Are Medical Care Prices Still Declining?
A Systematic Examination of Quality-Adjusted Price Index Alternatives for Medical Care

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Introduction

• Health care is 17.8% of GDP in 2015

• Spending per capita in the U.S. is an outlier among advanced economies

• Is health care spending worth it?

• Divide question into two parts:
  1. How much are we paying for treatment?
     → Redefine the quantity / real output
Redefine the Real Quantity

• Current definition: quantity/real output is the number of services provided

• Proposed redefinition: real output is the treatment of a condition
  • Example for heart attacks (AMI):
    – Nominal spending – total spending on heart attacks
    – Price index – expenditure per heart attack treatment
    – Quantity – the number of heart attacks
  • Better captures shifts in treatment

• Redefinition applied in Health Care Satellite Account at BEA
  • https://www.bea.gov/national/health_care_satellite_account.htm
30 select conditions accounted for 17% of spending in 2000, but over 40% of spending growth per capita from 2000 to 2014.

**Trend in Price of Treatment (HCSA - Blended Account)**

- **Hepatitis**
- **Rheumatoid Arthritis**
- **All conditions**
Introduction

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- Is health care spending worth it?

- Divide question into two parts:
  1. How much are we paying for treatment?
     → Redefine the quantity / real output
  2. How effective is the treatment?
     → Adjust for quality
Quality Adjustment

- Real output also depends on the quality of the treatments
  - Cutler et al. (1998) – Heart Attacks; Berndt et al. (2000) – Depression; and Shapiro et al. (2001) – Cataracts

- Health care is nearly half of the overall bias for PCE
  - Groshen et al. (2017)

- Quality adjustment is challenging – Hall (2016) and Sheiner and Malinovskaya (2016)
  - How to measure quality changes?
  - Attributing quality changes to medical care?
  - What method of quality adjustment to apply?
Scope

• Analyze alternative methods of quality adjustment:
  
  – Theoretical differences
  
  – Empirical differences for three acute conditions from 2001-2011
Findings

• Quality adjustment has a significant impact on measured inflation
  – Conservative quality-adjusted inflation rates are 1 percent below the unadjusted estimates

• Large range of quality-adjusted estimates depending on method and assumptions

• Cost-of-living indexes lead to much lower price growth
  – Prices are declining relative to overall inflation for all three conditions
Background: Concepts of Quality Adjustment

• Cost-of-living index (COLI)
  – Expenditures necessary to achieve a certain level of consumer utility given changing price levels
  – Adjusts based on the value of the good to the consumer
  – Common approach in health research literature
  – Value of consumer is often measured as the value of a life (e.g., Cutler et al. (1998))
  – Life expectancy (LE) index
Background: Concepts of Quality Adjustment

• Resource cost adjustment
  – Standard method of quality adjustment for producer price indexes (PPI)
  – Similar to user value adjustment, but using cost to producer, not benefits to consumers
  – Practical difficulties in health care
    • Attributing costs to quality change is challenging
  – Approach applied by BLS
    • Hospital PPI
    • Nursing home PPI
  – Resource cost (RC) index
Background: Concepts of Quality Adjustment

• Treatment endpoint adjustment
  – Berndt et al. (2002) – depression treatment
    • Expenditure to reach a treatment endpoint (i.e., remission), relative to no treatment at all
  – Treatment endpoint (TE) index

• Fixed treatment basket
  – Frank et al. (2004) – schizophrenia treatment
    • Regression used to fix treatment baskets for select technologies
    • Goal is to hold technology fixed, not “adjust” for quality
  – Basket price (BP) index
Alternative Methods

• Four methods to contrast with Unadjusted (UI) index
  – Life expectancy (LE) index – COLI based on value of a life
  – Resource cost (RC) index – similar to LE but adjusting for cost, not benefits
  – Treatment endpoint (TE) index – expenditure per effective treatment
  – Basket price (BP) index – measures the basket price of fixed technologies
Theoretical Differences

• Shift to new technology, but no actual improvement in quality
  – LE and TE index have no quality adjustment
  – RC and BP potentially change
  – Example: Using proton beam therapy for prostate cancer

• Quality improves, but costs do not change
  – LE and TE have a quality adjustment
  – RC and BP show no change
  – Example: Use of beta blocker upon discharge after a heart attack
Theoretical Differences

• LE index equals others when:
  – Monetized value of the quality change to consumer \( \approx \) change in the cost of the quality improvement

