

**A CHECKLIST FOR CONJOINT ANALYSIS APPLICATIONS IN HEALTH: REPORT OF THE  
ISPOR CONJOINT ANALYSIS GOOD RESEARCH PRACTICES TASK FORCE**

**FINAL DRAFT**

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## Abstract

1 **Background:** The application of conjoint analysis (a general term spanning discrete-choice  
2 experiments and other stated-preference methods) in health has increased rapidly over the  
3 past decade, yet the acceptance of these methods is hindered by the variations in methods,  
4 terminology, and quality in the absence of any consensus-based methodological standards.

5 **Objective:** The ISPOR Conjoint Analysis Good Research Practices Task Force was  
6 established by the ISPOR Board of Directors to identify good research practices for  
7 applications of conjoint analysis in health. The objective of this Task Force report is to present  
8 guidance for good research practices to inform authors, reviewers, and readers of conjoint-  
9 analysis applications in health.

10 **Methods:** The Task Force met regularly over the course of 24 months to identify the important  
11 steps in a conjoint analysis, to discuss good research practices for conjoint analysis, and to  
12 develop and refine the key criteria for identifying good research practices. ISPOR members  
13 contributed to this process through participation in three sessions at ISPOR meetings and  
14 European Congresses, as well as presentations at the First and Second Conjoint Analysis in  
15 Health Conferences. The progress of this group has also been made publicly available through  
16 the ISPOR website, and members of the ISPOR Patient Reported Outcomes / Patient  
17 Preferences Special Interest Group were asked to review the work.

18 **Results:** Task Force findings are presented as a ten-item Checklist, modeled on the iconic  
19 Checklist by Drummond and colleagues for cost-effectiveness analysis, covering: 1) The  
20 research question; 2) Attributes and levels; 3) Construction of tasks; 4) Experimental design; 5)  
21 Preference elicitation; 6) Instrument design; 7) Data collection plan; 8) Statistical analyses; 9)  
22 Results and conclusions; and 10) Study presentation.

23 **Conclusions:** This Checklist provides a framework for undertaking, assessing, and improving  
24 the quality of conjoint-analysis applications in health. While it was not our intention to offer  
25 detailed instruction on research practices, future manuscripts of the ISPOR Conjoint Analysis  
26 Good Research Practice Task Force will produce recommendations specifically focused on the  
27 design, analysis and interpretation of conjoint analysis applications in health, while two others  
28 will focus on standardizing terminology and the applications of conjoint analysis in identifying  
29 and valuing patient-relevant endpoints. Finally, the Checklist should not be interpreted as  
30 endorsing any one particular approach or methods used in conjoint analysis.

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32

## 33 **Introduction**

### 34 *Why are Preferences of Patients and other Stakeholders Important?*

35 Understanding how patients and other stakeholders perceive and value different  
36 aspects of their health or health care interventions is vital to the optimal design and evaluation  
37 of programs. Incorporating these values in decision-making, ultimately, may result in clinical,  
38 licensing, reimbursement, and policy decisions that better reflect the preferences of  
39 stakeholders, especially patients. Furthermore, aligning clinical practice, clinical practice  
40 guidelines, drug development, and health policy with patient preferences could improve the  
41 effectiveness of health interventions by improving adoption of, satisfaction with, and adherence  
42 to clinical treatments or public-health programs.

### 43 *What are Stated Preference Methods?*

44 Stated-preference studies employ a variety of methods that are grounded in economic  
45 theory. These methods fall into two broad categories:

- 46 ■ Methods using ranking, rating, or choice designs to quantify preferences for various  
47 attributes of an intervention (often referred to as conjoint analysis, discrete-choice  
48 experiments, or stated-choice methods) and
- 49 ■ Methods using direct elicitation to estimate the monetary value of a single intervention  
50 (including contingent valuation or willingness-to-pay and willingness-to-accept  
51 methods). (8-9).

