Estimating the cost of a life year using English PCT programme budgeting data and mortality rates

Acknowledgement: This study builds on work funded by the Health Foundation.
Introduction

• Cost of life year estimates: obtainable from a study of the relationship between health care spending and health outcome

• This relationship is of fundamental concern in health policy – extent to which additional health care expenditure yields patient benefits

• Health Technology Assessment agencies have greatly improved understanding at a micro level (eg cost effectiveness of individual therapeutic treatments)

• Rather surprisingly, the evidence at the macro level is mixed

• We take advantage of a major new dataset in the form of NHS programme budgets to address this question…and the results allow us to calculate the cost of a life year
Some background on links between spending and outcomes

- Cochrane, St Leger & Moore (1978)
  - 18 OECD countries; regression analysis relationship between mortality and per capita provision of health care inputs; little association

- Cremieux, Ouellette & Pilon (1999)
  - 10 Canadian Provinces 1978-92. Find that lower healthcare spend associated with increased infant mortality and lower life expectancy

- Nolte and McKee (2004)
  - Review of literature; note failure to identify strong and consistent relationship between health care expenditure and outcomes

- Nixon and Ullmann (2006)
  - Review 16 studies and undertake study of EU countries 1980-95; find health care spend relatively marginal contribution to improvements in life expectancy
Difficulties with studies of link between spending and outcomes

- Gravelle & Backhouse (1987)
  - lag between spending and outcome
  - data heterogeneity inherent in international comparisons
  - endogeneity issue (higher spend on health care might reflect higher mortality but would observe positive correlation)

- Conclude: mixed results might reflect weaknesses in studies rather than reality…and within country studies would avoid difficulties with data heterogeneity
English programme budgeting project

• Previously: mortality data available but difficult to relate to expenditure (latter expressed in terms of types of inputs purchased eg pay and non-pay)

• Aim was to develop a primary source of information…to give a greater understanding of what we are getting for the money invested in the National Health Service.

• Commenced in FY2003/4. Maps all NHS expenditure to 23 programmes of care based largely on medical conditions (ICD 10).

• Expenditure includes: pharmaceuticals, admitted patient care (inpatient and day case), non-admitted patient care (ambulatory hospital and community care), and primary care
English programme budgeting project

- Information collected as part of the statutory accounts process for local health administrations (152 Primary Care Trusts)

- PCTs already know what they are spending from their annual accounts. They split this expenditure into programmes eg
  - providers supply PCTs with expenditure data split by programme
  - the Business Services Authority supplies PCTs with prescribing data by programme
  - PCTs analyse their own data for community care
  - GMS / PMS expenditure goes to category 23 – other. Intention is that it will be audited by external auditors

- Budgeting data in public domain. See the DH website:
The 23 programmes of care…

1: Infectious diseases
2: Cancers and tumours
3: Blood disorders
4: Endocrine, nutritional & metabolic disorders
5: Mental health problems
6: Learning disability problems
7: Neurological problems
8: Eye and vision problems
9: Hearing problems
10: Circulation problems
11: Respiratory system problems
12: Dental problems
13: Gastro-intestinal problems
14: Skin problems
15: Musculoskeletal problems (excludes trauma)
16: Trauma and injuries
17: Genito-urinary system
18: Maternity and reproductive health
19: Neonatal conditions
20: Poisoning
21: Healthy individuals
22: Social care needs
23: Other (eg primary care)

**Bold** indicates outcome indicator (mortality) available by PCT.

But we can still incorporate the other programmes into our cost of life year estimates.
...and 49 sub-programmes of care

- Since FY2006/7, expenditure has been split between two or more sub-programmes in 13 of the 23 PBCs

- Example: PBC 2 cancers and tumours is split into ten sub-groups
  - 2a Cancer, head and neck
  - 2b Cancer, upper gastro-intestinal
  - 2c Cancer, lower gastro-intestinal
  - 2d Cancer, lung
  - 2e Cancer, skin
  - 2f Cancer, breast
  - 2g Cancer, gynaecological
  - 2h Cancer, urological
  - 2i Cancer, haematological
  - 2x Cancer, other
National per capita NHS expenditure is £1,345
Minimum and Maximum spend per person by PCT, FY2006/07, £

Note: expenditure is adjusted for variations in local input prices
Finding an outcome indicator for each programme

• Most studies use some form of mortality rate…we do too
• Cannot estimate programme specific cost of life year where no mortality rate
• Also, mortality more relevant for some PBCs (eg circulatory problems) than others (eg neurological problems~epilepsy)
• So: programme specific costs for some PBCs…and expect more reliable results for PBCs where mortality is more relevant outcome
• Note: focus on mortality ignores impact of spend aimed at chronic care and palliative care
• Approach extendable to other non-mortality outcome indicators (eg EQ-5D utility scores pre- and post- an operative procedure from PROMs programme)
Which mortality rate?

