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Multi-attribute decision modelling (MADM) as an aid to decision making: applications in healthcare and pharmaceuticals

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Multi-attribute decision modelling (MADM) is an established and powerful analytical tool that can be used to help objectify decision-making where a number of options or choices exist. In this ePaper, we review how it has been used in medicine and explore ways in which MADM could be deployed in a range of situations in the pharmaceutical sector. These situations include brand differentiation, scenario planning, market assessments, customer segmentation, resource planning, and value strategy. It is our contention that MADM has been under-utilized in pharma and there are many opportunities to further exploit this extremely useful and flexible tool.

Introduction

Mankind has been trying to objectify decision-making for centuries with Benjamin Franklin's 'Moral Algebra' perhaps being one of the first mathematical approaches documented.[1] With the emergence, between the wars, of analytical management theories and research, new methodologies and approaches were developed. The discipline of operational research was at the forefront of applying scientific analysis to support decision making in academia and in business, with many practitioners pioneering multi-attribute decision modelling (MADM) techniques (also described as multi-criteria decision analysis).[2] However, the use of such techniques in the healthcare sector is a relatively recent phenomenon.

MADM is now an established analytical tool, widely used in many business sectors to help

objectify decision-making. MADM is defined as a formal analysis which takes into account multiple attributes associated with certain actions or choices. The model scores and weighs these attributes for each alternative action in a comparative mathematical analysis. In this way it is hoped that an objective score emerges to inform and guide action towards the optimal choice or outcome. The term multi attribute decision modelling (or model) is often used interchangeably with multi criteria decision analysis (MCDA) and it could be argued that MADM is a subset of MCDA. It should be noted that MCDA is a technique and descriptor which is gaining traction in healthcare, in particular in the health technology assessment community, and in some pharmaceutical companies. In this ePaper we will be looking only at the use of models, so will stick to the term MADM.

MADM in healthcare and pharma

MADM has, over the last 20 years, been used to a limited degree in the medical sector, primarily as a guide to help physicians choose treatments.[3-6] Some of these analyses have been sponsored by pharmaceutical companies (see case studies), others have been independently undertaken. MADM is particularly powerful in this regard in that it brings a strong objective element to comparing different drug treatments or medical interventions. It does this by looking at the best possible composite score or profile across a range of predefined attributes (eg efficacy, safety, tolerability) and then measures how close each drug or intervention is to this hypothetical ideal profile. This is a particularly compelling analysis for products with a true objective edge over the competition (either through a meta-analysis, an extensive evidence base or genuine differentiating benefits or advances).

The first deployments of MADM in the pharmaceuticals have been in support of drug choices; however, there are many other potential uses. It is an incredibly robust and flexible methodology and any decision-making situation which could benefit from objective support could utilize a MADM. Some of these areas are noted below:

- Brand differentiation
- Portfolio planning and optimization
- Asset assessment and milestone testing
- Value strategy benchmarking
- KTL profiling and mapping
- Market assessments and segmentation
- Resource deployment (optimizing the marketing mix)

MADM methodology explained

At the core of a MADM is a comparison grid which lists choices for action against a series of common, comparable attributes. The last point is important in that for accurate and appropriate analysis, objective, comparable data or scores for each attribute must be available (or calculable). Figure 1 shows the steps needed to build a comparative grid, which then feeds the MADM.

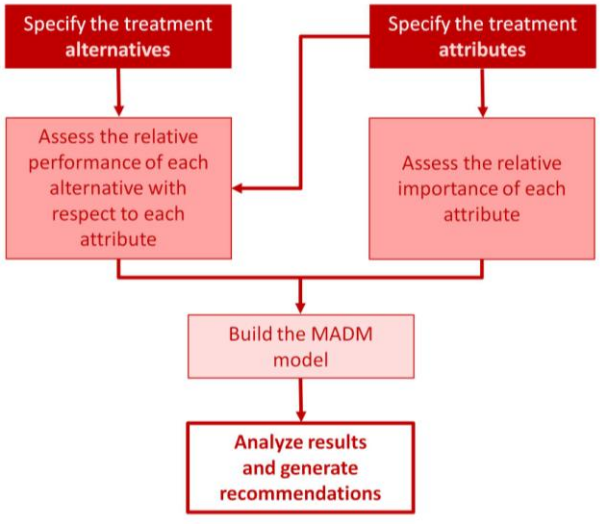

Figure 1. Key steps to build a MADM (for product assessment)

To take a simple illustrative example of how to build the core grid, let's consider the purchase of a new car. When choosing a car most people start with a short list of preferred models, but will then deploy a mixture of objective and subjective attributes when making the final choice. One such attribute may be fuel economy and it will be easy to list miles per gallon (mpg) figures for each vehicle in a grid. Similarly, figures such as maximum speed and acceleration will be available from manufacturers and reviewers – thus for these attributes clear objective and comparative numbers can be used to populate the grid.

