Applying Economic Analyses to Chronic Disease-related Interventions: A Primer

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Stated Preferences by Potential Participants

- Health Systems + Sustainability
- Introduction
- Special Topics
- Economic Eval + Costing
- Advanced + Emerging
What do Economists Care About?

• *Scarcity* of Resources: Questions about Efficiency, Growth and (In)Equality

• *Scarcity* of Resources: The *Roots* of Human and Organizational Behaviour that Drive Choices among Alternative Actions

• *Scarcity* of Resources: Assessing the *Desirability* of Policy Alternatives
Growth: Increasing the Availability of Resources

Graph showing the increase in resources availability for individual 1 from point C to point D.
Impoverishment/Inequality:
Individual 2 is Poor and Individual 1 is Not

- A*
- B*
- C

Poverty Line
Measures Used to Capture these Outcomes

• Effects on Ill Health on National Output and National Output per Capita

• Share of Income due Health Spending in Excess of “Threshold” (Catastrophic Spending)

• Proportion of People Falling Below the Poverty Line due to Income Losses and Health Expenditure; More Commonly: Proportion of People falling below the Poverty Line due to Health Spending
Examples: Economic Impacts of Ill Health

The macroeconomic impact of non-communicable diseases in China and India: Estimates, projections, and comparisons

David E. Bloom a, b, Elizabeth T. Caiero-Fonseca a, b, Mark E. McGovern a, b, Klaus Prettnier c, Anderson Stanciole d, Jonathan Weiss e, f, Samuel Bakkila e, f, Larry Rosenberg e, f
Economics of Individual (Rational) Behaviour

Actions yields *benefits*, but also *foregone opportunities*. A specific action is taken by an individual when perceived benefits (B) *exceed* perceived costs (C) of foregone opportunities

\[ B - C > 0 \]

*Examples:*

- High dropout rates in Hospital-based Rehabilitation for COPD patients in Australia when compared to Home-based Rehabilitation
- High Price Responsiveness of Poor when seeking Healthcare Services in Multiple Studies
Determinants of health care demand in poor, rural China: the case of Gansu Province

Dongfu Qian,1,* Raymond W Pong,2 Aitian Yin,3 K V Nagarajan4 and Qingyue Meng3

Accepted 3 December 2008

This paper examines the determinants that influence health care demand decisions in rural areas of Gansu province, China. This represents the first effort to identify and quantify the effect of price of care on choice of provider in China, and is the first quantitative examination of this topic focusing on poor rural areas in China. In the three-tier health care system in rural China, we further distinguish the public village clinics and private village clinics using a mixed multinomial logit model. The results show that price and distance play significant roles in choice of health care provider. The price elasticity of demand for outpatients is higher for low-income groups than for high-income groups. When outpatients have particular concerns about provider quality or reputation, or when their health status is poor, distance tends to matter less, i.e. they are willing to travel further in order to obtain better treatment for their illness. Insurance status has a significant impact on the choice of public village clinics relative to self-treatment. Furthermore, age and the attributes of illness are also statistically significant factors. We discuss the policy implications of the results for meeting the health care needs of the poor in rural China.
The “Rational” Behaviour of Organizations

Moving away from Fee-for-Service payment for hospital admissions to a payment system where fees were fixed in advance for type of hospital admission (prospective payment), lowered healthcare spending growth and out of pocket spending by patients.

A theoretical framework where hospitals respond to financial incentives – by lowering costs of care when payments are fixed in advance – is consistent with this observed outcome.
What about Government ‘Behaviour’?

Government Efforts to Reform its Public-Sector dominated health system stymied by the perception in the leadership that it did not have public support, and its view that the viewpoints espoused by key interest groups opposed to the reform had public opinion on their side.
The Economic Roots of NCDs: Obesity

Stylized Facts for US (Philipson 2008):

- Proportion of overweight adults increased from 42% in the early 1960s to nearly 68% in 2008 (CDC).


- Food Prices (per calorie consumed) fell Continuously

- Rising Female Labour Force Participation
Understanding Obesity from an Economic Lens

• Price of calorie consumption *decreased* because
  
  (a) agricultural productivity increased
  (b) preparation technology (home *versus* market) *and* economies of scale in production of processed food

• *Price of ‘calorie spending’ increased*

  (a) Movement from labor to leisure – changing nature of jobs: *pay* as opposed to being *paid* for calorie expenditure
Examples of Departures from rational behavior:

- Benefits and costs are weighted differently by individuals
- Individuals discount distant benefits at very high rates relative to current costs of medication adherence (hyperbolic discounting)
- Forgetfulness, difficulty in implementing complex adherence tasks for medication regime associated with chronic conditions

Scaling for Economists: Lessons from the Non-Adherence Problem in the Medical Literature

Omar Al-Ubaydli, John A. List, Danielle LoRe, and Dana Suskind

Many economists would be surprised to learn that patients adhere to the medications that physicians prescribe as little as 50 percent of the time (McDonald, Garg, and Haynes 2002). Clinical non-adherence is more than just an inconvenience to medical practitioners—it represents wasted resources and causes medical problems to evolve into forms that are even more expensive to
Assessing (Economic) Implications of Alternative Courses of Policy Action: National Income

