Incorporating Health Inequality Impacts into Cost-Effectiveness Analysis: A Framework

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PHRC Project on Distributional Cost-Effectiveness Analysis (2011-13)

A research project funded by the Public Health Research Consortium

This research has developed new methods for using cost effectiveness analysis (CEA) to analyse the health inequality impacts of health care interventions.

Click on the links below for further information

- Summary of the project
- Working papers
  - Workshop 1 in March 2012 (overview)
  - Workshop 2 in February 2013 (bowel cancer screening case study)

Summary of the project

- Project title: Identifying appropriate methods to incorporate concerns about health inequalities into economic evaluations of health care programmes
- Funded by: DH Policy Research Programme Public Health Research Consortium (PHRC)
- Duration: 1 April 2011 – 31 March 2013 (24 months)
- PI: Mark Sculpher
- Project team: Susan Griffin, Richard Cookson, Miqdad Asaria
- Advisers: Nigel Rice, Karl Claxton, Tony Culyer

http://www.york.ac.uk/che/research/equity/d-c-e-a/phrc/
Outline of Talk

- Background
- Aims and Scope of the Framework
- Stage 1: Modelling Health Distributions
- Stage 2: Ranking Health Distributions
Background
Expected Years of Life in Full Health
England and Wales

- Poorest Fifth: 62 years
- 2nd Poorest: 70 years
- Middle Fifth: 74 years
- 2nd Richest: 70 years
- Richest Fifth: 74 years

Quality adjusted life expectancy at birth

Health Impact Assessment (HIA)

Definitions of HIA

Many different people and organizations have defined HIA. Each definition is similar, differing through the emphasis given to particular components of the HIA approach. There is no correct definition; this is merely a sample of ways to describe HIA.

Main definition

A combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population.
Example HIA

Regeneration of the Ferrier Estate, Greenwich (early 2000s)


(~£23m over 7 years; deprived estate with 6,800 people)

“The HIA led to the identification of a number of possible short- and longer-term health outcomes for the local population, including

- a decrease in accident rates as a result of the provision of better designed and better quality housing;
- lower rates of respiratory disease and of stress and anxiety amongst residents as a result of more appropriate central heating systems and the elimination of infestation in their homes;
- improvements to diet and other health-related choices as a result of increasing opportunities for paid employment and higher income levels; and
- better psychological health and well being as a result of improved security measures and a reduction in levels of crime and the fear of crime.”

Why try to quantify health inequality impact within cost effectiveness analysis?

• Because public decision makers have to make hard choices about scarce resources and so need to know:

1. The **SIZE** of health inequality impact
   – Not enough to know: is the impact +ve or -ve?
   – Need to know: how large is the impact?

2. The **NET** health inequality impact
   – Reducing health inequality often requires investment
   – Other ways of investing resources can deliver health gain
   – Need to know: health gain MINUS health opportunity cost
Equity-efficiency trade-offs between improving population health and reducing health inequality

“Trade offs exist between redistribution of health resources to tackle health inequalities, and the NICE model of distribution, based on investing in the most cost-effective treatment for the whole population. These trade offs have never been explicitly articulated and examined and we recommend that they should be.”

House of Commons (2009).

Standard CEA

• Standard CEA ignores health inequality

• Developmental methods proposed but rarely applied and never used to inform decisions
Developmental methods

1. Equity weights

2. Opportunity cost of equity constraint

3. Multi criteria decision analysis
Aims and Scope of the Framework

“Distributional Cost-Effectiveness Analysis” (DCEA)
Aims

• To help cost effectiveness analysts provide useful information about health equity impacts that can be used to inform decisions about public expenditure on health care

• To help cost effectiveness analysts accommodate different value judgements about health inequality made by different decision makers and stakeholders
  – Facilitating a deliberative decision making process, not imposing a fully pre-specified theory of justice

• To encompass previously proposed methods (equity weighting, mathematical programming and MCDA)
  – A general framework, not a rival method
Accountability for reasonableness

“Resource allocation decisions in health care are rife with moral disagreements and a fair, deliberative process is necessary to establish the legitimacy and fairness of such decisions”

Daniels and Sabin 2008

“Key elements of fair process will involve transparency about the grounds for decisions; appeals to rationales that all can accept as relevant to meeting health needs fairly; and procedures for revising decisions in light of challenges to them. Together these elements assure ‘accountability for reasonableness’”

Daniels 2000


Scope of the Framework

• Only decisions by health sector organisations operating within a fixed health sector budget
  – e.g. in England: NICE, National Screening Committee, Public Health England, NHS England, DH

• Only decisions with no important non-health costs or benefits
  – Health care public health programmes
    • e.g. screening, immunisation, case finding, chronic disease management, smoking cessation, exercise referral
  – Health care treatment programmes
    • e.g. new drug, surgery, talking therapy
Why focus on health care?

