Risk Prediction Scores

- Huge degree of variability in perioperative risk
- Raw outcome measures poor markers of quality
- Scores developed for risk prediction; also used for risk adjustment for outcome measures
- Now widely used in public reporting of risk-adjusted outcomes (SCTS, New York State, others)
- 40 year-old
- Mitral regurgitation
- No other medical issues
- Normal LV function

- 85 year-old
- Aortic stenosis
- Previous CAG
- Moderate LV dysfunction
Risk Prediction Scores

- Huge degree of variability in perioperative risk
- Raw outcome measures poor markers of quality
- Scores developed for risk prediction; also used for risk adjustment for outcome measures
- Now widely used in public reporting of risk-adjusted outcomes (SCTS, New York State, others)
Risk Prediction Scores

• Early — Parsonnet, Cleveland Clinic, French, Pons, Ontario

• EuroSCORE (I and II)

• STS Predicted Risk Calculator

• Others — TuScore, AusScore
# Early Scoring Systems

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Type</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parsonnet</td>
<td>1989</td>
<td>Single centre, retrospective</td>
<td>3,500</td>
</tr>
<tr>
<td>Cleveland Clinic</td>
<td>1992</td>
<td>Single centre, retrospective</td>
<td>5,051</td>
</tr>
<tr>
<td>French</td>
<td>1995</td>
<td>Multi-centre, prospective</td>
<td>7,181</td>
</tr>
<tr>
<td>Pons</td>
<td>1996</td>
<td>Multi-centre, prospective</td>
<td>916</td>
</tr>
<tr>
<td>Ontario</td>
<td>1995</td>
<td>Multi-centre, retrospective</td>
<td>6,213</td>
</tr>
</tbody>
</table>
European system for cardiac operative risk evaluation (EuroSCORE)†

S.A.M. Nashef*, F. Roques, P. Michel, E. Gauducheau, S. Lemeshow, R. Salamon, the EuroSCORE study group

Papworth Hospital, Cambridge CB3 8RE, UK

Received 21 September 1998; accepted 29 March 1999
EuroSCORE

• European System for Cardiac Operative Risk Evaluation

• Developed from data set of 13,302 patients September to December 1995; validated in 1,479

• Initially additive:
  0–2 Low risk
  3–5 Medium risk
  6+ High risk

• Logistic score 2003

• Online calculator available at http://www.euroscore.org/calcold.html
EuroSCORE

Patient Factors
• Age
• Sex
• COPD
• PVD
• Neurological dysfunction
• Previous cardiac surgery
• Renal impairment
• Active endocarditis
• Critical preoperative state

Cardiac Factors
• Unstable angina
• LV dysfunction
• Recent MI
• Pulmonary hypertension

Procedural Factors
• Emergency
• Non-isolated CABG
• Thoracic aortic surgery
• Post-infarct VSD
EuroSCORE II

- Recognition that EuroSCORE overestimates risk
- Updated model, presented at EACTS meeting 2011
- 22,381 patients, May to July 2010; validated in 5,553 patients
- Adds ‘poor mobility’ & insulin-dependent diabetes, as well as more detail on functional status (NYHA & CCS classes)
Limitations

- Risk factors determined by multivariate analysis
- Predominantly isolated coronary artery surgery
- Rare factors not incorporated into models but may represent significant increase in perioperative risk
- Multiple reoperations
- Liver dysfunction, coagulopathy
- Right ventricular dysfunction
- Weight (over or under)
- Arrhythmias
- Predicts mortality only, not morbidity
STS Score

- Society of Thoracic Surgeons Adult Cardiac Surgery Database

- Derived from data for patients undergoing surgery between 1 Jan 2002 and 31 Dec 2006 (60% development, 40% validation):
  - 774,881 isolated CAG procedures
  - 109,759 isolated valve procedures
  - 101,661 combined CAG & valve procedures

- Data used to determine risk of mortality, plus 5 morbidity outcomes (stroke, renal failure, reoperation, DSWI, prolonged ventilation) and prolonged length of stay

- Online calculator at http://riskcalc.sts.org
<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>CAB Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV Replacement</td>
<td></td>
</tr>
<tr>
<td>MV Replacement Only</td>
<td></td>
</tr>
<tr>
<td>MV Repair</td>
<td></td>
</tr>
<tr>
<td>AV Replacement + CAB</td>
<td></td>
</tr>
<tr>
<td>MV Replacement + CAB</td>
<td></td>
</tr>
<tr>
<td>MV Repair + CAB</td>
<td></td>
</tr>
</tbody>
</table>

**Risk Scores**

- Procedure: CAB Only
- Risk of Mortality: 0.781%
- Morbidity or Mortality: 8.79%
- Long Length of Stay: 3.213%
- Short Length of Stay: 56.242%
- Permanent Stroke: 1.102%
- Prolonged Ventilation: 5.715%
- DSW Infection: 0.322%
- Renal Failure: 0.885%
- Reoperation: 3.455%

**Patient Age**

- 70

**Sex**

- Male
- Female

**Height (cm)**

- 175
# STS Score

<table>
<thead>
<tr>
<th>Patient Factors</th>
<th>Cardiac Factors</th>
<th>Procedural Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Heart failure</td>
<td>Non-elective</td>
</tr>
<tr>
<td>Sex</td>
<td>Unstable angina or MI</td>
<td>Reoperative status</td>
</tr>
<tr>
<td>Race</td>
<td>Arrhythmia</td>
<td></td>
</tr>
<tr>
<td>Height, weight</td>
<td>Valvular disease</td>
<td></td>
</tr>
<tr>
<td>Renal failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunosuppression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endocarditis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical preoperative state</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Limitations

- Only predicts outcomes for certain procedures:
  - Isolated CAG
  - Isolated AVR
  - Isolated MVR
  - Isolated MV repair
  - CAG & AVR
  - CAG & MVR
  - CAG & MV repair

- Omits certain factors (liver dysfunction, coagulopathy, RV dysfunction, pulmonary hypertension)

- More complex
An Australian risk prediction model for 30-day mortality after isolated coronary artery bypass: The AusSCORE

Christopher Reid, PhD,^a^ Baki Billah, PhD,^a^ Diem Dinh, PhD,^a^ Julian Smith, MBBS,^b^ Peter Skillington, MBBS,^c^ Michael Yii, MBBS,^d^ Seven Seevanayagam, MBBS,^e^ Morteza Mohajeri, MBBS,^f^ and Gil Shardey, MBBS^b^

The Journal of Thoracic and Cardiovascular Surgery • October 2009
Case Example

- 60 year-old man
- Previous CAG, patent LIMA to LAD, occluded native coronary arteries, LVEF 18%, dual-chamber AICD in situ
- Reoperative MVR September 2014 with mechanical prosthesis
- Prosthetic valve endocarditis with *S. epidermidis* April 2015
- Now referred for redo MVR for severe paravalvular leak with recurrent heart failure on maximal therapy, with worsening renal failure (Cr 350)
- What is his risk?
Case Example

- EuroSCORE II: 60.98%
- STS: 27.05%