• SMRs available by disease group
• Studies often use SMR for those aged < 75 years
• But SMR ignores the age at which the person dies
• Years of life lost rate (age standardised) per 10,000 population also available by disease group (assuming a 75 year life expectancy)
• YLL rate data in public domain (from NCHOD website: www.nchod.nhs.uk)
• YLL rate facilitates calculation of cost of a life year
Finding mortality rates for care programmes by PCT 1

<table>
<thead>
<tr>
<th>Expenditure data</th>
<th>Mortality data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• infectious diseases (A00-B99)</td>
<td>• infectious diseases (A00-B99)</td>
</tr>
<tr>
<td>• cancers (C00-C97, D00-D50)</td>
<td>• cancers (C00-C97: 98%)</td>
</tr>
<tr>
<td>• endocrine etc problems (E00-E89)*</td>
<td>• diabetes (E10-E14: 63%)</td>
</tr>
<tr>
<td>• neurological problems (G00-G99)*</td>
<td>• epilepsy(G40-G41: 13%)</td>
</tr>
<tr>
<td>• circulation problems (I00-I99)</td>
<td>• circulation problems (I00-I99)</td>
</tr>
</tbody>
</table>
Finding mortality rates for care programmes by PCT 2

Expenditure data

- respiratory problems (J00-J98)
- gastro-intestinal (K09-K92)
- trauma etc (S00-S99, T00-T35)
- genito-urinary problems (N00-N99)
- maternity (O00-O99) + neonates (P00-P96)

Mortality data

- asthma (J45-J46), bronchitis etc (J40-J44), pneumonia (J12-J18) 77%
- liver disease (K70, K73-K74) + ulcers (K25-K27) 65%
- fracture thighbone (S72) + skull injury (S02, S06, T90)
- renal failure (N18: 27%)
- infant mortality (<28 days)
Years of life lost rate by PCT

Figures assume a 75 year life expectancy
Total PCT spending and all causes of mortality

PCT expenditure per capita (MFF adjusted), FY2006/7, £

- all causes of death, annual YLL rate
- Fitted values
Total PCT spending and all causes of mortality

• Above plot ignores variations in need for health care

• Higher spending in some areas will reflect greater need for health care (eg due to local demographic profile, deprivation level)

• Department of Health has constructed a measure of the need for health care. For details see the exposition books on the DH website for details at: http://www.dh.gov.uk/en/Managingyourorganisation/Financeandplanning/Allocations/DH_091850

• Plot below shows relationship between outcome and spend holding constant need for health care
Total PCT spending and all causes of mortality: need adjusted

PCT expenditure per capita (MFF and need adjusted), FY2006/7, £

all causes of death, annual YLL rate

Fitted values
Equations to be estimated for each programme budget category

- Model based on PCT manager allocating fixed budget between 23 programmes seeking to maximise the health gain across all 23 PBCs

- For each programme, there is a health production function:
  \[ \text{Health outcome}_i = f_i(\text{need}_i, \text{expenditure}_i, \text{local cost factors}_i) \]

- This generates an expenditure choice equation:
  \[ \text{Expenditure}_i^* = g_i(\text{need}_i, \text{need in other PBCs}, \text{PCT budget}, \text{local cost factors}_{all}) \]
Data issues 1

• To be estimated:
  \[ \text{Health outcome}_i = f_i(\text{need}_i, \text{expenditure}_i, \text{local cost factors}_i) \]

• use mortality (YLL) rate as health outcome

• only have mortality rates for eleven PBCs

• use DH all service measure of need from weighted capitation formula as proxy for need \( i \) …but supplement this where appropriate (eg with disease prevalence rate)

