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Preference-Based Assessments

Development of a Prioritization Framework to Aid Healthcare Funding Decision Making in Health Technology Assessment in Australia: Application of Multicriteria Decision Analysis

Saval Khanal, PhD, Son Nghiem, PhD, Mel Miller, PhD, Paul Scuffham, PhD, Joshua Byrnes, PhD

ABSTRACT

Objectives: This study develops a prioritization framework to aid healthcare funding decision making in health technology assessment (HTA) in Australia using a multiple criteria decision analysis (MCDA) approach.

Methods: MCDA frameworks for HTAs were reviewed through literature survey to identify the initial criteria and levels within each criterion. Key stakeholders and experts were consulted to confirm these criteria and levels. A conjoint analysis using 1000Minds was undertaken with policy makers from the Department of Health to establish ranking criteria and weighting scores. Monte Carlo simulations were used to examine the sensitivity of findings to factors affecting the ranking and weighting scores. The MCDA was then applied to 6 examples of chronic care models or technologies projects to demonstrate the performance of this approach.

Results: Five criteria (clinical efficacy/effectiveness, safety and tolerability, severity of the condition, quality/uncertainty, and direct impact on healthcare costs) were consistently ranked highest by healthcare decision makers. Among the criteria, patient-level health outcomes were considered the most important, followed by social and ethical values. The analyses were robust to inform the uncertainty in the parameter.

Conclusions: This study has developed an MCDA tool that effectively integrates key priorities for HTA reviews, reflecting the values and preferences of healthcare stakeholders in Australia. Although this tool aims to align the assessment process more closely with health benefits, it also highlights the importance of considering other criteria.

Keywords: Australia, health technology assessment, multicriteria decision analysis, prioritization, stakeholder preference.

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Highlight

- Established knowledge includes prior studies on healthcare funding decision making and some regional pilot studies in Australia, notably in Queensland Health. The existing literature may touch upon multicriteria decision analysis frameworks but may lack a comprehensive examination of Australian policymakers' criteria preferences.
- This study unveils the preferences of Australian policymakers, emphasizing "patient-level health outcomes" and "social and ethical values" over cost considerations, providing unique insights into decision-making criteria.
- This study also demonstrates the multiple criteria decision analysis framework's practical utility as a transparent and cost-effective decision-aid tool, offering valuable implications for informed healthcare funding decisions and resource allocation.

Introduction

Chronic conditions account for more than two-thirds of the 41 million annual deaths worldwide and possess a huge socio-economic impact.[1] With a rise in the aging population and other risk factors, it is estimated that the prevalence of chronic conditions will increase further in the future as well. Consequently, the development of new technologies and care models is crucial to effectively address these challenges. However, countries face resource limitations and cannot allocate funding to every proposed model or technology. To address this issue, many countries have implemented health technology assessment (HTA) programs to determine whether to fund specific models and technologies. For example, in Australia, prescription medicines for the population are subsidized by the Pharmaceutical Benefits Scheme (PBS), and medical services are subsidized by the Medicare Benefits Schedule (MBS). The Pharmaceutical Benefits Advisory Committee and Medical Services Advisory Committee performs HTA on behalf of the Australian Government Department of Health for the items to be included in PBS and MBS.[2]

Similar to other HTA bodies, cost-effectiveness analysis has been a key, but not the only, factor for health technology assessment decision making in Australia.[2-5] However, healthcare is a complex process; hence, reliance on cost-effectiveness analysis can fail to address a broader range of criteria (eg, equity and safety) encountered in healthcare decision making. Multiple criteria decision analysis (MCDA) has been applied to support various organizations in the investment decision-making process for healthcare and health technologies.[2,6-14] Although not a substitute for a complete economic evaluation, MCDA can be used effectively to identify priorities for further consideration.[14-18] This is in recognition that undertaking a full economic assessment for all potential and available alternatives can be time consuming, expensive, and needs a certain level and quality of data for a valid application.

MCDA comprises a broad range of systematic decision-making methodologies. Its primary objective is to optimize the prioritization, ranking, and selection of options by incorporating multiple criteria into the evaluation process.[19,20] This process identifies which criteria should be included in the MCDA and determines the relative importance (weight) associated with each of those criteria. These decision criteria are the criteria by which different options/alternatives (healthcare models, technologies, etc) are prioritized; relative importance or weights for each criterion are applied to rank the different options for prioritization. MCDA helps allocate the funding (or any decision) to be transparent, explicit, systematic, pragmatic, efficient, and consistent with the goals of the funding organizations' objectives, such as government or other payers. The MCDA approach aims to support rather than replace existing deliberative processes by adding transparency and consistency through explicit scoring and weighting. MCDA has excellent potential in HTA, but more applied studies are required to improve its contribution to HTA.[10] In this article, we aimed to develop an MCDA framework to aid healthcare funding decision making in Australia by elucidating stakeholders' preferences. We have used 6 examples of chronic care models or technologies, showing how the framework works and also demonstrating the way a probabilistic sensitivity analysis can be performed to address uncertainties. This MCDA project was performed to inform the funding bodies about one method for prioritizing healthcare expenditure in Australia.

Methods

This study was conducted using a mixed method approach, which included both the assessment of expert opinions and quantitative analysis of scoring data. The analysis was conducted from the perspective of funding bodies—such as State governments or the Commonwealth government of Australia. The study was implemented in 4 steps: (1) establishing criteria for the decision survey, (2) defining levels within the established criteria, (3) weighting preferences for the established criteria, and (4) ranking all the available alternatives based on the weighted preference of the criteria.

