An empirical comparison of methods for meta-analysis of studies of diagnostic accuracy

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Outline

- Methods to be compared
- Nine example diagnostic meta-analyses
- Results
- Summary
Methods to compare

1. Separate random-effects meta-analysis of logit-transformed sensitivity and specificity, using:
   a) Empirical logit-transforms  
      Stata: meta
   b) Random-effects logistic regression  
      Stata: xtlogit

2. SROC curve by linear regression (Moses-Littenberg method)  
   SAS: NLMIXED

3. Bivariate

4. HSROC
# 9 example meta-analyses

<table>
<thead>
<tr>
<th>Test</th>
<th>Target Condition</th>
<th>No. of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial vaginitis</td>
<td>Pre-term birth</td>
<td>11</td>
</tr>
<tr>
<td>B-type natriuretic peptide</td>
<td>Heart failure</td>
<td>20</td>
</tr>
<tr>
<td>CT scan</td>
<td>Appendicitis</td>
<td>50</td>
</tr>
<tr>
<td>Electrocardiography</td>
<td>Left ventricular hypertrophy</td>
<td>17</td>
</tr>
<tr>
<td>Fetal fibronectin</td>
<td>Pre-term birth</td>
<td>21</td>
</tr>
<tr>
<td>Ottawa ankle rules</td>
<td>Fracture of the ankle / mid-foot</td>
<td>14</td>
</tr>
<tr>
<td>Alvarado prediction rules</td>
<td>Appendicitis</td>
<td>14</td>
</tr>
<tr>
<td>Scintigraphy</td>
<td>Appendicitis</td>
<td>28</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>Appendicitis</td>
<td>141</td>
</tr>
</tbody>
</table>
Results

• Summary points
• Summary ROC (SROC) curves
Comparison of summary points

Note: each point represents a single meta-analysis.
Summary curves

• Four examples:
Alvarado prediction rules for appendicitis

5 others also gave similar curves from all 3 methods
Electrocardiography for left ventricular hypertrophy
Ottawa ankle rules for fracture of ankle or mid-foot
Bacterial vaginitis for pre-term birth

![ROC curve with sensitivity and specificity metrics](image)

- **Sensitivity**
- **Specificity**

Legend:
- Blue line: HSROC
- Red dashed line: Moses-Litt.
- Green dashed line: Separate random-effects meta-analysis
Comparison of shape parameter (beta of HSROC model)
### Summary: comparing non-iterative methods to HSROC/bivariate model

<table>
<thead>
<tr>
<th>Method</th>
<th>Summary operating point</th>
<th>SROC curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moses-Littenberg</td>
<td>N/A</td>
<td>OK if don’t extrapolate</td>
</tr>
<tr>
<td>Separate random-effects meta-analyses</td>
<td>Good</td>
<td>OK if don’t extrapolate</td>
</tr>
</tbody>
</table>

Results from random-effects logistic regression appear less consistent.
Final thoughts

• Often little information on shape (scale / asymmetry) parameter even with many studies

• Heterogeneity widespread in *all* dimensions – a prediction region may be more appropriate than a confidence interval/region for the summary point

• More experience with methods is needed
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