• adjust expenditure for unavoidable variations in local input prices (eg wage rates) using the DH’s Market Forces Factor (a local cost factor)
Data issues 2

To be estimated:

$Expenditure_i^* = g_i(\text{need}_i, \text{need in other PBCs, PCT budget, local cost factors}_{\text{all}})$

- use [all cause mortality minus own PBC mortality] as proxy for need in other programmes

- all models estimated in logs so that regression coefficients can be interpreted as elasticities (i.e., show % change)

**Example:** suppose

$\text{Health outcome}_i = \text{const} + 2.0\text{need}_i - 0.5\text{expenditure}_i$

Implies that 1% increase in expenditure associated with 0.5% fall in mortality

- PCTs weighted according to their population size
Estimation issues 1

• To be estimated:
  \[ \text{Health outcome}_i = f_i(\text{need}_i, \text{expenditure}_i, \text{local cost factors}_i) \]
  \[ \text{Expenditure}_i^* = g_i(\text{need}_i, \text{need in other PBCs}, \text{PCT budget}, \text{local cost factors}_{\text{all}}) \]

• Cannot use simple OLS regression because:
  (a) expenditure in the outcome equation and
  (b) other programme need in the expenditure equation
  are likely to be endogenous (determined within the model) and OLS would
  result in biased coefficients

• Need to use an estimation technique that allows for this endogeneity

• We use two stage least squares: replace endogenous variable with its
  predicted value, and then apply OLS to the equations of interest
Estimation issues 2

- Example: application of 2SLS to cancer outcome model

- Replace
  \[ \text{health outcome}_i = f_i(\text{need}_i, \text{actual expenditure}_i, \text{environmental factors}_i) \]
  with
  \[ \text{health outcome}_i = f_i(\text{need}_i, \text{predicted expenditure}_i, \text{environmental factors}_i) \]

  where \textit{predicted cancer expenditure} has been obtained from the OLS regression:
  \[
  \text{actual cancer spend} = g(\text{need for cancer care, other variables believed to predict cancer spend but not mortality})
  \]

- These \textit{other variables believed to predict cancer spend but not mortality} are called ‘instruments’
• What variables to use as instruments?

• We constructed about a dozen variables, largely from the Population Census 2001, and found that the four below, or a subset of these, usually worked well:
  (a) proportion of households that are one pensioner households
  (b) proportion of population providing some unpaid care
  (c) Index of Multiple Deprivation 2007 score
  (d) proportion of residents in white ethnic group

• Precise instruments used determined by theoretical relevance and statistical tests. Latter were undertaken for: validity, relevance, and weakness.

• We intend to examine the sensitivity of the results to instrument selection.
Recall that we want to estimate:

\[ \text{Health outcome}_i = f_i(\text{need}_i, \text{expenditure}_i, \text{environmental factors}_i) \]

Example: cancer outcome model

We estimate \( \text{cancer mortality} = f(\text{need for cancer care, } \text{predicted cancer expenditure}) \)

where \( \text{predicted cancer spend} \) has been obtained from the OLS regression

\[ \text{actual cancer expenditure} = g(\text{need for cancer care, } \text{proportion of households that are one pensioner households, } \text{Index of Multiple Deprivation 2007 score}) \]

The proportion of households that are one pensioner households and the Index of Multiple Deprivation 2007 score serve as instruments for cancer spend.
Recap: equations to be estimated

(1) Health outcome$_i = f_i$(need$_i$, expenditure$_i$, local cost factors$_i$)

(2) Expenditure$_i^* = g_i$(need$_i$, need in other PBCs, PCT budget, local cost factors$_{all}$)

We use:
- YLL rate as health outcome
- DH all service measure of need as proxy for programme need
- local input prices as local cost factor and we have adjusted expenditure to allow for this
- [all cause YLL rate minus own programme YLL rate] as proxy for need in other programmes

Expenditure is for FY2006/7

YLL rate is based on mortality for three years pooled (2006, 2007, 2008)
Cancer mortality results