Establishing Criteria for Decision Survey

Literature on MCDA frameworks for HTAs were reviewed including those discussed in the context of healthcare systems in Germany,[21] the European Community,[22,23] Canada,[24] and Thailand[25] to determine the initial list of MCDA criteria applicable to prioritize publicly funded healthcare. We then conducted a stakeholder consultation with policymakers from the Department of Health and Human Services, Victoria Government; health policy/economics researchers from (ANONYMISED for Peer Review) University; and health policy experts from (ANONYMISED for Peer Review) Consultants to seek agreement on the criteria for the MCDA framework for HTA in Australia. Then, a pilot study with the above stakeholders who have no previous exposure to MCDA was conducted to finalize the list of criteria for the decision survey.

Defining Levels Within the Criteria and the Pilot Survey

The levels for each criterion were developed based on the same method as described in the previous section—through a literature survey, consultation process, and pilot survey. A pilot survey was completed using a small group of experts in HTA from the (ANONYMISED HEALTH ECONOMICS CENTER AT A UNIVERSITY for Peer Review) (n = 7), (ANONYMISED CONSULTING FIRM for Peer Review) (n = 2) and staff from the Victorian Department of Health and Human Services (n = 3). Face validity, mechanics of the survey, and finalization of the wording of criteria and their levels were also established at this phase.

Weighting—Estimating the Relative Importance of Each Criterion and Level Using Preferences

The 1000minds (www.1000minds.com) online survey platform was used for the design and delivery of the survey and to establish weights. To do this a conjoint analysis was undertaken using the Potentially All Pairwise Rankings of All Possible Alternatives (PAPRIKA) method within 1000minds to determine the relative weights associated with the different criteria of the MCDA.[26] PAPRIKA capitalizes on the "transitivity" theorem to minimize the number of choice tasks for each participant. That is, if a participant prefers B over A, and prefers C over B, then by transitivity C is preferred to A, and the participant would not be presented with this choice. Thus, the set of choice tasks presented to each participant depends on their previous responses. Linear programming embedded in 1000minds derives the relative importance for the levels for each criteria (ie, weights) based on the participant's choices; for technical details and a recent review see.[26,27]

To implement to survey, 75 participants were invited from Australian State and Commonwealth government departments of health. Participants were asked to answer a series of questions where they had to choose between 2 alternative scenarios. Each question provided information with respect to 2 of the criteria, with all other aspects of the alternatives considered equal.

Scoring and Applying Weights for Alternatives

We used 6 different projects related to the management of chronic illness as alternatives as presented in Table 1 here.

Each intervention was scored against each criterion. For each criterion, a numerical score was allocated, from 1 to 3 in 5 cases and from 1 to 2 in 3 cases, based on attributes (levels) of the intervention. Once the scoring was completed, the weight obtained from the preference survey was applied to each criterion score to obtain weighted criterion scores for each intervention. The weighted scores for each criterion were then added to obtain an overall weighted score for each intervention.

Sensitivity Analysis

We developed a decision-analytic model comprising criteria, weights, and scores in TreeAge® Pro R1. A probabilistic sensitivity analysis was carried out using a Monte Carlo simulation with 1000 iterations for the following 3 scenarios: scenario 1 (incorporating uncertainty in scores for the intervention); scenario 2 (incorporating uncertainty in the preference weights), and scenario 3 (incorporating uncertainty in both the scores and preference weights). We selected a Dirichlet distribution in case of preference weights (mean+/− SD) inputs in the simulation and uniform distribution in case of scores input in the model.

Results

The MCDA Framework

There was a relatively high consistency among international HTA communities regarding the decision criteria used for the prioritization.[20,28,29] Five criteria were consistently ranked highest by healthcare decision makers based on their relative importance, namely, clinical efficacy/effectiveness, safety and tolerability, severity of the condition, quality/uncertainty, and direct impact on healthcare costs. Other criteria identified but not necessarily systematically considered included innovation, societal benefit,

Table 1. Technology/models of care (interventions) that the MCDA was applied.

