Chapter 12
The Role of MCDA in Health Research Priority Setting

Roderik F. Viergever, Dimitrios Gouglas, and Noor Tromp

Abstract Health research priority-setting exercises aim to maximize the impact of investments in health research. An increasing number of priority-setting exercises for health research have taken place in the past two decades. These exercises have been conducted for various areas of health research and at various levels (global, regional, national, local and institutional). In this chapter, we discuss the similarities and differences between health research priority setting and health intervention priority setting, and we describe the current methodologies used in health research priority setting and the role of multi-criteria decision analysis (MCDA) therein. We provide three concrete suggestions for future methodological development in the field of health research priority setting: (1) recognize that many of the methodologies used to set health research priorities apply MCDA, (2) make use of well-established approaches or best practices for health research priority setting and (3) study in more detail the differences between health intervention and health research priority setting.

R.F. Viergever (✉)
Department for Health Evidence, Radboud University Medical Center, P.O. Box 9101, 6500 HB, Nijmegen, Netherlands

Research4health, Utrecht, The Netherlands
e-mail: rviergever@research4health.org

D. Gouglas
CEPI – Coalition for Epidemic Preparedness Innovations, Norwegian Institute of Public Health, Oslo, Norway

N. Tromp
Department for Health Evidence, Radboud University Medical Center, P.O. Box 9101, 6500 HB, Nijmegen, Netherlands

Royal Tropical Institute (KIT), Mauritskade 63, 1092 AD, Amsterdam, Netherlands

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12.1 Introduction

Health research[1] provides us with opportunities to mount a better response to health problems. There are different types of health research, and each type offers different opportunities for improving our responses to health problems. Research might measure the magnitude and distribution of a health problem; help to understand the causes of the problem; elaborate solutions; help to translate the solutions or evidence into policy, practice and products; or evaluate the impact of solutions (WHA document A63/22: WHO's role and responsibilities in health research: Draft WHO strategy on research for health 2010). Some research takes place on an individual level (i.e. biomedical research or clinical research); other research takes place on a population level (i.e. epidemiological research or health systems research) (Frenk 1993). Research that focuses on developing products can aim to develop a variety of different products, such as devices, medicines, vaccines, procedures or systems (Health technologies: Report by the Secretariat. World Health Organization Executive Board document EB 121/11 2007). Every year, approximately 240 billion US dollars are spent globally on health research (Røttingen et al. 2013). The challenges associated with distributing these funds in an optimal way have given rise to the growing field of health research priority setting.

Health research priority-setting exercises are used by researchers and policymakers to help them make choices about what health research to conduct or to invest in. These exercises range widely in coverage (global, regional, national, local and institutional) (Viergever et al. 2010a; McGregor et al. 2014), in scope (generalized vs. context specific) (Baltussen et al. 2010) and in their aims (e.g. setting a 'road map' for health research needs vs. prioritizing optimal investment options for funders of health research) (McGregor et al. 2014). A large number of health research priority-setting exercises have been conducted globally in recent years. Two reviews from 2006 to 2008 identified 344 and 258 reports of health research priorities, respectively (Oliver and Gray 2006; Stewart and Oliver 2008); a review of WHO-based health research priority setting from 2009 found 230 reports of health research priorities that were organized or coordinated through WHO headquarters in roughly 5 years before (Viergever et al. 2010a), and a review from 2014 by McGregor identified 91 health research priority-setting exercises from low- and middle-income countries (McGregor et al. 2014).

This chapter reviews the methodologies that have been developed to guide such priority setting, with a specific focus on the role of multi-criteria decision analysis (MCDA) in these methodologies. The chapter has three sections. First, to introduce the chapter, we discuss the similarities and differences between health research

[1] Research is defined here as in the *Frascati Manual* by the Organisation for Economic Co-operation and Development (OECD): 'Creative work undertaken on a systematic base in order to increase the stock of knowledge, including knowledge about man, culture and society, and the use of this knowledge to devise new applications' (Frascati manual: proposed standard practice for surveys on research and experimental development 2002). Health research is defined as in the *Revised field of science and technology* (*FOS*) *classification* in the *Frascati Manual* and includes the fields of basic medicine, clinical medicine, health sciences, medical biotechnology and other medical sciences (Working Party of National Experts on Science and Technology Indicators 2007).

priority setting and health intervention priority setting. Second, we describe the types of methodologies that are being used to set health research priorities and to what degree these apply MCDA. From this, several suggestions follow for future methodological development in the field of health research priority setting that we discuss in the final section of the chapter.