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Coefficient</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>6.500***</td>
<td>[0.436]</td>
</tr>
<tr>
<td>Need for health care</td>
<td>0.995***</td>
<td>[0.106]</td>
</tr>
<tr>
<td>Need for health care squared</td>
<td>1.162***</td>
<td>[0.348]</td>
</tr>
<tr>
<td>Cancer expenditure per person</td>
<td>-0.342***</td>
<td>[0.099]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model test statistics</th>
<th>Test statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endogeneity test of endogenous regressors</td>
<td>13.695</td>
<td>0.000</td>
</tr>
<tr>
<td>Instrument validity: Hansen J statistic</td>
<td>0.685</td>
<td>0.408</td>
</tr>
<tr>
<td>Instrument relevance: Kleibergen-Paap LM statistic</td>
<td>17.847</td>
<td>0.000</td>
</tr>
<tr>
<td>Weak instruments: Kleibergen-Paap Wald F statistic</td>
<td>13.279</td>
<td></td>
</tr>
<tr>
<td>Ramsey/Pesaran-Taylor RESET test</td>
<td>0.01</td>
<td>0.942</td>
</tr>
</tbody>
</table>

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1
## Cancer expenditure results

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Coefficient</th>
<th>Std Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>6.102***</td>
<td>[1.878]</td>
</tr>
<tr>
<td>Need for health care</td>
<td>1.854***</td>
<td>[0.304]</td>
</tr>
<tr>
<td>PCT budget per person</td>
<td>0.520**</td>
<td>[0.257]</td>
</tr>
<tr>
<td>Non-cancer mortality</td>
<td>-0.960***</td>
<td>[0.181]</td>
</tr>
</tbody>
</table>

### Model test statistics

<table>
<thead>
<tr>
<th>Test statistic</th>
<th>Test statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endogeneity test of endogenous regressors</td>
<td>22.817</td>
<td>0.000</td>
</tr>
<tr>
<td>Instrument validity: Hansen J statistic</td>
<td>0.116</td>
<td>0.733</td>
</tr>
<tr>
<td>Instrument relevance: Kleibergen-Paap LM statistic</td>
<td>42.882</td>
<td>0.000</td>
</tr>
<tr>
<td>Weak instruments: Kleibergen-Paap Wald F statistic</td>
<td>56.102</td>
<td></td>
</tr>
<tr>
<td>Ramsey/Pesaran-Taylor RESET test</td>
<td>0.04</td>
<td>0.844</td>
</tr>
</tbody>
</table>

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1
Calculating the cost of an additional life year: cancer 1

• We can use coefficient on expenditure in outcome equation to calculate the cost of an additional life year for each PBC

Example: the cost of an additional life year in the cancer programme

• The coefficient on expenditure is -0.342 in cancer outcome model

• This implies that a 1% increase in cancer expenditure is associated with a 0.342% decline in cancer mortality

• In FY2006/7 cancer spend totalled £4,122m so a 1% increase would cost £41.22m
Calculating the cost of an additional life year: cancer 2

• Recall: in FY2006/7 cancer spend totalled £4,122m so a 1% increase would cost £41.22m

• How many life years would this save?

• Across 2006/08 total life years lost to cancer was 2,207,021, with an annual average of 735,674 life years lost

• Thus a 1% increase in expenditure costing £41.22m would be associated with (0.00342*735,674 =) 2,516 fewer life years lost…

...and each life year saved would cost £16,383 (=£41.22m/2,516).

This estimate does not incorporate any quality of life effect.
Calculating the cost of an additional life year: the big four PBCs

• Can apply same process to other programmes

• Consider first the big four programmes (big in terms of life years lost)

• Cost per additional life year estimates
  Cancers and tumours £16,383
  Circulatory problems £9,466
  Respiratory problems £11,593
  Gastro-intestinal problems £20,892

• Estimates reasonably similar

• These estimates do not incorporate any quality of life effect
Calculating the cost of an additional life year: the other seven PBCs with a mortality rate

- Can also apply same process to other seven programmes

- Cost per additional life year estimates
  - Infectious diseases £630,798
  - Endocrine problems £114,416
  - Neurological problems £1,129,960
  - Genito-urinary problems £14,266,789
  - Trauma & injuries n/a
  - Maternity & neonates £45,158

- Estimates very dis-similar (from each other and big four PBCs)

- These estimates do not incorporate any quality of life effect
### The cost of an additional life year in individual programmes: summary

