



feature



Methods for exploring and eliciting patient preferences in the medical product lifecycle: a literature review

Vikas Soekhai^{1,7,8,5}, Chiara Whichello^{1,7,5}, Bennett Levitan², Jorien Veldwijk^{1,7}, Cathy Anne Pinto³, Bas Donkers^{4,7}, Isabelle Huys⁵, Eline van Overbeeke⁵, Juhaeri Juhaeri⁶ and Esther W. de Bekker-Grob^{1,7}, debekker-grob@eshpm.eur.nl

Preference studies are becoming increasingly important within the medical product decision-making context. Currently, there is limited understanding of the range of methods to gain insights into patient preferences. We developed a compendium and taxonomy of preference exploration (qualitative) and elicitation (quantitative) methods by conducting a systematic literature review to identify these methods. This review was followed by analyzing prior preference method reviews, to cross-validate our results, and consulting intercontinental experts, to confirm our outcomes. This resulted in the identification of 32 unique preference methods. The developed compendium and taxonomy can serve as an important resource for assessing these methods and helping to determine which are most appropriate for different research questions at varying points in the medical product lifecycle.

Introduction

There is an emerging consensus that the patient perspective should be incorporated within decisions in the medical product lifecycle (MPLC; see [Glossary](#)) [1–4], where the medical product lifecycle in this study is defined as the lifecycles of drugs, biologics and medical devices. Broadly encouraging the involvement of patients has, therefore, become increasingly important [5,6]. Taking the patient voice into consideration has not only become increasingly important for companies that develop new medical products but also for the authorities that assess, regulate and decide which products are effective, safe, well-tolerated and cost-effective [7–16].

To incorporate the patient voice, patient preferences need to be explicitly explored or

elicited through revealed- or stated-preference methods. In this paper, preference exploration methods are defined as qualitative methods that collect descriptive data through participant or phenomenon observation, examining the subjective experiences and decisions made by participants. Elicitation methods are defined as quantitative methods collecting quantifiable data for hypothesis testing and other statistical analyses. Whereas the use of revealed-preference methods still represents a methodological challenge in health, many different methods exist to assess stated preferences of patients [17,18]. An up-to-date compendium of different stated-preference methods to explore or elicit patient preferences within the MPLC is missing.

There have been few publications on what methods can be used to assess patient preferences in a scientific way, in the context of the MPLC specifically. In 2001, Ryan *et al.* [19] provided an overview of methods known at the time for eliciting public preferences for health-care. In 2015, the Medical Device Innovation Consortium (MDIC) developed an overview of different preference elicitation methods as part of their framework on incorporation of patient preferences into regulatory assessments of medical devices [20]. Although both publications made useful contributions, the study from Ryan *et al.* [19] does not reflect methods developed since 2001, and the study from the MDIC [20] did not include preference explora-

tion methods or use a systematic approach for identifying preference elicitation methods. Therefore, the aim of our study was to develop an up-to-date compendium and taxonomy of exploration and elicitation preference methods within the MPLC context. This will be an important step to further drive the incorporation of patient preferences forward, in addition to the study of van Overbeeke *et al.* [6], and in developing guidance on when and how to assess patient preferences scientifically in the context of decision-making in the MPLC.

Compendium of preference methods

A systematic literature review was conducted, followed by an analysis of prior reviews by Ryan *et al.* [19] and from the MDIC [20] and expert consultations with international preference experts, to identify all potential preference exploration and elicitation methods within the context of the MPLC. In this paper, a broad definition of a preference method was used: any method that enabled us to gain insight into a patient’s relative desirability or acceptability of specified alternatives; or choices among treatment alternatives or outcomes; or other attributes that differ among alternative health interventions [7]. Ultimately, 208 papers were analyzed during the systematic literature review to identify preference exploration and elicitation methods within the context of the MPLC. More information about the approach used in the systematic literature

review is provided in Appendix A.1 (see Supplementary material online). An alphabetical overview of all reviewed full-text papers is listed in Appendix B (see supplementary material online).

We identified 19 different methods: five exploration methods and 14 elicitation methods, in the systematic literature review. The most frequently cited exploration methods included focus groups (*n* = 29, 13.9%) and (semi-)structured individual interviews (*n* = 47, 22.6%), whereas most cited elicitation method papers included discrete choice experiments (*n* = 57, 27.4%) and the visual analog scale (*n* = 12, 5.8%). Contingent valuation (*n* = 11, 5.3%), standard gamble (*n* = 11, 5.3%) and time trade-off (*n* = 11, 5.3%) were also frequently included in the analyzed papers. Four studies included best–worst scaling type 1,2 (*n* = 4, 2%).

Through the analysis of the preference method reviews of Ryan *et al.* [19] and the MDIC [20], and after condensing several of these methods, we identified 23 preference exploration and elicitation methods. This selection included nine preference exploration and 14 elicitation methods. From these 23 preference methods, 13 methods were also identified in our systematic literature review (56%). The expert consultations confirmed the methods identified in the systematic literature review and in the analysis of prior preference method reviews. Also, consensus was reached on including four additional elicitation methods. The expert con-

sultations also resulted in the exclusion of methods focusing on scale-related (e.g., Likert scales) or decision-making framework-related (e.g., multicriteria decision analysis) techniques, because these techniques were regarded as inconsistent with our definition of a preference method. As described above, we identified 19 methods through the systematic literature review, the 23 methods through the analysis of previously conducted reviews and the four additional methods via expert consultations. In total, 32 unique preference methods were identified: ten exploration and 22 elicitation methods. Table 1 summarizes and briefly describes these methods.