• Typically consumer value is larger than cost in markets for new and innovative goods (e.g., statin drugs to lower cholesterol)
  – Value to the infra-marginal consumer
  – Challenge for many industries (e.g., computers, smart phones, and minivans)

• Additional challenge in health care because of well-known market distortions

• BP, TE, and RC indexes – likely understate improvements for consumers

• Example: New hepatitis C treatments (e.g., Sovaldi)
Data

• Medicare Fee-For-Service (FFS) Claims (5 percent sample)

• Following (Romley, Goldman, and Sood (2015)), sample includes patients with inpatient admission for:
  – Heart attack
  – Congestive heart failure
  – Pneumonia

• Additional selection rules:
  – Full year of FFS enrollment prior to the index admission (for risk adjustment based on diagnoses)
  – Full year after the admission or death within the year after the admission, to measure outcomes
# Distribution of Patients

<table>
<thead>
<tr>
<th>Total Events</th>
<th>Heart attack</th>
<th>Heart failure</th>
<th>Pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>62,939</td>
<td>96,290</td>
<td>109,739</td>
</tr>
<tr>
<td>Proportion</td>
<td>Proportion</td>
<td>Proportion</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>43.5%</td>
<td>36.9%</td>
<td>38.6%</td>
</tr>
<tr>
<td>Age group:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age: 65-69</td>
<td>11.7%</td>
<td>8.2%</td>
<td>8.9%</td>
</tr>
<tr>
<td>Age: 70-74</td>
<td>17.1%</td>
<td>13.2%</td>
<td>14.3%</td>
</tr>
<tr>
<td>Age: 75-79</td>
<td>20.0%</td>
<td>18.1%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Age: 80-84</td>
<td>20.9%</td>
<td>22.4%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Age: 85-89</td>
<td>17.4%</td>
<td>21.0%</td>
<td>19.6%</td>
</tr>
<tr>
<td>Age: &gt;=90</td>
<td>12.8%</td>
<td>17.2%</td>
<td>16.9%</td>
</tr>
</tbody>
</table>
Heart Attack (AMI): Trends in Mortality and Unadjusted Price – Severity Adjusted

AMI - Price

AMI - Mortality

$25,000  $30,000  $35,000  $40,000  $45,000  $50,000


0.12 0.14 0.16 0.18 0.20 0.22
Congestive Heart Failure (CHF): Trends in Mortality and Unadjusted Price – Severity Adjusted

CHF - Price

CHF - Mortality

$25,000  $30,000  $35,000  $40,000  $45,000  $50,000


0.11  0.12  0.13  0.14  0.15  0.16
Pneumonia (PNE): Trends in Mortality and Unadjusted Price – Severity Adjusted

![Graph showing trends in PNE (Price and Mortality) from 2001 to 2011.](image)
Trends in Mortality and Unadjusted Price – Severity Adjusted

Price (solid line)
$50,000
$45,000
$40,000
$35,000
$30,000
$25,000


Mortality (dotted line)
0.21
0.19
0.17
0.15
0.13
0.11
• Quality adjustment is clearly important for these conditions
• Positive relationship between price and quality
• Main question: how important is the quality change?
LE Index

- Unadjusted index + monetary change in benefit measure

\[ COLI_{disease} = \left( \frac{\text{Price of Treatment}_1}{\text{Price of Treatment}_0} \right) - \left( \frac{\Delta B}{\text{Price of Treatment}_0} \right) = \frac{\text{Price of Treatment}_1 - \Delta B}{\text{Price of Treatment}_0} \]

- How to measure \( \Delta B \)?

- Two issues:
  - Value of a life assumption
    - Range around $100,000 – Viscusi (2005)
    - Well studied, but controversial
  - Isolating contribution of treatment
    - Our approach: measure mortality in short windows in time around the event (e.g., 30, 60, or 90 days)
<table>
<thead>
<tr>
<th>Annual Value of A Life</th>
<th>30 days</th>
<th>60 days</th>
<th>90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50,000</td>
<td>$100,000</td>
<td>$150,000</td>
<td>$50,000</td>
</tr>
<tr>
<td><strong>AMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted index</td>
<td>1.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLI</td>
<td>-0.7%</td>
<td>-3.1%</td>
<td>-5.6%</td>
</tr>
<tr>
<td><strong>Congestive heart failure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted index</td>
<td>2.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLI</td>
<td>1.2%</td>
<td>0.1%</td>
<td>-1.1%</td>
</tr>
<tr>
<td><strong>Pneumonia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted index</td>
<td>2.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLI</td>
<td>-0.7%</td>
<td>-3.6%</td>
<td>-6.5%</td>
</tr>
</tbody>
</table>
• Ratio unadjusted index to quality change

\[ \text{TE} = \frac{\text{Price of Treatment}_1}{\sigma_1} / \frac{\text{Price of Treatment}_0}{\sigma_0} \]