12.2 What Are the Similarities and Differences Between Health Research and Intervention Priority Setting?

12.2.1 Similarities

Health research priority setting and intervention priority setting are similar in many ways. Both fields know a large variety of priority-setting methodologies and contexts for which priorities can be set, for example, ranging from deliberative to quantitative methodologies (IJzerman et al. 2014) and from generalized to context-specific contexts (Baltussen et al. 2010). Exercises in the two fields also share many considerations around aspects of the priority-setting process, such as the theories that underlie the methods for priority setting (e.g. multi-attribute utility theory), stakeholder mapping and selection, identifying and choosing criteria, assigning weights to criteria, scoring options, aggregating scores, reaching agreement on the final list of priorities (e.g. consensus approaches or majority rules approaches), presenting the priorities and implementing the priorities (IJzerman et al. 2014; Viergever et al. 2010b; Okello and Chongtrakul 2000).

12.2.2 Differences

However, there are also differences between these two areas of priority setting. The main conceptual difference between the two is that the problem that needs to be solved differs: prioritizing research is not the same as prioritizing interventions. In considering the value of various research options against a set of criteria, there is inherently more uncertainty about these values than in health intervention priority setting, because making decisions about which research will pay off requires an amount of future foresight. As Callahan has noted, 'While priority setting for health-care delivery is concerned only with meeting present needs, research aims at future as well as present needs' (Callahan 1999).

This conceptual difference has several practical consequences. First, the criteria that are used to appraise the various options differ between the two fields. There is certainly an overlap between the criteria used in both fields: both might take into account, for example, the (expected) health impact, cost or equity of the research or intervention options. However, other criteria differ: the expected feasibility of development of a health technology does not apply to interventions, because they have already been developed. The criteria that are used in both fields are listed in

reviews of health intervention (Tromp and Baltussen 2012) and health research (McGregor et al. 2014; Noorani et al. 2007) priority-setting exercises.

Second, because of the uncertainty associated with health research priority setting, the manner in which options are scored against criteria is often more subjective in health research priority setting, i.e. less directly based on data and more on stakeholder opinion. While subjectivity is inherent to both settings to some degree (e.g. in eliciting preferences for weights of criteria), many exercises that use MCDA to establish intervention priorities make use of objective data to populate the performance matrix.[2] Examples of such objective data about interventions are the effectiveness of the interventions and their cost (Baltussen et al. 2006; 2007). These data are commonly derived from the literature and may be used in mathematical modelling estimations. When such data are not available, which might be the case for criteria for which data are sparser and/or more difficult to quantify (such as equity), subjective judgements are used to score the intervention options based on the various criteria. Conversely, in health research priority setting, where objective data to populate a performance matrix are often not available, stakeholders are commonly presented with evidence collected prior to the exercise, but the dominant method for scoring research options against criteria is through stakeholder opinion (Viergever et al. 2010b).

There are several additional reasons for the use of stakeholder opinion, rather than objective data, in health research priority-setting exercises. First, while in health intervention priority-setting exercises, the number of intervention options that are prioritized (e.g. interventions to combat HIV/AIDS (Youngkong et al. 2012)) is often limited; in health research, the number of options that can be identified and prioritized is virtually unlimited. Even when the health research priority-setting exercise is limited to one health area (e.g. HIV), and even when it is limited to one area of research (e.g. biomedical research, clinical research, epidemiological research or health systems research (Frenk 1993)), the options are endless. Moreover, the level of granularity in defined research options can vary greatly per exercise, ranging from precise research questions to broad research areas (McGregor et al. 2014). In the aforementioned review of health research priority-setting exercises in low- and middle-income countries by McGregor, 35 % prioritized broad research areas, 42 % research topics and 23 % specific research questions (McGregor et al. 2014). Additionally, in health research priority setting, the research options are almost always identified by stakeholders during the priority-setting exercise, while in intervention priority setting, existing options are more often evaluated in advance (we reviewed the priority-setting studies compiled by McGregor (McGregor et al. 2014) and found that only one used a list of predetermined research options). The large amount of possible research options, combined with the fact that their level of granularity is often not yet determined prior to the exercise and that the options are mostly identified by stakeholders during the exercise, makes it difficult to collect objective data on the various research

[2] The population matrix describes the performance of the options against each criterion (Baltussen and Niessen 2006).

options in advance to support populating the performance matrix with objective data. It is noteworthy that while these are common aspects of many health research priority-setting exercises, that there are also health research priority-setting exercises where the number of options is more limited (e.g. (very) early HTAs can help to prioritize various research options and often only have a limited amount of options (Highlights in Early Health Technology Assessment 2011)). For these priority-setting exercises, the use of objective data might be more feasible.

To provide some insight into the workings of health research priority-setting exercises, we describe a case study of the development of a national health research agenda in Papua New Guinea (Box 12.1).

