Modelling BCG vaccination in the UK: What is the impact of changing vaccination policy?

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Motivation and Research objectives

- TB continues to be an important PH problem in UK
- BCG only vaccine available: universal > targeted programme

Research Objectives

1. Investigate the evidence used to justify the policy change from universal school age to selective neonatal vaccination, and estimate the present and future impact of this change
2. Determine the evidence for associations between BCG vaccination and outcomes for active TB cases
3. Forecast the impact of BCG shortages, optimise the policy response to these shortages, suggest policy changes to limit future shortages
Beneficial effects of BCG vaccination in outcomes for patients diagnosed with TB

• Aim: Quantify the effects of BCG vaccination on outcomes for individuals with notified TB in England and Wales

• Observational study using the Enhanced Tuberculosis surveillance system 2000-2014

• Considered several outcomes: Pulmonary disease, smear status, drug resistance, multiple episodes, all-cause mortality, successful treatment

• Univariable, and multivariable logistic regression adjusting for possible confounders: age, sex, UK birth status, ethnicity, Public Health England Centre (PHEC), and year of notification
## Results – BCG vaccination

### Summary of associations between BCG vaccination and outcomes for TB cases

<table>
<thead>
<tr>
<th>Outcome</th>
<th>OR</th>
<th>Pr(&gt;Chi)</th>
<th>aOR</th>
<th>Pr(&gt;Chi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug resistance</td>
<td>1.19 (1.06 to 1.33)</td>
<td>0.002</td>
<td>0.95 (0.84 to 1.08)</td>
<td>0.424</td>
</tr>
<tr>
<td>Multiple episodes</td>
<td>0.65 (0.6 to 0.72)</td>
<td>&lt;0.001</td>
<td>0.86 (0.77 to 0.96)</td>
<td>0.007</td>
</tr>
<tr>
<td>Sputum smear</td>
<td>0.98 (0.92 to 1.05)</td>
<td>0.641</td>
<td>1.06 (0.97 to 1.16)</td>
<td>0.186</td>
</tr>
<tr>
<td>Mortality</td>
<td>0.26 (0.23 to 0.3)</td>
<td>&lt;0.001</td>
<td>0.78 (0.66 to 0.93)</td>
<td>0.006</td>
</tr>
<tr>
<td>Successful treatment</td>
<td>1.58 (1.47 to 1.7)</td>
<td>&lt;0.001</td>
<td>1.14 (1.04 to 1.25)</td>
<td>0.004</td>
</tr>
<tr>
<td>Pulmonary TB</td>
<td>0.81 (0.78 to 0.85)</td>
<td>&lt;0.001</td>
<td>1.01 (0.96 to 1.07)</td>
<td>0.639</td>
</tr>
</tbody>
</table>
Discussion:

• This study indicates that there are beneficial effects of BCG vaccination on outcomes for TB cases.

Further work:

1. Investigate the association between BCG vaccination and all-cause mortality; differentiate between TB mortality and other causes, is BCG directly associated with decreased mortality or is it associated via treatment?

2. Develop and fit a data driven TB mathematical model, that captures current BCG vaccination policy and investigate the impact of a catch-up vaccination program
Acknowledgements

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