52 A simple distinction between these two groups of methods is that the former aims to  
53 estimate demand, which is derived from preferences, while the latter aims to estimate  
54 preferences more directly. As such, these two approaches have developed as somewhat  
55 separate disciplines, despite being grounded in consumer theory. However, in recent years,  
56 the distinctions between the two categories of methods have also blurred in practice, with  
57 researchers estimating demand using multiple question formats and researchers using  
58 preference estimates to calculate willingness-to-pay for attributes. For the purposes of this  
59 report, we will focus on the former, and for simplicity, we will use the term conjoint analysis to  
60 describe the various related methodologies. While both approaches have their relative  
61 advantages and disadvantages, there has been a remarkable increase in the application  
62 conjoint analysis in health (1, 2).

### 63 *Conjoint Analysis in Health*

64 Conjoint analysis is used to measure the relative value of specific components of health  
65 status and health care alternatives by decomposing an alternative into its constituent parts (10-  
66 13). For example, the component attributes that define a pharmaceutical intervention might

67 include efficacy outcomes, safety and tolerability outcomes, dosing convenience, mode of  
68 administration, and cost. In all conjoint analyses, different levels are assigned to each  
69 component attribute to create a series of profiles which study subjects evaluate in rating,  
70 ranking, or choice tasks. Subjects' systematic evaluation of alternative profiles allows  
71 researchers to infer the relative importance of each component attribute, as well as changes in  
72 the levels of each component attribute. In this report, we define a conjoint analysis as any  
73 study in which subjects are asked to evaluate at least two profiles, each defined by at least two  
74 component attributes with at least two possible levels for each attribute.

75 Stated-preference methods such as conjoint analysis are particularly useful for  
76 quantifying preferences for products or outcomes in cases where no markets exist or where  
77 market choices are severely constrained by regulatory and institutional factors, such as in  
78 health (14). Conjoint analysis has been applied successfully to measuring preferences for a  
79 diverse range of health applications. Some examples include cancer treatments (15), HIV  
80 testing (16) and treatment (17), dermatology services (18), asthma medications (19), genetic  
81 counseling (20), weight-loss programs (21), insulin therapy in type 2 diabetes (22), diabetes  
82 prevention programs (23), colorectal cancer screening (24), and treatments for Alzheimer's  
83 disease (25).

#### 84 *Background to the Task Force Report*

85 Conjoint analysis is grounded in several disciplines, including psychology, economics,  
86 decision sciences, and marketing. Thus a variety of different techniques and approaches are  
87 associated with the same term (3). In health, conjoint analysis has become an umbrella term  
88 that also spans several different methods. Such methods include discrete-choice experiments,  
89 stated-preference methods, adaptive conjoint-analysis methods, best-worst scaling, and many  
90 other methods. In health, conjoint analysis is rarely used to refer to compositional or self-  
91 explicated methods for measuring attribute importance, although such methods also form an  
92 important pillar in the history of conjoint analyses in marketing (47). The task force uses the  
93 term conjoint analysis so to include these methods, and suggests that authors using other  
94 terms or specialized methods also refer to conjoint analysis in their abstract or as a keyword so  
95 as to aid researchers in finding such applications.

96 The variety of terms, approaches and theoretical foundations make conjoint analysis a  
97 flexible, but challenging evaluation method in health. Such variation makes it difficult to identify  
98 many of the applications of these methods in the medical literature and complicates issues for  
99 those who wish to understand and interpret the results without necessarily mastering the  
100 foundations of conjoint analysis methods. Variations in conjoint analysis methods have also

101 made it difficult to assess which methods are appropriate, especially for survey-design and  
102 analysis methods (4), and have likely slowed the pace of publication of conjoint analyses in  
103 health. A lack of accepted methods has made it difficult to assess conjoint analysis during the  
104 peer review process of scientific journals. Reviewers often are unfamiliar with conjoint-  
105 analysis methods or, less frequently, disagree with this as a valuation method.

106 The ISPOR Patient Preference Methods (PPM) – Conjoint Analysis Working Group  
107 initiated the task force proposal and agenda to the ISPOR Health Science Policy Council.  
108 The ISPOR Board of Directors followed the HSPC recommendation to establish the Conjoint  
109 Analysis Good Research Practices Task Force approving the task force in March 2009.