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cost per additional life year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cancers and tumours</td>
<td>£16,383</td>
</tr>
<tr>
<td>2 Circulatory problems</td>
<td>£9,466</td>
</tr>
<tr>
<td>3 Respiratory problems</td>
<td>£11,593</td>
</tr>
<tr>
<td>4 Gastro-intestinal problems</td>
<td>£20,892</td>
</tr>
<tr>
<td>5 Infectious diseases</td>
<td>£630,798</td>
</tr>
<tr>
<td>6 Endocrine problems</td>
<td>£114,416</td>
</tr>
<tr>
<td>7 Neurological problems</td>
<td>£1,129,960</td>
</tr>
<tr>
<td>8 Genito-urinary problems</td>
<td>£14,266,789</td>
</tr>
<tr>
<td>9 Trauma &amp; injuries</td>
<td>n/a</td>
</tr>
<tr>
<td>10/11 Maternity &amp; neonates</td>
<td>£45,158</td>
</tr>
</tbody>
</table>

- Why are costs much larger for last seven PBCs?
- Mortality less relevant outcome indicator for these programmes
- Relatively more expenditure on chronic conditions and palliative care?
- But, as we shall see, these seven PBCs have little impact on cost of a life year across all programmes
Calculating the cost of an additional life year associated with a 1% budget change

- Hitherto have calculated the cost of an additional life year in individual programmes

- Now consider a 1% increase in total budget. What would be the cost per life year associated with this change?

- We need to know how this budgetary change would be split between each programme. See the coefficient on the PCT budget term in the expenditure equation.

- Example: the coefficient on the PCT budget term in the cancer expenditure equation (=0.52) implies that a 1% increase in budget would be associated with a 0.52% increase in expenditure in the cancer PBC.
Calculating the cost of an additional life year associated with a 1% budget change: the big 4 PBCs

- Big four programmes, 1% total budget change

- Total spend in 2006/7 of £17,268m

- 1% increase in total budget would increase spend on these PBCs by £101.35m…

- …and would reduce annual life years lost by 7,903

- Cost per life year is £12,824
Calculating the cost of an additional life year associated with a 1% budget change: the other 7 PBCs with a mortality rate

- Other seven programmes, 1% total budget change

- Total spend in 2006/7 of £16,509m

- 1% increase in total budget would increase spend on these PBCs by £96.39m…

- …and would reduce annual life years lost by 362

- Cost per life year is £266,128
Calculating the cost of an additional life year associated with a 1% budget change: recap for PBCs with a mortality rate

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Spend (£m) FY2006/7</th>
<th>Change in spend (£m) associated with 1% change in total budget</th>
<th>Change in annual life years lost associated with 1% increase in total spend</th>
<th>Cost (£) per life year gained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Big four programmes</td>
<td>£17,268</td>
<td>£101.35</td>
<td>7,903</td>
<td>£12,824</td>
</tr>
<tr>
<td>2 Other seven PBCs with a mortality rate</td>
<td>£16,508</td>
<td>£96.39</td>
<td>362</td>
<td>£266,128</td>
</tr>
<tr>
<td>3 All 11 PBCs with a mortality rate</td>
<td>£33,777</td>
<td>£197.74</td>
<td>8,265</td>
<td>£23,924</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change: what mortality gain for the other 12 PBCs?

- Cost per life year associated with a 1% budget change for those 11 PBCs with a mortality rate is £23,924

- What mortality gain should we assume for those 12 programmes without a mortality rate?

- Alternative 1: zero gain (a lower bound!)
Calculating the cost of an additional life year associated with a 1% budget change: assume zero mortality gain in 12 PBCs without a mortality indicator

<table>
<thead>
<tr>
<th></th>
<th>PBC description</th>
<th>Spend (£m) FY2006/7</th>
<th>Change in spend (£m) associated with 1% change in total budget</th>
<th>Change in annual life years lost associated with 1% increase in total spend</th>
<th>Cost (£) per life year gained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>All 11 programmes with a mortality rate</td>
<td>£33,777</td>
<td>£197.74</td>
<td>8,265</td>
<td>£23,924</td>
</tr>
<tr>
<td></td>
<td>Assume zero health gain in the other 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>programmes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>£34,119</td>
<td>£481.22</td>
<td>zero</td>
<td>n/a</td>
</tr>
<tr>
<td>4</td>
<td>All 23 programmes</td>
<td>£67,896</td>
<td>£678.96</td>
<td>8,265</td>
<td>£82,145</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change: what mortality gain for the other 12 PBCs?

