

Applying multi-criteria decision analysis for healthcare decision making



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Take home messages

- MCDA is a growing field of research with many applications in healthcare
- "There are as many MCDA methods as decision makers"
- Different MCDA methods produce different results for the alternatives
- Yet, different MCDA methods are able to rank the alternatives consistently
- Guidance regarding the appropriate MCDA method is difficult because of many different schools and lack of empirical studies
- MCDA does support groups making their decisions more transparent
- MCDA is not to be used to dictate a decision, i.e. the decision algorithm

An example using rank-weights



Outranking is inconclusive



Apply criteria and performance rank



Compute rank-weights

$$w_i = \frac{K - r_i + 1}{\sum_{j=1}^K K - r_j + 1}$$



Guidance for conducting MCDA...

- It is doubtful if an identification of the "best" MCDA method in general can be performed (De Montis et al, 2005)
- It is impossible to characterize all the DMS; there might exist as many DMS as there are decisions (Guitouni and Martel, 1998)
- All methods have their assumptions and hypotheses, on which is based all its theoretical and axiomatic development - these are the frontiers beyond which the methods cannot be used (Guitouni and Martel, 1998)

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Three seminal texts:

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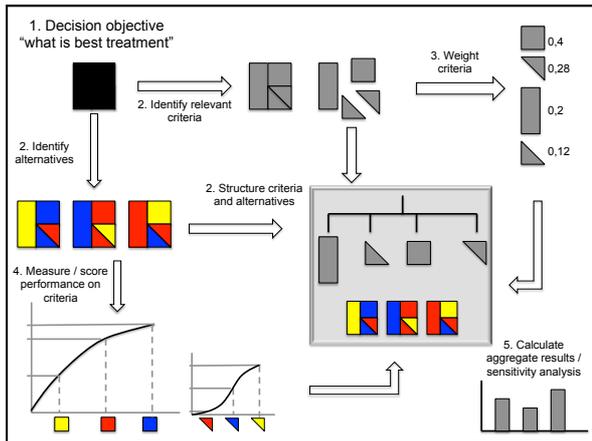
Three seminal texts:

Von Winterfeldt and Edwards, 1986
Structuring a problem – taking it from an initially vague and ill defined problem to one that can be formulated, modeled and analyzed mathematically – is the hardest yet most crucial part of decision analysis.

Keeney and Raiffa, 1993
"An extension of decision theory that covers any decision with multiple objectives. A methodology for appraising options on individual, often conflicting criteria, and combining them into one overall appraisal"

Belton and Stewart, 2002
"An umbrella term to describe a collection of formal approaches which seek to take explicit account of multiple criteria in helping individuals or groups explore decisions that matter"

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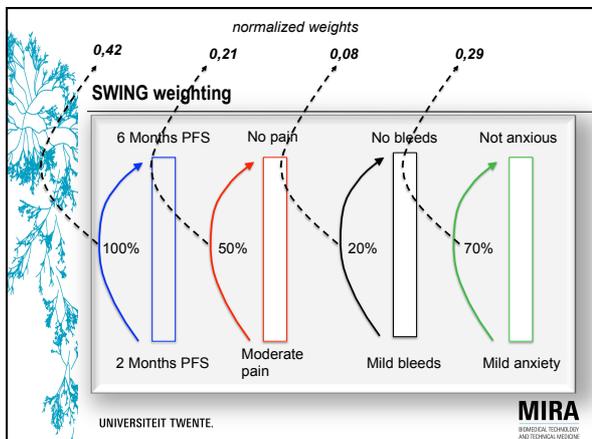
Quantitative methods for the elicitation of weights

- Compositional approaches:**
 - Ranking
 - Rating
 - Self-explicated methods
 - MCDA**
 - Outranking models
 - Value measurement models
 - Goal programming methods
- De-compositional approaches:**
 - Conjoint analysis
 - Best-worst scaling
 - Contingent valuation

In the compositional methods, respondents evaluate (pairs of) criteria separately, after which an overall composite value for the innovation is estimated.

In the de-compositional methods, respondents evaluate the innovation as a whole, and the impact of the various characteristics is calculated from these overall valuations.

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AHP – pairwise comparisons to compute criteria weights

Compare the relative importance with respect to Goal: Select best drug treatment

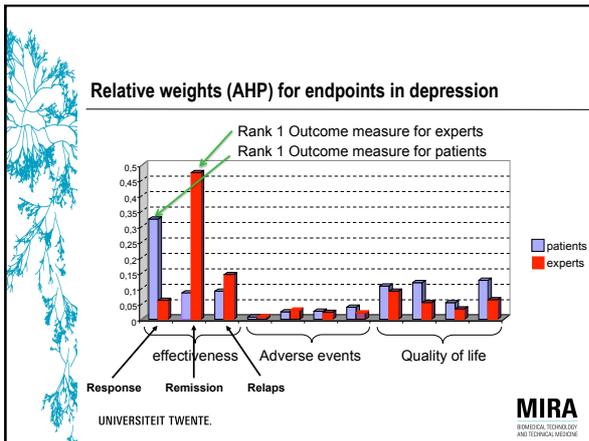
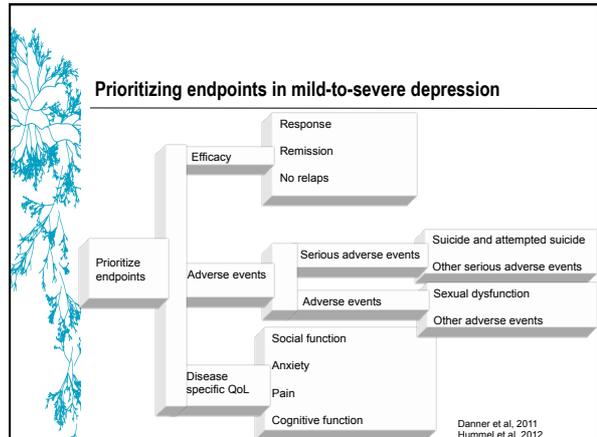
Clinical Benefit (symptom relieve due drug use) Impact of treatment (e.g. drug requires complex dosing schedule and monitoring)

