Estimating the Probability of a Positive Recommendation for Reimbursement for a New Drug in the UK Using an MCDA Approach

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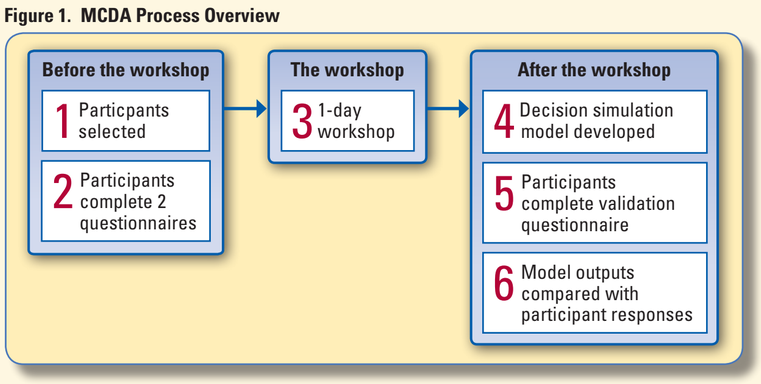
OBJECTIVE

- To use a multicriteria decision analytic (MCDA) approach to develop a regression model to estimate the probability of a positive recommendation for reimbursement by the National Institute for Health and Clinical Excellence (NICE) for a new drug in the United Kingdom (UK).

METHODS

- Figure 1 presents an overview of the MCDA approach.

Figure 1. MCDA Process Overview



The following steps were completed to derive quantitative estimates of the probability of a positive recommendation for reimbursement for a new drug in the UK:

1 Seven UK national payers or payer advisors, including health economists familiar with the practice of the National Health Service (NHS) for England and Wales and for Scotland, were invited to participate in the study.

2 Two preworkshop questionnaires were sent to the participants to identify the most important attributes and their relative importance for a reimbursement recommendation for a new treatment for four types of diseases: chronic non–life-threatening, chronic life-threatening, acute non–life-threatening, and acute life-threatening.

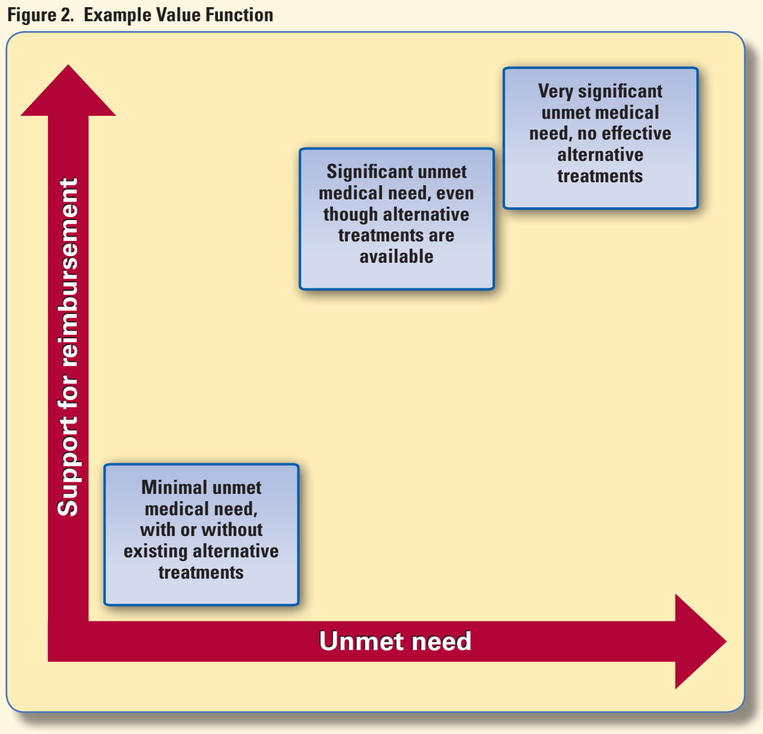
- The first questionnaire included a long list of decision attributes; participants were asked to select up to 10 items they considered most important and to identify the 3 most important items from among these.
- The second questionnaire included a short list of the most commonly selected decision attributes from the first questionnaire; participants were asked to assign 100 importance points among the short-listed attributes.

3 A 1-day workshop was held with the 7 participants, during which RTI Health Solutions (RTI-HS) completed the following tasks:

- Confirmed the relevant decision and decision attributes
  - Based on the preworkshop questionnaire responses and discussion at the beginning of the workshop, it was agreed that the cost per quality-adjusted life-year (QALY) was the most important attribute and that the relative importance for the other attributes should be assessed for products falling within different cost per QALY ranges (< £20,000, £20,000-£30,000, £30,000-£50,000, and > £50,000). Only the results for those products in the £20,000 to £30,000 range are shown.
- Revised the importance weights for the most important attributes for each cost per QALY range
- Developed level descriptors for the most important attributes
- Mapped each attribute level to a value function for each cost per QALY range
- Developed marginal drug profiles (profiles of hypothetical drugs just acceptable for a recommendation for reimbursement) for each cost per QALY range

Figure 2 presents an example of a value function for different levels for the attribute of unmet need.