Taxonomy of preference methods

There are many ways to group preference methods. In this study, we grouped the identified methods according to their manner of data collection and the similarities in their method of analysis. This grouping was not intended to be a formal lexicon but primarily served as a taxonomy to organize results and to develop a compendium of preference exploration and elicitation methods. Preference exploration methods can be grouped according to the number of participants the method utilizes in one session (Fig. 1). (Semi-)structured individual interviews, in-depth interviews and complaints procedures use interviews with one participant (*n* = 1) in a single setting or session. The Delphi

TABLE 1
Overview of identified methods

Method	Description	Refs
<i>Exploration methods</i>		
Citizens’ juries ^b	Group of individuals discussing issues on the basis of evidence provided by two trained moderators	[24,25]
Complaints procedures ^b	Method in which stakeholders can register complaints to be investigated by experts	[26,27]
Concept mapping ^b	Method that utilizes small groups of participants responding to various topics or issues, while ensuring each respondent is given equal opportunity to express their opinions and address other group dynamic issues	[28,29]
Delphi method ^{a,b}	Structured, iterative forecasting method involving a panel of experts who provide anonymous responses to questionnaires with the opportunity to revise their responses when the anonymous summary of response from the prior round is revealed	[30,31]
Dyadic interview ^{a,b}	Method that utilizes two participants in a single interview, responding to open-ended questions asked by an interviewer to identify how a product, service or opportunity is perceived	[32,33]
Focus group ^{a,b}	Method that utilizes a group of interacting individuals that provide information about a specific issue to identify how a product, service or opportunity is perceived	[34,35]
In depth – individual interview ^{a,b}	Interview technique that allows for an intensive discussion with one interviewee to explore their perspectives on a particular topic or theme, to gain a deeper understanding of this particular topic or theme. Often only a limited amount of questions or themes are prepared by the interviewer, and the rest of the questions are based on the response of the interviewee	[36,37]
Nominal group technique ^b	Method that utilizes a group process that involves making decisions by vote and ranking responses given by members of the group	[38,39]
Public meetings ^b	Method to gain public opinions on particular issues by allowing general members of the public to attend and voice their responses	[40,41]
(Semi-)structured individual interview ^{a,b}	Interview technique that allows new ideas to be brought up during the interview as a result of what the interviewee says in a semi-structured setting, whereas in the structured setting the interviewer strictly sticks to an interview guide and does not ask questions based on the response of the interviewee	[42,43]

TABLE 1 (Continued)

