Why bother about the economic consequences of vaccination?

Value for money of vaccines

The traditional (EPI) vaccines are considered to be one of the "best buys" in public health.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>East Asia and the Pacific</th>
<th>Europe and Central Asia</th>
<th>North African and the Caribbean</th>
<th>South East Asia</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per fully immunised child</td>
<td>13</td>
<td>24</td>
<td>18</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>% of children fully immunised</td>
<td>78</td>
<td>94</td>
<td>86</td>
<td>91</td>
<td>59</td>
</tr>
<tr>
<td>Immunisation cost</td>
<td>316</td>
<td>131</td>
<td>174</td>
<td>152</td>
<td>227</td>
</tr>
<tr>
<td>Deaths averted (2000s)</td>
<td>728</td>
<td>37</td>
<td>174</td>
<td>153</td>
<td>1,109</td>
</tr>
<tr>
<td>Cost/Death averted</td>
<td>434</td>
<td>950</td>
<td>1030</td>
<td>933</td>
<td>209</td>
</tr>
<tr>
<td>Cost/DALY prevented</td>
<td>85</td>
<td>395</td>
<td>438</td>
<td>166</td>
<td>16</td>
</tr>
</tbody>
</table>


Economic impact of vaccination

Mark Jit1,2
Modeling and Economics Unit, Public Health England
London School of Hygiene and Tropical Medicine

New Horizons for Vaccine Research and Innovation,
Brussels, 12-13 March 2014

Value for money of vaccines

The traditional (EPI) vaccines are considered to be one of the "best buys" in public health.

Economic impact of vaccination

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Global vaccine development pipeline

1950s - 1960s
- Polio, diphtheria, pertussis, tetanus, measles
- Cheap vaccines
- Delivered to infants or young children

1970s - today
- HPV, HIV, Measles, HPV
- Expensive vaccines
- Less common infections?
- Less severe?
- Alternative preventive measures (eg. screening)
- Non-traditional risk groups (eg. adults, adolescents)

Published economic evaluations

Published cost-effectiveness analyses of immunisation programmes from 1976 to May 2007

Kim et al. Pharmacoepidemiol. 2006; 16:101

Measles notifications - England & Wales

Average measles cases

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950 - 1968</td>
<td>400,000</td>
</tr>
<tr>
<td>2000 - 2010</td>
<td>3,000</td>
</tr>
</tbody>
</table>

Number of FICs in 2010

700,000

Number to vaccinate to prevent one case (guesstimate)

1.75

Direct cost of measles case

$300 (2002)

Global vaccine development pipeline

1930s - polo, diphtheria, pertussis, tetanus, measles.
- Cheap vaccines
- Delivered to infants or young children

1970s - today
- HPV, HIV, Measles, HPV
- Expensive vaccines
- Less common infections?
- Less severe?
- Alternative preventive measures (eg. screening)
- Non-traditional risk groups (eg. adults, adolescents)
What goes into an economic analysis?

Cost-effectiveness analysis

Usually cost of intervention (e.g., vaccination) = cost saved due to intervention

Incremental cost of intervention

Incremental effects of intervention

= £ per unit of effect

Measured in quantities like: episodes of disease prevented, life years gained, QALYs or DALYs gained

Cost effectiveness thresholds

<table>
<thead>
<tr>
<th>Country</th>
<th>Decision making body</th>
<th>Outcome measure</th>
<th>Willingness to pay for a QALY or DALY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Pharmaceutical Benefits Advisory Committee (PBAC)</td>
<td>QALY</td>
<td>A$30,000-A$50,000</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Health Care Insurance Board (CVZ)</td>
<td>QALY</td>
<td>€20,000</td>
</tr>
<tr>
<td>UK</td>
<td>National Institute for Health and Care Excellence (NICE)</td>
<td>QALY</td>
<td>£20,000 - £30,000</td>
</tr>
<tr>
<td>USA</td>
<td>Preventive Services Task Force (PSTF)</td>
<td>QALY</td>
<td>$50,000 - $100,000</td>
</tr>
<tr>
<td>Thailand</td>
<td>National Health Security Office</td>
<td>QALY</td>
<td>$10,000</td>
</tr>
<tr>
<td>Global</td>
<td>World Health Organization (WHO)</td>
<td>QALY</td>
<td>1-3 x GDP per capita</td>
</tr>
</tbody>
</table>

Measuring costs: who pays?

Health care provider or purchaser perspective

- Vaccination (dose and administration cost)
- Health care use to treat illness (drugs, staff, accommodation etc.)

Societal perspective

- Over the counter medicines
- Transport to seek health care
- Informal care
- Productivity loss due to morbidity (taking time off work due to own or others' sickness) and mortality

Direct and indirect costs of influenza

Estimated economic burden of influenza in 281 German patients (1995-6)

- Medication (6.4%) DM 9.3 million
- Outpatient services (9%) DM 13.1 million
- In-patient costs (2.4%) DM 3.4 million
- Indirect costs (22.2%) DM 119.7 million

Measuring benefits: QALYs

(DALYs work in a similar way)
### Measuring benefits: QALYs

<table>
<thead>
<tr>
<th>Condition</th>
<th>QALY loss</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year on treatment for cervical cancer</td>
<td>0.285</td>
<td>Myers et al. IPC abstract</td>
</tr>
<tr>
<td>Episode of genital warts</td>
<td>0.018</td>
<td>Woodhall et al. 571 2011, 8 458</td>
</tr>
<tr>
<td>Episode of rotavirus gastroenteritis</td>
<td>0.0022</td>
<td>Briss et al. 1992; 29 73</td>
</tr>
<tr>
<td>Episode of pneumococcal meningitis (excluding sequelae)</td>
<td>0.0023</td>
<td>Bennett et al. Arch Pediatr Adolesc Med 2000; 154 43</td>
</tr>
<tr>
<td>Episode of abscess media</td>
<td>0.0035</td>
<td>Petrosa et al. Value Health 2010; 13 343</td>
</tr>
<tr>
<td>Episode of Influenza (not hospitalised)</td>
<td>0.0078</td>
<td>Van Hoek et al. 571 2011; 6 7 7050</td>
</tr>
<tr>
<td>Episode of Influenza (hospitalised)</td>
<td>0.017</td>
<td>Van Hoek et al. 571 2011; 6 7 7050</td>
</tr>
<tr>
<td>Year with active untreated tuberculosis</td>
<td>0.32</td>
<td>Kruljesha et al. Int Tuberc Lung Dis 2010; 14 296</td>
</tr>
<tr>
<td>Year spent on tuberculosis treatment</td>
<td>0.19–0.21</td>
<td>Kruljesha et al. Int Tuberc Lung Dis 2010; 14 296</td>
</tr>
</tbody>
</table>

### What are some special considerations in economic analyses of vaccines?

### Herd immunity

Invasive pneumococcal disease in England and Wales before and after PCV7 introduction (2006), with correction for trends in case ascertainment.

Adler et al. Lancet Inf Dis 2011; 11 790

### Equity: impact by income of rotavirus vaccination

Macroeconomic impact

The effect of vaccination on UK GDP during a 1918/1958/1969-like pandemic

South et al. MLI 2009; 339 865–71
Economic considerations are increasingly important in justifying investment in new vaccines due to their high price/more complex impact compared to traditional vaccines.

Economics is not just about saving money, but about the optimal use of limited resources to achieve societal goals (health, equity, economic growth etc.)

Vaccines require specialised economic models to take into account their unique characteristics.