Journal Club / Research Article Summary - (Adapted from Schultz Table)

Date: 1/19/2011
Presenter: Liisa Carden, MD

ARTICLE: The PESI Score


• Country: Derivation and internal validation from 186 Pennsylvania hospitals. External validation from hospitals in Switzerland and France.

• Funding Sources: a grant from the National Heart, Lung, and Blood Institute and the Swiss Foundation in Medicine and Biology and the Swiss Medical Association

PURPOSE:

• Research Question(s)/Goal:
  Develop a clinical prediction rule to classify patients with PE into categories of increasing risk of mortality and other adverse medical outcomes to help potentially facilitate disposition.

DESIGN:

• Study Design:
  They chose patients across about a 3 year period (1/2000-11/2002) diagnosed with PE (or a primary diagnosis representing a complication of PE, such as respiratory failure, cardiogenic shock, syncope, etc) from a large database in Pennsylvania (including 186 hospitals). This amounted to 15,531 patients. They then randomized 10,354 (67%) of these patients to a derivation sample, and the remaining 5,177 (33%) of them to an internal validation sample to retrospectively test their predictive rule on. Also, they form an external validation sample, which is smaller and consists of 221 inpatients diagnosed with PE in 2 university hospitals in Switzerland and 1 in France, from which they prospectively attempt to validate their prediction rule.

• Dependent / outcome Variable(s):
  Primary outcome is 30-day mortality
  Secondary outcomes: recurrent venous thromboembolism, major bleeding, cardiogenic shock or cardiac arrest.

SETTING / SUBJECTS:

• Research Setting:
This is all essentially retrospective data collected from the USA and prospective data collected by phone calls, chart review, patient interviews in Switzerland and France.

- **Subjects:**
  - **Study population:**

Table 1 allows you to compare the patient characteristics of their derivation sample and 2 validation samples. They are similar with the exception of the external validation sample which you can see has fewer really sick patients, with comorbidities of lung dz, ckd, previous cva, or clinical findings that would indicate increased disease severity; such as pulse, bp, rr, loc.

- **Inclusion / Exclusion criteria:**
  Derivation sample and Internal Validation sample: Inpatients 18 years or older with ICD-9 code diagnoses of PE or a secondary complication of PE.
  External Validation sample: patients diagnosed with PE by spiral CT. Patients who had a contraindication to CT or patients who were severely ill were excluded.

### METHODS:

- **Instruments:**

They derived their prediction rule using logistic regression with 30-day mortality as the primary outcome and various clinical variables as predictors. See Table 2 for predictors. Then on the basis of the beta-coefficients of the model, they generated a point score dividing patients into five risk classes for 30-day mortality. See Table 3.

They do mention that they considered the addition of laboratory variables as predictors, and that the addition of them did provide a higher discriminatory power to the rule, but apparently thought the addition made the rule more complex without changing the Risk Class Distributions, so vetoed them.

### DATA ANALYSIS:

- **Level of Data:** Categorical
- **Statistics Used:**
  Detailed description on page 1042.

They compared their derivation sample with each validation sample using logistic regression with a robust variance estimator or exact X-squared tests. They also used the area under the receiver operating characteristic curves of the prediction rule to assess the discriminatory power of their predictive rule.

### RESULTS:

- **Brief answers to research questions:**

Table 4

Using 11 clinical predictors from the patients’ history and physical exam, they were able to classify patients into 5 risk classes of increasing risk of 30-day mortality or other adverse medical outcome. In all 3 samples the risk of mortality does increase with
increasing class number. There is only prospective data on the primary outcome of 30-day mortality.

TABLE 2. Independent predictors of 30-DAY mortality in the derivation sample and points assigned to the risk score

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Beta Coefficient of association with 30 day mortality</th>
<th>Points Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic characteristics</td>
<td></td>
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</tr>
<tr>
<td>Age, per yr</td>
<td>0.03 (0.02–0.03)</td>
<td>Age, in yr</td>
</tr>
<tr>
<td>Male sex</td>
<td>0.17 (0.02–0.32)</td>
<td>+10</td>
</tr>
<tr>
<td>Comorbid illnesses</td>
<td></td>
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<tr>
<td>Cancer</td>
<td>0.87 (0.71–1.03)</td>
<td>+30</td>
</tr>
<tr>
<td>Heart failure</td>
<td>0.31 (0.14–0.49)</td>
<td>+10</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>0.30 (0.12–0.47)</td>
<td>+10</td>
</tr>
<tr>
<td>Clinical findings</td>
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<tr>
<td>Pulse 110/min</td>
<td>0.60 (0.44–0.76)</td>
<td>+20</td>
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<tr>
<td>Systolic blood pressure &lt; 100 mm Hg</td>
<td>0.86 (0.67–1.04)</td>
<td>+30</td>
</tr>
<tr>
<td>Respiratory rate 30/min</td>
<td>0.41 (0.23–0.58)</td>
<td>+20</td>
</tr>
<tr>
<td>Temperature &lt; 36°F</td>
<td>0.42 (0.25–0.59)</td>
<td>+20</td>
</tr>
<tr>
<td>Altered mental status*</td>
<td>1.50 (1.30–1.69)</td>
<td>+60</td>
</tr>
<tr>
<td>Arterial oxygen saturation &lt; 90%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk Classes
- <=65 class I, very low risk
- 66–85 class II, low risk
- 86–105 class III, intermediate risk
- 106–125 class IV, high risk
- 125 class V, very high risk
30-day mortality rates across the derivation and validation samples:

- 0-1.6% in class I
- 1.7-3.5% in class II
- 3.2-7.1% in class III
- 4.0-11.4% in class IV
- 10.0-24.5% in class V

Patients in the external validation sample had a lower prevalence of most comorbid illnesses and fewer abnormal findings on physical exam compared with the other 2 groups. This weakens the power of their rule in the higher risk “classes”, III-V, as evident in the relatively wide 95% confidence interval of mostly class 4 + 5, but also somewhat class 1-3.

- Limitations?:
  Selection bias secondary to hospital coding procedures – given that they selected patients using ICD9 codes.
  Fewer severely ill patients in the external validation sample with notably lower overall mortality.

IMPLICATIONS FOR PRACTICE:

- Applicable to this clinical practice:
  I think that the authors are reasonable when they state “our rule is intended to supplement, not replace, clinical judgment.”

There needs to be further prospective data to validate this rule before it is implemented into practice.

- Feasibility (cost, resources, etc): Easily implemented.

- Clinically Relevant: Yes

LEVEL OF EVIDENCE / DECISION FOR USE:

- Background  Consider Replication  Ready for use

- Level of Evidence:
  IIb  Evidence obtained from at least one other type of well-designed quasi-experimental study