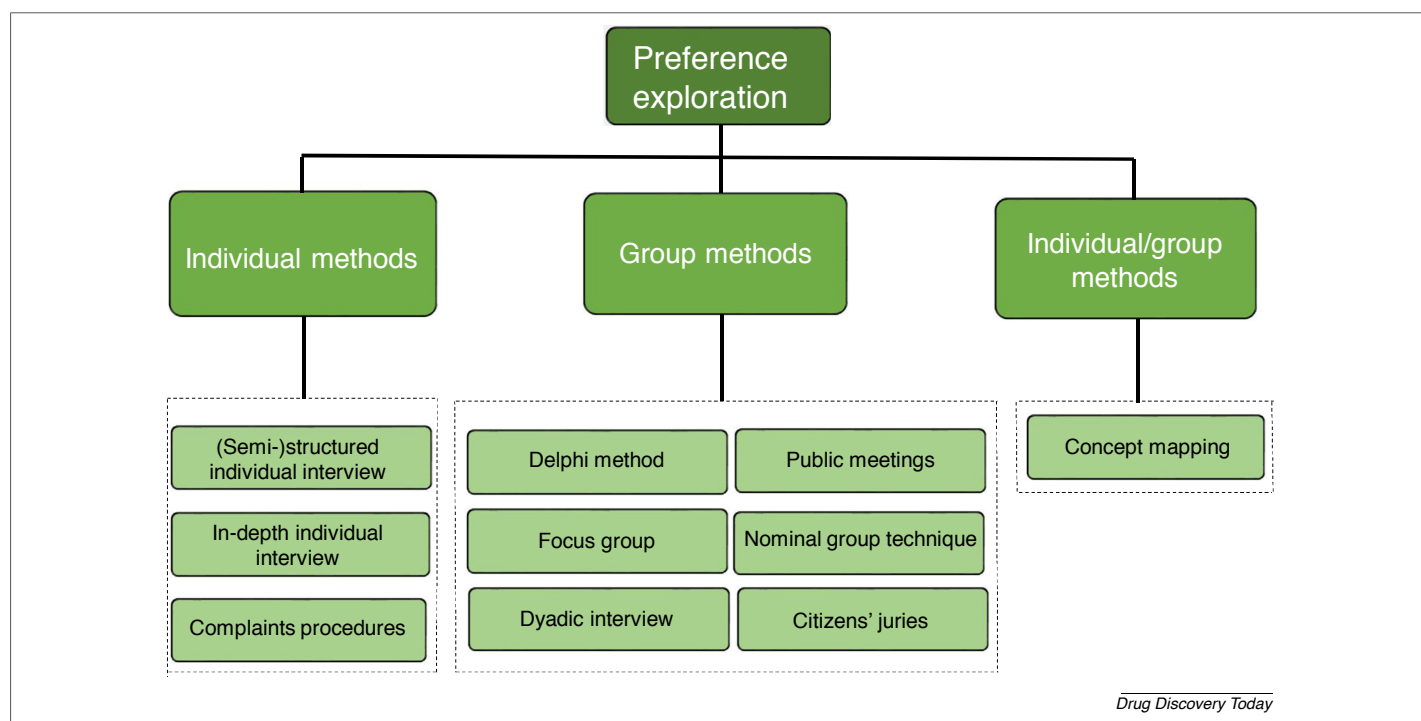
Method	Description	Refs
<i>Elicitation methods</i>		
Adaptive conjoint analysis ^a	Method similar to regular conjoint analysis, but with adaptive conjoint choice tasks based on the earlier choices made within the survey, in theory allowing the survey to focus attention on those attributes or levels of those attributes that have the most influence on the choices of that individual. Unlike discrete choice experiments this method is founded in the theory of conjoint measurement (CM), which is more focused on the behavior of number systems instead of the behavior of human preferences	[44,45,81]
Allocation of points ^b	Method that involves asking respondents to rate their conditions on scales, while knowing the weights which they attach to different criteria, indicating the relative importance of particular areas of their lives	[46,47]
Analytic hierarchy process ^{a,b}	Method in which responders assess the relative importance of pairs of attributes (treatment endpoints, properties, criteria, items, objects, etc.) toward achieving a goal, where these responses are used to compute a weight for each attribute	[20,48]
Best–worst scaling (types 1, 2, 3) ^{a,b}	Involves respondents answering surveys that include lists of attributes or profiles and being asked to indicate the best (or most appealing/important) and the worst (or least appealing/important) of them. This method consists of three types: in type 1 a set of attributes is showed that might not reflect the characteristics of any particular treatment, of which the respondent picks the best and worst. Type 2 involves a situation in which the attributes collectively characterize a particular profile and the respondent chooses the best and worst. In type 3 three or more profiles are shown and the respondent selects the best and worst profiles	[20,49,50]
Constant sum scaling ^c	Constant sum scaling consists of a comparative scale where respondents are asked to allocate a fixed amount (or constant sum) of points, dollars or anything among a set of objects according to a criterion	[51,52]
Contingent valuation ^{a,b}	Method to determine the willingness to pay (WTP), where individuals are presented with a choice between not having the commodity valued and having the commodity but forgoing a certain amount of money. The money being that they are willing to forgo to have the commodity is their WTP for that commodity. WTP can be calculated directly using a threshold or indirectly using a discrete choice experiment for example	[53,54]
Control preference scale ^a	The control preferences scale (CPS) is a method to determine the degree of control a patient wants regarding medical treatment. The preference orders are analyzed using unfolding theory to determine the distribution of preferences in different populations and the effect of covariates on consumer preferences	[55–57]
Discrete choice experiment ^{a,b}	Method that utilizes an attribute-based measure of benefit, during which individuals are offered a series of hypothetical choice situations (i.e., choice sets), from which they are asked to choose between two or more profiles. There are numerous variants of discrete choice experiments. In contrast to conjoint analysis, this method relies on a theory of the behavior of human preferences [for example random utility theory (RUM)]	[58,59,60,81]
Measure of value ^b	Method used to identify the optimal bundle of services to be provided given resource constraints. Individuals are asked to allocate a fixed amount of resources between different services. These allocations are analyzed to identify the trade-offs individuals make	[61]
Outcome prioritization tool ^a	Instrument that allows participants to prioritize outcomes making use of a specific tool according to the ‘trade-off’ principle, implying that they are willing to compromise on the less important outcomes	[62]
Person trade-off ^{a,b}	An extension of the time trade-off. With person trade-off an individual evaluates the health effects of interventions using persons (instead of time) as the equilibrating mechanism	[63,64]
(Probabilistic) threshold technique ^{a,b}	Method that determines the maximal change in one attribute respondents are willing to accept to achieve a given change in another attribute	[20,65]
Q-methodology ^c	Method that uses a specially designed response grid to present respondents with a set of statements and asking them to order, usually based on the extent to which they agree with them	[66,67]
Qualitative discriminant process ^b	Method that involves a scoring and ranking process based on decision analysis technique, involving the definition of options in terms of qualitative categories, then deriving a numeric point estimate and finally solving a maximization problem with given constraints	[68]
Repertory grid method ^a	Method used for eliciting personal constructs (i.e., what people think about a given topic). To identify preferences overlapping and rating techniques are used	[69,70]
Self-explicated conjoint ^c	Method that asks explicitly about the preference for each attribute rather than the preference of several	[71]
Standard gamble ^{a,b}	Method in which respondents are asked to choose between a certain outcome and a gamble that might result in either a better outcome with a probability P or a worse outcome than the original with a probability 1-P	[72,73]
Starting known efficacy ^a	Method similar to (probabilistic) threshold techniques, but with a specific known starting point. This method is specifically used within the context of the medical product lifecycle	[74]
Swing weighting ^b	Method for setting the weights in which a decision-relevant range is specified for each attribute, and the impact of ‘swinging’ the attribute through that entire range of values is assigned a weight relative to the impact of swinging the attribute with the largest weight	[19,20]
Test trade-off ^c	Method that can be regarded as an extension of the time trade-off that is specifically used to evaluate a new biomarker by using risks (instead of time) as the equilibrating mechanism	[75,76]
Time trade-off ^{a,b}	Method that presents individuals with a choice between living for a period in a specified, but less than perfect, state versus having a healthier life for a period of time, where time is varied until the respondent is indifferent to the alternatives	[20,77,78]
Visual analog scale ^{a,b}	A self-reporting instrument consisting of a line of predetermined length that separates extreme boundaries of the phenomenon being measured	[79,80]

In total 32 unique methods were identified.