• To make progress
  – Learn to crawl before trying to run

• Cross government policies may have larger impacts on health inequality
  – Non-healthcare public health (e.g. alcohol minimum price, school-based health promotion, free sport etc.)
  – Social and economic policy (e.g. on family, education, employment, housing, environment, transport, tax and social security, etc.)

• BUT they are much more complicated
  – Non-health costs outside the health budget
  – Non-health benefits
  – Impacts on income inequality as well as health inequality
Illustrative Example

Re-Design Options to Increase Uptake of the NHS Bowel Cancer Screening Programme
NHS Bowel Cancer Screening Programme

• Rolled out in 2006
• Everybody aged 60-74 invited for biennial gFOBT based screening
• Additionally flexible sigmoidoscopy currently being rolled out to people aged 55
• Overall uptake of pilots was 57% but large differences by gender, ethnicity and level of deprivation
Inequality in BCSP Uptake

- Male: 55%
- Female: 63%

Least Indian Areas (80%)
- 45%
- 55%
- 61%
- 65%
- 69%

Most Indian Areas (20%)
- 60%
- 56%

Most Deprived
- IMD 4: 45%
- IMD 3: 55%
- IMD 2: 61%
- Least Deprived: 69%
Two Redesign Options

• Universal Basic Reminder
  – Sent to everyone from central screening hub
  – Reminder letter sent to non-responders with statement that their GP recommends they participate
  – Assumed to increase uptake by 6% at a cost of £3.50 per person

• Targeted Enhanced Reminder
  – Sent to IMD groups 4 and 5 and to 20% of areas with highest population from Indian Subcontinent
  – Personal reminder letter and information pack sent by GP to non-responders
  – Assumed to increase uptake by 12% at a cost of £7 per person

• Both strategies have equal total costs per screening round of approximately £2.75 million
Strategic Review of Health Inequalities in England Post-2010 – The Marmot Review
Stage One:
Modelling Health Distributions
Modelling Health Distributions

• Select equity dimensions considered to represent “unfair” sources of inequality
  – e.g. income, gender, ethnicity etc.

• Health benefits by equity dimensions
  – Using QALYs or DALYs and other outcomes of interest e.g. utilisation, morbidity, mortality

• Health opportunity costs by equity dimensions
  – In general population, not just recipients
  – Using QALYs or DALYs (no other metric available, since displaced programmes are never known)
Modelling Health Distributions

• Baseline levels of lifetime health by equity dimensions
  – Using QALE or DALE ("Quality Adjusted” or “Disability Adjusted” Life Expectancy) and other outcomes of interest

• Overall and dimension-specific distributions of lifetime health with and without intervention
  – Using QALE or DALE (no other metric is available as opportunity costs are in QALYs or DALYs)

• Visualise the distributions
  – Use graphs and tables to describe, understand and communicate the patterns of distributional impact
Impact of Redesign on Health

Incremental Population QALYs Compared to No Intervention

<table>
<thead>
<tr>
<th>Health Quintile</th>
<th>Incremental Population QALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least Healthy</td>
<td>700</td>
</tr>
<tr>
<td>2</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>400</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
</tr>
<tr>
<td>Most Healthy</td>
<td>800</td>
</tr>
</tbody>
</table>

- targeted
- universal
Impact of Redesign on Health

Incremental Per Person QALYs Compared to No Intervention

- Male
- Female

Least Indian Areas (80%) Most Indian Areas (20%)

Least Deprived

Most Deprived

IMD 4
IMD 3
IMD 2

targeted
universal
Interlude
Extended CEA (“ECEA”)

- Dean Jamison and colleagues at the University of Washington have recently developed “Extended CEA” as part of their “Disease Control Priorities 3” project (www.dcp-3.org)
- This extends CEA to examines financial risk protection outcomes as well as health outcomes
- It also examines the distribution of outcomes in a manner consistent with our DCEA framework
- But does not exploit all potential features of DCEA:
  - Presents a “dashboard” of health and financial protection consequences by income group, in the form of a table
  - Focuses on one equity dimension at a time rather than overall distributions
  - Focuses on the distribution of health gains rather than the distribution of levels of lifetime health
  - Eschews Step 2: Rank Health Distributions
DCP3 - Disease Control Priorities

Welcome to DCP3

Disease Control Priorities, Third Edition will summarize and synthesize evidence of the effectiveness of global health interventions and provide comparative economic evaluation of policies to implement those interventions. Click here to learn more about the project.