Box 12.1

A case study of health research priority setting in Papua New Guinea

To exemplify the methods used in health research priority-setting exercises, we provide a case study here of a recent exercise that developed a national health research agenda for Papua New Guinea for the years 2013–2018 (Viergever et al. 2014). The purpose of the agenda was to inform the priorities for a planned national health research grants programme, funded by both the Papua New Guinea government and development partners. The development of the agenda was led by a steering committee that was assembled by the National Department of Health. Methodologically, the development of the priority-setting exercise was based mainly on the 'checklist for health research priority setting' and the essential national health research (ENHR) strategy. The exercise involved two stages. In the first, four workshops were held that each focused on a different research domain: reproductive, maternal and child health research, communicable disease research, research on healthy lifestyles and health systems research. For each domain, technical experts, including policymakers, practitioners and researchers, discussed the appropriate values underlying the exercise, decided on criteria that should be used in the priority-setting exercise, decided on the relevant more specific research areas under each research domain and identified 10–15 research topics for each research domain. In stage two, during one workshop, senior policymakers, practitioners and researchers further refined these topics. They also divided 100 points over the three criteria decided upon by the groups in the first stage to reflect their relative importance and then scored the research options against these criteria. In addition, they were asked to provide a score for the overall importance of each research option. Criteria-based scores and overall scores were then combined to form a final ranking of research topics. That final ranking was discussed and modified by the stakeholders in the meeting until a final consensus on the research topics was achieved. After this, participants in the meeting discussed the next steps, including the implementation of the agenda and plans for revision.

12.3 Health Research Priority Setting and MCDA

So, health research priority setting is similar in many ways to health intervention priority setting, but there are also differences. In this section, we review the various *methodologies* that are used to set health research priorities. To assess the degree to which MCDA is being applied in the field of health research priority setting, we compare these methodologies with MCDA. After that, we present an analysis of the degree to which MCDA has been applied in a sample of health research priority-setting *exercises*. In the final part of this section, we describe what the implications are from these analyses for the links between health research priority setting and MCDA.

12.3.1 Methodologies to Health Research Priority Setting (And Their Link with MCDA)

12.3.1.1 Three Types of Methodologies

Table 12.1 presents an overview of the three types of priority-setting methodologies that have been used to establish health research priorities in the past.

The first set of methodologies in Table 12.1 consists of methodologies that use multiple criteria in their decision-making processes but that have not been labelled as MCDA explicitly. These are all approaches that have been developed specifically for prioritizing health research. This set contains most[3] of the dominant approaches to health research priority setting: the essential national health research (ENHR) strategy, the Child Health and Nutrition Research Initiative (CHNRI) and the combined approach matrix (CAM) (Okello and Chongtrakul 2000; Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009). These approaches are 'comprehensive' in that they provide step-by-step guidance for the whole health research priority-setting process from planning to implementation, including, for example, preparatory activities (e.g. guidance for which stakeholders to include) and activities that come after priorities have been established (e.g. guidance for reporting of established priorities) (more detailed descriptions of these three approaches are provide in Table 12.1) (Viergever et al. 2010b).

The second set of methodologies in Table 12.1 consists of several MCDA methods that have been used to set health research priorities. The MCDA methods that have been applied in health research priority-setting exercises are, according to the classification of MCDA methods by Belton and Stewart (2002):

[3] Another is the Priority Setting Partnerships approach, which is mentioned under the third set of approaches, because it does not make use of multiple criteria.

- Qualitative MCDA methods (Owlia et al. 2011; Smith et al. 2009; Hummel et al. 2000)
- Value measurement methods, which can be further subcategorized as:
  - Scoring, weighted sum and linear additive models (Phelps et al. 2014; Doble et al. 2013; Research priorities for the environment, agriculture and infectious diseases of poverty: technical report of the TDR thematic reference group on environment, agriculture and infectious diseases of poverty 2013; Bahadori et al. 2011)
  - Analytic hierarchy process (AHP), analytic network process (ANP) and fuzzy AHP methods (Velmurugan and Selvamuthukumar 2012; Kahraman et al. 2014; Husereau et al. 2010; Ijzerman and Steuten 2011)
  - Multi-attribute utility methods (Phillips and Bana e Costa 2007)

Table 12.1 Three types of methodologies that are used to set health research priorities

	Context in which priority setting methodologies are applied	Examples of specific methodologies
1. Methodologies that use multiple criteria (not explicitly classified as MCDA)	National and global health research policy	*Essential National Health Research* (*ENHR*) *strategy*: the ENHR approach provides an approach for national-level health research priority setting with a strong focus on context specificity. It is flexible and at various steps of the priority-setting process, such as for the selection and weighting of criteria, offers options rather than prescriptive guidance. The ENHR strategy is commonly used for developing national health research agendas (Okello and Chongtrakul 2000) *Child Health and Nutrition Research Initiative* (*CHNRI*): CHNRI provides a method for conducting pairwise comparisons and elimination of options that are dominated by direct comparison, followed by scoring and weighted sum methods for valuing and ranking the competing options based on the relative importance of five predefined criteria: answerability, effectiveness, deliverability, equity and impact on disease burden. The method is commonly used in setting priorities for specific health areas at both the national and global level (Rudan et al. 2006) *Combined approach matrix* (*CAM*)/*CAM3D*: the combined approach matrix (CAM) mainly offers a structured framework for the collection of information according to several preselected criteria, including disease burden, current level of knowledge, cost-effectiveness and current resource flows. The method is commonly used to set priorities for specific health areas at both the national and global level (The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009; Ghaffar 2009). These approaches are reviewed in the 'checklist for health research priority setting' (Viergever et al. 2010b)