- What health gain should we assume for those 12 programmes without a mortality rate?

- Alternative 2: same gain on average as is observed for the 11 PBCs with a mortality rate, but a zero gain for PBC23 (GMS)

- On the assumption that gain associated with primary care reflected in programme specific mortality rates
Calculating the cost of an additional life year associated with a 1% budget change: assume zero health gain in PBC23 and average gain in 12 other PBCs

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Change in spend (£m) associated with 1% change in total budget</th>
<th>Change in annual life years lost associated with 1% increase in total spend</th>
<th>Cost (£) per life year gained</th>
</tr>
</thead>
<tbody>
<tr>
<td>All eleven programmes with a mortality rate</td>
<td>£33,777</td>
<td>8,265</td>
<td>£23,924</td>
</tr>
<tr>
<td>Assume zero health gain in PBC 23 (GMS, other)</td>
<td>£10,585</td>
<td>zero</td>
<td>n/a</td>
</tr>
<tr>
<td>Assume same gain in remaining 11 PBCs as in 11 PBCs with mortality rate</td>
<td>£23,534</td>
<td>16,845</td>
<td>£23,924</td>
</tr>
<tr>
<td>All 23 programmes</td>
<td>£67,896</td>
<td>25,110</td>
<td>£27,039</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change: recap

- Two alternatives:

  (a) if assume zero mortality gain in 11 PBCs without a mortality rate, then the cost is £82,145

  (b) if we assume a zero health gain in PBC 23 and the same gain in the other 11 PBCs without a mortality rate as in the 11 PBCs with a mortality rate, then the cost is £27,039.
Limitations 1

- Limited outcomes data (mortality rates for only 11 programmes) – but assumptions about gains in other programmes can be used to extend results to other PBCs

- Cross sectional data set (single year): intend to extend to panel

- Mortality experience the result of years of endeavour – but mortality data for three years. Could assume PCTs in equilibrium.

- Some health system expenditure difficult to assign to particular programmes
Limitations 2

- PCT accounting practice variable. PB accounts not audited.

- Primary Care Trusts were re-organised in 2006/7 and will be abolished so panel will be limited.

- No adjustment for quality of life effects at this stage.
Conclusions 1

• Expenditure has a demonstrably positive effect on outcomes in ten of the 11 programmes studied

• Approach most successful for those PBCs where mortality is a relevant outcome indicator

• Cost of an additional life year similar in these programmes:
  – £16,383 in cancer programme
  – £9,466 in circulatory disease programme
  – £11,593 in respiratory problems programme
  – £20,892 in gastro-intestinal problems programme
Conclusions 2

• Cost of an additional life year similar in these programmes:
  – £16,383 in cancer programme
  – £9,466 in circulatory disease programme
  – £11,593 in respiratory problems programme
  – £20,892 in gastro-intestinal problems programme

• These cost estimates are similar to those obtained previously using data on expenditure and mortality for different periods. Suggests results are relatively stable.

• For a small total budget change, the cost of a life year across all PBCs varies between £27k and £82k depending on assumed mortality gain in PBCs without a mortality rate.
Feedback wanted
How could we improve this study?

Q1 How could we improve the existing approach?
   Eg with better/more data on expenditure/need/outcomes?

Q2 Is there a better way to incorporate expenditure on PBCs:
   (a) where mortality data is less relevant?
   (b) where no mortality indicator is available?

Q3 How could we strengthen model estimation?
   Should we repeat the analysis for other years?

Q4 Is there an alternative approach? If so, what is it?