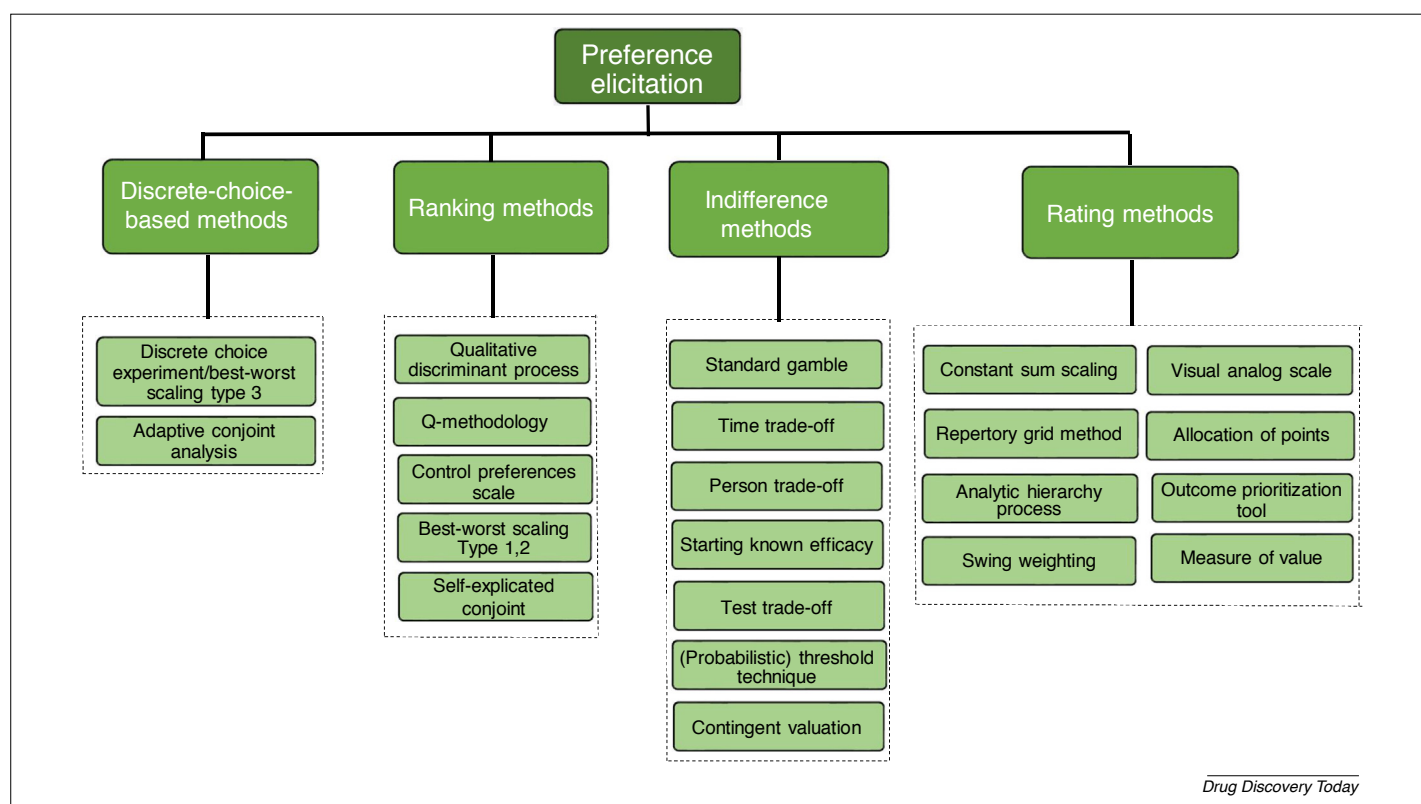
^a Identified in systematic review (19 methods).

^b Identified through analysis of previous preference method reviews (23 methods).

^c Identified with expert consultations (4 methods).

**FIGURE 1**

Grouping of preference exploration (qualitative) methods into three groups: individual, group and individual/group methods.

**FIGURE 2**

Grouping of preference elicitation (quantitative) methods into four groups: discrete choice based, ranking, indifference and rating methods.

method, focus groups, dyadic interviews, public meetings, nominal group technique and citizen juries typically direct questions to more than one participant ($n > 1$) in a single setting. Concept mapping can employ either individual or group settings for data collection ($n \geq 1$).

Preference elicitation methods can be grouped into four distinct groups (Fig. 2), with methods from left to right being able to answer a smaller subset of research questions [a discrete choice experiment (DCE) is for example able to provide willingness-to-pay (WTP) information and probability scores whereas contingent valuation provides WTP information only]. First, discrete choice-based methods typically examine the importance of trade-offs between attributes and their alternatives through a series of

choice sets that present (hypothetical) alternatives. Second, ranking (or related) methods were classified based on the use of ranking exercises to capture the order of alternatives or attributes within a presented set. Third, indifference techniques are methods that vary the value of one attribute in one of the alternatives until the participant is indifferent, or has no preference, between alternatives. Finally, rating (or related) methods are methods based on their utilization of comparative rating approaches, often allowing participants to express the strength of their preferences along a labeled scale.

Trends in the use of preference methods

With the systematic literature review, spanning 37 years of literature, we observed an overall

upwards trend in the number of MPLC patient preference studies per year. The mean number of preference studies increased from 1.1 per year to 6.5 per year to 20.3 per year. This is for the periods 1980–2000, 2001–2010 and 2011–2016, respectively (Appendix C, see supplementary material online). We also observed that our included papers originated from all over the world, covering five different continents (Table 2). The majority (73%) of papers were from North America ($n = 90$) and Europe ($n = 62$).

