What does the Value of Modern Medicine Say About the $50,000/QALY Threshold?

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Disclosures

- I have no financial conflicts of interest to declare 😞
Cost Effectiveness in Healthcare

- Strong theoretical recommendations for use in resource allocation decisions
- Many countries explicitly use CEA as a component of resource allocation and coverage decisions
- Has not been used to a great extent in the US
- Many countries use cost effectiveness explicitly in their resource allocation decisions
Why should we care about costs?

- Health care costs are becoming an **unsustainable** amount of many country’s gross domestic product
  - Irrespective of financing method, costs have been increasing for decades
- There have been questions regarding the **value** of what we purchase
Percent of GDP on Healthcare


$50,000 Threshold
International Comparison


$50,000 Threshold
Basic Review of CEA

- Purpose of Cost Effectiveness Analysis

Choose

Strategy 1

Series of downstream consequences
(clinical and financial)

CEA compares these simultaneously

Strategy 2

Series of downstream consequences
(clinical and financial)

$50,000 Threshold
CEA involves tradeoffs

$50,000 Threshold
Incremental Cost Effectiveness Ratio

Net Incremental Costs

Net Incremental Benefit

Change in Costs

Change in Benefits

A

B

$50,000 Threshold

$X \# \text{ of } $s$

$Y \# \text{ of QALYs}$
How does one use the ICER?

- In theory, each time a decision is made the entire set of expenditures should be re-compared with the new strategy

- But this is incredibly burdensome....
Using CEA Thresholds

- Simpler method is to develop limits that indicate the level society is willing to spend.
- This is done much more explicitly in Europe.
- NICE (National Institute for Health and Clinical Effectiveness)\(^1\)
  - ICER < $34,400: clearly cost effective
  - ICER $34,400-$51,600: sometimes reasonable
  - ICER > $51,600: rarely reasonable

What is the appropriate cutoff?

- The “standard” CEA limit has been historically $50,000 per quality adjusted life year (QALY)
  - The most common story is that $50,000/QALY was the calculated ICER for Dialysis (in ~1982)
  - Since we do dialysis, we must value QALYs at about this level
- Of course, if $50,000 were true in 1982...it should be about $121,000 in 2003 dollars\(^1\)

Our goal was to estimate the threshold

What Does the Value of Modern Medicine Say About the $50,000 per Quality-Adjusted Life-Year Decision Rule?

R. Scott Braithwaite, MD, MSc,* David O. Meltzer, MD, PhD,† Joseph T. King, Jr, MD,‡ Douglas Leslie, PhD,§ and Mark S. Roberts, MD, MPP‖

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Methods to estimate the limit

- Empiric evaluation of current choices:
  - Evaluate growth in healthcare spending and its effects
  - Evaluate the decisions not to purchase health insurance and its effects

- These will produce a lower and upper bound for the value of health care services
  - Change in healthcare spending is lower bound because we do it
  - Foregoing health insurance given its benefits is upper bound because those people do not do it

$50,000 Threshold
Inference from people’s actions

- This is a version of *revealed preferences*
- The basic assumptions are:
  - Society has made multiple decisions in the past regarding social expenditures for health
    - Creating Medicare, covering dialysis, • • • many more
    - We assume that society must value these services at *more* than what they cost (or we wouldn’t pay for them)
  - Members of society who can afford health insurance choose not to purchase
    - These individuals value health care services at *less* than what they cost (or they would buy it)
Lower bound limit on value:

- Society’s willingness to pay is equal to or exceeds the cost effectiveness of modern medical advances...we paid for them

\[
\text{CE Ratio} = \frac{\text{Cost}_{\text{Health care now}} - \text{Cost}_{\text{Health care in 1950}}}{\text{Benefit}_{\text{Health Care now}} - \text{Benefit}_{\text{Health care in 1950}}}
\]

- The idea is: calculate the CE ratio of the change from 1950 till now. This should be a lower bound

$50,000$ Threshold
Upper bound limit on value:

- Many people who could afford health insurance don’t purchase it. Society is OK with this. The incremental value of insurance must be less than the incremental value of health insurance.

\[
\text{CE Ratio} = \frac{\text{Cost}_{\text{Health insurance now}} - \text{Cost}_{\text{No health insurance now}}}{\text{Benefit}_{\text{Health insurance now}} - \text{Benefit}_{\text{No health insurance now}}}
\]

- Calculate the incremental CE ratio for purchasing health insurance. This should be an upper bound.