Figure 2. Example Value Function



4 After the workshop, RTI-HS developed the decision simulation model as follows: Step 1, used the data collected before and during the workshop to calculate a multiattribute value score (MVS) for each marginal profile; Step 2, created a database from the marginal profile scores; and Step 3, used the MVS database to derive a decision simulation model:

Step 1: Using the data collected before and during the workshop, RTI-HS calculated an MVS for each marginal profile as follows:

$$MVS = \Sigma w_i v_{ij}$$

where w_i is the importance weight assigned to the i^{th} criterion; j is the level selected to represent criterion i in the marginal profile; and v_{ij} is the value assigned to level j for criterion i. MVS values were transformed to a 0-1,000 scale.

Step 2: The designation of a profile as "marginal" implies that all profiles with an MVS value less than that of the marginal profile lead to a negative decision, and all profiles with an MVS value greater than that of the marginal profile lead to a positive decision.

- A database was constructed for each marginal profile, with two variables and 1,000 data points.
  - Variable 1 comprised consecutive MVS values from 1 to 1,000, and variable 2 was a dummy variable indicating a positive recommendation for reimbursement (value 1) or not (value 0), depending on the value of variable 1 (IF variable 1< MVS value for the marginal profile, THEN variable 2 = 0, ELSE variable 2 = 1).
  - The databases for all marginal profiles were then combined into one database.

Step 3: The MVS database was used to derive a decision simulation model using logistic regression to estimate the probability of a positive recommendation for reimbursement in the NHS as a function of the MVS value.

5 A postworkshop validation questionnaire was sent to the participants asking them to provide ratings of the likelihood of positive recommendations for reimbursement for selected hypothetical drugs.

6 RTI-HS compared the model outputs with participant responses for hypothetical products from the postworkshop questionnaire to validate the decision simulation model.

RESULTS

- Table 1 shows the 10 most important attributes identified for a positive recommendation for reimbursement and their relative importance weights for a new drug with a cost per QALY estimate of between £20,000 and £30,000 in the UK.

Table 1. Attributes and Relative Importance Weights for a Product With a Cost per QALY Between £20,000 and £30,000 in the UK

Attribute	Relative Importance Weight (%)
Robustness of supporting clinical evidence	31
Robustness of modeled ICER	25
Relative efficacy	8
Availability of alternative treatments	8
Relative safety of new drug	7
Ease of adoption of new treatment	7
Incremental impact on quality of life	5
Budget impact	4
Unmet need	3
Size of proposed population	1

ICER = incremental cost-effectiveness ratio.

- Table 2 presents the attribute levels and relative values for a positive recommendation for reimbursement (between 0–1) for the different attributes. The lower the value, the less support there is for a positive recommendation for reimbursement.

Table 2. Attribute Levels and Relative Values for a Positive Recommendation for Reimbursement

Attribute	Level 1 (Value)	Level 2 (Value)	Level 3 (Value)	Level 4 (Value)
Robustness of supporting clinical evidence	Clinical evidence not relevant to payers (0)	Weak intermediate endpoints and indirect comparisons (0.25)	Relevant endpoints and comparators (1)	
Robustness of modeled ICER	Model structurally invalid (0)	De novo model with no validation and limited data for input values (0.52)	Well-established model, strong input data sources and SOC comparator (1)	
Relative efficacy	Inferior to SOC (0)	Equivalent to SOC (0.31)	Marginally superior to SOC (0.63)	Markedly superior to SOC (1)
Availability of alternative treatments	> 3 differentiated alternative treatments (0)	1–3 differentiated alternative treatments (0.36)	No effective alternative treatments (1)	
Relative safety of new drug	AEs worse than SOC (0)	AEs same as SOC (0.65)	AEs better than SOC (1)	
Ease of adoption of new treatment	Major changes in service delivery (0)	Unclear whether service delivery will change (0.71)	No changes in service delivery (1)	
Incremental impact on quality of life (using standard scale)	Utility score worse by ≥ 0.1 (0)	Some improvement in utility (0.71)	Improvement in utility ≥ 30% (1)	
Budget impact	Increase in total health care costs (0)	Total health care costs do not change (0.5)	Decrease in total health care costs (1)	
Unmet need	Lifetime reduction < 0.3 QALYs (0)	Lifetime reduction 0.3-3 QALYS (1)	Lifetime reduction > 3 QALYS (1)	
Size of proposed population	> 200,000 (0)	7,000-200,000 (0.36)	< 7,000 (1)	

AE = adverse event; SOC = standard of care.

- Using the data collected before and during the workshop, the logistic regression equation estimated was:

$$Y = -6.2354 + 0.0101 * MVS$$

where Y is the log-odds of a positive recommendation for reimbursement in the NHS, and MVS is the multiattribute value score as described above.

- The estimate of the probability of a positive recommendation for reimbursement for a new product (P_{new}) was obtained by first rating the new product on the attributes and then using these ratings with the importance weights to calculate an MVS for the new product (MVS_{new}). The MVS then was used as an input into the following equation:

$$P_{new} = \frac{1}{(1 = e^{-6.2354 + 0.0101 * MVS_{new}})}$$

- When compared with participant decisions for hypothetical products included in the postworkshop questionnaire using the logistic regression model, the estimates of the probability of a positive reimbursement recommendation for the hypothetical products had 71% positive predictive value and 91% negative predictive value.

CONCLUSIONS

- An MCDA process can provide both a qualitative understanding and quantitative estimates of the relative importance, attribute levels, and value scales of different market and product attributes that influence positive reimbursement recommendations by NICE in the UK.
- Further research that could be completed would be to validate the model against actual decisions that have been made in the UK over the last 10 years.

CONTACT INFORMATION

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