Name of the projects	Description
Project 1	The model of care involved remotely monitoring and managing the health of people in their homes, which involved the following activities: the patient is given advice or recommendations for action while in their own home the patient may be referred to appropriate health service when needed the patient may also seek further advice from an on-call consultant Patients are provided with an Android tablet and equipment such as a blood pressure cuff and pulse oximeter to measure the oxygen in their blood. Every day patients are asked to enter their information into the tablet. If any issues are identified, a team of nurses can respond to support the patient immediately, either by phone or by video conferencing. The expert team at Personalized Health Care also offer patients the opportunity to have a health coaching catch-up fortnightly to explore strategies to better manage their health condition.
Project 2	This project is a national telehealth home monitoring trial for chronic disease for aged care and is Australia's first large-scale trial of telehealth. The test patients were provided with a telehealth device that included participant/clinician video conferencing capabilities, messaging features and the delivery of clinical and study-specific questionnaires, as well as vital signs devices to monitor their electrocardiogram, heart rate, spirometry, blood pressure, oxygen saturation, body weight, and body temperature, with glucometer an optional add-on. The 12-month trial enabled chronic disease patients to self-manage their conditions at home through the provision of telehealth services. Health workers could assess changes in their patient's conditions remotely and provide appropriate care interventions'. Patients eligible to take part in the trial were first given a questionnaire, then they were connected to the internet and monitored by both a coordinator and a project officer who divided tasks such as monitoring, technical support, and admin. The telehealth systems were trialed at the 5 different sites using different models of care. The sites in the Tasmania state and Australian Capital Territory represented one model where patients received normal care in the community but were monitored by a team of specialist nurses based in hospital settings. The sites in New South Wales, Queensland, and Victoria represented another model of care whereby patients were monitored by nurses operating in community settings without necessarily the backing and support of a regional hospital. Community-based telemonitoring models appeared to generally deliver better economic results than hospital-based models.
Project 3	This model of care is based on one of the Kidneys Services based in Queensland and it involves the delivery of renal care by upskilled GPs and Practice Nurses working under the direct supervision of an on-site nephrologist. Patients can be referred to the service by their own GP. Alternatively, they may be referred to the service if their chronic kidney disease is stable and judged to be suitable for community care by their nephrologist. The shared model of care in operation through this Kidneys Service means that patients can maintain more of their care with their usual GP and reduce or eliminate the need to visit a hospital for appointments. Our clinical team will liaise with both your GP and your specialist to maintain your health in the community. All of the services provided are bulk billed, maintaining Queensland Health's commitment to delivering high-quality care, which is free at the point of delivery.
Project 4	This is support software that creates a virtual patient model for clinicians to calculate an accurate dosage. It is a clinician-focused software platform that uses Bayesian precision dosing methods to predict the best drug doses to be monitored with Therapeutic Drug Monitoring. It uses a combination of app and web-based platform to individualize doses immediately and easily, removing the reliance on blood collection. The platform can create individual profiles of pharmacokinetics and pharmacodynamics. It has cloud-based management and record systems that can be customized to clinician needs. Key drug packages currently available are for oncology, transplant medicine, and pediatrics.
Project 5	This project plans to expand the telehealth program of Australia based one of the world's largest and most comprehensive aeromedical organizations in partnership with a leading IT company. The plan aimed to expand the specialties, including cardiology, respiratory medicine, psychiatry, rheumatology, and gerontology in the rural areas of Victoria state in Australia. This telehealth service offers the following: Varied specialist appointments between city-based specialists and regional patient Online, easy-to-use booking system User-friendly access through a web browser Provision of multiple appointments to be booked at once Supportive concierge service for all users
Project 6	It is an application and online platform that aims to diagnose and measure the severity of chronic and acute respiratory conditions using cough and breathing sound information. Instead of using a stethoscope to identify lung conditions, the application measures the information from audible sounds in the atmosphere, which they claim contain more information than the sounds, and automatically interprets them. The technology has taken a machine learning approach to develop highly accurate algorithms which diagnose disease from cough and respiratory sounds. Machine learning is an artificial intelligence technique that constructs algorithms with the ability to learn from data. In their approach, signatures that characterize the respiratory tract are extracted from cough and breathing sounds. Subsequently, they start matching signatures in a large database of sound recordings with known clinical diagnoses. The machine learning tools then find the optimum combination of these signatures to create an accurate diagnostic test or severity measure (this is called classification).

GP indicates general practitioners; MCDA, multiple criteria decision analysis.

Table 2. MCDA criteria used in this project and their measure and definition/consideration

Criteria	Measure	Criteria definition/ considerations
Burden of condition	Size of population	* Number of people affected by the condition (eg, incidence and prevalence).
Evidence base	Quality of evidence	* Level of evidence, quality of evidence, number of studies, consistency of results across studies, bias, confidence in evidence etc.
Clinical benefit	Effectiveness and efficacy	* The magnitude and direction of the models of care/ technology's effect should be considered. Desirable effects relative to undesirable, ie, net clinical benefit.
Elements of cost in the model of care and cost of technology/ therapeutics	Cost	* A measure of the cost of the models of care/technology to implement.
Cost consequences/ offsets		* The cost offsets/impact of the new models of care/technology, ie, reduced hospitalizations; increased GP visits.
Organizational feasibility	Implementation capacity	* The ease with which the models of care/health technology can be adopted by looking at other enablers and/ or barriers to diffusion. * Infrastructure/geography/ clinical services capability framework/impact on other service streams (eg, rehabilitation services).
Equity	Social & ethical values	* Target identified groups of special needs; consistency with a broader social framework.
Patient experience	Patient centeredness	* Patient experience (eg, convenience to adherence to treatment), accessibility, out-of-pocket costs.

GP indicates general practitioners; MCDA, multiple criteria decision analysis.

access and equity, stakeholder pressures, operational feasibility, and benefits to caregivers.[30-32] Based on the review of the literature[15,33,34] and the consultation process defined in the methodology section, the following MCDA framework was adopted (Table 2).

Demography of the Participants Participating in the Preference Survey

The response rate for the survey was 52%, that is, 39 out of 75 invited participants completed the survey. Incomplete survey responses were excluded from the analysis. The highest number of responses were received from those located in Victoria (n = 13), followed by Western Australia (n = 9) and finally, employees of the Commonwealth government (n = 7). Representation by individuals of Commonwealth and State governments in the survey is shown in Figure 1.