$50,000 \text{ Threshold}$
LB: ICER of modern health care

- Life expectancy is 9.3 years longer than in 1950
- Some component of that is due to health care services 😊
  - Bunker et al\(^1\) estimated that life expectancy gains from health care 1950-1995 was 3.8 years
  - Makenback\(^2\) estimated the same gain at 3.9 years in the Netherlands
- Extrapolating this to 2003, we estimate LE benefit to be 4.7 years

Effect of health care on mortality

TABLE 1. Mortality for Selected Ages by Type of Health Care

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Mortality Rate, 2003*</th>
<th>Mortality Rate, 1950†</th>
<th>Mortality Rate, 2003 Assuming 1950 Health Care</th>
<th>Mortality Increase Attributable to 1950 Health Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>0.0070</td>
<td>0.0318</td>
<td>0.0198</td>
<td>183</td>
</tr>
<tr>
<td>10</td>
<td>0.0002</td>
<td>0.0008</td>
<td>0.0005</td>
<td>150</td>
</tr>
<tr>
<td>20</td>
<td>0.0009</td>
<td>0.0013</td>
<td>0.0011</td>
<td>22</td>
</tr>
<tr>
<td>30</td>
<td>0.0010</td>
<td>0.0018</td>
<td>0.0014</td>
<td>40</td>
</tr>
<tr>
<td>40</td>
<td>0.0021</td>
<td>0.0037</td>
<td>0.0029</td>
<td>38</td>
</tr>
<tr>
<td>50</td>
<td>0.0044</td>
<td>0.0084</td>
<td>0.0065</td>
<td>48</td>
</tr>
<tr>
<td>60</td>
<td>0.0098</td>
<td>0.0186</td>
<td>0.0144</td>
<td>47</td>
</tr>
<tr>
<td>70</td>
<td>0.0239</td>
<td>0.0433</td>
<td>0.0341</td>
<td>43</td>
</tr>
<tr>
<td>80</td>
<td>0.0593</td>
<td>0.0959</td>
<td>0.0786</td>
<td>33</td>
</tr>
<tr>
<td>90</td>
<td>0.1540</td>
<td>0.2430</td>
<td>0.2007</td>
<td>30</td>
</tr>
</tbody>
</table>

$50,000 Threshold
Mortality effect of health care

Survival, 2003
Survival, 1950
Survival, in 2003 with 1950’s health care
Current life expectancy benefit to 2003 health care

$50,000 Threshold
AGE

Survival, 2003
Survival, 1950
Survival, in 2003 with 1950’s health care
Current life expectancy benefit to 2003 health care
Estimating change in costs

- Used age-stratified yearly costs from the MEPS

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0–5</td>
<td>$2190</td>
<td>$284</td>
<td>$1905</td>
</tr>
<tr>
<td>6–64</td>
<td>$4148</td>
<td>$539</td>
<td>$3609</td>
</tr>
<tr>
<td>65–74</td>
<td>$13,062</td>
<td>$1698</td>
<td>$11,364</td>
</tr>
<tr>
<td>75+</td>
<td>$22,630</td>
<td>$2942</td>
<td>$19,688</td>
</tr>
<tr>
<td>All age groups</td>
<td>$5698</td>
<td>$741</td>
<td>$4957</td>
</tr>
</tbody>
</table>

Model effects in a birth cohort:

- Expose to the effectiveness of 1950’s health care
- Expose to the effectiveness of 2003 health care

**Outcomes**
- 2003 mortality rates (assuming 1950’s health care)
- 2003 mortality rates (assuming current health care)

**Costs**
- 1950 expenditures for health care
- 2003 expenditures for health care

$50,000 Threshold
Upper Bound: ICER of insurance:

- There is some evidence that insurance confers a survival benefit (in observational studies).
- There is good evidence that costs affects the amount of health care purchased.
  - RAND health insurance experiment estimates the elasticity of demand at -0.31, which represents the rate at which consumption changes with change in price.
Insurance and expenditures:

- MEPS data reveals that patients with insurance pay 18% of full costs of care (estimate of change in price with insurance)
- Using the formula for elasticity:

\[
\varepsilon = \frac{(Q_2 - Q_1)}{(P_2 - P_1)} \times \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2}
\]