(Continued)

Table 12.1 (Continued)

	Context in which priority setting methodologies are applied	Examples of specific methodologies
2. Methodologies that use multiple criteria (classified as MCDA)	National and global health research policy, pharmaceutical R&D portfolio management, health-care organization specific priority setting, early HTA	*Qualitative MCDA methods*, such as *listing/checklist* methods and *group decision/team expert choice* methods: deliberative processes that use multiple criteria to inform decisions in the presence of few discrete options and often in the absence of clearly defined contexts or sufficient data. Such methods have been applied in priority setting for health research in low- and middle-income countries, in health-care organizations and for new product development (Owlia et al. 2011; Smith et al. 2009; Hummel et al. 2000) *Value measurement methods*, such as Scoring, weighted sum, linear additive models: variety of simple additive models that combine option values on multiple criteria into aggregate values, multiplying the value scores on each criterion by the weight of that criterion, then adding all weighted scores together. Such models have been applied in priority setting for new product development, health-care organizational contexts and research for infectious diseases of poverty (Phelps et al. 2014; Doble et al. 2013; Research priorities for the environment, agriculture and infectious diseases of poverty: technical report of the TDR thematic reference group on environment, agriculture and infectious diseases of poverty 2013; Bahadori et al. 2011) Analytic hierarchy process (AHP), analytic network process (ANP) and fuzzy AHP methods: AHP structure options into a hierarchy of an overall objective with multiple criteria through pairwise comparisons between options and consistency checks of stakeholder preferences. ANP is an advanced version of AHP which uses a network structure to value and rank options. Fuzzy set theory can be combined with AHP for priority ranking when data is incomplete. AHP, ANP and fuzzy AHP have been applied in priority setting for pharmaceutical R&D portfolio management, health research investments, health-care organizational contexts and early HTAs (Velmurugan and Selvamuthukumar 2012; Kahraman et al. 2014; Husereau et al. 2010; Ijzerman and Steuten 2011) Multi-attribute utility methods: multi-attribute utility theory (MAUT), multi-attribute value theory (MAVT) or multi-criteria portfolio analysis (MCPA) models aim to rank options through use of value functions of options against a set of multiple criteria in light of uncertainty. MAUT has been applied in budget planning and resource allocation in the pharmaceutical sector (Phillips and Bana e Costa 2007)

Table 12.1 (Continued)

	Context in which priority setting methodologies are applied	Examples of specific methodologies
		Outranking methods: direct comparison models and cross-examining option performances, followed by elimination of outperformed options across a set of multiple criteria. Outranking methods have been applied in the prioritization of contract research organizations in the pharmaceutical industry (Varlan and Le Paillier 1999) *Goal*, *aspiration or reference-level methods*: range of mathematical models which focus on deriving maximum/minimum values of options against a set of multiple objectives or constraints (criteria). Examples of such models include integer, multi-objective programming, multi-objective optimization and heuristics. Their application in health research priority setting concerns predominantly the domain of pharmaceutical R&D portfolio management (Hassanzadeh et al. 2014; Patel et al. 2013; Subramanian et al. 2000; Sonntag and Grossman 1999; Grossman 1975)
3. Methodologies that do not use multiple criteria	National and global health research policy, pharmaceutical R&D portfolio management, health-care organization specific priority setting, early Health Technology Assessment (HTA), priority setting for health services and health outcomes research, national health research policy	*Patient priority-setting partnerships*: collaborative methods bringing patients, carers and clinicians together to establish priorities for health research, particularly for health service and health outcome research (Cowan and Oliver 2013). Used often in the United Kingdom for establishing national research priorities for specific areas of health *Payback analysis*: family of return on investment methods, commonly used in setting priorities as part of early HTA and pharmaceutical R&D portfolio management (Chilcott et al. 2003; Fleurence 2007) *Value of information*: willingness-to-pay method for information guiding decision-making, commonly used in setting priorities for pharmaceutical R&D portfolio management, health services research and health outcomes research (Claxton and Sculpher 2006; Myers et al. 2011; 2012; Eckermann et al. 2010; Meltzer et al. 2011; Hassan et al. 2009; Schmidt 2010) *Real options*: option valuation methods for capital budgeting decisions under uncertainty, commonly used for setting priorities in pharmaceutical R&D portfolio management (Lo Nigro et al. 2014; Zapata and Reklaitis 2010; Johal et al. 2008; Hartmann and Hassan 2006; Kolisch et al. 2005; Jacob and Kwak 2003; Rogers et al. 2002; Rosati 2002) *Various clinical trial simulation*, *investment appraisal and threshold analyses*: wide range of methods spanning from trial design optimization techniques to horizon scanning of trends and unexpected issues and health economic modelling, commonly used in setting priorities as part of early HTA and for health services and health outcomes research (Miller 2005)