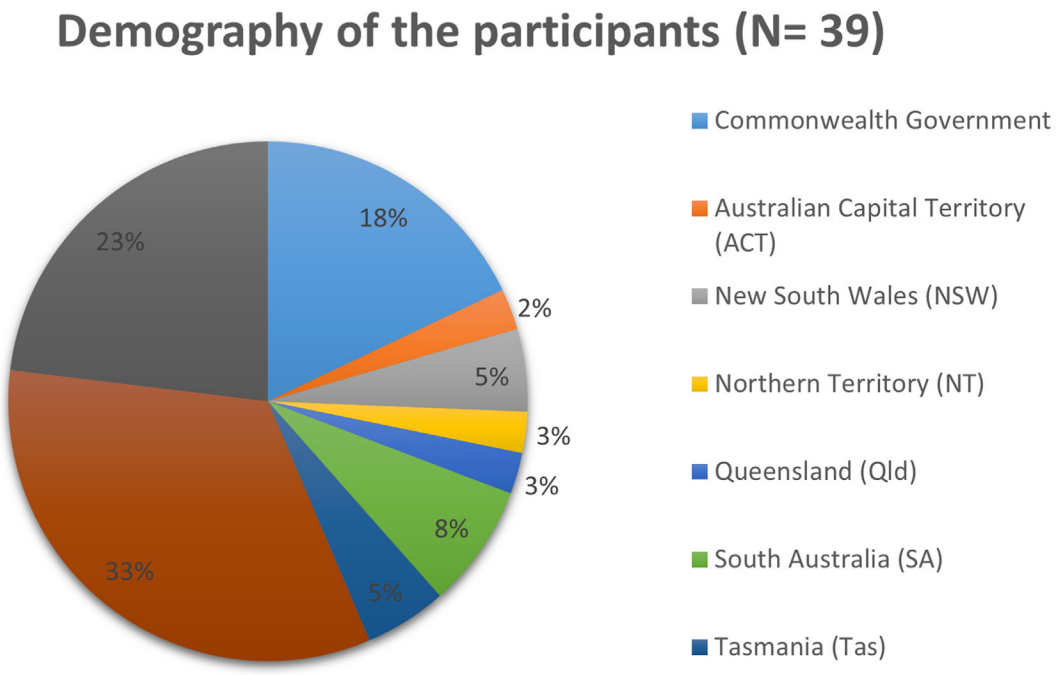
Relative Importance (Weights) of the Criteria

From the preference survey conducted with different stakeholders, we calculated the mean preference weights for each criterion. Based on their responses, patient-level health outcomes were considered the most important criteria (24%), followed by social and ethical values (19%). Interestingly, the policymakers did not consider the feasibility (6%) and the number of people likely to receive the intervention (4%) as important criteria when compared with others (Table 3).

Scores and Rank of the Hypothetical Projects

Table 4 shows how the application of criteria weights in the score changes the ranking of the projects. The upper section (containing unweighted scores and ranks) of this table shows that projects 1, 2, and 3 all rank equally based on the sum of scores attributed to each of the criteria. Subsequently, when the criteria weights obtained from the preference survey were applied to the score, there was a substantial change in the score and ranking. This is because all 8 criteria were assumed to have equal importance in the case of the unweighted score; however, in the case of the weighted score, each criterion had its own weight (derived from the preference survey) and was scored differently based on their importance. For example, from a preference survey with

Figure 1. Commonwealth/state representation of the survey participants.



health policymakers, the patient-level health outcomes were considered essential criteria; therefore, projects that resulted in substantial improvement in quality of life were scored 23.4%, and the criterion—number of people likely to receive intervention—was least important, only weighting 4.4% out of 100.

Sensitivity Analysis

The Supplemental File shows the expected scores of different projects under different scenarios following the Monte Carlo simulation. During all scenarios, project 2 remains the favorite option, ranking the highest among the 6 projects. A result of the Monte Carlo Simulation Strategy Selection informed that under each scenario, project 2 would be likely to be preferred by all stakeholders. For example, in the case of scenario (uncertainty in scores), project 2 is likely to be selected 85 times out of 100. Further details are available in Figure 2.

Discussion

The overall aim of this study was to develop the multicriteria decision analysis framework to prioritize healthcare funding in Australia and demonstrate how the probabilistic sensitivity analysis can be added to the framework to address uncertainty in the parameters. We surveyed to understand the most important criteria the policymakers consider while prioritizing any new health technologies and then developed an MCDA framework for aiding decision making about funding prioritization. There were altogether 39 policymakers representing all the states, territories, and also the Commonwealth government of Australia. The weights based on policymakers' preferences were then used further in 6 hypothetical projects to show how MCDA can be used to rank the priority interventions.

Although a small pilot study has been conducted in one of the Department of Health in Australia (Queensland Health) to make a funding decision at the state level,[35] to our knowledge, this is the first study that identified the preferred criteria and their weighted importance, which the policymakers across Australia value most to prioritize healthcare funding. The preference survey provides the framework that the policymakers can use to shortlist or select priority medicines/devices/care models for further detailed evaluation or to build the case for a full HTA. The framework provides a transparent yet very consistent decision-making tool. For example, in the case of 6 different hypothetical projects included in this study, the weighted ranks are different from the unweighted ones signifying the importance of adding preference weights in the MCDA framework. Prioritizing certain medicine/device/care models and performing a full technology assessment would be good value instead of performing a detailed assessment for all available medicine/device/care models. Hence, the MCDA, when used as a decision-aid tool, has the potential to be more cost-effective than the traditional methods. In this case, we could perform a detailed HTA for project 2 instead of performing the assessments for all 6 projects. The criteria used in our survey aligns closely with those established in other countries such as the United States[17] and various European countries, such as Sweden, Andalusia, Poland, and Belgium.[22] However, notable differences reflect the unique healthcare contexts of each region. In the United States, there is a balanced approach, with significant importance given to disease severity (26.2%), disadvantaged populations (21.8%), and broader economic impact (17.3%).[17] This reflects the complexities of the private insurance-based system and diverse stakeholder input. Conversely, the stakeholders in European countries consistently prioritize therapeutic benefit, with substantial weightings assigned across different countries, such as Sweden at 44.5%, Andalusia at 54.3%, Poland at 40.0%, and Belgium also at 40.0%.[22] This underscores its critical role in health funding decisions across the continent. Safety profile is also highly valued, generally ranking second (though third in Poland), with weightings ranging from 20.0% to 33.3%. In Australia, although therapeutic benefit and safety profile are significant, the focus shifts toward "Patient-Level Health Outcomes" and "Social and Ethical

