Integrating stakeholder preferences in comparative effectiveness research using multi-criteria decision analysis (MCDA) and Conjoint Analysis (CA)

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Multiple endpoints in comparative effectiveness research

- In CER we wish to make an informed decision based on available clinical evidence for multiple endpoints.
- Primary endpoints chosen in clinical trials may not be the most relevant endpoints for patients and other stakeholders.
- Also, process related factors contribute to the actual use by stakeholders and are usually neglected in decision making.
- Three approaches for including stakeholder preferences
  - Stakeholder representatives in appraisal committees
  - Elicitation of preferences to guide deliberative process
  - Integration of preferences in quantitative framework
All MCDA and CA methods decompose a decision problem into a set of criteria (attributes and levels):

I want the best treatment:

- **Clinical Outcome**
  - Drug A: symptom relief
  - Drug B: partial relief
  - Drug C: partial relief

- **Adverse Events**
  - Drug A: high blood pressure
  - Drug B: high blood pressure
  - Drug C: No adverse events

- **Out-of-Pocket Costs**
  - Drug A: 5 US$
  - Drug B: 3 US$
  - Drug C: 5 US$
And they use a linear additive value function to determine the relative preference for the alternatives:

\[
\text{drug A: } (C_1 L_{1,1} + C_2 L_{2,1} + C_3 L_{3,1}) = 0.375
\]
Multi-criteria decision analysis and Conjoint Analysis

- Multi-criteria Decision analysis (MCDA) is a subdiscipline of operations research that explicitly considers multiple criteria in decision making. MCDA methods enable the evaluation of many alternatives by explicit ranking, rating or pairwise comparison of criteria and alternatives. (See: Belton & Steward, 2002)
  - The Analytic Hierarchy Process (AHP) is one of the most widely used MCDA techniques available (Saaty, 1989)

- Conjoint Analysis (CA) methods offer subjects a series of choices among two or more product profiles. The pattern of choices reveals the implicit decision weights patients attach to therapeutic benefits, harms, processes and costs that describe the treatment profiles (ISPOR taskforce, 2012)
MCDA and CA: an example

- Suppose a study in which we will select a good restaurant for dinner. We have defined 3 criteria ($C_i$) and 3 levels ($L_i$)
  - Cooking style: Italian, Greek or Thai
  - Travel distance: need a car, walking or cycling
  - Price: 15$, 20$, 30$

- Conjoint analysis will generate scenarios based on the levels ($L_i$). In this case, $27 \ (3^3)$ scenario’s describe all possible combinations in the decision space.

- MCDA will ask you which criteria and levels ($C_i$ and $L_i$) are important using ranking, rating or pairwise comparisons. 12 comparisons can describe the complete decision space.
Conjoint analysis

- Each participant receives N choice sets.
- Based on their response it is possible to estimate the part-worth utility of the levels and to estimate attribute weights.
- E.g. if Thai food is presented in X scenarios and if a respondent picks all these scenarios we can assume Thai food is an important factor.
Analytic Hierarchy Process (MCDA)

Choose the best restaurant

Style

Thai 0.5
Italian 0.3
Greek 0.2

Price

15$ 0.7
20$ 0.2
25$ 0.1

Travel

Car 0.3
Bicycle 0.1
Foot 0.6

Restaurant 1

0.52

Restaurant 2

0.23

Restaurant 3

0.25
# MCDA vs. Conjoint analysis methods

<table>
<thead>
<tr>
<th>MCDA (e.g. AHP)</th>
<th>CA methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helps to improve judgment</td>
<td>Imitates consumers’ judgment</td>
</tr>
<tr>
<td>Decomposed</td>
<td>Holistic evaluation</td>
</tr>
<tr>
<td>Hierarchical</td>
<td>Matrix structure</td>
</tr>
<tr>
<td>Low cognitive stress</td>
<td>Cognitive stress</td>
</tr>
<tr>
<td>Less realistic</td>
<td>Realistic task</td>
</tr>
<tr>
<td>Flexible</td>
<td>Less flexible (e.g. design)</td>
</tr>
<tr>
<td>Not really used in marketing</td>
<td>Use in marketing (i.e. creates a hypothetical market)</td>
</tr>
<tr>
<td>Decision sciences / OR</td>
<td></td>
</tr>
<tr>
<td>Possible to use in N=1 or as consensus building tool (group-decision)</td>
<td></td>
</tr>
</tbody>
</table>

MCDA methods: the Analytic Hierarchy Process

Decision objective (treatment)

Criterion 1

Criterion 2

Criterion 3

Criterion 3.1

Criterion 3.2

Alternative 1

Alternative 2

\[ C_1 + C_2 + C_3 = 1 \]

\[ C_{3.1} + C_{3.2} = 1 \]

\[ A_1 + A_2 = 1 \]
Verbal scale of importance in pairwise comparisons:
1. Equal
2. Equal to moderate
3. Moderate
4. Moderate to Strong
5. Strong
6. Strong to very strong
7. Very strong
8. Very strong to extreme
9. Extreme

Decision matrix
Eigenvalue to obtain criteria ($C_i$) and level ($L_i$) weights (1)

Matrix with pairwise comparisons
(4 criteria, 6 comparisons)

<table>
<thead>
<tr>
<th></th>
<th>Clinical benefit</th>
<th>Adverse event</th>
<th>Treatment impact</th>
<th>Co-payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical benefit</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Adverse event</td>
<td>1/3</td>
<td>1</td>
<td>1/3</td>
<td>1/5</td>
</tr>
<tr>
<td>Treatment impact</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Co-payment</td>
<td>1/7</td>
<td>1/5</td>
<td>1/3</td>
<td>1</td>
</tr>
</tbody>
</table>

Reciprocal scores of pairwise comparisons

Sum score

6.48   7.20   6.67   11.20

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Eigenvalue to obtain criteria ($C_i$) and level ($L_i$) weights (2)

1. Obtain normalized scores for each cell using the sum score
2. The average for each row gives you the “priority scores”
Group decision support systems (GDSS)
Decision structure in case of anti-depressants

Prioritize endpoints

- Efficacy
  - Response
  - Remission
  - No relapse

- Adverse events
  - Serious adverse events
    - Suicide and attempted suicide
    - Other serious adverse events
  - Adverse events
    - Sexual dysfunction
    - Other adverse events

- Disease specific QoL
  - Social function
    - Anxiety
  - Pain
  - Cognitive function
How patients and experts value patient relevant endpoints

Weighted preference for three antidepressants
General remarks on use of MCDA and CA methods

- MCDA or stated preference techniques do support decision making. They do not make the decision.

- Stated preference techniques are used to obtain stakeholder preferences over a range of treatment options. MCDA techniques, like AHP, can also support the process of decision making.

- The value of MCDA is not the decision algorithm itself but the process of making the decision problem more transparent and explicit.

- Preference data is to be used in conjunction with clinical data. They cannot replace the original clinical evidence.