MULTIPLE DECISION CRITERIA FOR ASSESSING AN INCREMENTAL COST-EFFECTIVENESS RATIO OF EXPENSIVE HEALTH TECHNOLOGIES

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Objective

To develop a new method that naturally extends the UK NICE way of single-threshold for incremental cost-effectiveness ratio (ICER). It aims to provide multiple decision criteria for assessing an ICER of expensive health technologies such as molecular-targeted cancer drugs and regenerative medicine products.

Methods

A new theory was developed, assuming that a cost-effectiveness function specific to a disease area is known as the form of $C = f(E)$ (where C:cost and E:effectiveness), on the curve of which treatment alternatives are located as points, at least two points $P_1$ and $P_2$, having a pair of C and E on the C-E plane. The point $P_1$ represents the best comparator, and $P_2$ as the second best for a new technology X notified at the point $P_1$, $(E_1, \text{known})$, $C_1$(not determined). Existence of such a cost-effectiveness function is a pre-requisite for our tangent methods [1,2]. Under those assumptions, we estimated three benchmarks based on the cost-effectiveness function: 1) the ICER represented by the slope from $P_2$ to $P_1$, 2) the tangent at $P_1$, 3) the tangent at the point on the cost-effectiveness curve which intersects with the vertical line at the point: $(E, C)=(e_0, 0)$. Furthermore, the magnitude of relationship was examined between the three benchmarks and the ICER of the technology X defined by the slope of the line connecting $P_2$ with $P_1$.

Results

Multiple decision criteria at six levels were identified and formulated as for acceptance of a new health technology as shown in Figure 1: 1) accepted (simple dominance), 2) preferred (extended dominance), 3) less preferred, 4) minimally preferred, 5) not preferred, but negotiable, and 6) not accepted. Those six levels are defined by identifying five benchmarking points: $D_1(E_1, C_1)$ to $D_5(E_5, C_5)$ that locate on the vertical line at $E_5$. Those were identified as points of intersection with the lines/curve: 1) (for $D_2$) the extension between $P_1$ and $P_2$, 2) (for $D_3$) the tangent at $P_1$, and 3) (for $D_4$) the line through $P_1$ which is parallel to the tangent at $D_4$, and also 4) (for $D_5$) the curve of the cost-effectiveness function.

The range of decision level was determined by theoretical development with the equations as follows: $C_2 = (C_1 - C_0)(E_1/E_0) + (E_1/E_0)$, $C_3 = f'(E_1)(E_0 - E_1) + C_1$, $C_4 = f(E_1)$, $C_5 = f'(E_1)(E_0 - E_1) + C_1$, where the notation of $f'(E)$ denotes the derivative of cost-effectiveness function $f(E)$ at $E = E_0$.

Table 1. An example of estimated multiple ranges of ICER.

<table>
<thead>
<tr>
<th>Decision Level</th>
<th>Range of Cost</th>
<th>Range of ICER</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>under 100,000</td>
<td>under 0</td>
<td>accepted</td>
</tr>
<tr>
<td>Level 1</td>
<td>100,000 to 294,298</td>
<td>0 to 31,638</td>
<td>preferred</td>
</tr>
<tr>
<td>Level 2</td>
<td>129,248 to 140,547</td>
<td>31,638 to 43,860</td>
<td>less preferred</td>
</tr>
<tr>
<td>Level 3</td>
<td>140,547 to 150,000</td>
<td>43,860 to 54,086</td>
<td>minimally preferred</td>
</tr>
<tr>
<td>Level 4</td>
<td>150,000 to 160,820</td>
<td>54,086 to 65,789</td>
<td>not preferred, but negotiable</td>
</tr>
<tr>
<td>Level 5</td>
<td>over 160,820</td>
<td>over 65,789</td>
<td>not accepted</td>
</tr>
</tbody>
</table>

Example

To clarify the concept of our tangent methods for multiple ICERs decision, numerical calculations were performed based on the HIV/AIDS case [3,4]. Let a hypothetical new tertiary intervention for HIV/AIDS have the clinical benefit with 8.59QALY, compared to the primary comparator $P_1(7.68QALY, 100,000USD)$ and the secondary one $P_0(6.9QALY, 50,000USD)$ on the cost-effectiveness curve with the function: $QALY = -8.38 + 2.28ln(Cost)$ and the derivative: $f'(QALY)=2.28/Cost$. The results are shown Table 1, which indicates the new technology cannot be accepted over 65,789USD/QALY, and suggests that a higher threshold could be allowed beyond 50,000USD/QALY commonly recognized as a standard.

Conclusion

Our study offers a new approach for making multi-decisions on a target technology in the context of its alternatives, which are specific to a disease category and already available in the market. It would be useful in making reimbursement and pricing decisions with scientific ground as a natural extension beyond the NICE assessment using single-threshold.

References


Figure 1. Concept of multiple decision criteria to assess an ICER of new technology using tangent methods.

The cost of a new technology can take 6 levels on the vertical line, $E = E_0$:
1) less than $C_1$
2) between $C_1$ and $C_2$
3) between $C_2$ and $C_3$
4) between $C_3$ and $C_4$
5) between $C_4$ and $C_5$
6) more than $C_5$

Each level corresponds to a decision as shown in the figure from “unconditionally accepted” to “not accepted”, respectively.

The $P_1$ in the figure illustrates an example when $C_1$ locates between $C_1$ and $C_2$. The decision points $D_1$ to $D_5$ are defined as follows: $D_5$: a point with $E_1$ and $C_5$; $D_4$: a point at which the line between $P_0$ and $P_1$ extends and intersects with the vertical line at $E_5$; $D_3$: a point at which the tangent at $P_1$ intersects with the vertical line at $E_5$; $D_2$: a point at which the C-E curve intersects with the vertical line at $E_5$; $D_1$: a point where the line through $P_1$, parallel to the tangent at $D_4$, intersects with the vertical line at $E_5$. 

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