- Outranking methods (Varlan and Le Paillier 1999)
- Goal, aspiration or reference-level methods (Hassanzadeh et al. 2014; Patel et al. 2013; Subramanian et al. 2000; Sonntag and Grossman 1999; Grossman 1975)

In contrast with the methodologies in the first set, none of these methods are specific to health research priority setting: all are generic MCDA methods that have been applied to establish health research priorities. Moreover, these methods are not 'comprehensive' priority-setting approaches: they often only provide guidance for the decision-making process itself, while comprehensive priority-setting approaches provide broader guidance for all steps of the priority-setting process (Viergever et al. 2010b).

Finally, the third set of methodologies in Table 12.1 consists of methodologies that do not make use of multiple criteria. For example, an approach that is frequently used in priority-setting exercises for health research in the United Kingdom, the Priority Setting Partnerships approach, only uses one, prespecified criterion (overall importance) to appraise research options (Cowan and Oliver 2013). This set consists of methodologies that are only used in health research priority setting (the Priority Setting Partnerships approach) as well as generic methods for prioritizing various options (most others).

12.3.1.2 An Implicit Link Between Health Research Priority Setting and MCDA

As noted above, this first set of approaches – consisting of many of the dominant approaches to health research priority setting – makes use of multiple criteria, but the explicit links between these approaches and MCDA are minimal: none of them make any mention of MCDA. To consider whether these approaches do apply MCDA (just without explicitly mentioning it), we have taken the key principles of MCDA as recently proposed by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) MCDA Task Force (IJzerman et al. 2014) and compared these with the characteristics of these three approaches (Okello and Chongtrakul 2000; Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009) and with 'the checklist for health research priority setting' (see Box 12.2), a checklist that was developed based on a review of the dominant approaches in health research priority setting and that describes nine 'things to think about' when doing health research priority setting (the checklist also makes no explicit mention of MCDA) (Viergever et al. 2010b). The results of this comparison are described in Table 12.2, which make clear that many of the 'things to think about' that the checklist for health research priority setting describes as important are aimed at promoting the use of criteria, structure, explicitness and transparency – the key principles of MCDA (Viergever et al. 2010b). Many of the specific, comprehensive approaches to health research priority setting (ENHR, CHRNI, CAM) also note to aim to enhance systematicness, explicitness and transparency (Okello and Chongtrakul 2000;

Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009). Moreover, the common steps undertaken in these approaches are similar to the steps taken in MCDA. In health research priority setting, a stepwise approach is usually followed that includes (1) the identification of health research options, (2) the (pre-)specification of criteria and their relative weights against which the research options are appraised and (3) the assessment, comparison and prioritization of options based on their performance against the criteria (Viergever et al. 2010b; Okello and Chongtrakul 2000; Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009). MCDA approaches generally also follow a series of steps: (1) the identification of options to be appraised, (2) the specification of criteria and their relative weights against which the options are appraised and (3) the assessment, comparison and prioritization of the options based on their performance against the criteria (Devlin and Sussex 2011).

Therefore, while the dominant approaches in health research priority setting do not mention to use MCDA, they do appear to adhere to the principles of MCDA and generally follow similar steps as in MCDA.

Box 12.2

The checklist for health research priority setting

The checklist for health research priority setting (Viergever et al. 2010b) provides guidance for planning and organizing health research prioritization exercises and recommends that there are at least nine things to think about when setting health research priorities:

1. Context: defining the contextual factors that underpin the priority-setting exercise
2. Use of a comprehensive approach: deciding whether a ‘comprehensive’ approach to priority setting is appropriate
3. Inclusiveness: deciding which stakeholders should be involved and why
4. Information gathering: considering what information should be collected in preparing the priority-setting exercise
5. Planning for implementation: establishing plans for translation of the priorities to actual research (via funding and policies) as soon as possible
6. Criteria: selecting the right criteria for setting priorities
7. Methods for deciding on priorities: deciding what methods to use for identifying research options and for arriving at priorities from a list of research options
8. Evaluation: planning how and when to re-evaluate the established priorities
9. Transparency: making sure to transparently report both the priorities and the priority-setting process