110 Members of the Task Force the agreed that developing strict guidelines for conducting  
111 conjoint analysis in health was not possible for the following reasons:

- 112 • One of the strengths of conjoint analysis is its flexibility, and imposing strict guidelines  
113 could limit novel applications and methods development;
- 114 • Given the interdisciplinary nature of conjoint analysis, it would be unlikely that a  
115 consensus of best practices would be reached – especially because the comparative  
116 effectiveness of many rival methods has not been studied empirically;
- 117 • Many of the possible applications of conjoint analysis in health have been unexplored.  
118 Best practices would be difficult to establish during a period of rapid methodological  
119 advancement.

120 The Task Force thus endeavored to provide broad guidance on good research practices  
121 by suggesting a structure to guide development, analysis, and publication of conjoint analyses  
122 in health, without necessarily endorsing any one approach.

123 Consequently, this report deviates from the traditional approach taken by ISPOR Task  
124 Force reports (5-7) in that it serves as part tutorial on conjoint analysis and part  
125 recommendations on good research practices. The task force chose to provide its  
126 recommendations in the form of a Checklist identifying good research practices. It will benefit  
127 those reviewing, reading, or otherwise assessing the validity of an application of conjoint  
128 analysis in health.

### 129 *How the Checklist was Developed*

130 The ISPOR Conjoint Analysis Good Research Practices Task Force met regularly over  
131 the course of 24 months to identify the important steps of a conjoint analysis, to discuss good  
132 research practices for conjoint analysis, and to develop and refine the final Checklist. ISPOR  
133 members were engaged in the development of the Checklist through multiple sessions at the  
134 ISPOR International and European Congress, presentations at the First and Second Conjoint

135 Analysis in Health Conferences, and via the ISPOR website. The final format of the Checklist  
136 was then modeled after the ten-point Checklist for cost-effectiveness analysis developed by  
137 Drummond and colleagues (26). Each item on the Checklist includes key references, potential  
138 pitfalls, and recommendations for good research practices.

#### 139 *How Should the Checklist be Used?*

140 This Checklist should be used to understand the steps involved in producing good  
141 conjoint analysis research. By outlining a systematic process of good research practices for  
142 applying conjoint analysis – from formulating the research question through the presentation of  
143 the results (either in presentations, abstracts, reports or manuscripts) – we aim to facilitate the  
144 research process and to highlight important issues that often are neglected or poorly executed.  
145 In producing the Checklist, we aim to be as inclusive as possible – both in terms of the  
146 accessibility to a broad readership and applicability to a variety of conjoint analysis methods.  
147 We are highlighting “good research practices” rather than “best research practices”, hence we  
148 have written in a non-technical way, with many elements of the Checklist presenting “food-for-  
149 thought” rather than a necessary or sufficient argument for research excellence.

150 We caution readers, especially those likely to serve as peer reviewers, that conjoint  
151 analysis describes a *variety* of methods. A pluralistic approach to review is needed.  
152 Throughout this report we encourage researchers to provide, and reviewers to expect,  
153 explanation and justification for the methods chosen by researchers, rather than promote any  
154 specific method. Like any contribution in health and medicine, the goal of good scientific  
155 practice is to produce replicable results. While we do not advocate that the Checklist be used  
156 to score articles or measure a threshold of acceptability, we acknowledge that it might be used  
157 in that way. Our intention is that the Checklist be used as means to improve the quality of  
158 conjoint analysis research in health and not as a hurdle to publishing.

#### 159 **Description of the Checklist**

160 The findings of the Task Force are presented as a ten-item Checklist, summarized in  
161 Figure 1 (see page 26). The Checklist includes: 1) Research question; 2) Attributes and  
162 levels; 3) Construction of tasks; 4) Experimental design; 5) Preference elicitation; 6) Instrument  
163 design; 7). Data collection plan; 8) Statistical analyses; 9) Results and conclusions; and 10)  
164 Study presentation.

165 Implicit in the structure of the Checklist is that some tasks should be considered jointly  
166 or collectively. For example, in constructing the preference-elicitation tasks, experimental  
167 design and preference-elicitation methods should be considered together. Likewise, instrument  
168 design is closely related to data collection, and choice of statistical analysis and the ability to

169 draw results and conclusions also are inseparable. More experienced researchers might note  
170 additional connections (or suggest that all ten items are linked). We highlight these particular  
171 relationships to emphasize that the Checklist should not be used as a simple “cook book”.

