Medical Technology and Health Care Spending

### Introduction

- Spending on HC is rising faster than GDP
- HC prices are rising faster than the CPI
- These two trends have lead for many to bemoan the “high cost” of medical care
- Robert Wood Johnson Foundation
  
  — Perhaps most critically, the need to constrain health care costs is an overarching theme of many health reform proposals.

## Table: Historical and Projected Average Annual Growth Rate in Medicare Spending Per Capita and Other Measures

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Medicare spending per capita</td>
<td>6.0%</td>
<td>5.5%</td>
</tr>
<tr>
<td>Private health insurance per capita</td>
<td>2.9%</td>
<td>2.5%</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>4.2%</td>
<td>4.1%</td>
</tr>
<tr>
<td>CPI</td>
<td>2.2%</td>
<td>2.1%</td>
</tr>
</tbody>
</table>

### Chart: Annual Increase in National Health Expenditures and Their Share of Gross Domestic Product, 1961-2023

Health care spending

- Spending = $\sum p_i q_i$, where i indexes products
- Has spending increased because
  - Using health care more (increased q)
  - Prices have increased (increased p)
  - More products
- In many cases, observers use “spending” “costs” and “prices” interchangeably
A couple of questions to consider?

• Are we spending too much on health care?
  How would we know?

• To answer these questions ask yourself
  – Why do expenditures increase?
  – Why do prices for a product rise?
  – Do not think of HC in particular – answer these questions for any particular product

Why we should not worry

• Ebbs and flows

• Is it quality adjusted?

• Who is paying the cost?

Why we should worry

• Excess burden of taxation

• Intergeneration equality

• Excess burden of moral hazard

Newhouse

• Why have expenditures (P*Q) increased so rapidly in health care

• Simple decomposition
  – Expenditures = price*quantity
  – E=PQ
  – ΔE = PΔQ + ΔPQ
  – How much due to ΔP, how much to ΔQ
Candidate reasons for increase in health care expenditures

- Aging of the population
- Increased insurance
- Increased income (income effects)
- Supplier induced demand
- Factor productivity in service sector
- End of life care

Aging

- Average age of the population has been increasing for past half century
  - Population over 65 represented 8% in 1950
  - 12 percent today
  - 20 percent by 2040
- Newhouse: hold 1950’s spending constant, increase share of elderly
- Explains only 15% of the increase

Let $\theta_i$ be fraction of people in group $i$
- 3 groups <18, 19-64, 65+
- $S_i$ be average spending per capita in group
- Total spending is a weighted average of spending across groups
- Hold spending per group constant but impose 1950’s population weights

\[
S^{50} = \theta_1^{50}S_1^{50} + \theta_2^{50}S_2^{50} + \theta_3^{50}S_3^{50}
\]

\[
S^{87} = \theta_1^{87}S_1^{87} + \theta_2^{87}S_2^{87} + \theta_3^{87}S_3^{87}
\]

\[
S^{*50} = \theta_1^{50}S_1^{87} + \theta_2^{50}S_2^{87} + \theta_3^{50}S_3^{87}
\]

\[
\frac{(S^{87} - S^{*50})}{S^{*50}} = 0.15, \text{ only 15%}
\]
Insurance

- Over time, fraction of people with insurance increased considerably
  - 1940, 10%
  - 2000, 85%
- Average coinsurance rate went from 67% to 27% between 1950 and 1987
- RAND HEI:
  - Movement from 95% to 0% coinsurance increases demand by 31%

• 95 percentage drop in price generated a 31 percent increase in use for an elasticity of demand of roughly -0.32
• 1950-1980 saw a (27-67)/67 = -0.60 or a 60% drop in price (coinsurance)
• Which means demand should have increased by 18% (-0.6)(-0.3)
• Use increased by a factor of 5, so < 3%
• What does this reasoning miss?