Table 12.2 The characteristics of several 'comprehensive' approaches for health research priority setting and the 'checklist for health research priority setting' (see Box 12.2), assessed against the key principles of multi-criteria decision analysis (MCDA)

According to the ISPOR MCDA Task Force (IJzerman et al. 2014), MCDA, as generally understood…	In health research priority setting …
… comprises a broad set of methodological approaches, stemming from operations research	… a broad set of approaches is used. The 'checklist for health research priority setting' explicitly recommends using a 'comprehensive' approach, which are approaches that provide step-by-step guidance for the entire priority-setting process. Examples of such approaches include The essential national health research (ENHR) strategy (Okello and Chongtrakul 2000), the Child Health and Nutrition Research Initiative (CHNRI) (Rudan et al. 2006), the combined approach matrix (CAM) (The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009) and Priority Setting Partnerships (Petit-Zeman et al. 2010)
… decomposes complex decision problems, where there are many factors to be taken into account ('multiple criteria') by using a set of relevant criteria	… criteria are recommended in many of these approaches, as well as by the checklist for health research priority setting (the exception is the Priority Setting Partnerships which does not recommend the use of multiple criteria but uses one criterion for overall importance). There are ten larger groups of criteria that are typically used in health research priority-setting exercises (McGregor et al. 2014). Different criteria can be used in priority-setting exercises for specific types of research, such as health technology assessments (Noorani et al. 2007) However, priority-setting exercises only rarely use one of the comprehensive approaches listed above – most develop their own methods (Viergever et al. 2010a; McGregor et al. 2014). A review from 2014 of priority-setting exercises in low- and middle-income countries showed that 67 % of these exercises used criteria (McGregor et al. 2014). Amongst research priority-setting exercises organized or coordinated through WHO headquarters, this percentage is lower (10–31 %) (Viergever et al. 2010a)
… provides a way of structuring such decisions and aims to help the decision-maker be clear about what criteria are relevant and the relative importance of each in their decisions	… when criteria are used, emphasis is commonly placed on the judgement of the decision-maker in establishing the values or objectives of the exercise and, to a variable extent, in identifying relevant criteria, in determining their relative importance and in assessing the contribution of each option to each performance criterion Structure is provided by most comprehensive health research priority-setting approaches by providing guidance on Identifying the options (or alternatives) to be appraised Identifying the criteria (or attributes) against which the options are appraised Considering the relative importance between the different criteria Assessing the performance of options against a number of criteria

Table 12.1 (Continued)

According to the ISPOR MCDA Task Force (IJzerman et al. 2014), MCDA, as generally understood…	In health research priority setting …
	Moreover, if the approaches recommend a quantified process, rather than a deliberative process (IJzerman et al. 2014), the approaches also provide guidance on Eliciting weights that reflect the relative importance between the different criteria based on some sort of preference assessment or modelling Using a certain valuation metric to estimate values that reflect the performance of options against a number of criteria Calculating the overall (weight-adjusted or unadjusted) value of options against all the relevant criteria in a performance matrix, supported by some sort of trade-off analysis in order to list, rank, select or sort the various options
… generally entails being explicit about both the criteria and the weights	… explicitness is a key aspect of health research priority setting. This includes explicitness about criteria and the weights that are used but also about the context (because it determines aspects of the priority-setting process); which approach is used (and why); which stakeholders are included as decision-makers (and why); which information needs to be collected; how the priorities will be implemented; how to reach final agreement on priorities, such as via consensus, pooled ranking or both (and why); and when the priorities will be evaluated and revisited (Viergever et al. 2010b)
… facilitates transparent and consistent decisions	… transparent reporting of both the methods (see points under explicitness above), and the results of a health research priority-setting exercise is considered important in most methodologies for health research priority setting. The checklist for health research priority setting, for example, argues that transparency, amongst others, allows for consistent revision of the priorities when they are evaluated (Viergever et al. 2010b)

12.3.2 Health Research Priority Exercises and MCDA

In the previous section, we described the types of methodologies that are being used to set health research priorities. In this section, we present an analysis of a sample of health research priority-setting *exercises*. Specifically, we assessed the degree to which MCDA methods were applied in these exercises. To do so, we assessed the methodologies applied in the 118 studies relating to a total of 91 health research priority exercises listed in a review by McGregor et al. (2014) for health research priority setting in low- and middle-income countries (McGregor et al. 2014). The large majority of these exercises did not explicitly mention to have used an MCDA

approach: only one noted to have used MCDA. A minority of studies used a specific, comprehensive health research priority-setting approach (24 used CHNRI, 7 used ENHR and 3 used CAM). As we established in the previous section, these approaches do not explicitly mention MCDA but do adhere to the principles of MCDA and generally follow the same steps as MCDA. Therefore, in this analysis of exercises, we have considered the exercises using these approaches as applying MCDA, only implicitly so (except in the case of two exercises that used the ENHR method but did not describe the explicit use of criteria).