Q5 Any other comments/suggestions?
Appendix

Further information about the calculations behind the cost of life year estimates
## Calculating the cost of an additional life year: the big four PBCs

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Spend (£m) FY2006/7</th>
<th>1% of spend (£m) FY2006/7</th>
<th>Outcome elasticity (without negative sign)</th>
<th>Total life years lost, &lt;75 years, 2006/08</th>
<th>Annual average life years lost (=E/3)</th>
<th>Change in annual life years lost associated with 1% increase in spend (=F*D)</th>
<th>Cost (£) per life year gained (=C/G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cancers and tumours</td>
<td>£4,122</td>
<td>£41.22</td>
<td>0.342</td>
<td>2,207,021</td>
<td>735,674</td>
<td>2,516</td>
<td>£16,383</td>
</tr>
<tr>
<td>2 Circulatory problems</td>
<td>£6,161</td>
<td>£61.61</td>
<td>1.434</td>
<td>1,361,634</td>
<td>453,878</td>
<td>6,509</td>
<td>£9,466</td>
</tr>
<tr>
<td>3 Respiratory problems</td>
<td>£3,285</td>
<td>£32.85</td>
<td>2.622</td>
<td>324,223</td>
<td>108,074</td>
<td>2,834</td>
<td>£11,593</td>
</tr>
<tr>
<td>4 Gastro-intestinal problems</td>
<td>£3,700</td>
<td>£37.00</td>
<td>1.536</td>
<td>345,908</td>
<td>115,303</td>
<td>1,771</td>
<td>£20,892</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year: the other seven PBCs with a mortality indicator

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Spend FY2006/7 (£m)</th>
<th>1% of spend FY2006/7 (£m)</th>
<th>Outcome elasticity (without negative sign)</th>
<th>Total life years lost, &lt;75 years, 2006/08</th>
<th>Annual average life years lost (=E/3)</th>
<th>Change in annual life years lost associated with 1% increase in spend (=F*D)</th>
<th>Cost (£) per life year gained (=C/G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Infectious diseases</td>
<td>£1,053</td>
<td>£10.5</td>
<td>0.047</td>
<td>106,552</td>
<td>35,517</td>
<td>16.7</td>
<td>£630,798</td>
</tr>
<tr>
<td>2 Endocrine problems</td>
<td>£1,852</td>
<td>£18.5</td>
<td>0.842</td>
<td>57,672</td>
<td>19,224</td>
<td>161.9</td>
<td>£114,416</td>
</tr>
<tr>
<td>3 Neurological problems</td>
<td>£2,790</td>
<td>£27.9</td>
<td>0.112</td>
<td>66,137</td>
<td>22,046</td>
<td>24.7</td>
<td>£1,129,960</td>
</tr>
<tr>
<td>4 Genito-urinary problems</td>
<td>£3,482</td>
<td>£34.8</td>
<td>0.073</td>
<td>10,030</td>
<td>3,343</td>
<td>2.4</td>
<td>£14,266,789</td>
</tr>
<tr>
<td>5 Trauma &amp; injuries</td>
<td>£3,758</td>
<td>£37.6</td>
<td>n/a</td>
<td>30,000</td>
<td>10,000</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>6/7 Maternity &amp; neonates</td>
<td>£3,574</td>
<td>£35.7</td>
<td>0.482</td>
<td>492,600</td>
<td>164,200</td>
<td>791.4</td>
<td>£45,158</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change

<table>
<thead>
<tr>
<th>PBC description</th>
<th>FY2006/7</th>
<th>Spend elasticity</th>
<th>Change in spend (£m) associated with 1% change in total budget (B*C/100)</th>
<th>Outcome elasticity (without negative sign)</th>
<th>Total life years lost, &lt;75 years, 2006/08</th>
<th>Annual average life years lost (=F/3)</th>
<th>Change in annual life years lost associated with 1% increase in total spend (=C<em>E</em>G/100)</th>
<th>Cost (£) per life year gained (=D/H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancers and tumours</td>
<td>£4,122</td>
<td>0.520</td>
<td>£21.43</td>
<td>0.342</td>
<td>2,207,021</td>
<td>735,674</td>
<td>1,308</td>
<td>£16,383</td>
</tr>
<tr>
<td>Circulatory problems</td>
<td>£6,161</td>
<td>0.540</td>
<td>£33.27</td>
<td>1.434</td>
<td>1,361,634</td>
<td>453,878</td>
<td>3,515</td>
<td>£9,466</td>
</tr>
<tr>
<td>Respiratory problems</td>
<td>£3,285</td>
<td>0.672</td>
<td>£22.08</td>
<td>2.622</td>
<td>324,223</td>
<td>108,074</td>
<td>1,904</td>
<td>£11,593</td>
</tr>
<tr>
<td>Gastro-intestinal problems</td>
<td>£3,700</td>
<td>0.664</td>
<td>£24.57</td>
<td>1.536</td>
<td>345,908</td>
<td>115,303</td>
<td>1,176</td>
<td>£20,892</td>
</tr>
<tr>
<td><strong>Big four programmes</strong></td>
<td>£17,268</td>
<td><strong>£101.35</strong></td>
<td><strong>4,238,786</strong></td>
<td><strong>1,412,929</strong></td>
<td><strong>7,903</strong></td>
<td><strong>£12,824</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other seven programmes</td>
<td>£16,509</td>
<td><strong>£96.39</strong></td>
<td><strong>762,991</strong></td>
<td><strong>254,330</strong></td>
<td><strong>362</strong></td>
<td><strong>£266,128</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All eleven programmes with a mortality rate</td>
<td>£33,777</td>
<td><strong>£197.74</strong></td>
<td><strong>5,001,777</strong></td>
<td><strong>1,667,259</strong></td>
<td><strong>8,265</strong></td>
<td><strong>£23,924</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change: assume zero mortality gain in the 12 PBCs without a mortality indicator