• Implications of Intervention for “Cost of Illness”

• Implications of intervention for National Output and Output per Capita (GDP or GDP per capita)
The ‘Cost of Illness’ (COI) Measure

• COI (of a disease): Direct (medical care) costs + Indirect costs (‘Lost Income’) to Households and/or Society

\[
\sum_{h=1}^{H} \sum_{i=1}^{I_h} MC_{ih} + \sum_{h=1}^{H} \sum_{i=1}^{I_h} u_{ih} p_{ih} d_{ih} W_{ih}
\]

• \(MC_{ih}\) refers to medical expenditures for NCD for individual ‘i’ in household “h”, when there are H households

• ‘u’ refers to the employment rate; ‘p’ is the ‘labor force participation rate’, ‘d’ is the number of days sick or unable to work and ‘W’ is the gross wage (plus benefits). ‘ih’ refers to individual “i” living in household ‘h’
Arguments in Favour of COI Method

• Outcomes appear ‘reasonable’
  (a) large health expenditures lead to lowered availability of other potentially desirable items to people
  (b) captures losses in output

• Relatively Easy to Calculate
Cost of Illness Estimates for NCDs: Some Estimates from the Literature

• Diabetes

COI for India (Medical Care Costs = US$2.6 Billion; Indirect Costs = $20.4 Billion
COI for USA (Medical Care Costs = US$134.8 Billion; Indirect Costs = US$41.4 Billion
Source: Economic Intelligence Unit (2007)

• Seven chronic conditions (cancer, diabetes, hypertension, stroke, heart disease, pulmonary conditions, mental illness) cost the US economy $1.3 trillion annually (COI)

$1.1 Trillion of Indirect Costs
$200 Billion of Direct Costs
Source: Carmona et al. (2007), The Milken Institute
Limitations of the COI Measure

- Governments are interested in impacts on GDP or GDP per capita

- Conceptually iffy: standard approach is often to add a single year measure (usually medical care costs in the current year) to total income losses across several years (if people die or become disabled). This sometimes leads to very large estimates. What happens if unemployment rates are high?

- Usually fails to consider competing risks and intra-household coping responses

- Perhaps best used as an indicator of losses to small groups of households affected by the health condition (or gains from intervention) after limiting analysis to similar time periods for Direct Costs and Indirect Costs.
Measuring Impacts on National Income: The Aggregate Production Function

If Gross Domestic Product (National Income) is denoted by \( Y \) and suppose

\[
Y = f(K, L, T)
\]

• \( T \) (technological achievement), \( L \) (‘effective’ labour) and \( K \) (physical capital, e.g., machinery)

• What ‘other’ inputs can you think of?

**Premise**: National income growth is driven by changes in \( T, K \) and \( L \)
Impacts of NCDs on National Income

• **Impact on Human Resources (labor inputs and productivity):** loss of work time due to illness and disability, lower levels of schooling, loss of ‘experienced’ workers, care-giving

• **Impact on Physical Capital Stock:** Savings for investment diverted into medical expenses – government, households, firms; impact on foreign direct investment (FDI).

• **Technological Change:** Allocations to R & D; reallocating resources for R & D to medical care
Aggregate Impacts: Mathematical Models

• Start by describing a *specific* mathematical relationship between Y and T, L and K

• Plug in key parameter estimates of production function (pre-existing data)

• Assess impact of health spending on government, firms and household savings and translate that into impacts on investment

• Assess the impact of morbidity/mortality on labor time and labor quality.

In general, it is difficult to assess the effect on technology
Mathematical Models for Estimating GDP Impacts

<table>
<thead>
<tr>
<th>Country</th>
<th>Cumulative Loss of GDP between 2006-2015 from major chronic conditions (US$ Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>13.81</td>
</tr>
<tr>
<td>India</td>
<td>16.68</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.49</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.62</td>
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<tr>
<td>Vietnam</td>
<td>0.27</td>
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</tbody>
</table>
Aggregate Impacts: Regression Models

• Cross-national or cross-provincial regression analyses linking GDP or GDP per capita to

(a) health indicators such as life expectancy at birth/various ages and;
(b) other determinants of growth (from the aggregate production function) such as education, work experience, indicators of physical capital stock.

