Methods for the Estimation of the NICE Cost Effectiveness Threshold

Karl Claxton,\textsuperscript{1,2} Steve Martin,\textsuperscript{2} Marta Soares,\textsuperscript{1} Nigel Rice,\textsuperscript{1,2} Eldon Spackman,\textsuperscript{1} Sebastian Hinde,\textsuperscript{1} Nancy Devlin,\textsuperscript{3} Peter C Smith,\textsuperscript{4} Mark Sculpher\textsuperscript{1}

1. Centre for Health Economics, University of York, UK
2. Department of Economics and Related Studies, University of York, UK
4. Imperial College, London, UK
What do we need?

• Need to compare
  – Health *expected* to be gained
  – Health *expected* to be lost due to additional NHS costs

• Expected health effects of changes in NHS expenditure

• What its not
  – Consumption value of health (willingness to pay)
  – Marginal productivity of ‘ideal’ NHS

• No simple relationship with changes in
  – Budget, prices and productivity
  – Health production outside NHS
How can we estimate effects of expenditure on mortality?

Change in overall expenditure

How are changes in expenditure allocated to PBCs?

How does a change in PBC expenditure effect PBC mortality?

Cost per death averted

All 23 PBCs

11 PBCs
How can we estimate effects on life years

How are changes in expenditure allocated to PBCs?

Change in overall expenditure

Cost per death averted

How does a change in PBC expenditure effect PBC mortality?

11 PBCs

Cost per life year

What are the LY effects of changes in PBC mortality?

11 PBCs

All 23 PBCs
How can we adjust life years for quality?

How are changes in expenditure allocated to PBCs?

Cost per death averted

How does a change in PBC expenditure affect PBC mortality?

Cost per life year

What are the LY effects of changes in PBC mortality?

Cost per QALY (mortality)

Adjust life year effects for quality

Change in overall expenditure

All 23 PBCs

11 PBCs

11 PBCs

11 PBCs
How can we adjust life years for quality?

Change in overall expenditure

- How are changes in expenditure allocated to PBCs?
- How does a change in PBC expenditure effect PBC mortality?
- Change in overall expenditure

11 PBCs

- Health effects of changes in expenditure at same rate as other 11PBCs
- What are the LY effects of changes in PBC mortality?

11 PBCs

- Health effects of changes in expenditure at same rate as other 11PBCs
- Adjust life year effects for quality

Cost per death averted

Cost per life year

Cost per QALY (mortality)

11 PBCs

PBC 23 GMS

PBC 23 GMS

PBC 23 GMS

11 PBCs

11 PBCs

11 PBCs

Health effects of changes in expenditure at same rate as other 11PBCs

Health effects of changes in expenditure at same rate as other 11PBCs

Health effects of changes in expenditure at same rate as other 11PBCs
# Estimates of the threshold (2008-09)

<table>
<thead>
<tr>
<th></th>
<th>Cost per death averted</th>
<th>Cost per life year</th>
<th>Cost per QALY (mortality effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>QoL associated with LYS</em></td>
<td>-</td>
<td>1</td>
<td>Norms</td>
</tr>
<tr>
<td><em>QoL during disease</em></td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>YLL per death averted</em></td>
<td>-</td>
<td>4.5 YLL</td>
<td>4.5 YLL</td>
</tr>
<tr>
<td><em>QALYs per death averted</em></td>
<td>-</td>
<td>4.5 YLL</td>
<td>3.8 QALY</td>
</tr>
</tbody>
</table>

11 PBCs (with mortality)

|                             | £105,872               | £23,360            | £28,045                           |

All 23 PBCs

|                             | £114,272               | £25,214            | £30,270                           |
How can we account for possible effects on quality of life?

1. How are changes in expenditure allocated to PBCs?
2. How does a change in PBC expenditure effect PBC mortality?
3. % effect of a change in PBC expenditure on burden of disease (LY)

All 23 PBCs

11 PBCs
How can we account for possible effects on quality of life?

- How are changes in expenditure allocated to PBCs?

  - Change in overall expenditure
    - How are changes in expenditure allocated to PBCs?
      - All 23 PBCs

  - How does a change in PBC expenditure affect PBC mortality?
    - 11 PBCs

  - % effect of a change in PBC expenditure on burden of disease (LY)
    - 11 PBCs

  - Same % effect on burden of disease (totals from the other 11 PBCs)
    - 11 PBCs

- PBC 23 GMS
How can we account for possible effects on quality of life?