172 In the remaining sections, we describe issues to be considered in evaluating each of  
173 these ten items and elaborate on additional points within each section. These are summarized  
174 in table 1. We have kept cross-referencing to a minimum and avoided referencing complex  
175 articles or books from other disciplines. We caution readers not to consider this report as an  
176 exhaustive reference, but simply as an introduction to conjoint analysis good research  
177 practices.

178 TABLE INSERTED HERE

179 1) *The Research question*

180 The first item in the Checklist is common to all scientific research and relates to the  
181 research question. Specifically, “**Was a well-defined research question stated and is  
182 conjoint analysis an appropriate method for answering it?**”

183 Following generally accepted research practices in health, a conjoint analysis study  
184 must clearly state a well-defined research question that delineates what the study will attempt  
185 to measure (8). For example, a conjoint analysis might be undertaken to quantify patients’  
186 relative preferences for cost, risk of complications, and health care service location. In addition  
187 to defining the research question, researchers should indicate any hypotheses to be tested in  
188 the study or acknowledge that the study is exploratory and/or descriptive. The hypotheses may  
189 be implicit in the research question itself.

190 For example, in a conjoint analysis estimating the rate at which subjects are willing to  
191 accept tradeoffs between two attributes, the testable null hypothesis is that the preference  
192 weight for one level of the attribute is not statistically significantly different from the preference  
193 weight for a different level of that attribute. In other words, the hypothesis test is designed to  
194 infer whether a change in the level of one attribute (e.g., a change in surgical wait time from  
195 one month to two months) is statistically significant. If the null hypothesis is rejected for a given  
196 attribute, then the change in the attribute level is statistically significant indicating that subjects  
197 are not willing to trade other attributes for changes in that attribute.

198 Second, the research question should define the study perspective including any  
199 relevant decision-making or policy context. The research question, “What are patients willing to  
200 pay for treatment to reduce the rate of relapse in multiple sclerosis?” includes both the items to  
201 be measured – the tradeoff between cost and reduction in relapse rates – the perspective and  
202 decision-context of the analysis – and the study perspective in the context of the patients’

203 decision about multiple sclerosis treatment. In a health policy context, the research question  
204 might be: “What level of increase in waiting time for non-emergency surgery is the public  
205 willing to accept to reduce the rate of surgical errors?” Here, the items to be measured include  
206 waiting periods for non-emergency surgery and the rate of surgical errors. The perspective is  
207 that of the government or health-service provider in which the preferences of the general public  
208 are estimated in the context of health policy for delivering non-emergency surgical health-care  
209 services.

210 A conjoint analysis should explain why conjoint methods are appropriate to answer the  
211 research question. Conjoint analysis is well suited to evaluate services or products that differ in  
212 their component attributes and for decisions-makers that are willing to accept tradeoffs among  
213 component attributes. Because the examples of research questions presented above involve  
214 explicit tradeoffs between measureable attributes, conjoint analysis methods are appropriate in  
215 each case. However, they are not the only method for answering these research questions.

216 In the first example, contingent valuation is a likely alternative for estimating patients’  
217 willingness to pay to reduce the rate of relapse in multiple sclerosis. In the second example,  
218 observational data from a pilot program for reducing surgical errors in which surgical waiting  
219 times are increased may provide enough information to answer the research question.  
220 Therefore, researchers should identify not only whether conjoint analysis can be used to  
221 answer the research question, but also *why* conjoint analysis is preferable to alternative  
222 methods.

## 223 *2) Attributes and levels*

224 A central feature of a conjoint analysis is the combination of the attributes and levels. It  
225 is addressed in the second key point the in the Checklist: “***Were the attributes and attribute***  
226 ***levels supported by evidence?***”

227 The objective of conjoint analysis is to elicit preferences or values over the range of  
228 attributes and attribute levels that define the profiles in the conjoint analysis tasks. All  
229 attributes that potentially characterize the alternatives should be considered. (Some may be  
230 excluded to ensure that the profiles are plausible to subjects.) For the chosen attributes, the  
231 attribute levels should encompass the range that may be salient to subjects even if those  
232 levels are hypothetical or not feasible given current technology. Again, some limitation may  
233 need to be made in the choice of attribute levels. Authors should explain both inclusions and  
234 omissions of attributes and levels.