But how can MADM cope with subjective attributes, such as reliability, or even more tricky factors such as 'brand kudos' or 'desirability index', where no actual measurements exist? In the case of the latter, personal preference has a big part to play, but let's suppose any individual bias is eliminated in the initial filter from a long list of vehicle manufacturers to a short list. For subjective measures in this example the purchaser can simply insert their own score for kudos or 'prestige', if that is something they wish to include. A scale of 1–5 or 1–10, an arbitrary percentage score are all acceptable for subjective data, provided they are consistently deployed. The MADM can cope with different dimensions or units *down* the option columns – it is *across* the attribute rows that consistency and comparability of definition and units must be applied, eg mpg urban cycle, acquisition costs in pounds or dollars.

Figure 2 shows an example of how a new car choice comparator table may look (n.b. these are not real data).

Attributes	Weighting	Vehicle			
		RAV 4	CRV	Kuga	Touran
Maximum speed mph	Can be changed by user to reflect contrasting needs or priorities. In this case different family members may have contrasting viewpoints, and hence weightings.	105	118	98	92
Acceleration (0–60 mph, s)		9.0	9.5	8.8	10.3
CO2 emissions, g/km		188	177	197	190
Fuel economy, mpg urban		34	37	33	28
Acquisition cost, £000s		30.3	29.5	28.9	28.5
Running costs, p/mile		45	51	55	39
'Admiring glances' index		3	4	3	1

Figure 2. Illustrative example comparing four different 4x4s (or 'SUVs')

In Figure 2 the ideal profile is shaded in green (based on a best car for least cost mindset). A mathematical MADM would plot all four SUVs against this profile and show which is closest to ideal. At first glance this may appear to be the CRV but even though the RAV4 gets no green boxes it may turn out, on balance, to be closest to the ideal. In this example a full analysis will not always be carried out since such tables are invariably used to reinforce our personal choices (and we can always tweak the weightings to get our preferred car to the top!). However, in the examples used in medicine and explored later in this ePaper, a full mathematical MADM was built. Such a model and indeed the process of building it can provide revealing insights and supportive evidence.

Once the comparative grid is devised there are many ways of mathematically executing a multi-attribute decision analysis to give overall rankings and scores (over 50 methodologies noted in the literature). These include an approach as straightforward as simple additive weighting through to more

complex methodologies such as 'fuzzy integral techniques' or multiplicative exponential weighting. One of the most commonly used and, we believe, most apposite methods in healthcare, is known as TOPSIS (technique for ordered preference for similarity to the ideal solution). This approach is preferred because it combines a simple concept with robust and reproducible mathematics. TOPSIS was used in the drug choice case studies described below, as well as other examples noted in further reading.

MADM as a tool to inform and influence drug prescribing choices

Case study 1: Triptans for the treatment of migraine[4]

Scenario: The sixth drug to market in a single class of agent (triptans) has superior efficacy and a favourable outcome in an independently published meta-analysis but suffers from slow and low market penetration.

Analysis: Full TOPSIS MADM is run on all six triptans approved for the treatment of migraine. This analysis results in two of the newer, lower market-share products coming out ahead of the old established market leader (ie nearer to the 'ideal' choice based on TOPSIS score). Additional MADMs are run with different weightings and from different customer group perspectives (including patients) all of which confirm the initial finding that two of the six triptans are 'ahead of the pack' on this objective and validated analysis.

Outputs: Four primary papers, nine abstracts, six posters, all providing rich published evidence, enduring materials and citations to support an aggressive marketing campaign.

Outcome: Increased market penetration for the clinically superior newcomer brand.

Case study 2: Biologic agents for plaque psoriasis[5]

Scenario: Market leader anticipates a scenario where newer drugs may erode their leadership position.

Objective: Establish an appropriate first-choice biologic position in the treatment of plaque psoriasis for an appropriately targeted patient population (in this case the largest segment of market).

