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

Vikas Soekhai[1,7,8,§], Chiara Whichello[1,7,§], Bennett Levitan[2], Jorien Veldwijk[1,7], Cathy Anne Pinto[3], Bas Donkers[4,7], Isabelle Huys[5], Eline van Overbeeke[5], Juhaeri Juhaeri[6] 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 healthcare. 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-

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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

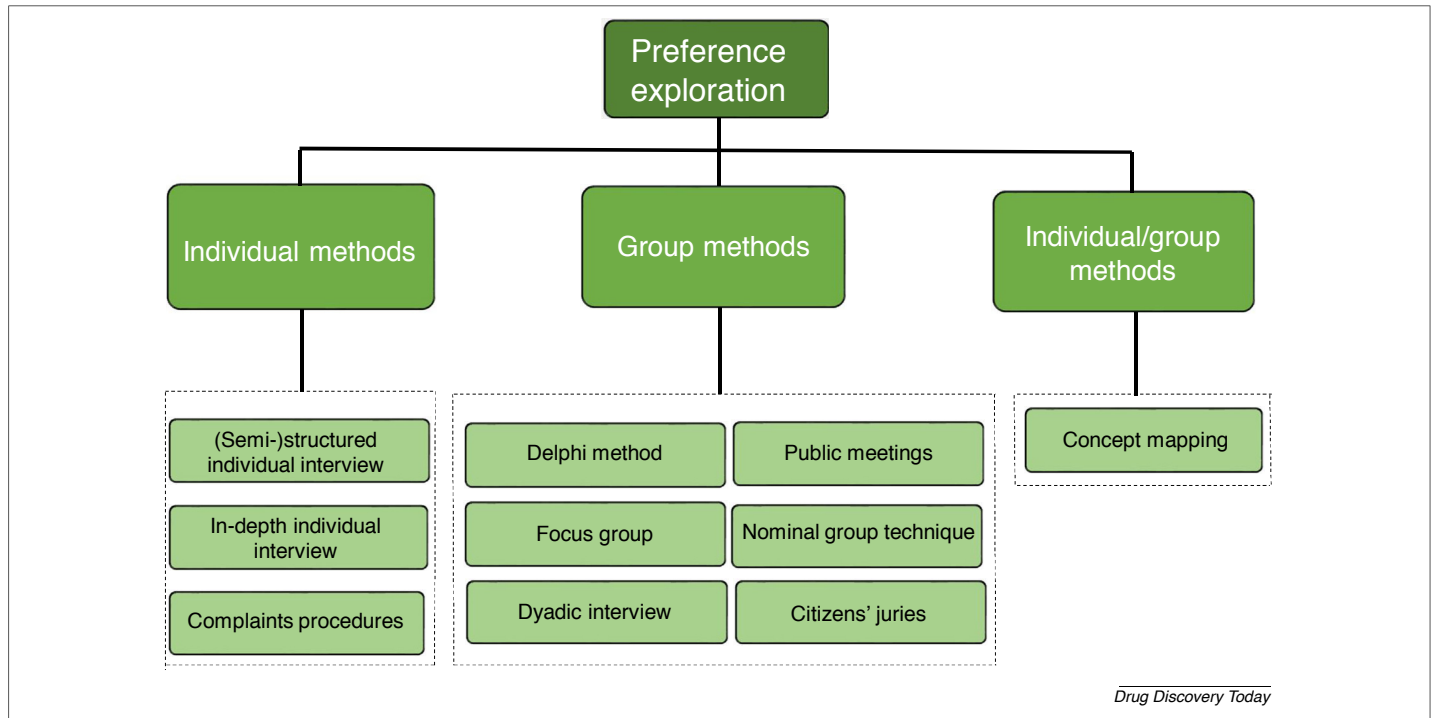| Method	Description	Refs
Exploration methods		