Table 3. Criteria and levels, and preference weights.

Criteria and levels within criteria	Preference weight (Mean [SD])
Number of people likely to receive the intervention	
100 000 people or less	0%
More than 100 000 people	4.4% (5.0%)
Quality of evidence	
Very low or low evidence (pilot project, case study)	0%
Moderate evidence (a small, randomized control trial, large cohort studies)	8.5% (4.8%)
High evidence (large multicenter randomized control trial, meta-analysis)	13.8% (6.2%)
Patient-level health outcomes	
Small or no improvement in quality of life or in life expectancy	0%
Moderate improvement in quality of life or life expectancy	12.2% (5.6%)
Substantial improvement in quality of life or life expectancy	23.4% (6.8%)
Cost to implement and run the new model of care	
High cost (one-off cost of $30 000 per person or equivalent of $2500 per person per year)	0%
Moderate cost (one-off cost of $12 500 per person or equivalent of $1000 per person per year)	5.2% (1.2%)
Low cost (one-off cost of $2500 per person or equivalent of $200 per person per year)	10.3% (2.2%)
Cost offsets or savings (eg, hospital or general practitioner presentations avoided, unnecessary diagnostic tests avoided, etc)	
No cost-savings or potential increased ongoing costs	0%
Small cost-savings (<$1000 per person per year)	8.1% (4.3%)
Substantial cost-savings (>$1000 per person per year)	13.8% (5.8%)
Organizational feasibility (existing infrastructure, time, and capacity to implement)	
Low feasibility (needs major system changes, eg, significant changes to legislation or funding environment)	0%
Moderate feasibility (needs moderate system changes, eg, moderate changes to legislation or funding environment, upskill workforce)	3.6% (4.8%)
Highly feasible (no/slight modification in the health system)	5.7% (5.4%)
Social and ethical values (does it address the needs of a group with special considerations?)	
No	0%
Yes	19.3% (6.1%)
Patient experience (improves access, convenience, and patient out-of-pocket costs)	
No change in patient experience	0%
Improved patient experience	9.2% (5.0%)

Values." This reflects a stronger emphasis on clinical effectiveness and addressing inequity over procurement costs, given the government-subsidized healthcare funding through schemes such as the PBS and the MBS. This difference highlights how Australia's healthcare funding structures, which alleviate direct financial burdens on patients and providers, influence the prioritization of criteria. Additionally, HTA decisions in Australia are mainly conducted from a healthcare system perspective, with private payers, such as insurance companies, having little say in these decisions. Also, our survey accounted for patient-level outcomes and cost offsets (savings), which are crucial determinants of incremental cost-effectiveness ratios (ICERs). These elements demonstrate that the preferred technology would have a lower ICER than alternative technologies, suggesting a higher likelihood of being within willingness-to-pay (WTP) thresholds. Although WTP may not be directly incorporated within the MCDA framework, it is indirectly addressed through these factors.

Based on this MCDA framework, several policy recommendations can be made. First, adopting a structured and transparent MCDA framework is crucial for ensuring consistency and openness in funding decisions. This involves clearly defining criteria and their weights and making the process accessible to stakeholders for scrutiny. Engaging a diverse range of stakeholders, including healthcare professionals, patients, policymakers, and the public, ensures that the prioritization process reflects societal needs. Emphasizing equity helps address health disparities by prioritizing interventions that improve access for underserved populations. Clinical effectiveness, with some focus on cost, remain primary criteria to maximize the health impact of limited resources. Improving data quality supports accurate evaluations, whereas incorporating flexibility and regular updates allows the MCDA framework to adapt to new evidence and changing priorities. Encouraging innovation and research is vital because investing in cutting-edge technologies and novel treatments can lead to significant healthcare advancements; therefore, some of the focus should also be given to these criteria while making a decision. Utilizing sensitivity analysis helps understand the impact of uncertainties in criteria weights and evidence quality, ensuring

Table 4. Scoring and ranking of projects with and without stakeholder preference.