235 Identifying attributes should be supported by evidence regarding the potential range of  
236 preferences and values that people may hold. Sources of evidence should include literature

237 reviews and other evidence regarding the impact of a disease and the nature of a health  
238 technology, clinical experts, and interviews or focus groups with individuals who represent the  
239 population from which study subjects are likely to be drawn.

240 The choice of whether focus groups or interviews should be used depends on many  
241 factors, including the nature of the questions asked and subjects included in the research.  
242 Simple thematic, descriptive or phenomenological analysis is generally sufficient for guiding  
243 attribute selection. Such qualitative research will provide the basis for identifying the full set of  
244 attributes and possible levels that characterize the profiles in the preference space. Discussion  
245 with experts and further pilot testing with subjects (including the potential rating/ranking of  
246 attributes) can be used to narrow down the list of attributes if necessary.

247 The subset of all possible attributes that should be included in the conjoint analysis  
248 tasks can be determined based on three criteria: relevance to the research question; relevance  
249 to the decision-context; and whether attributes are related to one another. Attributes central to  
250 the research question or to the decision-context must either be included in these tasks or held  
251 constant across all profiles.

252 For example, when eliciting patients' preferences for a surgical intervention, the efficacy  
253 of the intervention almost certainly is an important outcome. However, if the research is  
254 designed to estimate patients' willingness-to-pay or willingness-to-wait to have a less-invasive  
255 surgical procedure, then it may make sense to exclude efficacy from the set of attributes and to  
256 inform participants that efficacy does not vary between the profiles.

257 Similarly, it is important to control for any potential attributes that are omitted from the  
258 conjoint analysis tasks, but which correlate with attributes that are included in these tasks. In  
259 the US health care market, insurance coverage and out-of-pocket medical expenses for  
260 procedures are routine for many patients. Cost may be perceived as correlated with  
261 improvements in medical outcomes or access to advanced interventions. If cost is not included  
262 in such a study, it should be controlled for by informing subjects that it is constant across  
263 profiles.

264 Finally, the wording, description and any supporting material given to the respondents  
265 for the attributes and attribute levels should be presented and justified. Ambiguities, ranges  
266 and qualitative descriptors should be avoided. If used, a justification should be given and  
267 supporting evidence should be presented.

### 268 3) *Construction of tasks*

269 Conjoint analysis tasks can be assembled in a number of different ways; hence it is  
270 important to ask "***Was the construction of the conjoint tasks appropriate?***"

271 First, each profile that subjects are asked to evaluate could include the full set of  
272 attributes included in the study (a full-profile task) or a subset of the attributes included in the  
273 study (a partial-profile task). Prior to constructing tasks with full profiles, researchers should  
274 determine, through qualitative research or quantitative pilot tests whether or not subjects can  
275 reasonably evaluate the full profiles or if they will employ simplifying heuristics, such as  
276 focusing on only a few attributes while ignoring others, when completing the conjoint tasks. If  
277 this happens, researchers learn nothing about subject preferences among the attributes that  
278 the subjects ignore and the importance of the attributes on which subjects focus likely will be  
279 overstated. If each task contains a partial profile, researchers must understand the effect of  
280 omitting some attributes in some tasks while omitting other attributes in different tasks. The  
281 way in which certain attributes are omitted can introduce biases in the results of the study. An  
282 effective solution to this problem is to show full profiles, but constrain some attribute levels to  
283 be the same (overlap) between profiles. (46)

284 The number of profiles or alternatives included in each task will influence the cognitive  
285 process by which subjects evaluate the task. It also has implications for the experimental  
286 design (see Checklist item 4 – experimental design). In addition, the number of asks often  
287 varies from study to study, depending on the type and difficulty of each task. In some studies,  
288 subjects may be presented with a set of many alternative profiles and asked to order or rank  
289 the profiles from most preferred to least preferred. In this type of study, subjects often  
290 complete only one task. In other studies, profiles are grouped in sets of two or three and  
291 subjects are asked to rate, rank, or choose among these alternatives. Because each task  
292 includes only a small subset of the overall number of potential profiles, subjects often are  
293 asked to complete multiple tasks. In this case, researchers should justify both the number of  
294 profiles in each task and the number of tasks included in the data-collection instrument.