Analyzing the separate use of preference exploration and elicitation methods over time, we observed a trend of preference exploration methods being used more frequently in recent years. We did not consider the period 1980–2005 because this period only included a few

TABLE 2

Background information of identified patient preference methods in the systematic review focusing on the medical product lifecycle

Method	Frequency	Continents of origin	Study numbers
<i>n</i> = 19	<i>n</i> = 208 ^a	(%)	Continents (frequency) ^a
<i>Exploration methods</i>			<i>n</i> = 208
Delphi method	3	(1.4)	Asia (2), North America (1)
Dyadic interview	1	(0.5)	Africa (1)
Focus group	29	(13.9)	Africa (1), Asia (2), Australia/Oceania (3), Europe (15), North America (8)
In depth – individual interview	9	(4.3)	Asia (1), Australia/Oceania (1), Europe (3), North America (4)
(Semi-)structured individual interview	47	(22.6)	Africa (2), Asia (6), Australia/Oceania (6), Europe (18), North America (15)
<i>Elicitation methods</i>			
Adaptive conjoint analysis	3	(1.4)	North America (3)
Analytic hierarchy process	1	(0.5)	Europe (1)
Best-worst scaling (types 1, 2, 3)	4	(1.9)	Asia (1), Australia/Oceania (1), North America (2)
Contingent valuation	11	(5.3)	Asia (2), Australia/Oceania (1), North America (2)
Control preference scale	3	(1.4)	Asia (1), North America (2)
Discrete choice experiment	57	(27.4)	Africa (1), Asia (7), Australia/Oceania (6), Europe (15), North America (28)
Outcome prioritization tool	1	(0.5)	Europe (1)
Person trade-off	1	(0.5)	Europe (1)
Repertory grid method	1	(0.5)	Europe (1)
Standard gamble	11	(5.3)	Asia (1), Australia/Oceania (1), Europe (2), North America (7)
Starting known efficacy (Probabilistic) threshold technique	1	(0.5)	North America (1)
Time trade-off	2	(1.0)	North America (2)
Visual analog scale	11	(5.3)	Australia/Oceania (1), Europe (2), North America (8)
	12	(5.8)	Asia (2), Europe (3), North America (7)

^a Included countries per continent: Africa – Kenya, South Africa; Asia – China, Iran, Japan, Malaysia, Singapore, South Korea, Taiwan, Thailand, Turkey; Australia/Oceania – Australia; Europe – France, Germany, UK, Hungary, The Netherlands, Norway, Spain; North America – Canada, USA.

data points to compute representative percentages. For the period 2002–2006, 33.3% of the papers used a preference exploration method to gain insights into patient preferences (computed as the frequency of an exploration or elicitation method in each individual paper). This increased to 48.8% in the period 2007–2011 and to 45.8% for 2012–2016. Among preference exploration methods, the proportion of studies that used focus groups increased from 23% in the period 2002–2006 to 35% in the period 2012–2016. The proportion of (semi-)structured individual interviews remained more or less constant with 55% in the period 2002–2006 and 52% in the period 2012–2016, whereas in-depth individual interviews decreased from 23% in 2002–2006 to 8% in 2012–2016. Over time, we also observed more diversity within the group of preference exploration methods. The Delphi method and dyadic interviews began appearing in 2007.

Among preference elicitation methods, we observed that the number of papers that made use of a discrete choice experiment increased from 38% in 2002–2006 to 58% in 2012–2016. Papers that included a visual analog scale decreased from 16% to 3%, and contingent valuation showed a similar trend (17% to 9%). Standard gamble and time trade-off showed an upward trend, from 5% and 4% in 2002–2006 to 9% and 6% in 2012–2016, respectively. Overall, we observed that, over time, a more diverse group of preference elicitation methods was used.

Comparison of sources

The results of this study were partly in line with the results found by Ryan *et al.* (2001) and the MDIC (2015) [19,20]. Fifty-six percent (13 out of 23) of methods reported by Ryan *et al.* [19] and/or the MDIC [20] were identified in our systematic literature review. The differences arise because: (i) the search in this study focused specifically on methods to obtain patient preferences for drugs and medical devices, whereas Ryan *et al.* [19] focused on public views on the provision of healthcare; (ii) MDIC [20] excluded preference exploration methods; and (iii) the MDIC [20] effort did not use a systematic approach for identifying methods. The taxonomy of preference methods proposed in this study is also in line with results from Mt-Isa *et al.* [21], Zhang *et al.* [22] and Gonzalez *et al.* [23], in which elicitation methods were grouped by rating, ranking and trade-off (which included choice-based methods) techniques, although many other ways to group these methods are possible.

Results from our study's systematic literature review (19 preference methods identified) showed that most reviewed papers used focus groups, (semi-)structured individual interviews, discrete choice experiments or the visual analog scale to gain insights into patient preferences. Most of these studies were conducted in North America or Europe. We also showed that the mean number of patient preference studies for drugs and medical devices increased over time. Furthermore, this study showed that, for preference exploration and elicitation methods, a more diverse mix of methods (exploration and elicitation methods) was used over time to explore or elicit preferences.

Concluding remarks

In this study we developed an up-to-date compendium and taxonomy of preference exploration and elicitation methods in the context of the MPLC. The systematic review (19 methods), analysis of prior conducted preference method reviews (23 methods) and expert consultations (four methods) contributed to this compendium. In total, 32 unique methods were identified. Preference exploration methods were grouped in three main groups, whereas the preference elicitation methods were grouped in four main groups. Because choosing which method to use will depend on the MPLC phase and what the measured preferences are being used for, future research might focus on determining which methods are most appropriate to explore or elicit patient preferences, and under what circumstances, throughout the different phases in the MPLC. In addition, it might be of interest for future research to focus on the specific combinations of preference exploration and elicitation methods used in mixed-method studies, and the reasoning behind such study designs.