Income effects

- 1940 and 1990, real GDP/capita increased by 180%
- Income elasticity of demand for medical care is 0.2 to 0.4
- Demand should have increased by 36% to 72%
- Actual use increased by 780% over this time period, about 10% of total
End of life care

- Those nearing death have incredibly high medical costs
  - 6% of seniors die each year in Medicare
  - Represent 27.9% of all expenses in 1999
  - Average Medicare spending for person in last year of life, $25,000 in 1999
  - about $3,000 for survivors
- This fraction has been pretty stable over time. Was 28% in 1978

Technology

- All of the factors so far, probably about 25% of the increase in medical care use over time
- What explains the rest? Technology
- MRIs, open heart surgery (CABG), angioplasty, CT scans, anti-psychotropic drugs, hip-knee replacements, neo-natal intensive care. All not available 40 years ago. Now, commonplace

Some evidence for Technology

- Rate of increase in medical costs similar across countries – suggests something broad based like technology
- Next table: If these other factors were important, we would see big increase in hospital admissions over time and length of stay. We don’t. What we see is an increase in price/admission

Table 3
Utilization of Short Stay General Hospitals

<table>
<thead>
<tr>
<th>Year</th>
<th>Adms / 1000</th>
<th>Length of Stay (days)</th>
<th>Disps / 1000</th>
<th>Adjusted Cost / Disp ($2002 dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>110.1</td>
<td>8.1</td>
<td>993.1</td>
<td>n.a.</td>
</tr>
<tr>
<td>1985</td>
<td>128.9</td>
<td>7.6</td>
<td>993.0</td>
<td>$114*</td>
</tr>
<tr>
<td>1990</td>
<td>144.9</td>
<td>8.2</td>
<td>1180.1</td>
<td>$172</td>
</tr>
<tr>
<td>1995</td>
<td>160.4</td>
<td>7.6</td>
<td>1219.2</td>
<td>$202</td>
</tr>
<tr>
<td>2000</td>
<td>135.4</td>
<td>7.1</td>
<td>901.5</td>
<td>$657</td>
</tr>
<tr>
<td>2005</td>
<td>134.6</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>
How technology generates spending

- New product to consume
  - Could displace current spending
  - Could reduce spending in other areas (offset)
- Many new products treat the symptoms and not the disease
  - Lipitor, HBP medication, Viagra, HRVs
  - In these cases, drugs work but one uses the Rx forever
- Mechanical relationship: Increase spending by expanding life

Example: HIV/AIDS Drugs

- Early 1990s, quarterly mortality rates for patients w/ AIDS of 7.5%, annual rates of roughly 30%
- 1995:4, 1996:1, three new drug introduced to fight virus
  - Work by preventing the virus from replicating in the host
- Use rates increase immediately and aggregate mortality falls 70% in 18 months
• AIDS drugs are expensive, $12K/year in some cases
• AIDS patients are expensive, $20K/year
• ARVs extend life considerably
• This medical advance, by construction, increases lifetime spending by a considerably amount
• Let \( r = \rho \), so lifetime costs are now \( M_o / \delta \)
• After ARVs, assume costs increase to \( M_i \) and period mortality rates falls to \( \delta_A \)
• Change in life expectancy is \( (1/\delta_A) - (1/\delta) \)
• Quarterly mortality falls from 7.5 to 2.2 percent
  – life expectancy after diagnoses goes from 3.6 to 11.2 years
• \( M_i \) is $6242 and ARVs increase spending by 16% to $7241
• Lifetime costs increase from $83K to $329K

• Cost per life saved is \( (\$329K - \$83K) / (11.2 - 3.6) \)
  = $33K/life year saved (2005 $)
• Amazing lifesaving potential
• Although expensive, it is cheap in relative terms
• So although costs are increasing a lot, this is a cost-effective program

What are some costs/life saved?

