ECONOMICS OF TREATMENT CHOICE AND IMPLICATIONS FOR COST-EFFECTIVENESS POLICY

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What are the potential uses of CBA/CEA?

- Public funding of medical treatment
  - UK (NICE)
  - Analogous agencies in Canada, Germany, Australia, etc.
- Agency advocacy (CDC advocacy re: preventative interventions – immunization, Pap smears, HIV screening)
- Private insurer coverage decisions
- General policy decision – value to the king!
  - Bridge
  - School
  - Revise the City Charter to move the Department of Prisons out from under the domain of the Department of Human Services.
What are analyses based on?

• Methodologies
  • Clinical trials
  • Decision models
  • What else?
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• Methodologies
  • Clinical trials
  • Decision models
  • What else?

• Data
  • Accounting data from trials
  • Accounting data more broadly – cost reports, etc.
  • Clinical data from trials
  • Outcome data from trials
  • Outcome data more broadly – observational, etc.
  • Survey data – cohorts, QALYs, WTP
  • Administrative data
  • What else?
Can we infer CEA/CBA in practice?

- Causality
- External validity
  - Benefit/effectiveness and cost heterogeneity across hospitals, doctors
  - Diffusion of best practices, dynamics in cost, learning
- Patient heterogeneity
  - Unobserved
  - Observed to patient, provider, and payer
  - Observed only to patient/provider
- “Off-label” use
- Larger questions
  - Can we make optimal policy decision in the presence of these factors?
  - Or implement second-best program in the presence of these factors?
Examples: benefit heterogeneity in cardiac care

• Provider benefit heterogeneity
  • Patients receiving stents in low-volume medical centers have higher mortality than in low-volume medical centers
  • Carotid endarterectomy mortality in clinical trial hospitals (1.4%) lower than in nontrial high-volume hospitals (1.7%) or low-volume hospitals (2.5%)

• Patient CE heterogeneity: percutaneous coronary intervention (PCI)
  • Substantial improvement in survival (compared to drug therapy) within 12/24 hours of heart attack – highly cost-effective
  • No mortality benefit, small (transitory) symptom benefit for patients with stable angina – not cost-effective

See Chandra, Jena, Skinner (JEP 2011)
Example: hospital CE heterogeneity

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Adj. 1 year mortality, 1992</td>
<td>0.346</td>
<td>0.366</td>
<td>0.415</td>
<td>0.326</td>
<td>0.361</td>
<td>0.291</td>
</tr>
<tr>
<td>Adj. 1 year mortality, 2004</td>
<td>0.297</td>
<td>0.250</td>
<td>0.305</td>
<td>0.289</td>
<td>0.356</td>
<td>0.294</td>
</tr>
<tr>
<td>Mortality diff.</td>
<td>−0.049</td>
<td>−0.116</td>
<td>−0.110</td>
<td>−0.037</td>
<td>−0.005</td>
<td>0.003</td>
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<tr>
<td>Adj. 1 year expenditures, 1992</td>
<td>19,991</td>
<td>14,785</td>
<td>16,492</td>
<td>22,961</td>
<td>18,799</td>
<td>15,425</td>
</tr>
<tr>
<td>Adj. 1 year expenditures, 2004</td>
<td>27,388</td>
<td>21,904</td>
<td>23,494</td>
<td>41,002</td>
<td>28,717</td>
<td>23,326</td>
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<tr>
<td>Expenditure diff.</td>
<td>7,397</td>
<td>7,119</td>
<td>7,001</td>
<td>18,041</td>
<td>9,918</td>
<td>7,901</td>
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<tr>
<td>PCI rate, 1992</td>
<td>0.27</td>
<td>0.33</td>
<td>0.17</td>
<td>0.23</td>
<td>0.23</td>
<td>0.43</td>
</tr>
<tr>
<td>PCI rate, 2004</td>
<td>0.47</td>
<td>0.59</td>
<td>0.43</td>
<td>0.42</td>
<td>0.35</td>
<td>0.53</td>
</tr>
<tr>
<td>Beta blocker, 1994/95</td>
<td>0.67</td>
<td>0.64</td>
<td>0.65</td>
<td>0.76</td>
<td>0.55</td>
<td>0.35</td>
</tr>
<tr>
<td>Aspirin (%), 1994/95</td>
<td>0.88</td>
<td>0.82</td>
<td>0.91</td>
<td>0.95</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>Effectiveness ratio</td>
<td>$12,455</td>
<td>$5,064</td>
<td>$5,251</td>
<td>$40,231</td>
<td>$163,633</td>
<td>Not defined</td>
</tr>
</tbody>
</table>