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Spend (£m) FY2006/7</th>
<th>Spend elasticity</th>
<th>Change in spend (£m) associated with 1% change in total budget (B*C/100)</th>
<th>Outcome elasticity (without negative sign)</th>
<th>Total life years lost, &lt;75 years, 2006/08</th>
<th>Annual average life years lost (=F/3)</th>
<th>Change in annual life years lost associated with 1% increase in total spend (=C<em>E</em>G/100)</th>
<th>Cost (£) per life year gained (=D/H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 11 programmes with a mortality rate</td>
<td>£33,777</td>
<td></td>
<td>£197.74</td>
<td></td>
<td>5,001,777</td>
<td>1,667,259</td>
<td>8,265</td>
<td>£23,924</td>
</tr>
<tr>
<td>Assume zero health gain in the other 12 programmes</td>
<td>£34,119</td>
<td></td>
<td>£481.22</td>
<td></td>
<td>zero</td>
<td>zero</td>
<td>zero</td>
<td>n/a</td>
</tr>
<tr>
<td>All 23 programmes</td>
<td>£67,896</td>
<td></td>
<td>£678.96</td>
<td></td>
<td>5,001,777</td>
<td>1,667,259</td>
<td>8,265</td>
<td>£82,145</td>
</tr>
</tbody>
</table>
Calculating the cost of an additional life year associated with a 1% budget change: assume zero mortality gain in PBC23 and average gain in 11 other PBCs

<table>
<thead>
<tr>
<th>PBC description</th>
<th>Spend (£m) FY2006/7</th>
<th>Spend elasticity</th>
<th>Change in spend (£m) associated with 1% change in total budget (B*C/100) negative sign</th>
<th>Outcome elasticity (without negative sign)</th>
<th>Total life years lost, &lt;75 years, 2006/08</th>
<th>Annual average life years lost (=F/3)</th>
<th>Change in annual life years lost associated with 1% increase in total spend (=C<em>E</em>G/100)</th>
<th>Cost (£) per life year gained (=D/H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All eleven programmes with a mortality rate</td>
<td>£33,777</td>
<td></td>
<td>£197.74</td>
<td>5,001,777</td>
<td>1,667,259</td>
<td>8,265</td>
<td>£23,924</td>
<td></td>
</tr>
<tr>
<td>Assume zero health gain in PBC 23 (GMS, other)</td>
<td>£10,585</td>
<td>0.739</td>
<td>£78.22</td>
<td>zero</td>
<td>zero</td>
<td>zero</td>
<td>zero</td>
<td>n/a</td>
</tr>
<tr>
<td>Assume same gain in remaining 11 PBCs as in 11 PBCs with mortality rate</td>
<td>£23,534</td>
<td></td>
<td>£403.00</td>
<td>16,845</td>
<td></td>
<td></td>
<td>£23,924</td>
<td></td>
</tr>
<tr>
<td>All 23 programmes</td>
<td>£67,896</td>
<td></td>
<td>£678.96</td>
<td>25,110</td>
<td></td>
<td></td>
<td>£27,039</td>
<td></td>
</tr>
</tbody>
</table>