognoses

Lung

Skin

Vasculature

Schulam, Wigley, Saria, AAAI 2015
Schulam, Saria, NIPS 2015
Schulam, Saria. JMLR 2016
Models for Individualizing Prognoses

<table>
<thead>
<tr>
<th>Model / Years of Data</th>
<th>1</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Spline+GP</td>
<td>0.59</td>
<td>0.63</td>
<td>0.74</td>
</tr>
<tr>
<td>PwoC</td>
<td>0.57</td>
<td>0.71</td>
<td>0.84</td>
</tr>
<tr>
<td>Proposed</td>
<td>0.68</td>
<td>0.75</td>
<td>0.87</td>
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</tbody>
</table>

(a) AUCs for detecting declining individuals.

(b) ROCs comparing B-spline GP at 1 year, PwoC at 1 year, and proposed model at years 1, 2, and 4.
Physiologic Signals: Collected but Dropped after 48 hours

Heart Rate
Respiratory Rate
Oxygen Saturation
Physiologic Signals: Collected but Dropped after 48 hours
**Physiscore: Automated, Accurate Risk Assessment in Newborns**

- Identifies premature infants at risk for major complications
- Useful for resource allocation, managing infant transport, staffing-ratio

<table>
<thead>
<tr>
<th></th>
<th>APGAR (Standard of care)</th>
<th>CRIB</th>
<th>SNAP-II</th>
<th>SNAPPE-II</th>
<th>Physiscore (Our tool)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time from birth</strong></td>
<td>5 mins</td>
<td>12 hours</td>
<td>12 hours</td>
<td>12 hours</td>
<td>3 hours after birth</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>0.69</td>
<td>0.85</td>
<td>0.82</td>
<td>0.87</td>
<td>0.91</td>
</tr>
<tr>
<td><strong>Invasive testing</strong></td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>
Measurement that is **Non-invasive, Low cost, Instrumented on existing device for risk stratification.**
Discussion

• What infrastructure do we need so that we can put these data to use for patients?

• How can we enable more rapid innovation w/ EHRs?
Thank you!
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