• \( \sigma_t \) – fraction of treatments that reach a successful endpoint relative to no treatment

• Rate of successful endpoint without treatment is an unknown
## TE Index – Alternative Rates of Success for Untreated Cases

<table>
<thead>
<tr>
<th>Condition</th>
<th>Rate of Success for Untreated Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td><strong>AMI</strong></td>
<td></td>
</tr>
<tr>
<td>Unadjusted index</td>
<td>1.7%</td>
</tr>
<tr>
<td>Average Success Rate</td>
<td></td>
</tr>
<tr>
<td>with Treatment</td>
<td></td>
</tr>
<tr>
<td>Treatment Endpoint Index (CAGR)</td>
<td>0.6%</td>
</tr>
<tr>
<td><strong>Congestive heart failure</strong></td>
<td></td>
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<td>Unadjusted index</td>
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<td></td>
</tr>
<tr>
<td>Treatment Endpoint Index (CAGR)</td>
<td>0.7%</td>
</tr>
</tbody>
</table>
• Unadjusted index - Resource Cost (RC) of quality change

\[
RC = \left( \frac{\text{Price of Treatment}_{1}}{\text{Price of Treatment}_{0}} \right) - \left( \frac{\Delta RC}{\text{Price of Treatment}_{0}} \right) = \frac{\text{Price of Treatment}_{1} - \Delta RC}{\text{Price of Treatment}_{0}}
\]

• How to measure cost of technological change \(-\Delta RC\) ?

• Assumption of constant cost per outcome:

\[
\Delta RC = \text{Price of Treatment Per Outcome} \cdot \Delta \text{Successful Outcome}
\]

\[
\Delta RC = \left( \frac{\text{Price of Treatment}_{1}}{\sigma_{1}} \right) \cdot (\sigma_{1} - \sigma_{0})
\]

• Implies:

\[
RC = \frac{\text{Price of Treatment}_{1} - \left( \frac{\text{Price of Treatment}_{1}}{\sigma_{1}} \right) \cdot (\sigma_{1} - \sigma_{0})}{\text{Price of Treatment}_{0}} = \frac{\text{Price of Treatment}_{1} (\frac{\sigma_{0}}{\sigma_{1}})}{\text{Price of Treatment}_{0}}
\]

\[
RC \approx TE
\]
• Run regression for each year:

\[ Y_i = \alpha + X_i \beta + Z_i \gamma + \varepsilon_i \]

- \( Y_i \) — patient spending
- \( X_i \) — patient-level severity controls
- \( Z_i \) — technologies or evidence-based treatment

• Are we able to select the “correct” technologies?

• Technologies for AMI
  - Catheterization (CATH), Percutaneous Coronary Intervention (PCI), and Coronary Artery Bypass Grafting (CABG)

• Technologies for Congestive Heart Failure
  - Implantable Cardioverter Defibrillator (ICD), Cardiac Resynchronization Therapy Defibrillators (CRT-D), and Cardiac Resynchronization Therapy Pacemaker (CRT-P)
Comparison of Indexes – Heart Attack

- Unadjusted index
- TE index
- BP index
- LE index

($100,000/year valuation)

Comparison of Indexes – Congestive Heart Failure

Unadjusted index
BP index
TE index
LE index
($100,000/year valuation)

Comparison of Indexes – Pneumonia

Unadjusted index

TE index

LE index ($100,000/year valuation)

Conclusion

• Quality adjustment methods indicate an upward bias when not adjusting for quality

• COLI method suggests that average medical care price for the selected conditions are still declining

• Estimates vary across methods and assumptions; hard to choose among them

• Reporting a range of estimates using different methods may be one approach for addressing the wide range of estimates we observe.
Discussion Questions

• Should we develop a range of quality-adjusted estimates for the Health Care Satellite Account? Are there disadvantages for producing a range?

• Is there a public benefit to producing quality-adjusted prices for only a subset of conditions? (e.g., 5-10 conditions out of 200+)

• Is a method that uses the value of a statistical life (e.g., the LE measure) an appropriate methodology to deflate final consumption for the health care sector? Recommended alternatives?

• How to expand beyond acute conditions? Could measures of population health by condition be an intermediate step (e.g., DALYs or QALYs)?