Objective

- Determine the diagnostic test accuracy of screening tests for atrial fibrillation (AF) in adults (≥18 years) who have not sought medical attention due to symptoms of AF in primary or community care settings.

Methods

- We undertook systematic reviews of screening tests studied in diagnostic cohort and diagnostic case-control studies.
- Index tests were non-invasive and suitable for screening to detect arrhythmia.
- Reference standard was cardiologist interpreted 12-lead electrocardiogram (ECG).
- For each test we used Hierarchical Summary Receiver Operating Characteristic (HSROC) meta-analysis to estimate relationship between sensitivity and specificity.

\[
n_{ij} \sim \text{Bin}(n_i, p_{ij})\]

- Sensitivity, or “True positives”

\[
s_{ij} \sim \text{Bin}(n_{ij}, p_{ij})\]

- 1-specificity, or “False positives”

for the \(j\)th trial comparing the index to the reference test and arm \(i\).

- Logistic link functions were used to model the probabilities

\[
\logit(p_{ij}) = \beta \times \sigma_{ij} + \frac{1}{2} \alpha_{ij}
\]

\[
\logit(p_{ij}) = \theta_{ij} - \frac{1}{2} \alpha_{ij}
\]

- where \(\theta_{ij}\) and \(\alpha_{ij}\) are the observed threshold and accuracy.
- Separate random effects were used to model between observation (within trial) variation and between study variation.
- We explored assumptions on the shape (\(\beta\)) of the HSROC curve: no asymmetry in the curve (\(\beta = 1\)), common shape across tests, independent shapes across tests, and exchangeable shapes.

Results

<table>
<thead>
<tr>
<th>Test</th>
<th>N obs</th>
<th>N studies</th>
<th>Sensitivity at mean of HSROC</th>
<th>Specificity at mean of HSROC</th>
<th>Diagnostic Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified blood pressure monitor</td>
<td>3</td>
<td>2</td>
<td>0.953 (0.851, 0.993)</td>
<td>0.916 (0.759, 0.983)</td>
<td>2.5 (2.14, 2.67)</td>
</tr>
<tr>
<td>Single lead ECG - auto</td>
<td>3</td>
<td>3</td>
<td>0.967 (0.9, 0.995)</td>
<td>0.9 (0.742, 0.975)</td>
<td>2.46 (2.1, 2.65)</td>
</tr>
<tr>
<td>Single lead ECG - nurse</td>
<td>3</td>
<td>1</td>
<td>0.929 (0.711, 0.995)</td>
<td>0.92 (0.7, 0.992)</td>
<td>2.52 (2.01, 2.7)</td>
</tr>
<tr>
<td>Single lead ECG - GP</td>
<td>1</td>
<td>1</td>
<td>0.94 (0.67, 0.99)</td>
<td>0.973 (0.838, 1)</td>
<td>2.65 (2.31, 2.72)</td>
</tr>
<tr>
<td>Single lead ECG - cardio</td>
<td>9</td>
<td>2</td>
<td>0.959 (0.878, 0.992)</td>
<td>0.927 (0.802, 0.984)</td>
<td>2.53 (2.23, 2.67)</td>
</tr>
<tr>
<td>2 stage screening strategy</td>
<td>7</td>
<td>2</td>
<td>0.941 (0.826, 0.989)</td>
<td>0.964 (0.889, 0.993)</td>
<td>2.62 (2.43, 2.7)</td>
</tr>
<tr>
<td>Photoplethysmography</td>
<td>1</td>
<td>1</td>
<td>1 (1, 1)</td>
<td>0.856 (0.516, 0.989)</td>
<td>2.19 (1.68, 2.69)</td>
</tr>
<tr>
<td>12 lead ECG - auto</td>
<td>9</td>
<td>6</td>
<td>0.903 (0.803, 0.961)</td>
<td>0.98 (0.958, 0.993)</td>
<td>2.67 (2.61, 2.7)</td>
</tr>
<tr>
<td>12 lead ECG - nurse</td>
<td>2</td>
<td>1</td>
<td>0.967 (0.824, 1)</td>
<td>0.84 (0.484, 0.982)</td>
<td>2.33 (1.62, 2.67)</td>
</tr>
<tr>
<td>12 lead ECG - GP</td>
<td>1</td>
<td>1</td>
<td>1 (1, 1)</td>
<td>0.973 (0.843, 1)</td>
<td>2.65 (2.32, 2.72)</td>
</tr>
<tr>
<td>&gt;1 and &lt;12 lead ECG - auto</td>
<td>2</td>
<td>1</td>
<td>0.83 (0.474, 0.978)</td>
<td>0.985 (0.937, 0.999)</td>
<td>2.68 (2.55, 2.71)</td>
</tr>
<tr>
<td>&gt;1 and &lt;12 lead ECG - cardio</td>
<td>2</td>
<td>1</td>
<td>0.981 (0.756, 1)</td>
<td>0 (0.999, 1)</td>
<td>2.72 (2.72, 2.72)</td>
</tr>
<tr>
<td>Pulse palpation - nurse</td>
<td>3</td>
<td>2</td>
<td>0.919 (0.749, 0.988)</td>
<td>0.787 (0.497, 0.949)</td>
<td>2.21 (1.64, 2.58)</td>
</tr>
</tbody>
</table>

- Results generated using OpenBUGS and are presented as mean and 95% credible intervals.
- Model fit metrics suggested a random effect model with independent shapes.
- Most tests had high sensitivity.
- Trained GP interpreted 12-lead ECG gave very high sensitivity and specificity, suggesting similar diagnostic performance as gold standard.
- Automatically interpreted modified blood pressure monitor and Single-lead ECG interpreted by cardiologist, GP, nurse, or algorithm all had high sensitivity and specificity.
- The specificity of automatically interpreted 12-lead ECG was very high but nurse interpretation was lower.
- ECGs with between 1 and 12 leads had specificity >0.98, but sensitivity differed between automatic and cardiologist interpretation.
- Photoplethysmography had very high sensitivity but low specificity.
- Pulse palpation by nurse has poorest diagnostic performance with low sensitivity and specificity.
- All 2-stage screening strategies performed well.

Conclusions

- The generally high sensitivity of identified index tests indicates that all are suitable as screening tests but specificity varied between tests and interpreters.

References