Analysis: Full TOPSIS MADM is run on all four biologic agents approved for the treatment of psoriasis. This analysis results in the market leader coming out on top for the biggest patient segment (ie nearer to the ideal choice). A second model including two pipeline products was run to anticipate where the emerging competitors would fit in.

Outputs: Interactive model for use in advisory boards and other meetings. One very dynamic advisory board. One primary paper, which furnished ammunition for affiliates to compartmentalize competitors into difficult-to-treat patient segments.

Outcome: Market share erosion is slowed, increased confidence in the market leader, newer products are marginalized and positioned towards the tough to treat, smaller market segments.

Benefits of the MADM approach to decision-making support and analysis

AMICULUM Consulting believes that there are many instances across our industry where a well-executed MADM would not only aid sound decision-making but would also provide valuable evidence for publications, customer engagement, educational initiatives and promotional source data. Moreover, taking a formalized MADM approach to decision making and comparative analyses in your planning can have a number of

additional benefits beyond objectivity and reproducibility as follows:

- It has not been widely adopted, so can help brands, franchises and individuals stand out from the crowd
- It is transparent, so the analytical component cannot be criticised as a biased 'black box' model
- It can be put through a thorough internal pressure testing prior to rollout to customers
- It can be changed in real time bringing an exciting and dynamic element to workshops and advisory boards
- It can be used with many different stakeholders, each having an interest in different elements (and thus an opportunity to realign or influence the model towards factors which are of most relevance to them)
- It can generate a wide range and volume of publications and other outputs (different data cuts, emphases for different audiences and patient segments, interactive models and apps)
- It has longevity and robustness allowing for a quick and simple re-analysis when new drugs enter the market or guidelines change (thus triggering more attendant outputs)

Future applications

As noted above, there are many benefits which a MADM analysis can bring in many sectors and applications across the pharma lifecycle and across different departments and teams (commercial/marketing, medical affairs, market access, business development), see Figure 3.

Brand differentiation and support	Portfolio planning and assessment	Resource deployment
Testing and clarification of pre-launch positioning scenarios	Market potential and gap analysis	Objective marketing mix analysis
Competitor launch threat characterization and defence	Objectivity diminishes single brand partiality or dominance	Flexible budget planning: matched to changing scenarios
Data and evidence generation (plugging publications gap)	Reduces risk of over-subjective brand favouritism driving key stage decisions	Pressure test resource switching in a safe but predictive model
Drug choice support tool	Optimize co-positioning and segmentation	Match investment to channels that have biggest impact and plot metrics over time
Payer positioning support	Provides evidence to support appropriate and credible target segmentation	Phased launch analyses for maximal market penetration
Product comparator model for MSLs or sales reps	Optimum drug combination assessments	

Figure 3. Potential applications for MADM across the product lifecycle

AMICULUM has looked at a few dynamic markets and specific scenarios in pharma which could benefit from a MADM at this time and these are noted in Figure 4. Should any of these resonate for you or if you have other scenarios crying out for a healthy dose of objectivity please contact us. A glance at these examples reveals that they have a number of characteristics in common as follows:

- Dynamism triggered by new (superior) treatment options
- Multiple treatments currently available (four or more)
- New entrants or novel classes of drug just 'around the corner'
- Some clear differences between the treatment options (supported with objective data)
- Clarifying the picture with objective data will confer competitive advantage

Space precludes us from citing the many different therapy areas or market sectors which fulfil all of these criteria. What is clear though is that if you, your team and your brands are involved in one of these turbulent markets – and most importantly – you have a product that stacks up well on objective measures, then a MADM should get serious consideration in your next round of planning.

Scenario/market sector	Triggers for analysis
Hepatitis C	Emergence of direct acting antiviral agents and new oral regimes
COPD and asthma	Launches of once-daily fixed-dose combination long-acting beta-2 agonist/long-acting anticholinergic inhalers
Multiple sclerosis	Increasing number of treatment options
Biologics in rheumatoid arthritis (and other inflammatory conditions)	Increasing number of treatment options and differentiated products for RA, psoriasis and IBD
Anticoagulants and anti-thrombotics	New product launches increasing range of treatment options
Oncology	Increasingly complex treatment algorithms and new combinations, eg prostate cancer, breast cancer

Figure 4. Market or therapy area sectors which could benefit from a MADM

References and further reading

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