• Tengs et al., 1994. Review 587 life saving interventions
• Range: some save costs and save lives, others cost $10 billion per life saved (1993 $)
  – CPI in 1993 = 144.5
  – CPI in 2014 = 236.7
  – Ratio = 236.7/144.5 = 1.638, so these numbers should be increased by about 64%

![Fig. 1. Distribution of cost/life-year saved estimates (n = 587).]
What values are “worth it”

• Compare CLS (cost per life saved) to what people are willing to pay (Value of a statistical life)
• Currently, EPA uses $7.4 million VSL ($2006)
  – http://yosemite.epa.gov/ee/epa/eed.nsf/pages/MortalityRiskValuation.html#whatvalue

• VSLY = value of a statistical life year
• Sum VSLY over all year for VSL
• \[ VSL = \Sigma_t VSLY/(1+r)^t \]
• Example:
  – VSLY = $150,000, r=0.03, 80 years VSL =$4.5 million
  – VSLY = $150,000, r=0.03, 30 years VSL =$3.5 million
  – VSLY = $250,000, r=0.03, 80 years VSL =$7.5 million

The Difficulty of Measuring Prices in Health Care

• Price indexes must keep ‘all else constant’
  – Difficult to do when quality is changing rapidly (e.g., medical)
  – Boskin commission CPI overstates true inflation by
    • All good by 1.1 percentage points per year
    • Medical care growth by 3 pp/yr
• CPI only uses OOP spending as prices
  – With health care reform, OOP will decline and will make it seem that prices have fallen

Laspyeres Price Index

\[ SPI_t = \frac{\sum_{i=1}^{n} P(t_i)Q(t_i)}{\sum_{i=1}^{n} P(t_0)Q(t_0)} \]

\[ n \quad number \ of \ products \]
\[ t_0 \quad original \ period \]
\[ t_1 \quad new \ period \]
\[ P_i \quad prices \ product \ i \]
\[ Q_i \quad quantity \ product \ i \]
Cutler and McClellan

- Construct price index for treatment of AMI (heart attack)
- One procedure with rapidly changing costs and outcomes
- Need to “hold all else constant”
- Solution: What is the cost of saving “one more life year”
  - Aggregates costs
  - Allows quality adjustments (declining)
  - But holds quality constant
Table 1. Life Expectancy According to Age Group and Year, 1960–2000.

<table>
<thead>
<tr>
<th>Age</th>
<th>Life Expectancy</th>
<th>Cumulative Change (1960–2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>69.90</td>
<td>70.76</td>
</tr>
<tr>
<td>1 Yr</td>
<td>57.35</td>
<td>57.33</td>
</tr>
<tr>
<td>45 Yr</td>
<td>29.20</td>
<td>30.12</td>
</tr>
<tr>
<td>65 Yr</td>
<td>14.39</td>
<td>13.00</td>
</tr>
</tbody>
</table>

Table 3. Present Value of Average Medical Spending per Person According to Age Group and Year.

<table>
<thead>
<tr>
<th>Age</th>
<th>Average per Capita Spending</th>
<th>Cumulative Change (1960–2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>13,943</td>
<td>25,528</td>
</tr>
<tr>
<td>1 Yr</td>
<td>18,760</td>
<td>32,704</td>
</tr>
<tr>
<td>45 Yr</td>
<td>27,241</td>
<td>33,286</td>
</tr>
<tr>
<td>65 Yr</td>
<td>11,495</td>
<td>34,626</td>
</tr>
</tbody>
</table>

Figure 1. Longitudinal Trends in the Costs per Year of Life Gained in Four Age Groups. Spending per year of life gained was defined by the change in spending over the decade divided by the change in expected years of life over the decade.
Simple calculation

- 1950-1990 PV of lifetime medical payments increased by $35,000
- Over the same period, life expectancy increased by 7 years
- PV of these benefits is $130K (tacked on at the end of life, assume 2% real IR -- $100K CLYS)
- Even if health care can explain only 1/4 of these benefits, medical care pays for itself

- Assume 80 year life span, tack-on the 7 years at the end, discount back to present

$$\sum_{t=81}^{87} \frac{100,000}{(1.02)^t} = \$132,746$$