• Relate NCD morbidity/mortality to the above ‘explanatory’ variables from other empirical analyses to arrive at estimated effects on GDP or GDP per capita.
### Determinants of GDP: Regression Analysis

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Natural Log (Labour Input)</td>
<td>0.708</td>
<td>0.522</td>
</tr>
<tr>
<td>Natural Log (Physical Capital)</td>
<td>0.342</td>
<td>0.340</td>
</tr>
<tr>
<td>Life Expectancy at birth (years)</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>Natural Log (Life Expectancy at Birth)</td>
<td></td>
<td>0.723</td>
</tr>
<tr>
<td>Years of Schooling</td>
<td>0.082</td>
<td></td>
</tr>
<tr>
<td>Natural Log (Years of Schooling)</td>
<td></td>
<td>0.256</td>
</tr>
<tr>
<td>Experience (in years)</td>
<td>0.266</td>
<td></td>
</tr>
<tr>
<td>Experience-Squared</td>
<td>-0.005</td>
<td></td>
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</tbody>
</table>
NCDs and Economic Impacts: The Case of Multiple Competing Risks

Longevity Complementarities under Competing Risks

William H. Dow
Tomas J. Philipson
Xavier Sala-i-Martin

AMERICAN ECONOMIC REVIEW
VOL. 89, NO. 5, DECEMBER 1999
(pp. 1358-1371)

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• When there are multiple competing causes of morbidity and death, eliminating one set of causes may lead households & policymakers to direct spending (or resources) to other health conditions

• Ascribing economic impacts of NCDs needs care when competing risks are involved. Special caution when estimating the impacts of specific conditions (say Diabetes)
Distribution of Aggregate Outcomes: Catastrophic Spending, Impoverishment and Income

Common Assumption: Ill health and health spending DO NOT reduce total household income or expenditures (Doorslaer et al. 2006). This is hard to defend, although valid when time periods are short.

• Proportion of people reporting catastrophic spending (proportion of total income spent on medical care exceeding some threshold)

• Proportion of people experiencing medical impoverishment (whether disposal income left over after medical spending is enough to live on)

Many health service intervention trials offer opportunities to assess these impacts in a more careful way.
# Economic Burden of Cancer on Indian Households

Mahal et al (2013)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Households With Cancer</th>
<th>Matched Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>OOP Spending in 15-day reference period (INR)</td>
<td>118.33</td>
<td>44.77</td>
</tr>
<tr>
<td>Outpatient Visits (15-day period per 100 persons)</td>
<td>20.1</td>
<td>14.2</td>
</tr>
<tr>
<td>Hospital stays (1-year period per 100 persons)</td>
<td>27.5</td>
<td>10.2</td>
</tr>
<tr>
<td>OOP Expenditure on individuals without cancer (15-day period) (INR)</td>
<td>38.30</td>
<td>48.98</td>
</tr>
<tr>
<td>OOP Expenditure on conditions other than cancer (15-day period, INR)</td>
<td>15.54</td>
<td>28.83</td>
</tr>
<tr>
<td>Adult Work Participation Rate (%)</td>
<td>48.50</td>
<td>51.82</td>
</tr>
</tbody>
</table>
Economic Evaluation of NCD Interventions

Usually *Two* Forms:

- Whether an Intervention (typically a health services type intervention) is effective in influencing outcomes of interest?
  (e.g., Statistical Significance, or Effect size)

- Is the intervention ‘worth it’, given the investment required?
  (This is what people in the Ministry of Finance are usually interested in)
Cost-Effectiveness Analysis

- Comparison of two or more interventions (or a new intervention compared with an existing practice)

- Outcomes are measures of health (number of years lived, QALYs, DALYs, etc.), that are likely to be affected by the interventions

- ‘Costs’ of an intervention depend on the entity making a decision (Private versus Social Costs) – includes financial AND non-financial (opportunity) costs.

- Comparison of Ratios of Outcomes to Costs (Cost-Effectiveness Ratios). Note that these assessments are essentially probabilistic, and that costs and outcomes are jointly determined

The Incremental Cost-Effectiveness Ratio is useful for comparing a new intervention with an existing practice.
Cost-Benefit Analysis

• Both Benefits and Costs are measured in *monetary* terms.

• *Net Benefits (B – C) or the Net Present Value (NPV) Method*: Interventions are ranked by the magnitude of ‘net benefit’

\[
\text{NPV}(0, r, T) = \sum_{t=0}^{T} \frac{(B_t - C_t)}{(1+r)^t}
\]

*Rate of Return or the Internal Rate of Return (IRR) method*. This estimates the annual average return on investment in the intervention and ranks interventions by ‘rate of return’. The IRR is the rate of return that solves the following equation

\[
\sum_{t=0}^{T} \frac{(B_t - C_t)}{(1+r)^t} = 0
\]
Example: Internal Rate of Return

- Imagine an investment of $2 today yields a health benefit equivalent to $3, one year from now. Then the internal rate of return (or IRR) is given by $R$ where

$$-2 + \frac{3}{(1 + R)} = 0$$

So what is $R$?
Economic Evaluation: State of the Literature

• Many Economic Evaluations of NCD interventions in High Income Countries

Excellent information base, including financial data, validated Quality of Life instruments exist, excellent household and other survey data, cost data, etc.

Lack information on household-level economic impacts – heavy focus on clinical outcomes

• Very limited literature in Low and Middle-Income countries
Some Outstanding Issues (for Group Work)

• How does one undertake an economic evaluation when “scaling up” an intervention?

  What makes ‘scaling up’ different (if at all) from a standard intervention exercise? How does this impact the economic evaluation strategy?

• How does one evaluate Equity and Sustainability outcomes of a program of implementation research?

  What does one mean by sustainability and equity? How might one measure one or both of them? What are the implications (if any) for economic evaluation?