Using Net Benefits to Report Cost-Effectiveness Results

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Net Benefits Framework

- Net benefit framework transforms cost and effect into a linear function:
  
  Net monetary benefit (NMB) = \( \frac{E \cdot \lambda - C}{\lambda} \) + \( E \)
  
  Net health benefit (NHB) = \( \frac{-C}{\lambda} + E \)

- NMB and NHB are monotonic linear functions and make it statistically simpler to calculate confidence intervals compared to an ICER.

- However, a net benefit approach also allows us a better way to present cost-effectiveness results:
  - More informative (chart conveys much more information)
  - More useful (facilitates other aspects of CE analysis – sensitivity analysis, pricing, etc.)

**NB Line**

- Increasing cost shifts the entire line down

- Increasing effectiveness rotates the line up from the intercept

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* "Probably the best statistical graphic ever drawn. This map by Charles Joseph Minard portrays the losses suffered by Napoleon’s army on the Russian campaign of 1812. Beginning at the Polish-Russian border, the thick band shows the size of the army at each position. The path of Napoleon’s retreat from Moscow, the bitterly cold winter, is depicted by the dark lower band, which is tied to temperature and time scales.”
  - Edward R. Tufte, *The Visual Display of Quantitative Information*
NB Method for Reporting CE Results

- Transform cost and effect for each treatment option into net benefit framework and plot the linear transformation with net monetary benefit on the y-axis and WTP on the x-axis; provide table of NMB at various plausible WTP thresholds (no ICERs necessary)

<table>
<thead>
<tr>
<th>WTP Threshold</th>
<th>NMB $30,000</th>
<th>NMB $40,000</th>
<th>NMB $50,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$1,000</td>
<td>$0</td>
<td>$1,000</td>
</tr>
<tr>
<td>B</td>
<td>$1,000</td>
<td>$3,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>C</td>
<td>$1,000</td>
<td>$4,000</td>
<td>$7,000</td>
</tr>
<tr>
<td>D</td>
<td>$0</td>
<td>$4,000</td>
<td>$8,000</td>
</tr>
</tbody>
</table>

Note: Treatment with the highest NMB appears in bold.

How to Interpret a Net Benefit Chart

- (1) Each line represents a Tx option, (2) intercept at y-axis equals the cost of each option, (3) slope represents the effectiveness (steeper = more effective), (4) option with the highest NMB at a given WTP is the most cost-effective, (5) the CE frontier is the solid line at the top of the chart, (6) the incremental NB between any set of options is the vertical distance between the lines, (7) the ICER is where two lines on the frontier intersect

Dominance and Extended Dominance

- Dominance – B (red line) is dominated by A (blue line) because A always has higher NB than B (note this will obtain only when one treatment is less costly and more effective)
- Extended dominance – C (green line) is extendedly dominated by A (blue line) and D (purple line) because the combination of A and D always have higher NB than C

Enhanced Graphical Information

- The NMB chart quickly and intuitively displays the following information in CE analyses:
  - NMB
  - Incremental NMB
  - ICER
  - Dominance
  - Extended-dominance
  - WTP
  - CE frontier
- This information is all visually available to the viewer in contrast to the CE plane where the ICER (i.e., slope of the line), and whether it is smaller or larger than a given WTP threshold, is not directly visually interpretable.
Simplified Analyses

- **Decision making:** The net benefit method simplifies the decision making process by rendering it a simple maximization problem. This makes identifying the cost-effective option conceptually more straightforward than under the ICER method where a decision maker must identify the greatest ICER with a value below their WTP threshold.
- **Multiple comparator analyses:** There is no need to rank order options or to eliminate dominated and extendedly-dominated options in conducting a CE analysis. With the net benefit method a CE analysis consists of calculating NMB for all options plotted across a range of reasonable WTP values.
- **Ability to rank CE of options:** The NMB method allows options to be easily ranked at a given WTP threshold from most cost-effective to least cost-effective. This may be particularly useful when some options included in an analysis are not available in a particular geographic region or when it is necessary to offer providers and patients treatment alternatives.

Greater Transparency

- **Willingness to pay:** Using the ICER method the role of WTP is often opaque. CE analyses may report normative results that one option is cost-effective without explicitly identifying a WTP value. Or analyses may select WTP values to yield a desired result. Using the NMB method the analysis is entirely descriptive and allows the decision maker to identify their preferred option based on their own explicit WTP threshold.
- **Impact of cost and effect on uncertainty:** NMB analysis reveals that costs have a relatively larger impact on CE results at low WTP values (due to the NMB line shifting up or down). However, at high WTP values changes in effectiveness have a relatively larger impact on CE results (due to the magnified effect of changes in slope on NMB at high WTP values). The CE plane does not reveal this relationship between cost, effectiveness, and WTP.

Improved Sensitivity Analyses

- **Enhanced one-way sensitivity analyses:** One-way sensitivity analyses with the ICER method often yield uninterpretable results when ICERs are negative and can behave erratically when differences in effectiveness are small. Using the net benefit method to conduct one-way sensitivity analyses eliminates this problem and simplifies multiple comparator analyses since NMB for each comparator is independent of the other comparators a one-way analysis can be conducted for each comparator using NMB as the output.
- **Consistency with PSAs:** Utilizing the NMB method for reporting deterministic results of CE analyses provides for greater methodological consistency. Similar chart types can be used for reporting both deterministic and probabilistic analyses (similarities to the CEAC will facilitate interpretation of the NMB chart). Reporting ICERs for deterministic results and net benefits for PSAs is more conceptually challenging.

Supplemental Analyses

- **Facilitates conduct of pricing and efficacy analyses:** The net benefit method can be used to conduct pricing analyses, as changes in cost move the NMB line vertically. Therefore, it is easy to dynamically assess the impact of price changes on cost-effectiveness. Similarly, NMB analysis can be used for early phase assessment of cost-effectiveness, as changes in effectiveness alter the slope of the NMB line and can serve to assess the impact of a range of efficacy values on cost-effectiveness.
How to Create a NMB Chart

• STEP 1: Calculate Net Monetary Benefit

  Net Monetary Benefit

  Formula in Excel:
  \[ \text{NMB} = \text{Effectiveness} \times \text{WTP} - \text{Cost} \]

• STEP 2: Calculate Chart Values for Dotted Lines

  Dotted Line Values

  Formula in Excel:
  \[ = \text{IF}(	ext{B3} = \text{MAX}(	ext{B3:B6}), \text{NA}(), \text{B3}) \]

• STEP 3: Calculate Chart Values for Solid Line

  Solid Line Values

  Formula in Excel:
  \[ = \text{IF}(	ext{B3} = \text{MAX}(	ext{B3:B6}), \text{B3}, \text{NA}()) \]

• STEP 4: Setup Chart
  Use a line chart
  Create a separate series for each comparator
  Create separate series for dotted lines and solid lines
  WTP values for Horizontal Axis Label
Questions

1. Can these two methods be used concurrently?
2. What is the incremental value for regions where the willingness to pay threshold is explicit?
3. What is the value for regions where the willingness to pay threshold is not explicit?
4. Does this increase transparency or add complexity?