Citizens' juries[b]	Group of individuals discussing issues on the basis of evidence provided by two trained moderators	[24,25]
Complaints procedures[b]	Method in which stakeholders can register complaints to be investigated by experts	[26,27]
Concept mapping[b]	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
Elicitation methods		
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).
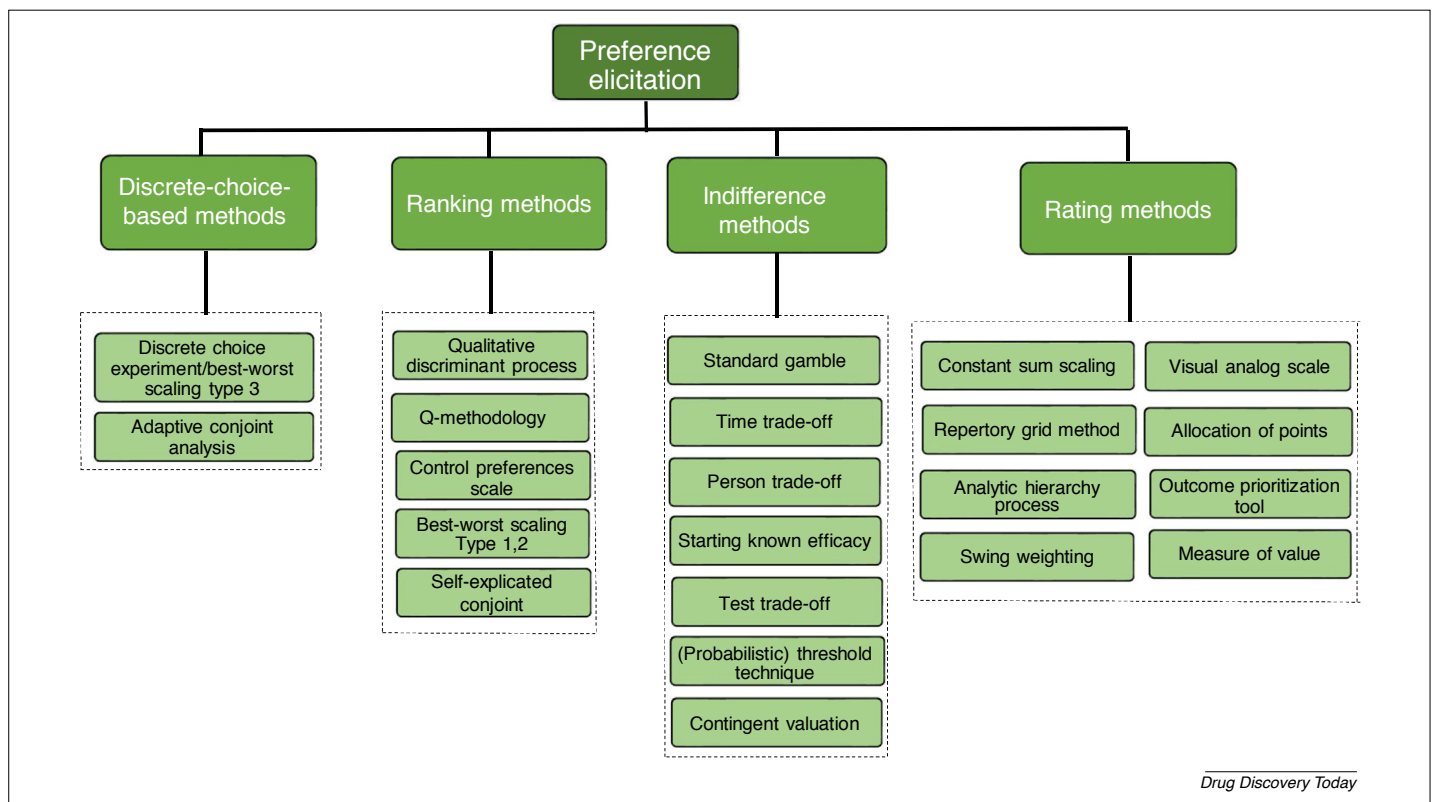[b] Identified through analysis of previous preference method reviews (23 methods).
[c] Identified with expert consultations (4 methods).