Acknowledgments

The authors would like to thank J. Bridges (Johns Hopkins Bloomberg School of Public Health), B. Craig (International Academy of Health Preference Research), J.M. Gonzalez (Duke University), T. Hammad (EMD Serono), B. Hauber (RTI Health Solutions), R. Hermann (AstraZeneca), R. Johnson (Duke University), U. Kihlbom (Uppsala University), A. Mohamed (Bayer), V. Patadia (Sanofi), S. Russo (European Institute of Oncology) and A. Stiggelbout (Leiden University Medical Center) for their valuable input during the writing of this paper. This work has received support from the EU/EFPIA Innovative Medicines Initiative [2] Joint Undertaking PREFER grant no. 115966. This text

and its contents reflect the authors' and the PREFER project's view and not the view of IMI, the European Union or EFPIA.

Appendices A–C. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi: <https://doi.org/10.1016/j.drudis.2019.05.001>.

References

- Hoos, A. *et al.* (2015) Partnering with patients in the development and lifecycle of medicines: a call for action. *Ther. Innov. Regul. Sci* 49, 929–939
- Anderson, M. and McCleary, K. (2016) On the path to a science of patient input. *Sci. Transl. Med.* 8, 336ps11
- Smith, M.Y. *et al.* (2016) Patient engagement at a tipping point – the need for cultural change across patient, sponsor, and regulator stakeholders: insights from the DIA conference, “Patient Engagement in Benefit Risk Assessment Throughout the Life Cycle of Medical Products”. *Ther. Innov. Regul. Sci.* 50, 546–553
- de Bekker-Grob, E.W. *et al.* (2017) Giving patients' preferences a voice in medical treatment life cycle: The PREFER Public–Private Project. *Patient* 10, 263–266
- Anderson, R.M. and Funnell, M.M. (2005) Patient empowerment: reflections on the challenge of fostering the adoption of a new paradigm. *Patient Educ. Counsel.* 57, 153–157
- van Overbeeke, E. *et al.* (2019) Factors and situations influencing use of patient preference studies along the medical product lifecycle: a literature review. *Drug Discov. Today* 24, 57–68
- FDA (2016) *Guidance for Industry, Food and Drug Administration Staff and Other Stakeholders. Patient Preference Information – Voluntary Submission, Review in Premarket Approval Applications, Humanitarian Device Exemption Applications, and De Novo Requests, and Inclusion in Decision Summaries and Device Labeling.* Public Report 2016. 2016
- FDA (2017) *Public Workshop On Patient-Focused Drug Development: Guidance 1 Collecting Comprehensive And Representative Input.* Public Report 2017a. 2017
- FDA (2017) *The Voice of the Patient: A Series of Reports from FDA's Patient-Focused Drug Development Initiative.* Public Report 2017b. 2017
- FDA (2017) *PDUFA Reauthorization Performance Goals And Procedures Fiscal Years 2018 Through 2022.* Public Report 2017c. 2017
- Kievit, W. *et al.* (2017) Taking patient heterogeneity and preferences into account in health technology assessments. *Int. J. Technol. Assess. Health Care* 33, 562–569
- Abelson, J. *et al.* (2016) Public and patient involvement in health technology assessment: a framework for action. *Int. J. Technol. Assess. Health Care* 32, 256–264
- Lowe, M.M. *et al.* (2016) Increasing patient involvement in drug development. *Value Health* 19, 869–878
- Stewart, K.D. *et al.* (2016) Preference for pharmaceutical formulation and treatment process attributes. *Patient Prefer Adherence* 10, 1385–1399
- Minion, L.E. *et al.* (2016) Endpoints in clinical trials: what do patients consider important? A survey of the ovarian cancer national alliance. *Gynecol. Oncol.* 140, 193–198
- Bloom, D. *et al.* (2018) The rules of engagement: CTTI recommendations for successful collaborations

