Economic evaluation of public health interventions

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Outline

1) Background
2) Are PH interventions good “value for money”?  
   • What does “value for money” mean?  
   • What does the evidence say?  
3) Challenges in the economic evaluation of PH interventions  
4) Conclusion
Definition of “Public Health” (WHO)

• Public health refers to all organized measures (whether public or private) to prevent disease, promote health, and prolong life among the population as a whole. Its activities aim to provide conditions in which people can be healthy and focus on entire populations, not on individual patients or diseases.
A seemingly (too) low priority on prevention

Expenditures on prevention & public health in % of total health exp. (2004)

Source: OECD Health Data (2006)
...and a (too?) low priority on prevention research:

Proportion of Combined Total Spend by Research Activity

- Health Services 4.8%
- Disease Management 2.3%
- Treatment Evaluation 8.1%
- Treatment Development 8.5%
- Detection and Diagnosis 5.2%
- Prevention 2.5%
- Aetiology 34.5%
- Underpinning 34.1%

Data source: UKCRC Health Research Analysis
 Possibly due to a lack of cost-effectiveness evidence in public health (Wanless 2004)
“Although there is often evidence on the scientific justification for action and for some specific interventions, there is generally little evidence about the cost-effectiveness of public health and preventative policies or their practical implementation. (...) This, coupled with a lack of funding of public health intervention research and slower acceptance of economic perspectives within public health, all contribute to the dearth of evidence of cost-effectiveness.”

Wanless (2004)
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What does “value for money” mean? → “economic evaluation”

• “**Comparison** of two or more courses of action in terms of their costs and consequences”

• Should we introduce new ‘treatment’ X?
  – What is the extra cost (compared with current or no treatment)?
  – What is the extra benefit (compared with current or no treatment)?
    • Is it worth it (given alternative uses for those resources)?
    • Does it increase overall (net) health gain?

\[
\frac{C_{2} - C_{1}}{E_{2} - E_{1}} \leq \lambda
\]
Cost-Effectiveness Analysis

△ Cost

△ Effectiveness

Opportunity Cost of Health Budget

Accept

Reject

More effective
more costly

Less effective
less costly

More effective
more costly

Less effective
less costly

Accept

Reject
What does the evidence say?
Systematic review: Economic evaluation of primary prevention of CVD

Phase I: n=195
What kind of studies do exist?

Phase II: n=35
(Diet, weight mgt., physical activity)
What methodological, systematic problems of relevance to a broader set of prevention?

Source: Schwappach/Boluarte/Suhrcke 2007
Interventions by prevention category

![Graph showing the number of studies by prevention category: Clinical prevention has 170 studies, Health promotion has 20 studies, and Screening has 5 studies.]

Source: Schwappach/Boluarte/Suhrcke 2007
## Intervention targets by study setting

<table>
<thead>
<tr>
<th>Target</th>
<th>% of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dyslipidemia</td>
<td>31%</td>
</tr>
<tr>
<td>2. Smoking</td>
<td>22%</td>
</tr>
<tr>
<td>3. High blood pressure</td>
<td>13%</td>
</tr>
<tr>
<td>4. High blood glucose levels</td>
<td>7%</td>
</tr>
<tr>
<td>5. Dietary intake</td>
<td>7%</td>
</tr>
<tr>
<td>6. Obesity</td>
<td>6%</td>
</tr>
<tr>
<td>7. Physical inactivity</td>
<td>3%</td>
</tr>
<tr>
<td>8. Atrial fibrillation</td>
<td>2%</td>
</tr>
<tr>
<td>9. Various</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: Schwappach/Boluarte/Suhrcke 2007
Cost-effectiveness estimates from 21 economic analyses (incl. 200 cost-effectiveness estimates) underpinning public health guidance published by NICE between 2006 and 2010

Number (%) and median values of ranges of the estimated incremental cost per QALY for public health interventions

<table>
<thead>
<tr>
<th>Cost saving (intervention dominates)</th>
<th>£0–&lt;£20 000</th>
<th>£20 000–£30 000</th>
<th>&gt;£30 000</th>
<th>Intervention was dominated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%)</td>
<td>30 (15)</td>
<td>141 (70.5)</td>
<td>7 (3.5)</td>
<td>11 (5.5)</td>
</tr>
<tr>
<td>Median</td>
<td>N/A</td>
<td>£1030</td>
<td>£25 150</td>
<td>£90 786</td>
</tr>
</tbody>
</table>