Our analysis of the 118 studies compiled by McGregor et al. showed that:

- While only one of the 118 studies is explicitly mentioned to have used MCDA, more than 60 % of the 118 studies applied some sort of qualitative (23 %) or quantitative (39 %) form of MCDA:
  - Amongst the 27 studies that applied qualitative MCDA, 15 studies applied some sort of listing/sorting model, 5 studies applied ENHR (with use of explicit criteria), 4 studies applied a consensus-based approach and 3 studies applied CAM for the prioritization of research options. All studies listed the prioritized options as their final output, without generating any values or scores for the listed options.
  - Amongst the 46 studies deploying quantitative MCDA, 31 studies deployed a scoring, weighted sum, linear additive model (of which 7 studies used their own scoring, weighted sum, linear additive model and 24 used a specific model (CHNRI)). In addition, 14 studies used a scoring model but not weighted. Finally, one study used the nominal group technique (not weighted), making explicit use of well-defined, multiple criteria. Almost all studies ranked the prioritized options as their final output, using Likert and/or visual analogue scales to measure their performance. Only one study provided a rating without ranking the options (Lawn et al. 2007), and one additional study sorted the prioritized options in a list without further ranking (Chapman et al. 2014).
  - The remaining 45 studies (that did not apply MCDA methods) applied a wide range of formal or less formal methods, including consultative group processes (12 %); priority listing/sorting approaches (8 %); informal consensus-based methods (7 %); ENHR with no use of explicit criteria (2 %); stepwise approaches, i.e. combinations of literature reviews, key informant interviews and consultative group processes (4 %); formal consensus-based methods (e.g. the nominal group technique with no use of explicit criteria) (3 %); survey-based methods (2 %); and concept-mapping approaches (1 %).
- As it becomes clear from the previous points, in this analysis, we did not consider the assignment of weights to criteria a condition for MCDA. Although in all of the studies that applied quantitative MCDA weights could have been assigned to criteria through a simple, weighted sum approach, in order to reflect their relative importance, 31 studies assigned weights to criteria and 15 did not. We looked in more detail at the seven non-CHNRI studies that assigned weights to criteria: five of these assigned equal weights to all criteria and two studies assigned unequal weights.

- In terms of option identification, only one study used a list of predetermined research options (Technical workshop on setting research priorities for reproductive health in crisis settings: Summary of Proceedings 2011). All other studies constructed the options through similar techniques including Delphi/Hanlon methods, consultative group processes, surveys or combinations of literature reviews, key informant interviews and group discussions. Studies deploying the CHNRI methodology used an outranking approach of direct pairwise comparisons and elimination of options.
- In contrast, the majority of the studies applied predefined criteria, using either a previously established framework (Viergever et al. 2010b; Rudan et al. 2006; Varkevisser et al. 2003) or without specifying further. The few studies that determined criteria as part of the priority-setting process employed a mix of consultative group processes.
- Only one study included some form of deterministic sensitivity analysis to address uncertainty in the priority-setting process (Madi et al. 2007). In addition, a few studies calculated mean scores and standard deviations for the ranked options.

12.3.3 Implications: Health Research Priority Setting and MCDA

In our view, three conclusions follow from the two sections above that assess the role of MCDA in health research priority-setting methodologies and exercises:

1. Many health research priority-setting methodologies and exercises adhere to the principles of MCDA and follow the same steps as in MCDA.
2. However, many of these methodologies and exercises do not explicitly make reference to MCDA. Particularly, many of the dominant approaches for health research priority setting, such as ENHR, CHNRI and CAM, do not make any mention of MCDA, while they all adhere to MCDA's principles and propose multi-criteria decision models for establishing health research priorities that emphasize structure, explicitness and transparency. Moreover, in the review by McGregor, only one health research priority-setting exercise in low- and middle-income countries noted to have applied MCDA, while, according to our analysis and interpretation of methods deployed, more than 60 % in fact appears to have applied some form of qualitative or quantitative MCDA.
3. There are issues with the quality of priority-setting exercises in the area of health research. Several reviews in health research priority setting have shown that amongst the exercises that use multiple criteria, the degree of explicitness, systematicness and transparency varies on a grey scale from non-existent to highly explicit, systematic and transparent (McGregor et al. 2014; Viergever et al. 2010b; Reveiz et al. 2013). In our own review of the 118 health research priority-setting studies in low- and middle-income countries compiled by

McGregor, we found that research options were not always independent, the criteria against which options were prioritized were not always preference independent or mutually exclusive, scoring options based on Likert and/or visual analogue scales masked the frequent lack of objective data and validated measurement instruments for some of the criteria considered and priority-setting outcomes are generally not certain but the scoring models applied only rarely dealt with that uncertainty. In the next section, we provide suggestions for how the quality of these exercises might be improved.