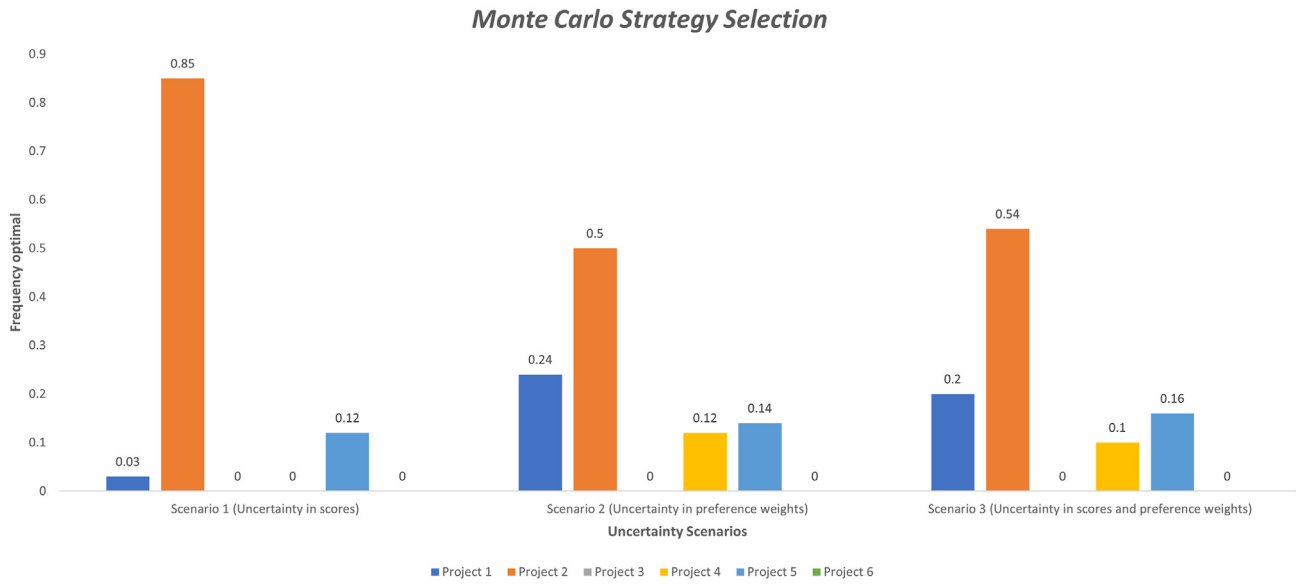
Criteria	Unweighted Scores (without stakeholder preference)					
	Project 1	Project 2	Project 3	Project 4	Project 5	Project 6
Number of people likely to receive the intervention	2	1	1	2	2	2
Quality of evidence	2	3	2	2	3	2
Patient-level health outcomes	2	2	2	3	2	2
Cost to implement and run the new model of care	3	2	2	2	2	2
Cost offsets or savings (hospital or general practitioner presentations avoided, unnecessary diagnostic tests avoided, etc)	2	3	2	2	2	2
Organizational feasibility (existing infrastructure, time and capacity to implement)	2	2	2	2	2	2
Social and ethical values (does it address the needs of a group with special considerations?)	2	2	2	2	2	1
Patient experience (convenience, patient out-of-pocket costs)	2	2	2	1	2	2
Total	17	17	15	16	17	15
Unweighted rank	Equal 1st	Equal 1st	Equal 5th	Equal 4th	Equal 1st	Equal 5th
	Weighted Scores (with stakeholder preference)					
Number of people likely to receive the intervention	4.42%	0.00%	0.00%	4.42%	4.42%	4.42%
Quality of evidence	8.53%	13.75%	8.53%	8.53%	13.75%	8.53%
Patient-level health outcomes	12.21%	12.21%	12.21%	23.44%	12.21%	12.21%
Cost to implement and run the new model of care	10.32%	5.19%	5.19%	5.19%	5.19%	5.19%
Cost offsets or savings (hospital or general practitioner presentations avoided, unnecessary diagnostic tests avoided, etc)	8.15%	13.84%	8.15%	8.15%	8.15%	8.15%
Organizational feasibility (existing infrastructure, time, and capacity to implement)	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%
Social and ethical values (does it address the needs of a group with special considerations?)	19.27%	19.27%	19.27%	19.27%	19.27%	0.00%
Patient experience (convenience, patient out-of-pocket costs)	9.24%	9.24%	9.24%	0.00%	9.24%	9.24%
Total	75.76%	77.12%	66.22%	72.61%	75.85%	51.36%
Weighted rank	2nd	1st	5th	4th	3rd	6th

robust and adjustable funding decisions. Following these recommendations can improve the effectiveness, fairness, and transparency of health funding decisions, leading to better health outcomes and more efficient resource use.[36,37] Countries should adopt structured and transparent MCDA frameworks to ensure consistent and open decision making. Engaging diverse stakeholders, including healthcare professionals, patients, and policymakers, ensures that decisions reflect societal needs.

One of the biggest strengths of this study is that it is one of the few studies which elucidated the Australian stakeholders preferred criteria and associated weights based on their importance in making a funding decision. The article provides a practical approach to the way how MCDA can be used as a decision-aid tool in funding decision making. The addition of probabilistic sensitivity analysis added robustness to the findings. For example, in this case, project 2 was most likely to be selected for funding based on the stakeholders' preference.

Some limitations of this study are noted. First, the current study only included 6 example projects; however, these projects were typical health department projects requiring decision making around future funding. Second, the participants in this study were policymakers from various states and territories across Australia. Although we ensured a broad representation across different regions, detailed demographic data, such as age, professional experience, and specific backgrounds (medical doctors, health economists, legal experts, etc) were not collected. We acknowledge that including such detailed information would enhance the context and interpretation of our findings. Furthermore, the

Figure 2. Monte Carlo selection strategy under different scenarios.



representation from some states/territories in the preference survey was relatively low. A larger sample size and/or higher response rate might have elicited different weights and potentially more representative findings. This is a limitation we aim to address in future studies by collecting comprehensive demographic information and striving for a larger, more balanced sample.