- between sponsors and patient groups around clinical trials. *Ther. Innov. Regul. Sci* 52, 206–213
- 17 Beshears, J. *et al.* (2008) How are preferences revealed? *J. Public Econ.* 92, 1787–1794
 - 18 Lambooi, M.S. *et al.* (2015) Consistency between stated and revealed preferences: a discrete choice experiment and a behavioural experiment on vaccination behaviour compared. *BMC Med. Res. Methodol.* 15, 19
 - 19 Ryan, M. *et al.* (2001) Eliciting public preferences for healthcare: a systematic review of techniques. *Health Technol. Assess.* 5, 1–186
 - 20 Medical Device Innovation Consortium (MDIC) (2015) *Patient Centered Benefit–Risk Project Report: A Framework for Incorporating Information on Patient Preferences Regarding Benefit and Risk into Regulatory Assessments of New Medical Technology.* Public Report 2015. 2015
 - 21 Mt-Isa, S. *et al.* (2013) *IMI-PROTECT Benefit–Risk Group RECOMMENDATIONS REPORT: Recommendations for the Methodology and Visualisation Techniques to be Used in the Assessment of Benefit and Risk of Medicines.* IMI PROTECT Recommendations Report 2013. 2013
 - 22 Zhang, W. *et al.* (2015) When drug discovery meets web search: learning to rank for ligand-based virtual screening. *J. Cheminform.* 7, 5
 - 23 Gonzalez, J.M. *et al.* (2017) Comparing preferences for outcomes of psoriasis treatments among patients and dermatologists in the U.K.: results from a discrete-choice experiment. *Br. J. Dermatol.* 176, 777–785
 - 24 Mitton, C. *et al.* (2009) Public participation in health care priority setting: a scoping review. *Health Policy* 91, 219–228
 - 25 Street, J. *et al.* (2014) The use of citizens' juries in health policy decision-making: a systematic review. *Soc. Sci. Med.* 109. <http://dx.doi.org/10.1016/j.socscimed.2014.03.005>
 - 26 Bourne, T. *et al.* (2015) The impact of complaints procedures on the welfare, health and clinical practise of 7926 doctors in the UK: a cross-sectional survey. *BMJ Open* 2015, 5
 - 27 Wensing, M. and Grol, R. (1998) What can patients do to improve health care? *Health Expect.* 1, 37–49
 - 28 Burke, J.G. *et al.* (2005) An introduction to concept mapping as a participatory public health research method. *Qual. Health Res.* 15, 1392–1410
 - 29 Trochim, W. and Kane, M. (2005) Concept mapping: an introduction to structured conceptualization in health care. *Int. J. Quality Health Care* 17, 187–191
 - 30 Boulkedid, R. *et al.* (2005) Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. *PLoS One* 6, e20476
 - 31 de Meyrick, J. (2003) The Delphi method and health research. *Health Education* 103, 7–16
 - 32 Eisikovits, Z. and Koren, C. (2010) Approaches to and outcomes of dyadic interview analysis. *Qual. Health Res.* 20, 1642–1655
 - 33 Morgan, D.L. *et al.* (2013) Introducing dyadic interviews as a method for collecting qualitative data. *Qual. Health Res.* 23, 1276–1284
 - 34 Basch, C.E. (1987) Focus group interview: an underutilized research technique for improving theory and practice in health education. *Health Education Quarterly* 14, 411–448
 - 35 Schulze, B. and Angermeyer, M.C. (2003) Subjective experiences of stigma. A focus group study of schizophrenic patients, their relatives and mental health professionals. *Soc. Sci. Med.* 56, 299–312
 - 36 Harris, M.A. *et al.* (2000) Validation of a structured interview for the assessment of diabetes self-management. *Diab. Care* 23, 1301
 - 37 Williams, J.B. (1988) A structured interview guide for the Hamilton Depression Rating Scale. *Arch. Gen. Psychiatry* 45, 742–747
 - 38 Allen, J. *et al.* (2004) Building consensus in health care: a guide to using the nominal group technique. *Br. J. Commun. Nurs.* 9, 110–114
 - 39 Gallagher, M. *et al.* (1993) The nominal group technique: a research tool for general practice? *Fam. Pract.* 10, 76–81
 - 40 Ham, C. (1997) Priority setting in health care: learning from international experience. *Health Policy* 42, 49–66
 - 41 McComas, K.A. (2001) Theory and practice of public meetings. *Commun. Theor.* 11, 36–55
 - 42 Barriball, L.K. and While, A. (1994) Collecting data using a semi-structured interview: a discussion paper. *J. Adv. Nurs.* 19, 328–335
 - 43 Whiting, L.S. (2008) Semi-structured interviews: guidance for novice researchers. *Nurs. Standard* 22, 35–40
 - 44 Beusterien, K.M. *et al.* (2005) Understanding patient preferences for HIV medications using adaptive conjoint analysis: feasibility assessment. *Value Health* 8, 453–461
 - 45 Fraenkel, L. *et al.* (2001) Understanding patient preferences for the treatment of lupus nephritis with adaptive conjoint analysis. *Med. Care* 39, 1203–1216
 - 46 Haywood, K.L. *et al.* (2003) Patient centered assessment of ankylosing spondylitis-specific health related quality of life: evaluation of the Patient Generated Index. *J. Rheumatol* 30, 764
 - 47 Schwappach, D.L.B. and Strassmann, T.J. (2006) Quick and dirty numbers? The reliability of a stated-preference technique for the measurement of preferences for resource allocation. *J. Health Econ.* 25, 432–448
 - 48 Liberatore, M.J. and Nydick, R.L. (2006) The analytic hierarchy process in medical and health care decision-making: a literature review. *Eur. J. Operation. Res.* 189, 194–207
 - 49 Flynn, T.N. (2010) Valuing citizen and patient preferences in health: recent developments in three types of best–worst scaling. *Expert Rev. Pharmacoecon. Outcome. Res.* 10, 259–267
 - 50 Flynn, T.N. *et al.* (2007) Best–worst scaling: what it can do for health care research and how to do it. *J. Health Econ.* 26, 171–189
 - 51 Mai, R. and Hoffmann, S. (2012) Taste lovers versus nutrition fact seekers: how health consciousness and self-efficacy determine the way consumers choose food products. *J. Consumer Behaviour* 11, 316–328
 - 52 Skedgel, C.D. *et al.* (2015) Choosing vs. allocating: discrete choice experiments and constant-sum paired comparisons for the elicitation of societal preferences. *Health Expect.* 18, 1227–1240
 - 53 Bärnighausen, T. *et al.* (2007) Willingness to pay for social health insurance among informal sector workers in Wuhan, China: a contingent valuation study. *BMC Health Service. Res.* 7, 114
 - 54 Cunningham, S.J. and Hunt, N.P. (2000) Relationship between utility values and willingness to pay in patients undergoing orthognathic treatment. *Commun. Dental Health* 17, 92–96
 - 55 Degner, L.F. *et al.* (1997) The Control Preferences Scale. *Can. J. Nurs. Res.* 29, 21–43
 - 56 McPherson, C.J. *et al.* (2001) Effective methods of giving information in cancer: a systematic literature review of randomized controlled trials. *J. Public Health* 23, 227–234
 - 57 Henrikson, N.B. *et al.* (2011) Measuring decisional control preferences in men newly diagnosed with prostate cancer. *J. Psychosoc. Oncol.* 29, 606–618
 - 58 Bridges, J.F.P. *et al.* (2011) Conjoint analysis applications in health – a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. *Value Health* 14, 403–413
 - 59 Soekhai, V. *et al.* (2019) Discrete choice experiments in health economics: past, present and future. *Pharmacoeconomics* 37, 201–226
 - 60 Lancsar, E. and Louviere, J. (2008) Conducting discrete choice experiments to inform healthcare decision-making. *Pharmacoeconomics* 26, 661–677
 - 61 Weinstein, M.C. *et al.* (2003) Principles of good practice for decision analytic modeling in health-care evaluation: report of the ISPOR Task Force on Good Research Practices – modeling studies. *Value Health* 6, 9–17
 - 62 Case, S.M. *et al.* (2015) Older adults' recognition of trade-offs in healthcare decision-making. *J. Am. Geriatr. Soc.* 63, 1658–1662
 - 63 Green, C. (2001) On the societal value of health care: what do we know about the person trade-off technique? *Health Econ.* 10, 233–243
 - 64 Nord, E. (1995) The person-trade-off approach to valuing health care programs. *Med. Decision Making* 15, 201–208
 - 65 Kopec, J.A. *et al.* (2007) Probabilistic threshold technique showed that patients' preferences for specific trade-offs between pain relief and each side effect of treatment in osteoarthritis varied. *J. Clin. Epidemiol.* 60, 929–938
 - 66 Cross, R.M. (2005) Exploring attitudes: the case for Q methodology. *Health Education Res.* 20, 206–213
 - 67 van Exel, J. *et al.* (2007) Care for a break? An investigation of informal caregivers' attitudes toward respite care using Q-methodology. *Health Policy* 83, 332–342
 - 68 Mullen, P.M. (1999) Public involvement in health care priority setting: an overview of methods for eliciting values. *Health Expect.* 2, 222–234
 - 69 Davis, C.J. *et al.* (2006) Communication challenges in requirements elicitation and the use of the repertory grid technique. *J. Comput. Inform. Syst.* 46, 78–86
 - 70 Rowe, G. *et al.* (2005) Assessing patients' preferences for treatments for angina using a modified repertory grid method. *Soc. Sci. Med.* 60, 2585–2595
 - 71 Riquelme, H. and Rickards, T. (1992) Hybrid conjoint analysis: an estimation probe in new venture decisions. *J. Business Venturing* 7, 505–518
 - 72 Gafni, A. (1994) The standard gamble method: what is being measured and how it is interpreted. *Health Services Res.* 29, 207–224
 - 73 Morimoto, T. and Fukui, T. (2002) Utilities measured by rating scale, time trade-off, and standard gamble: review and reference for health care professionals. *J. Epidemiol.* 12, 160–178
 - 74 Man-Son-Hing, M. *et al.* (1996) Warfarin for atrial fibrillation. The patient's perspective. *Arch. Intern. Med* 156, 1841–1848
 - 75 Baker, S.G. and Kramer, B.S. (2014) Evaluating surrogate endpoints, prognostic markers, and predictive markers: some simple themes. *Clin. Trials* 12, 299–308
 - 76 Baker, S.G. *et al.* (2012) Evaluating a new marker for risk prediction using the test tradeoff: an update. *Int. J. Biostat.* 8, 1–17
 - 77 Arnesen, T. and Trommald, M. (2005) Are QALYs based on time trade-off comparable?—A systematic review of TTO methodologies. *Health Econ.* 14, 39–53