12.4 Methodological Development in Health Research Priority Setting: The Way Forward

This chapter shows that there is a wide range of health research priority-setting methodologies and approaches that all take a different view on how health research priorities should be set. Because of the different contexts for which health research priorities are set (in terms of coverage, scope and aims), one best practice or gold standard for health research priority setting is not appropriate (Viergever et al. 2010b). However, there is consensus that health research priority-setting exercises can benefit from process guidance and that there are at least nine aspects to any health research priority-setting process on which such guidance is needed (see Box 12.2) (Viergever et al. 2010b). Several recommendations follow from this chapter with regard to next steps for guidance development in the area of health research priority setting.

First, while MCDA has become a well-recognized methodology for health *intervention* priority setting (IJzerman et al. 2014), as we have shown above, explicit reference to MCDA is almost completely absent from the methodological literature on health *research* priority setting. The large majority of the health research priority-setting exercises that have been conducted in recent years and the dominant approaches to health research priority setting (Viergever et al. 2010b; Okello and Chongtrakul 2000; Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009; Cowan and Oliver 2013) do not make any mention of MCDA. As we have shown in this chapter, while not all methodologies for setting health research priority setting can be classified as MCDA, most do adhere to the principles of MCDA and follow the same steps as in MCDA, even when they do not explicitly make mention of MCDA. The methodological development in health research priority setting appears to have taken place largely separately from development in the area of MCDA for health intervention priority setting in the past two decades. This lack of explicit use of MCDA in health research priority-setting exercises may reflect a lack of awareness by health research priority-setting experts on the body of literature around MCDA. In our view, it would be advantageous to bring these two bodies of literature together. By recognizing that the dominant approaches to health research priority setting apply MCDA, the field of health research priority setting could benefit from the experience that has been developed with the application of MCDA, both in health and in other areas.

This could, for example, expand the number of methodologies and approaches that decision-makers in health research can choose from to set health research priorities. Moreover, more explicit use of MCDA in health research priority setting would allow decision-makers to benefit from the guidance that has been developed in the field of MCDA for more specific aspects of the priority-setting process, such as on the theories that underlie MCDA (e.g. multi-attribute utility theory), stakeholder mapping and selection, identifying and choosing criteria, eliciting weights to address the relative importance of criteria, selecting the most appropriate technique for scoring the options, aggregating these scores, reaching agreement on the final list of priorities (e.g. consensus methods or majority rules methods), presenting the priorities and implementing the priorities (IJzerman et al. 2014).

Second, in order for health research priority-setting exercises to benefit from such methodological developments, it is important that these exercises apply standard approaches to priority setting. Yet, several reviews, and our own analysis for this chapter, have shown that the use of standard approaches to priority setting is rare in health research priority-setting exercises (Viergever et al. 2010a; McGregor et al. 2014). Following best practices, such as the checklist for health research priority setting (Viergever et al. 2010b) or one of the specific, comprehensive approaches to health research priority setting (ENHR, CHNRI, CAM) (Okello and Chongtrakul 2000; Rudan et al. 2006; The 3D combined approach matrix: an improved tool for setting priorities in research for health 2009), can help health research priority-setting exercises to adhere to the MCDA principles of structure, explicitness and transparency. As noted by McGregor, in her review of health research priority-setting exercises in low- and middle-income countries, 'While not consistently used, the application of established methods provides a means of identifying health research priorities in a repeatable and transparent manner' (McGregor et al. 2014).

Third, lessons might be learned from comparisons between the fields of health intervention priority setting and health research priority setting, for example, by comparing the preparatory activities that are generally conducted in these two fields, by comparing how priority-setting methods are generally applied and by comparing how established priorities are implemented and reported. Studying any differences in these areas in more depth and creating further clarity on what the two fields might learn from each other might help both fields to advance methodologically. Particularly, the field of health research priority setting might be able to learn from the experience that has been acquired in health intervention priority setting with using objective data to populate performance matrices. Although, as we have argued above, the different conceptual nature of research priority setting necessitates a more subjective approach, there might be middle ground that deserves to be explored more than it has been to date. In many health research priority-setting exercises, research options are scored against criteria by stakeholders while for some criteria, such as the burden of a particular health problem, more objective judgements might be feasible. Vice versa, the field of health research priority setting has developed extensive experience with the inclusion of a wide range of stakeholders, including patients, service providers,

researchers, policymakers and others in the priority-setting process and with soliciting subjective judgements about the value of research options against criteria (Viergever et al. 2010b). In areas of health intervention priority setting where objective data are not available and which are based more on stakeholder opinion, this experience may prove useful.

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