Conclusion

In this study, we demonstrated the way how MCDA could be incorporated to make the decision about healthcare funding. Although not a substitute for full economic evaluation, the MCDA framework developed in this study can be used to inform the HTA in Australia and possibly elsewhere, including the uncertainty analyses. For example, the preference weight obtained from the survey can be used to shortlist priority healthcare technologies from the wide range of available technologies and only take shortlisted technologies for full economic evaluations. Although only 6 projects were illustrated in this example, MCDA can be performed by including hundreds of new and emerging technologies to shortlist priority technologies for further consideration.

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section.

Supplemental Material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.jval.2024.07.003.

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Author Affiliations: Centre for Applied Health Economics, School of Medicine and Dentistry, Griffith University, Nathan, Queensland, Australia (Khanal, Scuffham, Byrnes); Department of Health Economics, Wellbeing and Society, Australian National University, Canberra, Australian Capital Territory, Australia (Nghiem); Siggins Miller Consultants, Brisbane, Queensland, Australia (Miller).

Correspondence: Dr. Saval Khanal, PhD, Center for Applied Health Economics, Sir Samuel Griffith Centre (N78), Room 1.11, Griffith University, Nathan Campus, Nathan, QLD 4111, Australia. Email: khanalsaval@gmail.com; Prof. Joshua Byrnes, PhD, Center for Applied Health Economics, Sir Samuel Griffith Centre (N78), Room 1.11, Griffith University, Nathan campus, Nathan, QLD 4111, Australia. Email: j.byrnes@griffith.edu.au

Author Contributions: *Concept and design:* Khanal, Miller, Scuffham, Byrnes
Acquisition of data: Miller, Byrnes
Analysis and interpretation of data: Khanal, Nghiem, Byrnes
Drafting of the manuscript: Khanal
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REFERENCES

1. Murray CJ, Abbafati C, Abbas KM. Five insights from the global burden of disease study 2019. *Lancet*. 2020;396(10258):1135–1159.