NCD Synergies Network

DCP3 Project Director Rachel Nugent participates in inaugural network meeting in Kigali, Rwanda

Recent News

Pan American Conference To Address Maternal and Child Health Inequalities

DCP3 Chapters Available for Review

Prioritize Cervical Cancer Screenings in Post-2015 Era, Experts Say

Millions Saved Second Call for Proposals

DCP3 and the Center for Global Development invite DCP3 editors and authors to submit case study proposals for the newest edition of Millions Saved: Case Studies in Global Health.

Click here for more information on submitting case studies.
Should ranking be eschewed or embraced?

“It is clear that with appropriate aggregation assumptions all entries on the dashboard could be collapsed into a single figure of merit. Our judgement, in going no further than presenting the dashboard, was that the inevitably arbitrary assumptions underlying aggregation would obscure the conclusions of an ECEA.”

Verguet, Laxminarayan and Jamison (2012)

Stage Two:
Ranking Health Distributions
Ranking Health Distributions

• Estimate total health for each decision option
  – Encompasses analysis of the opportunity cost of equity constraints = difference in total health between “equitable” and “inequitable” options

• Check for distributional dominance
  – Is one distribution better for everyone? (Pareto)
  – Does one distribution improve total health and reduce health inequality according to almost any concept of inequality?
    (Atkinson, Shorrocks)
Ranking Health Distributions

• Compute multiple health inequality measures
  • Use multiple measures of interest to stakeholders, including absolute and relative measures and summary and extreme group measures

• Examine trade-offs between (1) improving population health and (2) reducing health inequality
  – Use appropriate simple SWFs with one or two inequality aversion parameters (e.g. Atkinson for relative inequality and Kolm for absolute inequality)
  – Encompasses MCDA: other decision criteria can be added
  – Encompasses equity weighting: values of the SWF parameter(s) imply different sets of equity weights
# Health Inequality Measures

<table>
<thead>
<tr>
<th>Relative Inequality Indices</th>
<th>standard gFOBT</th>
<th>gFOBT + targeted</th>
<th>gFOBT + universal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Gap Index (ratio)</td>
<td>0.17592</td>
<td>0.17586</td>
<td>0.17596</td>
</tr>
<tr>
<td>Relative Index of Inequality (RII)</td>
<td>0.18674</td>
<td>0.18668</td>
<td>0.18678</td>
</tr>
<tr>
<td>Gini Index</td>
<td>0.03112</td>
<td>0.03111</td>
<td>0.03113</td>
</tr>
<tr>
<td>Atkinson Index (ε=1)</td>
<td>0.00172</td>
<td>0.00172</td>
<td>0.00172</td>
</tr>
<tr>
<td>Atkinson Index (ε=30)</td>
<td>0.06281</td>
<td>0.04305</td>
<td>0.04309</td>
</tr>
</tbody>
</table>

ε=1 represents low relative inequality aversion while ε=8 represents high relative inequality aversion.

<table>
<thead>
<tr>
<th>Absolute Inequality Indices</th>
<th>standard gFOBT</th>
<th>gFOBT + targeted</th>
<th>gFOBT + universal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Gap Index (range)</td>
<td>11.03064</td>
<td>11.02726</td>
<td>11.03325</td>
</tr>
<tr>
<td>Slope index of inequality (SII)</td>
<td>12.94123</td>
<td>12.93691</td>
<td>12.94438</td>
</tr>
<tr>
<td>Kolm Index (α=0.025)</td>
<td>0.20430</td>
<td>0.20416</td>
<td>0.20439</td>
</tr>
<tr>
<td>Kolm Index (α=0.5)</td>
<td>4.48739</td>
<td>4.58587</td>
<td>4.58883</td>
</tr>
</tbody>
</table>

α=0.025 represents low absolute inequality aversion while α=0.125 represents high absolute inequality aversion.
Which Policy is Best (Relative)?

![Graph showing the comparison between Universal and Targeted EDE policies based on the constant relative inequality aversion (Atkinson $\varepsilon$)].