Change in overall expenditure

- How are changes in expenditure allocated to PBCs?
- How does a change in PBC expenditure effect PBC mortality?
- % effect of a change in PBC expenditure on burden of disease (LY)
- Measures of QALY burden of disease
  - Life years (ONS)
  - Quality of life (HoDAR MEPS)
  - Age, gender and duration of disease (GBD)

Cost per QALY (life year and quality effects)

- Same % effect on burden of disease (totals from the other 11PBCs)
## Estimates of the threshold (2008-09)

<table>
<thead>
<tr>
<th></th>
<th>Cost per death averted</th>
<th>Cost per life year</th>
<th>Cost per QALY (mortality effects)</th>
<th>Cost per QALY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>QOL associated with LYs</strong></td>
<td>-</td>
<td>1</td>
<td>Norms</td>
<td>Based on burden</td>
</tr>
<tr>
<td><strong>QOL during disease</strong></td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>Based on burden</td>
</tr>
<tr>
<td><strong>YLL per death averted</strong></td>
<td>-</td>
<td>4.5 YLL</td>
<td>4.5 YLL</td>
<td>4.6 YLL</td>
</tr>
<tr>
<td><strong>QALYs per death averted</strong></td>
<td>-</td>
<td>4.5 YLL</td>
<td>3.8 QALY</td>
<td>12.7 QALY</td>
</tr>
<tr>
<td><strong>11 PBCs (with mortality)</strong></td>
<td>£105,872</td>
<td>£23,360</td>
<td>£28,045</td>
<td>£8,308</td>
</tr>
<tr>
<td><strong>All 23 PBCs</strong></td>
<td>£114,272</td>
<td>£25,214</td>
<td>£30,270</td>
<td>£18,317</td>
</tr>
</tbody>
</table>
## What are the expected health consequences of £10m?

<table>
<thead>
<tr>
<th></th>
<th>Change in spend (£000)</th>
<th>Additional deaths</th>
<th>LY lost</th>
<th>Total QALY lost</th>
<th>Due to premature death</th>
<th>Quality of life effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Totals</strong></td>
<td>£10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>£324.000</td>
<td>3</td>
<td>27</td>
<td>19</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Circulatory</td>
<td>£550.000</td>
<td>17</td>
<td>84</td>
<td>78</td>
<td>53</td>
<td>25</td>
</tr>
<tr>
<td>Respiratory</td>
<td>£332.000</td>
<td>10</td>
<td>12</td>
<td>166</td>
<td>7</td>
<td>159</td>
</tr>
<tr>
<td>Gastro-intestinal</td>
<td>£232.000</td>
<td>2</td>
<td>18</td>
<td>32</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Infectious diseases</td>
<td>£237.000</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Endocrine</td>
<td>£137.000</td>
<td>&lt; 0.5</td>
<td>4</td>
<td>44</td>
<td>2</td>
<td>42</td>
</tr>
<tr>
<td>Neurological</td>
<td>£433.000</td>
<td>1</td>
<td>5</td>
<td>79</td>
<td>3</td>
<td>76</td>
</tr>
<tr>
<td>Genito-urinary</td>
<td>£336.000</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Trauma &amp; injuries*</td>
<td>£558.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maternity &amp; neonates*</td>
<td>£495.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
<td>0</td>
<td>&lt; 0.5</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Disorders of Blood</td>
<td>£292.000</td>
<td>&lt; 0.5</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Mental Health</td>
<td>£2,532.000</td>
<td>2</td>
<td>7</td>
<td>51</td>
<td>4</td>
<td>46</td>
</tr>
<tr>
<td>Learning Disability</td>
<td>£147.000</td>
<td>&lt; 0.5</td>
<td>1</td>
<td>2</td>
<td>&lt; 0.5</td>
<td>1</td>
</tr>
<tr>
<td>Problems of Vision</td>
<td>£275.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
<td>4</td>
<td>&lt; 0.5</td>
<td>3</td>
</tr>
<tr>
<td>Problems of Hearing</td>
<td>£124.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
<td>6</td>
<td>&lt; 0.05</td>
<td>6</td>
</tr>
<tr>
<td>Dental problems</td>
<td>£409.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.05</td>
<td>7</td>
<td>&lt; 0.05</td>
<td>7</td>
</tr>
<tr>
<td>Skin</td>
<td>£279.000</td>
<td>&lt; 0.5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Musculo skeletal</td>
<td>£514.000</td>
<td>&lt; 0.5</td>
<td>2</td>
<td>25</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Poisoning and AE</td>
<td>£132.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
<td>1</td>
<td>&lt; 0.5</td>
<td>1</td>
</tr>
<tr>
<td>Healthy Individuals</td>
<td>£501.000</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
<td>0</td>
<td>&lt; 0.05</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td>Social Care Needs</td>
<td>£426.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other (GMS)</td>
<td>£735.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Implications for policy

• On balance likely to underestimate health effects
  – £18,317 per QALY is likely to be an overestimate

• Current NICE threshold range maybe too high
  – Paying too much not too little for branded drugs
  – Too much not too little utilisation at current prices

• No evidence that the threshold has grown
  – With total expenditure or prices

• Evidence that imposing greater costs means a lower threshold
  – Threshold is more likely to fall as HCS comes under pressure

• Uncertainty in the estimate?
  – A policy threshold should be less than the mean (£18,317)
What type of data and research could improve the estimate?

- Longer and more complex lag structure
  - Duration of effect on mortality might be feasible (capture more health effects)
  - Estimating life year effect of mortality more problematic
- Simultaneous estimation across PBCs
  - Likely to capture more health effects
- Evolving PBC data
- Extending measures of health outcome
  - Analysis of PROMs data
  - Problem of duration of effect
- Incidence and duration of disease
  - WHO updated GBD
  - GPRD