2. Kim H, Byrnes J, Goodall S. ISPOR Australia Chapter executive committee. Health technology assessment in Australia: the pharmaceutical benefits advisory committee and medical services advisory committee. *Value Health Reg Issues*. 2021;24:6–11.
3. Kapiriri L, Razavi D. How have systematic priority setting approaches influenced policy making? A synthesis of the current literature. *Health Policy*. 2017;121(9):937–946.
4. Ciani O, Grigore B, Taylor RS. Development of a framework and decision tool for the evaluation of health technologies based on surrogate endpoint evidence. *Health Econ*. 2022;31(Suppl 1):44–72.
5. Garattini L, Bozzetto M, Nobili A, Mannucci P. Health technology assessment for pharmaceuticals in the European Union: what lessons after two decades? *Intern Emerg Med*. 2022;17(5):1251–1253.
6. Marsh K, Dolan P, Kempster J, Lugon M. Prioritizing investments in public health: a multi-criteria decision analysis. *J Public Health*. 2013;35(3):460–466.
7. Tony M, Wagner M, Khoury H, et al. Bridging health technology assessment (HTA) with multicriteria decision analyses (MCDA): field testing of the EVIDEM framework for coverage decisions by a public payer in Canada. *BMC Health Serv Res*. 2011;11(1):1–13.
8. Goetghebeur MM, Wagner M, Khoury H, Levitt RJ, Erickson LJ, Rindress D. Bridging health technology assessment (HTA) and efficient health care decision making with multicriteria decision analysis (MCDA) applying the EVIDEM framework to medicines appraisal. *Med Decis Mak*. 2012;32(2):376–388.
9. Drake JI, de Hart JCT, Monleón C, Toro W, Valentim J. Utilization of multiple-criteria decision analysis (MCDA) to support healthcare decision-making FIFARMA, 2016. *J Mark Access Health Policy*. 2017;5(1):1360545.
10. Marsh KD, Sculpher M, Caro JJ, Tervonen T. The use of MCDA in HTA: great potential, but more effort needed. *Value Health*. 2018;21(4):394–397.
11. de Andrés-Nogales F, Cruz E, Calleja MÁ, et al. A multi-stakeholder multi-criteria decision analysis for the reimbursement of orphan drugs (FinMHU-MCDA study). *Orphanet J Rare Dis*. 2021;16(1):1–12.
12. Santos MdS, Morais QCD, Cramer H, et al. Application of the MCDA method for assessing new technologies for familial hypercholesterolaemia treatment. *J Bras Econ Saúde*. 2021;13(1):14–20.
13. Campolina AG, Estevez-Diz MDP, Abe JM, de Soárez PC. Multiple criteria decision analysis (MCDA) for evaluating cancer treatments in hospital-based health technology assessment: the Paraconsistent Value Framework. *PLoS One*. 2022;17(5):e0268584.
14. Khanal S, Schmidtke KA, Talat U, Turner AM, Vlaev I. Using multi-criteria decision analysis to describe stakeholder preferences for new quality improvement initiatives that could optimize prescribing in England. *Front Health Serv*. 2023;3:1155523.
15. Wahlster P, Goetghebeur M, Kriza C, Niederlander C, Kolominsky-Rabas P. National Leading-Edge Cluster Medical Technologies 'Medical Valley EMN'. National leading-edge cluster medical technologies'medical valley EMN. Balancing costs and benefits at different stages of medical innovation: a systematic review of multi-criteria decision analysis (MCDA). *BMC Health Serv Res*. 2015;15:262.
16. Qiu Y, Thokala P, Dixon S, Marchand R, Xiao Y. Topic selection process in health technology assessment agencies around the world: a systematic review. *Int J Technol Assess Health Care*. 2022;38(1):e19.
17. McQueen RB, Inotai A, Zemplenyi A, Mendola N, Németh B, Kalo Z. Multi-stakeholder perceptions of additional value elements for United States value assessment of health interventions. *Value Health*. 2024;27(1):15–25.
18. Sánchez-Martínez F-I, Abellán-Perpiñán J-M, Martínez-Pérez J-E, Gómez-Torres J-L. Design of a multiple criteria decision analysis framework for prioritizing high-impact health technologies in a regional health service. *Int J Technol Assess Health Care*. 2024;40(1):e21.
19. Marsh K, IJzerman M, Thokala P, et al. Multiple criteria decision analysis for health care decision making—emerging good practices: report 2 of the ISPOR MCDA emerging good practices task force. *Value Health*. 2016;19(2):125–137.
20. Thokala P, Devlin N, Marsh K, et al. Multiple criteria decision analysis for health care decision making—an introduction: report 1 of the ISPOR MCDA emerging good practices task force. *Value Health*. 2016;19(1):1–13.
21. Wahlster P, Goetghebeur M, Schaller S, Kriza C, Kolominsky-Rabas P. National Leading-Edge Cluster Medical Technologies 'Medical Valley EMN'. National leading-edge cluster medical technologies'medical valley EMN. Exploring the perspectives and preferences for HTA across German healthcare stakeholders using a multi-criteria assessment of a pulmonary heart sensor as a case study. *Health Res Policy Syst*. 2015;13:24.
22. Angelis A, Kanavos P. Multiple criteria decision analysis (MCDA) for evaluating new medicines in health technology assessment and beyond: the advance value framework. *Soc Sci Med*. 2017;188:137–156.
23. Martelli N, Hansen P, van den Brink H, et al. Combining multi-criteria decision analysis and mini-health technology assessment: a funding decision-support tool for medical devices in a university hospital setting. *J Biomed Inform*. 2016;59:201–208.
24. Diaby V, Goeree R, Hoch J, Siebert U. Multi-criteria decision analysis for health technology assessment in Canada: insights from an expert panel discussion. *Expert Rev Pharmacoecon Outcomes Res*. 2015;15(1):13–19.
25. Mohara A, Youngkong S, Velasco RP, et al. Using health technology assessment for informing coverage decisions in Thailand. *J Comp Eff Res*. 2012;1(2):137–146.
26. Hansen P, Ombler F. A new method for scoring additive multi-attribute value models using pairwise rankings of alternatives. *J Multi Criteria Decis Anal*. 2008;15(3-4):87–107.
27. Sullivan T, Hansen P, Ombler F, Derrett S, Devlin N. A new tool for creating personal and social EQ-5D-5L value sets, including valuing 'dead'. *Soc Sci Med*. 2020;246:112707.
28. Brixner D, Maniadakis N, Kalo Z, Hu S, Shen J, Wijaya K. Applying multi-criteria decision analysis (MCDA) simple scoring as an evidence-based HTA methodology for evaluating off-patent pharmaceuticals (OPPs) in emerging markets. *Value Health Reg Issues*. 2017;13:1–6.
29. Greco S. Multiple criteria decision analysis and sustainable development. In: Greco S, Ehrogott M, Figueira J, eds. *Multiple Criteria Decision Analysis: State of the Art Surveys*. New York, NY: Springer; 2016:1235–1267.
30. Dionne F, Mitton C, Dempster B, Lynd LD. Developing a multi-criteria approach for drug reimbursement decision making: an initial step forward. *J Popul Ther Clin Pharmacol*. 2015;22(1):e68–e77.
31. Dionne F, Mitton C, Macdonald T, Miller C, Brennan M. The challenge of obtaining information necessary for multi-criteria decision analysis implementation: the case of physiotherapy services in Canada. *Cost Eff Resour Alloc*. 2013;11(1):11.
32. Castro Jaramillo HE, Goetghebeur M, Moreno-Mattar O. Testing multi-criteria decision analysis for more transparent resource-allocation decision making in Colombia. *Int J Technol Assess Health Care*. 2016;32(4):307–314.
33. Adunlin G, Diaby V, Xiao H. Application of multicriteria decision analysis in health care: a systematic review and bibliometric analysis. *Health Expect*. 2015;18(6):1894–1905.
34. Marsh K, Caro JJ, Hamed A, Zaiser E. Amplifying each patient's voice: a systematic review of multi-criteria decision analyses involving patients. *Appl Health Econ Health Policy*. 2017;15(2):155–162.
35. Howard S, Scott IA, Ju H, McQueen L, Scuffham PA. Multicriteria decision analysis (MCDA) for health technology assessment: the Queensland Health experience. *Aust Health Rev*. 2018;43(5):591–599.
36. Frazão TD, Camilo DG, Cabral EL, Souza RP. Multicriteria decision analysis (MCDA) in health care: a systematic review of the main characteristics and methodological steps. *BMC Med Inform Decis Mak*. 2018;18(1):1–16.
37. Thokala P, Duenas A. Multiple criteria decision analysis for health technology assessment. *Value Health*. 2012;15(8):1172–1181.