- One can calculate that the uninsured would use ~35% fewer medical services

$50,000 Threshold
Insurance and health benefit

- So, when people buy health insurance, they only actually increase utilization by 35%
- We assume they also purchase 35% of the benefit (this is probably not exactly true...)
  - (they are receiving some benefit of modern health care even without paying for insurance)
- We applied these mortality reductions to non-elderly adults (we assumed that at 65 they acquire aces to Medicare)
# Mortality effect of insurance

## TABLE 3. Mortality for Selected Ages by Access to Health Insurance

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Mortality Rate, 2003 Without Health Insurance</th>
<th>Mortality Rate, 2003 Without Health Insurance</th>
<th>Increase Compared With Health Insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>0.0070</td>
<td>0.0115</td>
<td>64, 0.0045</td>
</tr>
<tr>
<td>10</td>
<td>0.0002</td>
<td>0.0003</td>
<td>53, 0.0001</td>
</tr>
<tr>
<td>20</td>
<td>0.0009</td>
<td>0.0010</td>
<td>8, 0.0001</td>
</tr>
<tr>
<td>30</td>
<td>0.0010</td>
<td>0.0011</td>
<td>14, 0.0001</td>
</tr>
<tr>
<td>40</td>
<td>0.0021</td>
<td>0.0024</td>
<td>13, 0.0003</td>
</tr>
<tr>
<td>50</td>
<td>0.0044</td>
<td>0.0051</td>
<td>17, 0.0007</td>
</tr>
<tr>
<td>60</td>
<td>0.0098</td>
<td>0.0114</td>
<td>16, 0.0016</td>
</tr>
<tr>
<td>70</td>
<td>0.0239</td>
<td>0.0275</td>
<td>15, 0.0036</td>
</tr>
<tr>
<td>80</td>
<td>0.0593</td>
<td>0.0661</td>
<td>11, 0.0068</td>
</tr>
<tr>
<td>90</td>
<td>0.1540</td>
<td>0.1703</td>
<td>11, 0.0163</td>
</tr>
</tbody>
</table>
Cost of Non-employer health insurance

- Used Kaiser family foundation 2003 survey
- Based on cost of premium for employer-based care (under estimate of cost) of $3383

$50,000 Threshold
Results

- **Lower Bound (expenditure change, 1950-2003)**
  - Health care has added 4.7 years to life expectancy (0.65 discounted)
  - Lifetime costs have increased by $452,000 ($118,000 discounted)
  - ICER = $183,000/life year gained
  - ICER = $109,000/QALY gained

- **Upper Bound (value of Health insurance)**
  - 1 year of Insurance adds 0.021 years of life expectancy (0.013 discounted)
  - 1 year costs $3383
  - ICER = $264,000/life year gained
  - ICER = $297,000/QALY gained

$50,000 Threshold
Comparisons

- Our lower bound QALY rule (\$109,000/QALY) is very close to inflation adjusted $50,000/QALY rule form the 1980’s (\$121,000/QALY) and to the WHO 3x’s per capita GDP rule ($113,000/DALY)

- Our upper bound ($297,000/QALY) is similar to Ubel’s upper estimate ($265,000/QALY)
Conclusion:

- We argue that the current, $50,000 per QALY decision rule is not consistent with observed spending behavior in the United States at a societal level.
What does one do with this?

- Value based insurance design: payment tier limits
  - ICER <$100,000/QALY: *(high value services)*
  - ICER $100,000-$300,000/QALY: *(intermediate value services)*
  - ICER >$300,000/QALY: *(low value services)*
- We can manipulate cost sharing for respective value of services to alter utilization
Application of Cost Sharing

- Estimate the effect if VBID is applied only to pharmacy benefits
- Estimate the effect if VBID is extended to all health care purchases
- For each scenario, estimate under the following expenditure goals
  - VBID is not cost neutral
  - VBID must be cost neutral
  - VBID must be cost saving
Expenditure goals of VBID

- Not budget neutral
  - Reduce cost sharing for high value services
  - Leave intermediate and low value as they are

- Budget neutral
  - Reduce cost sharing for high value services
  - Leave intermediate value services as is
  - Increase cost sharing for low value services to offset increased utilization of high value services

- Budget savings
  - Adjust cost sharing in high and low value services to produce savings that would pay for uninsured $50,000 Threshold
Model:

- Age $t$
- Health Expenditure, unadjusted for cost sharing
- Distribution of ICERs for US Health care purchases