- Universal EDE is shown to be better for lower values of $\varepsilon$.
- Targeted EDE is shown to be better for higher values of $\varepsilon$.

The graph illustrates the population QALYs comparison between the two policies as the constant relative inequality aversion parameter ($\varepsilon$) varies.
Which Policy is Best (Absolute)?

![Graph showing the comparison between Universal and Targeted EDE (Population QALYs) based on Constant Absolute Inequality Aversion (Kolm α). The graph indicates that Universal EDE is better for lower values of Kolm α, while Targeted EDE is better for higher values.](image)
Sensitivity of Results to Alternative Social Value Judgements

<table>
<thead>
<tr>
<th>Social Value Judgment</th>
<th>Preferred Strategy based on Social Welfare Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S = standard screening</td>
</tr>
<tr>
<td></td>
<td>U = screening + universal basic reminder</td>
</tr>
<tr>
<td></td>
<td>T = screening + targeted enhanced reminder</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IMD</th>
<th>Ethnic Diversity</th>
<th>Gender</th>
<th>Atkinson EDE (ε = 1)</th>
<th>Atkinson EDE (ε = 20)</th>
<th>Kolm EDE (α = 0.025)</th>
<th>Kolm EDE (α = 0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair</td>
<td>Fair</td>
<td>Fair</td>
<td>U</td>
<td>U</td>
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<td>U</td>
</tr>
<tr>
<td>Fair</td>
<td>Unfair</td>
<td>Fair</td>
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</tbody>
</table>
Thank you.
Health Gain measured using “Quality Adjusted Life Years” (QALYs)
Standard CEA

Cost-effectiveness “threshold value” (e.g. £20,000 per QALY)

Net Health Benefit = Health Gained Minus Health Displaced

Cost (C)

Health Gain (HG)

HD_y

C_y

HD_y

HG_y

Y
Net Health LOSS = Health Gained Minus Health Displaced

Standard CEA

Health Gain

Cost

Health Gain (HG)

- \( \text{CG}_x \)
- \( \text{HD}_x \)

\( \text{HG}_x \)
Intervention X

- Health Gain\(_X\) \(= 70,000\) QALYs
- Cost\(_X\) \(= £1.6bn\)
- Threshold value \(= £20,000\)
- Health Displaced\(_X\) \(= \frac{£1.6bn}{£20,000} = 80,000\) QALYs
- Net Health Loss \(= 70,000 - 80,000 = 10,000\) QALYs
  i.e. not cost effective: \(\Rightarrow\) an overall population health loss
- But does \(X\) reduce inequality, and if so by how much?
- Is this health inequality reduction “worth” the health loss?
## Extensions to Existing Sheffield CEA Model

<table>
<thead>
<tr>
<th>Parameter that varies by subgroup</th>
<th>Handled in analysis</th>
<th>Adjustment variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cause mortality</td>
<td>✓</td>
<td>Gender, Deprivation</td>
</tr>
<tr>
<td>Incidence of bowel cancer and severity</td>
<td>❌</td>
<td></td>
</tr>
<tr>
<td>Uptake of screening programme</td>
<td>✓</td>
<td>Gender, Deprivation, Ethnic Diversity</td>
</tr>
<tr>
<td>Quality adjustment of health gains</td>
<td>✓</td>
<td>Gender, Deprivation</td>
</tr>
<tr>
<td>Opportunity cost of spending NHS money on screening</td>
<td>Partially</td>
<td>Equally distributed but modelled</td>
</tr>
</tbody>
</table>
Atkinson SWF

\[ h * (1 - I) \]

- \( h \) is mean health
- \( I \) is the Atkinson index of inequality in health on a scale from 1 (fully unequal) to 0 (fully equal)
- \( \varepsilon \) is the “inequality aversion” parameter
  - \( \varepsilon = 0 \) implies that only mean health matters; higher \( \varepsilon \) implies greater concern for inequality \textit{vis a vis} mean health; and as \( \varepsilon \) tends to infinity concern focuses only on the worst off person)

\[ A_\varepsilon = 1 - \frac{h_{ede}}{h} \]

\[ A_\varepsilon = 1 - \left[ \frac{1}{n} \sum_{i=1}^{n} \left[ \frac{h_i}{h} \right]^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \]

\[ h_{ede} = \left[ \frac{1}{n} \sum_{i=1}^{n} [h_i]^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \]

equally distributed equivalent health divided by mean health
<table>
<thead>
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