See Chandra, Jena, Skinner (JEP 2011)
Application: technology and expenditure growth

Contrast 3 types of health care treatments with different contributions to trends in health care sector productivity

• Type I: High cost-effectiveness for treated patients
  • Antibiotics (bacterial infection)
  • Aspirin/beta blockers (heart attack patients)
  • Anti-retroviral drugs (HIV/AIDS)

See Chandra & Skinner (JEL 2012)
Application: technology and expenditure growth

Contrast 3 types of health care treatments with different contributions to trends in health care sector productivity

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See Chandra & Skinner (JEL 2012)
Application: technology and expenditure growth

Contrast 3 types of health care treatments with different contributions to trends in health care sector productivity

• Type II: High productivity for some patients, low cost-effectiveness for treated patients
  • Angioplasty with stent
    • Heart attack vs. stable angina
    • Variation in taste for surgery

See Chandra & Skinner (JEL 2012)
Application: technology and expenditure growth
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Contrast 3 types of health care treatments with different contributions to trends in health care sector productivity

• Type III: Limited evidence on productivity
  • Vertebroplasty
  • Proton beam therapy for prostate cancer
  • Management of chronic illness

See Chandra & Skinner (JEL 2012)
Application: technology and expenditure growth

Key argument

• Improved health comes from Type I/II treatments
• Cost growth comes from Type II/III treatments

What to do about overuse of Type II/III treatments?
• Flat of the curve?

Lack of evidence vs. evidence of lack?
• Innovation is a process
• Expert opinion evolves

• See, e.g., American Heart Association and American College of Cardiology new guidelines: MDs urged to use statins as first-line treatment broadly for heart disease risk (controversial)
Application: technology and expenditure growth

Recent controversy – robotic surgery

• Expensive ($1-2.5m up front)
• Reduces complications from surgery (e.g., removal of prostate tumors)
• Shorter hospital stay
• Arguments
Application: technology and expenditure growth

Recent controversy – robotic surgery

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• Arguments
  • Zeke Emanuel – a “pseudo-innovation”
  • Mark Pauly – I don’t think you ought to regard [shorter stays, fewer complications] as being of no value
  • Scott Harrington – it often takes many years of experience with a new medical technology to really determine how well it’s working
Potential solution (e.g., Pauly 2012)

Typical approach: use cost-effectiveness to determine coverage *per se*

- Zero cost-sharing for covered services
- No coverage/reimbursement otherwise

Idea: use cost-effectiveness along with optimal insurance design

- Cost-sharing in [0,1] can expand coverage to those who value it
  - Depends on how decision-maker views consumer “valuation”
  - Depends on observability of heterogeneity
Baseline model

Measure benefit $B$, cost $C$ for target (homogeneous) population; cover if $B*W > C$
## Introducing heterogeneity

<table>
<thead>
<tr>
<th>Monetary Value of Health</th>
<th>Marginal Health Product</th>
<th>Homogenous</th>
<th>Heterogenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogenous</td>
<td></td>
<td>(1) Simple Benchmark Model</td>
<td>(2) Preference-driven Demand</td>
</tr>
<tr>
<td>Heterogenous</td>
<td></td>
<td>(3) Health-driven Demand</td>
<td>(4) Combined Care</td>
</tr>
</tbody>
</table>
Introducing cost-sharing – numerical example

Cost Sharing and Marginal Cost Effectiveness: Example

<table>
<thead>
<tr>
<th>Coinurance Proportion</th>
<th>Total Spending</th>
<th>Fair Premium</th>
<th>Total QALYs</th>
<th>Marginal QALYs</th>
<th>Marginal $/QALY</th>
<th>Average $/QALY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100,000</td>
<td>0</td>
<td>2.5</td>
<td>2.5</td>
<td>40,000</td>
<td>40,000</td>
</tr>
<tr>
<td>0.75</td>
<td>110,000</td>
<td>27,500</td>
<td>2.68182</td>
<td>0.18182</td>
<td>55,000</td>
<td>41,000</td>
</tr>
<tr>
<td>0.50</td>
<td>120,000</td>
<td>60,000</td>
<td>2.807</td>
<td>0.125</td>
<td>80,000</td>
<td>42,750</td>
</tr>
<tr>
<td>0.25</td>
<td>130,000</td>
<td>97,500</td>
<td>2.876</td>
<td>0.0625</td>
<td>160,000</td>
<td>45,300</td>
</tr>
<tr>
<td>0</td>
<td>140,000</td>
<td>140,000</td>
<td>2.907</td>
<td>0.0313</td>
<td>320,000</td>
<td>48,275</td>
</tr>
</tbody>
</table>
Some wrinkles