**UNISURED (prevailing cost sharing):**
- High cost sharing ↓ expenditure
- LE gain = Expenditure/ICER

**INSURED (prevailing cost sharing):**
- Prevailing cost sharing-current expenditure
- LE gain = Expenditure/ICER

**VBID (variable cost sharing):**
- Cost sharing ↑, ↓, or ↔ expenditure
- LE gain = Expenditure/ICER

- Probability of Surviving

Effect on purchase
Effect on life expectancy

No cost sharing if ICER <$100,000
18% cost sharing if ICER $100,000 - $300,000
>18% cost sharing if ICER >$300,000

$50,000 Threshold
Distribution of ICERs

- Distribution of published ICERs is available*
- However, this is not likely the distribution of actual expenditures
- Varied proportions <100K, 100-300K and >300 K until current expenditure/life expectancy resulted

*Center for the Evaluation of Value and Risk in Health. The Cost-Effectiveness Analysis Registry, ICRHPS, Tufts Medical Center. Available from:

$50,000 Threshold
Mechanics

- Expenditures must match observed current expenditures
- Health effects must match observed current benefits
- Std deviation of ICER distribution must be at least as large as published

$50,000 Threshold
Effect of copayment on utilization

- RAND health insurance experiment estimated the elasticity of demand (noted previously, which results in:

<table>
<thead>
<tr>
<th>Percent Cost Sharing</th>
<th>Index of Demand for Health Services (current = 1.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1.06</td>
</tr>
<tr>
<td><strong>18%</strong></td>
<td><strong>1.00</strong></td>
</tr>
<tr>
<td>20%</td>
<td>0.98</td>
</tr>
<tr>
<td>30%</td>
<td>0.90</td>
</tr>
<tr>
<td>40%</td>
<td>0.85</td>
</tr>
<tr>
<td>50%</td>
<td>0.81</td>
</tr>
<tr>
<td>100%</td>
<td>0.65</td>
</tr>
</tbody>
</table>

$50,000 Threshold
## Uninsured Population, By age

<table>
<thead>
<tr>
<th>Age Group (years)</th>
<th>Percent Uninsured</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-17</td>
<td>11%</td>
</tr>
<tr>
<td>18-24</td>
<td>30%</td>
</tr>
<tr>
<td>24-34</td>
<td>26%</td>
</tr>
<tr>
<td>35-44</td>
<td>18%</td>
</tr>
<tr>
<td>45-64</td>
<td>14%</td>
</tr>
<tr>
<td>≥65</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Meara E, et al., *Health Affairs* 2004; 23:176-183

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$50,000$ Threshold
Cost Sharing by ICRE strata

- Cost sharing for high value services eliminated
- Cost sharing for intermediate value services left at 18%
- Cost sharing for low value services by goal:
  - When no requirement for budget neutrality: 18%
  - When overall budget neutrality:
    - From societal perspective: 21%
    - From payer’s respective: 23%
    - From patient’s perspective: 26%
  - When cost savings required to expand coverage: 30%
    $50,000 Threshold
Results: VBID on Pharmacy

<table>
<thead>
<tr>
<th>Life Expectancy</th>
<th>No VBID</th>
<th>VBID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>Societal</td>
</tr>
<tr>
<td>Δ VBID</td>
<td></td>
<td>Low-value copays increased to keep spending constant by perspective</td>
</tr>
<tr>
<td>Δ VBID</td>
<td>-</td>
<td>4.73</td>
</tr>
<tr>
<td>Expenditures, per-capita,</td>
<td>Estimate</td>
<td>5688</td>
</tr>
<tr>
<td>Δ VBID</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Expenditures, national ($B)</td>
<td>Estimate</td>
<td>1654</td>
</tr>
<tr>
<td>Δ VBID</td>
<td>-</td>
<td>2</td>
</tr>
</tbody>
</table>

$50,000 Threshold
## Results: VBID on All Services

<table>
<thead>
<tr>
<th></th>
<th>No VBID</th>
<th>VBID</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>↓ copays for high-value; Low-value copays unchanged</td>
<td>Low-value copays increased to keep spending constant by perspective</td>
</tr>
<tr>
<td></td>
<td>↓copays for high-value; Low-value copays unchanged</td>
<td>Societal</td>
</tr>
<tr>
<td>Life Expectancy gain</td>
<td>Estimate</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Δ VBID</td>
<td>-</td>
</tr>
<tr>
<td>Expenditures, per-</td>
<td>Estimate</td>
<td>5688</td>
</tr>
<tr>
<td>capita, national ($B)</td>
<td>Δ VBID</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Estimate</td>
<td>1654</td>
</tr>
<tr>
<td></td>
<td>Δ VBID</td>
<td>-</td>
</tr>
</tbody>
</table>
Years