Source: Owen et al 2011, J o Public Health
The increasing number of published economic evaluations of nutrition interventions using QALY or DALY measures

- 54 studies
- 205 interventions

Source: Cobiac et al 2013
Nutrition-related interventions and studies, by country, identified in the present review

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of interventions</th>
<th>Number of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>57</td>
<td>14</td>
</tr>
<tr>
<td>United States</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Brazil</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Mexico</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Russia</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>South Africa</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>New Zealand</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Sweden</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chile</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Argentina</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Belgium</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Global*</td>
<td>42</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Cobiac et al 2013
Cost-effectiveness of nutrition interventions

Cost saving, 35, 17%
Dominated, 3, 2%
>3 × GDP, 37, 18%
1–3 × GDP, 16, 8%
<1 × GDP, 112, 55%

Source: Cobiac et al 2013
Conclusions from CEA review of nutrition related interventions

• Majority of studies cost-saving or cost-effective
• Salt regulation shown as particularly cost-effective or even cost-saving
• The more favourable interventions come from shifting the distribution of risk in the population and lower per person intervention costs
• Individually targeted interventions seem less cost-effective

➤ How literally can we take those findings?
  – Publication bias
  – What is the right cost-effectiveness threshold?
  – Most cost-effective interventions based on least credible study design
  – Big differences between study methodologies and assumptions
Nutrition-related CEAs by perspective

- Health sector, 22
- Societal, 18
- Not specified, 10
- Societal + health sector, 4

Source: Cobiac et al 2013
Nutrition-related CEAs by time horizon

Source: Cobiac et al 2013
The number of cost-effectiveness studies addressing different cost components of nutrition interventions (total number of studies = 53).

Source: Cobiac et al 2013
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The four main challenges (Weatherly et al 2009)

– Attribution of effects
  • Often targeted at populations or communities rather than specific individuals.
  • Impact over long time periods.
  • Difficult to undertake RCTs for comparing relevant alternatives.

– Measuring & valuing outcomes
  • Standard health gain measurements (i.e. QALYs) may be inadequate.
  • It may be necessary to measure the effect on individuals not directly targeted by the intervention.
  • Non health benefits are also important

– Identifying intersectoral costs and consequences

– Incorporating equity considerations
Attributing effects / assessing effectiveness
Problems of using observational data, i.e. in the absence of RCT evidence

• Selection bias
• Omitted variables
• Reverse causality
• Measurement bias
Quasi-experimental / econometric approaches

• Quasi-experimental and econometric methods to estimate an intervention’s effectiveness rely on finding, in observational data, a 'natural' quasi-experiment that mimics the randomization of a controlled experiment.

• Widely applied in economics (eg labour economics, education)

• See also recent MRC Guidance on Natural Experiments
Some relevant approaches

1) *Control for the confounding variables directly*

2) “Fixed effects” to control for fixed, unobservable, characteristics that may be associated both with selection into the sample and with outcomes

3) Instrumental variable approach

4) Propensity score matching

5) Regression discontinuity
Impact on alcohol purchasing of a ban on multi-buy promotions: a quasi-experimental evaluation comparing Scotland with England and Wales
Conclusions

• Overall low priorities on public health / prevention may partly reflect scarce cost-effectiveness evidence
• The cost-effectiveness evidence has grown but remains small compared to clinical areas
• Some encouraging evidence to suggest particularly favourable cost-effectiveness of population level interventions
• A lot more work needed to
  – Improve underlying effectiveness evidence
  – Cover yet unexplored areas (eg marketing, availability restrictions)
  – Incorporate equity concerns into cost-effectiveness
  – Develop suitable, complex modelling approaches
Additional material
The need to make choices based on economic criteria

• All collectively funded health systems have to make choices about the allocation of health care resources.

• The underlying problem is one of scarcity of resources:
  – Not everything that offers a benefit can feasibly be funded
  – Economic evaluation is about doing as much ‘good’ as possible with a fixed budget

• The key notion of Opportunity Costs
  – If resources are spent on one intervention or programme, they are foregone for use in providing other alternatives.