• Equity

• Administrative cost of insurance – trade off against health benefit, risk protection

• For new services (and elsewhere), demand curve not observed

• Risk protection
This approach in practice – Einav, Finkelstein, & Williams (2015)

Graphical framework for evaluation of alternative insurance options

- UK: full cost of non-CE treatments (“no top up”)
- US: full coverage (no, or little, cost)
- Middle ground: “top up”
  - Consumers pay marginal cost of more expensive treatment

Context – lumpectomy + radiation for breast cancer

- Clinical trials indicate no survival differential relative to mastectomy
- Estimate the (relative) demand curve
  - Translate distance into dollars
- Evaluate welfare effects of different insurance options
EFW: The details

• Lumpectomy + radiation costs $14K more
  • $39K for mastectomy in Medicare patients (Polsky et al., 2003)

• No observable (out-of-pocket) price variation
EFW: The details

- Lumpectomy + radiation costs $14K more
  - $39K for mastectomy in Medicare patients (Polsky et al., 2003)

- No observable (out-of-pocket) price variation

- Demand curve relates travel distance to choice
  - Radiation therapy requires 25 treatments spread over 5 weeks
EFW: The model

Figure 1: Conceptual framework: Treatment choice

- Incremental price of L (p)
- Total Cost of L
- Incremental Cost of L (c)
- L share

Points:
- A
- B
- C
- D
- E

Levels:
- $L_{No\ top-up}$
- $L_{Top-up}$
- $L_{Full\ coverage}$
EFW: The estimation
EFW: The welfare comparison
Some more complicated scenarios (Basu)

So far, we’ve dealt with several cases

• Homogeneity
• Heterogeneity with symmetric perfect information
• Heterogeneity with asymmetric (one-sided perfect) information
  • Optimal coinsurance balances moral hazard and risk protection

What might we miss?

• Imperfect information
• Incomplete information
• Combinations
Imperfect information

Even absent heterogeneity, consumer/patient may over- or underestimate the value of the treatment (as suggested by clinical trials)

• E.g., vertebroplasty

• Potential solution: value-based insurance
Incomplete information

Clinical evidence may provide incomplete information about the marginal benefit curve, even if consumer/patient has perfect information on that evidence.

- Suppose $B = E_i \{b(x_k)\}$, $i$ is individual, $k$ is risk class.
- If $B > p$, then for any cost-sharing $c \leq 1$, all patients will choose treatment.
- Cost-sharing doesn’t really do anything; insurance likely leads to higher equilibrium price.
- Potential solution: individualization.
There may be many scenarios with combinations of these failures

• **Suppose**
  • incomplete measure of average benefit is $B$
  • individuals have additional information $b_i$ about own risk type, which may be imperfect

• **Equilibrium outcome will depend on insurer expectations**
  • Given rational expectations, achievement of first-best will depend on distribution and precision of private information
    • (Paternalistic) copays can yield optimum through self-selection
    • If insurer anticipates more moral hazard than reality, too little coverage
Practical solution (Basu)

Econometrics

- Collapse multi (high)-dimensional outcomes and behavior into individual-level latent characteristics
- Use latent characteristics to establish individualized treatment effects

Application: Substance abuse treatments (SATs)

- Long-stay vs. short-stay vs. outpatient
- Outcome: number of robberies

Result – individualized CERs that vary by patient type and treatment choice

- For patients choosing long-stay, outpatient treatment is expected to produce the biggest reduction in robberies per patient
Practical solution (Basu)

Punchline: SP needs to know MB and DEMAND
Personalized medicine – genomics

Genomics are emerging as a method of tracing out heterogeneity in patient response

- Warfarin – two gene variants associated with increased risk of excess bleeding
- BRCA1/2 – higher risk of breast/ovarian cancer associated with particular heritable mutations
- Gleevec (imatinib) for chronic myelogenous leukemia
Personalized medicine – genomics

What are the economic issues?

- Cost of the test – some tests cost $100-$500; list price for BRCA mutations is $4,000
- What follows a positive test? Test does not clear cost-effectiveness threshold if MD does not alter Warfarin
  - What is the cost of the treatment? Gleevec costs about $87,000/year
- Cost of development
  - Monopoly rents
  - Large effect can potentially be demonstrated on smaller population
  - …but only once that population has been identified