Expenditures per capita

NO VBID  ↓ VBID on high value  Cost neutral (society)  ↑ VBID on low value, ↑ coverage  ↓ VBID on high value  Cost neutral (society)  ↑ VBID on low value, ↑ coverage

VBID on Pharmacy  VBID on all services

$50,000 Threshold
Life Expectancy Gains

The diagram illustrates the relationship between life expectancy gains and the level of cost-sharing for different types of insurance. The x-axis represents the percentage of cost-sharing, while the y-axis shows the life expectancy gains. The threshold for $50,000 is indicated at the bottom of the graph.

- Value linked, universal insurance: The line indicates a steady decrease in life expectancy gains as cost-sharing increases.
- Value linked, current insurance: The line shows a significant decrease in life expectancy gains at lower cost-sharing levels, approaching a plateau at higher cost-sharing.
- Not value linked, universal insurance: The line indicates a gradual decrease in life expectancy gains as cost-sharing increases.
- Not value linked, current insurance: The line shows a steady decrease in life expectancy gains as cost-sharing increases, but at a slightly lower rate compared to the value linked insurance.

The graph highlights the impact of different insurance types on life expectancy gains at various levels of cost-sharing.
Overall Costs

- Not value linked, universal insurance
- Value linked, universal insurance
- Value linked, current insurance
- Not value linked, current insurance

Annual Expenditure ($billions)

- $1,900
- $1,800
- $1,700
- $1,600
- $1,500
- $1,400
- $1,300
- $1,200
- $1,100
- $1,000

% cost-sharing

- $50,000 Threshold

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## Sensitivity Analysis

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Base Case</th>
<th>Elasticity Lower (-0.23)</th>
<th>Elasticity Higher (-0.39)</th>
<th>VBID Thresholds Lower (50-100K)</th>
<th>VBID Thresholds Wider (50-500K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO VBID</td>
<td>4.70</td>
<td>4.70</td>
<td>4.70</td>
<td>4.70</td>
<td>4.70</td>
</tr>
<tr>
<td>VBID, cost sharing, high value decreased</td>
<td>4.95</td>
<td>4.88</td>
<td>5.05</td>
<td>4.93</td>
<td>4.93</td>
</tr>
<tr>
<td>VBID, low value cost sharing to keep societal costs constant</td>
<td>4.95</td>
<td>4.88</td>
<td>5.04</td>
<td>4.92</td>
<td>4.93</td>
</tr>
<tr>
<td>VBID, low value cost sharing to keep payer costs constant</td>
<td>4.94</td>
<td>4.87</td>
<td>5.04</td>
<td>4.92</td>
<td>4.92</td>
</tr>
<tr>
<td>VBID, low value cost sharing to keep patient costs constant</td>
<td>4.94</td>
<td>4.87</td>
<td>5.03</td>
<td>4.91</td>
<td>4.92</td>
</tr>
<tr>
<td>VBID, low value cost sharing to expand health insurance</td>
<td>5.14</td>
<td>5.02</td>
<td>5.28</td>
<td>5.08</td>
<td>5.12</td>
</tr>
</tbody>
</table>
Potential Use:

- **High Cost Health Service**
  - Perform comparative effectiveness analysis
  - Benefit?
    - Yes: Perform cost-effectiveness analysis
      - Info sufficient: High Value
        - No cost-sharing
      - Info not sufficient: Intermediate Value
        - Do not change cost-sharing
      - Additional Research
    - No: Additional Research
  - Info not sufficient: Low Value
    - Increase cost-sharing

$50,000 Threshold
Caveats (lots of them)

- No representation for ineffective health care
  - There is evidence we do a lot that is not only expensive, but *ineffective*: it actually decreases survival
  - This *underestimates* the effect of moving towards VBID

- Each new purchase is considered random each year
  - No accounting for high-cost individuals and the effect on them
Caveats (lots of them)

- We do not know the actual distribution of ICERs on health care purchased in the US.

![Distribution of purchases](image.png)

$50,000 Threshold
Conclusions

- VBID has the potential to alter consumption patterns, and change types of healthcare purchases
- Life expectancy gains are possible by:
  - Decreasing co-pays for high value services
  - Increasing co-pays for low-value services
- There is sufficient low value care being purchased that reducing demand for it can offset costs of uninsured
Questions?

$50,000 Threshold