- 78 Brazier, J. *et al.* (1999) A review of the use of health status measures in economic evaluation. *J. Health Services Res. Policy* 4, 174–184
- 79 Holdgate, A. *et al.* (2003) Comparison of a verbal numeric rating scale with the visual analogue scale for the measurement of acute pain. *Emerg. Med.* 15, 441–446
- 80 Räsänen, P. *et al.* (2006) Use of quality-adjusted life years for the estimation of effectiveness of health care: a systematic literature review. *Int. J. Technol. Assess. Health Care* 22, 235–241
- 81 Louviere, J. *et al.* (2010) Discrete choice experiments are not conjoint analysis. *J. Choice Model.* 3, 57–72

GLOSSARY

Medical product lifecycle (MPLC) term to describe the lifecycles of drugs and medical devices

Patient preferences relative desirability or acceptability of specified alternatives; or choices among treatment alternatives or outcomes; or other attributes that differ among alternative health interventions [7]

Preference elicitation method quantitative methods collecting quantifiable data for hypothesis testing and other statistical analyses

Preference exploration method qualitative methods that collect descriptive data through participant or phenomenon observation, examining the subjective experiences and decisions made by participants

Quality-adjusted life year (QALY) a measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life [77]

Vikas Soekhai^{1,7,8,§}
Chiara Whichello^{1,7,§}
Bennett Levitan²
Jorien Veldwijk^{1,7}
Cathy Anne Pinto³
Bas Donkers^{4,7}
Isabelle Huys⁵
Eline van Overbeeke⁵
Juhaeri Juhaeri⁶
Esther W. de Bekker-Grob^{1,7,*}

¹Erasmus School of Health Policy & Management, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands

²Janssen Research & Development, 1125 Trenton-Harbourton Road, PO Box 200, Titusville, NJ, 08560, USA

³Merck, Sharpe & Dome, 2000 Galloping Hill Rd., Kenilworth, NJ, 07033, USA

⁴Department of Business Economics, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands

⁵Clinical Pharmacology and Pharmacotherapy, University of Leuven, Herestraat 49 Box 521, Leuven, 3000 Belgium

⁶Sanofi, 55 Corporate Drive Bridgewater, NJ, 08807, USA

⁷Erasmus Choice Modelling Centre, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands

⁸Department of Public Health, Erasmus MC – University Medical Centre, Dr. Molewaterplein 40, 3000 CA Rotterdam

*Corresponding author.

[§]Joint first author.