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Impact of treatment (e.g. drug requires complex dosing schedule and monitoring)
Side effects (any adverse event related to drug use)
Additional costs to patients (post of packing)

Clinical Dr. Impact of t. Side effect. Additional

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

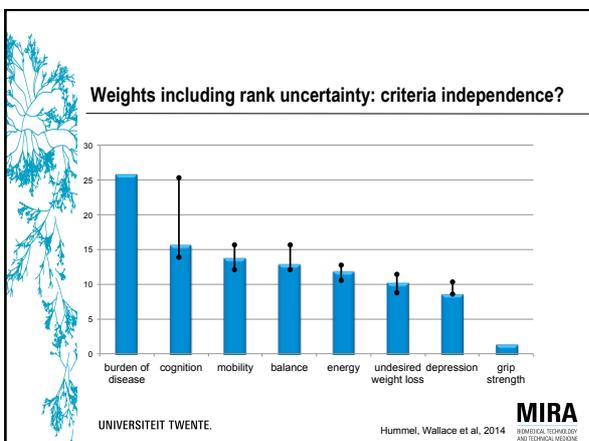
Decision matrix



Prioritizing frailty indicators for medical nutrition

Frailty criterion	Suggested clinical outcome measure
1. Mobility	Gait Speed
2. Balance	Tinetti scale for balance or the balance part of the short physical performance battery (SPPB)
3. Energy	Six-Minute Walk Distance
4. Grip Strength	Jamar Dynamometer (kg per hand)
5. Undesired weight loss	Weight loss (kg)
6. Cognition	The General Practitioner Assessment of Cognition, incl. Clock Drawing Test
7. Depression	PHQ9 test from Cornell or the Geriatric Depression scale (15 items)
8. Burden of disease	Number of acute hospitalizations and length of stay in the hospital

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- ### Behavioural biases in MCDA
- "Weight elicitation method" bias
 - Different methods produce different weights, basically because the scale we offer is interpreted to match the DM's decision heuristic
 - E.g. SMART basically is interpreted as an ordinal scale
 - "Range" bias
 - DM's do not account for the attribute's measurement scale
 - E.g. attribute weight may be the same for salary range \$500-\$1000 vs. \$500-\$2000
 - "Hierarchical structuring bias", construction of hierarchies may cause bias
 - "Splitting" bias
 - Criteria decomposed in many sub-criteria tend to overestimate the weight
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Example: splitting bias

- In hierarchies, criteria with many sub-criteria tend to be receiving more weight (Stillwell, 1987; Weber, 1988; Pöyhönen, 1997)
- Splitting-bias, i.e. if attribute presented in more detail it increases the weight it receives (Hämäläinen, 2003)

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Health Technology Assessment and Priority Setting

Hierarchical representation of goals and criteria for prioritizing technology assessment research at CADTH.

UNIVERSITEIT TWENTE. Huserneau, et al: Priority setting for health technology assessment at CADTH. *Int J Techn Assess Health Care*. 2010; 26(3):341-7. **MIRA** BIOMEDICAL TECHNOLOGY AND TECHNICAL MEDICINE

Use of MCDA in HTA: where is cost in the equation?

Might be relevant for priority setting

Resource allocation decisions

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Use of MCDA for Health Technology Assessment

- Criteria involve multiple factors relevant for decision making, i.e. outcomes, budgets, burden, prevalence etc.
- Issues
 - Do we need one fixed set of criteria for HTA?
 - What measure of value? Can we use fixed criteria to include value?
 - Do we need to construct a societal preference function for the criteria?
 - How to handle costs if concerned about resource allocation?
- Decision maker uncertainty
 - Structural uncertainty, i.e. did we consider all relevant criteria?

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Conclusions and take-home messages

- Strength of MCDA is to support the deliberative process
 - It is required to be very explicit about criteria to consider
 - Explicit value judgment by different stakeholders
 - Decision makers will not accept MCDA for the decision algorithm
- Several sources of bias exist while structuring clinical endpoints for prioritization
- Decisions makers most uncertain about assumptions in the model
 - Structural uncertainty, i.e. did we pick the right criteria and outcomes
 - Uncertainty about synthesizing and integration of clinical evidence
- Not clear how to implement in current procedures
 - HTA decision (as other decisions) making is an iterative process

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