Preference exploration

Individual methods

Group methods

Individual/group methods

(Semi-)structured individual interview

In-depth individual interview

Complaints procedures

Delphi method

Focus group

Dyadic interview

Public meetings

Nominal group technique

Citizens' juries

Concept mapping

Drug Discovery Today

FIGURE 1

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

Preference elicitation

Discrete-choice-based methods

Ranking methods

Indifference methods

Rating methods

Discrete choice experiment/best-worst scaling type 3

Adaptive conjoint analysis

Qualitative discriminant process

Q-methodology

Control preferences scale

Best-worst scaling Type 1,2

Self-explicated conjoint

Standard gamble

Time trade-off

Person trade-off

Starting known efficacy

Test trade-off

(Probabilistic) threshold technique

Contingent valuation

Constant sum scaling

Repertory grid method

Analytic hierarchy process

Swing weighting

Visual analog scale

Allocation of points

Outcome prioritization tool

Measure of value

Drug Discovery Today

FIGURE 2

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

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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
$n = 19$	$n = 208^a$	(%)	Continents (frequency)^a	$n = 208$
Exploration methods				
Delphi method	3	(1.4)	Asia (2), North America (1)	24, 107, 308
Dyadic interview	1	(0.5)	Africa (1)	269
Focus group	29	(13.9)	Africa (1), Asia (2), Australia/Oceania (3), Europe (15), North America (8)	2, 14, 17, 18, 43, 45, 71, 72, 84, 97, 109, 116, 119, 121, 211, 220, 222, 236, 253, 269, 282, 283, 286, 290, 294, 300, 308, 313, 317
In depth – individual interview	9	(4.3)	Asia (1), Australia/Oceania (1), Europe (3), North America (4)	32, 41, 108, 147, 173, 191, 193, 211, 316
(Semi-)structured individual interview	47	(22.6)	Africa (2), Asia (6), Australia/Oceania (6), Europe (18), North America (15)	2, 9, 17, 18, 21, 30, 41, 43, 57, 58, 65, 67, 87, 94, 100, 101, 120, 129, 141, 153, 162, 164, 184, 193, 198, 205, 211, 215, 217, 222, 226, 229, 230, 232, 239, 267, 268, 269, 272, 280, 284, 285, 286, 302, 306, 310, 323
Elicitation methods				
Adaptive conjoint analysis	3	(1.4)	North America (3)	88, 89, 243
Analytic hierarchy process	1	(0.5)	Europe (1)	221
Best-worst scaling (types 1, 2,3)	4	(1.9)	Asia (1), Australia/Oceania (1), North America (2)	133, 180, 189, 300
Contingent valuation	11	(5.3)	Asia (2), Australia/Oceania (1), North America (2)	29, 35, 144, 148, 155, 166, 167, 180, 199, 244, 298
Control preference scale	3	(1.4)	Asia (1), North America (2)	147, 175, 316
Discrete choice experiment	57	(27.4)	Africa (1), Asia (7), Australia/Oceania (6), Europe (15), North America (28)	19, 25, 26, 34, 42, 48, 57, 66, 73, 79, 80, 90, 100, 101, 109, 114, 117, 119, 122, 133, 134, 154, 155, 160, 161, 163, 166, 179, 180, 184, 192, 194, 200, 212, 213, 215, 218, 219, 222, 227, 229, 234, 238, 239, 243, 246, 247, 249, 257, 264, 266, 272, 281, 309, 311, 312, 313
Outcome prioritization tool	1	(0.5)	Europe (1)	304
Person trade-off	1	(0.5)	Europe (1)	274
Repertory grid method	1	(0.5)	Europe (1)	255
Standard gamble	11	(5.3)	Asia (1), Australia/Oceania (1), Europe (2), North America (7)	34, 42, 155, 180, 195, 200, 209, 219, 237, 277, 312
Starting known efficacy	1	(0.5)	North America (1)	201
(Probabilistic) threshold technique	2	(1.0)	North America (2)	42, 172
Time trade-off	11	(5.3)	Australia/Oceania (1), Europe (2), North America (8)	33, 34, 78, 155, 180, 200, 209, 219, 237, 277, 318
Visual analog scale	12	(5.8)	Asia (2), Europe (3), North America (7)	93, 115, 168, 171, 178, 195, 208, 223, 278, 281, 287, 314

^{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

Appendices A–C. Supplementary data

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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 Levitan[2]
Jorien Veldwijk[1,7]
Cathy Anne Pinto[3]
Bas Donkers[4,7]
Isabelle Huys[5]
Eline van Overbeeke[5]
Juhaeri Juhaeri[6]
Esther W. de Bekker-Grob[1,7,*]

[1]Erasmus School of Health Policy & Management, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands
[2]Janssen Research & Development, 1125 Trenton-Harbourton Road, PO Box 200, Titusville, NJ, 08560, USA
[3]Merck, Sharpe & Dome, 2000 Galloping Hill Rd., Kenilworth, NJ, 07033, USA
[4]Department of Business Economics, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands
[5]Clinical Pharmacology and Pharmacotherapy, University of Leuven, Herestraat 49 Box 521, Leuven, 3000 Belgium
[6]Sanofi, 55 Corporate Drive Bridgewater, NJ, 08807, USA
[7]Erasmus Choice Modelling Centre, Erasmus University Rotterdam, P.O. Box 1738, Rotterdam, 3000 DR the Netherlands
[8]Department of Public Health, Erasmus MC – University Medical Centre, Dr. Molewaterplein 40, 3000 CA Rotterdam

*Corresponding author.

§Joint first author.

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