... Opportunity Costs are the value of the next best alternative: if resources can be better spent elsewhere, an intervention is not cost-effective.
To be useful for decision-making, any economic evaluation must consider 4 key issues

1) What are the alternatives?
2) What measure of benefit?
   - Health?
   - “Welfare”? (requires benefits to be expressed as the equivalent amount of consumption, i.e. the amount of money that an individual would be willing to receive in return for the (dis-)benefits offered)
3) How can the costs and benefits of each alternative be estimated?
   - Evidence synthesis; Decision-analytic modelling
4) What will be given up as a consequence of additional costs?
   - Without this, econ evaluation remains only a description of costs and consequences
   - Key question irrespective of whether benefits are measured in health or more broadly
Economic evaluation of prevention is on the rise

Number of studies identified

Source: McDaid & Needle 2007
Public Health Topics Addressed by Economic Evaluation

- Infect. disease
- Exercise / PA
- Health promotion
- Screening
- Vaccination

Source: McDaid & Needle 2007
Systematic review evidence

- The long term effectiveness of obesity prevention interventions (Lehnert et al 2012)
- Decision-analytical modelling
- N=41
- 21 behavioural interventions
- 12 community interventions
- 8 environmental interventions
- Most good value for money, 7 cost-saving, 10 not cost-effective
## Systematic review evidence (Lehnert et al 2012)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target population</th>
<th>ICER (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioural interventions (diet/nutrition)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician counselling</td>
<td>UK, 22-65 years, BMI&gt;25</td>
<td>17,405</td>
</tr>
<tr>
<td>Low calorie diet</td>
<td>NL, 20-70y, BMI&gt;30</td>
<td>21,411</td>
</tr>
<tr>
<td>Weight watchers diet</td>
<td>Australia, 18-65y, BMI&gt;27</td>
<td>123,619</td>
</tr>
<tr>
<td><strong>Behavioural interventions (physical activity)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP prescription</td>
<td>Australia, 40-79y, no PA</td>
<td>9,713</td>
</tr>
<tr>
<td>Internet-based interv.</td>
<td>Australia, &gt;14y, internet users</td>
<td>1,498</td>
</tr>
<tr>
<td><strong>Behavioural interventions (lifestyle)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifestyle intervention</td>
<td>Switzerland, 25-54y, BMI&gt;27</td>
<td>4,394</td>
</tr>
<tr>
<td><strong>Community interventions (lifestyle)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community intervention</td>
<td>NL, 20-80y</td>
<td>4,555</td>
</tr>
<tr>
<td><strong>Community interventions (physical activity)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedometers</td>
<td>Australia, &gt;14y</td>
<td>Cost-saving</td>
</tr>
<tr>
<td>Category</td>
<td>Location</td>
<td>Age Group</td>
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<td>----------------------------------------------------</td>
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<tr>
<td>Comm.-wide campaign</td>
<td>US, 25-54y</td>
<td></td>
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<tr>
<td><strong>Community interventions (specific settings)</strong></td>
<td></td>
<td></td>
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<tr>
<td>Active after school</td>
<td>Australia, 5-11y</td>
<td></td>
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<tr>
<td>School-based interv.</td>
<td>UK, 8-9y</td>
<td></td>
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<tr>
<td>Worksite interventions</td>
<td>UK, 18-65y</td>
<td></td>
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<tr>
<td><strong>Environmental interventions (fiscal measures)</strong></td>
<td></td>
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<tr>
<td>Fiscal measures</td>
<td>UK, whole society</td>
<td></td>
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<tr>
<td></td>
<td>Australia, &gt;18y</td>
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<tr>
<td><strong>Environmental interventions (food/nutrition labelling)</strong></td>
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<td></td>
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<tr>
<td>Food labelling</td>
<td>UK, whole society</td>
<td></td>
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<tr>
<td></td>
<td>Australia, &gt;20y</td>
<td></td>
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<tr>
<td><strong>Environmental interventions (advertisement legislation)</strong></td>
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<tr>
<td>Adv. Regulation</td>
<td>UK, 2-18y</td>
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<tr>
<td><strong>Environmental interventions (mass media campaign)</strong></td>
<td></td>
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<tr>
<td>Mass media camp.</td>
<td>Australia, 25-60y</td>
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</tbody>
</table>
Systematic review evidence

- Substantial variation between studies
- Substantial uncertainty around mean effect estimate
- Limited direct comparability among different studies.
- At face value, interventions modifying a target population’s environment (fiscal/regulatory) were most cost-effective
- Can we take the evidence at face value?
Potentially important differences between studies

- Modelling structure and approach
- Perspective (health care vs society)
- Time horizon
- Discounting
- Treatment of unrelated future costs
- Quality of intervention effectiveness evidence (RCT, modelling, observational studies, quasi-experiments)
- ...

(RCT, modelling, observational studies, quasi-experiments)