#### 295 *4) Experimental design*

296 Experimental design is the process of systematically manipulating the attribute levels to  
297 create the profiles and tasks. It is important to ask “***Was the choice of experimental design***  
298 ***justified and evaluated?***”

299 The goal of a conjoint analysis experimental design is to create a set of tasks that will  
300 yield as much statistical information as possible to obtain unbiased, precise parameter  
301 estimates of the underlying preference model (usually preference weights for all attribute  
302 levels) (27-28). There are several design properties that should be considered when choosing  
303 an experimental design in a conjoint analysis study. A design is orthogonal if all effects can be  
304 estimated independently of all other effects. (The effects are uncorrelated.) A design is

305 balanced when each level of an attribute is presented the same number of times across the set  
306 of tasks. Furthermore, efficient estimation requires a small variance matrix. If a design is  
307 orthogonal and balanced, then it has optimum efficiency.

308         Researchers should examine and test several design approaches. A full-factorial design  
309 in which every possible profile is presented allows estimating main effects and interactions.  
310 However, the number of profiles required by a full-factorial design is too numerous for subjects  
311 to easily and credibly evaluate for most practical applications. Fractional-factorial designs offer  
312 a means of decreasing the number of tasks required in the data-collection instrument.  
313 Fractional-factorial designs are orthogonal profiles including only uncorrelated attributes  
314 constructed from a subset of the full-factorial. These designs guarantee that all attribute main  
315 effects are independently estimable, and they allow for the independent estimation of some  
316 attribute interactions if such interactions are defined during design construction (13).

317         Fractional-factorial designs can be generated using published “catalog designs” (29-30)  
318 or statistical programs (e.g., SAS, SPSS). In choice-based conjoint analysis, the orthogonal  
319 arrays are used as “seed” profiles. Choice alternatives are generated from the seed design  
320 using techniques that enforce the design criterion of no correlation between attributes  
321 (orthogonality), level balance (each attribute level occurs with equal frequency), and minimal  
322 level overlap (each attribute level only appears once in a given choice) (27). These criteria  
323 provide good statistical efficiency for linear models. However, for non-linear probabilistic  
324 models (e.g., the conditional logit model) more statistically efficient designs can be constructed  
325 by using design algorithms to search for an experimental design that minimizes the D-  
326 efficiency summary measure of average variance. (27, 31).

327         Large designs can be blocked into multiple sub-designs to limit the number of tasks  
328 each respondent must complete. This blocking approach also allows for the independent  
329 identification of all parameters and interactions, but a loss of orthogonality may occur if a  
330 proportion of the sub-designs are not returned (13). Therefore, researchers should ensure that  
331 each sub-design is randomly assigned to subjects.

332         Strict orthogonality is a desirable statistical property. However, if attributes are related  
333 to one another, an orthogonal design could result in illogical combinations of attribute levels in  
334 a given profile in the conjoint analysis task. For example, if one attribute defining a profile is  
335 the need for medication (no medication required or 2 tablets a day), it makes no sense to  
336 combine certain levels of this attribute with certain levels of an attribute describing the side  
337 effects of the medication (mild or severe) because some profiles would include a combination  
338 of the “no medication required” level of the need for medication attribute with the “severe” level

339 of the side-effect attribute. Eliminating such combinations introduces nonzero correlations in  
340 the design. Researchers should evaluate whether such correlations compromise estimating  
341 unbiased parameters.

342 The problem of plausible combinations is an illustration instance of the larger challenge  
343 of potential tradeoffs between minimizing statistical error and minimizing measurement error  
344 (see Checklist item 6 – instrument design). (REF Maddalla, Phillips, Johnson). Conjoint  
345 analysis questions based on statistically efficient designs may be too difficult for subjects to  
346 answer accurately, so any theoretical gains in statistical efficiency may be negated by an  
347 unacceptable cognitive burden.

348 Conjoint analysis tasks can include an opt-out alternative. In these cases, the opt-out  
349 alternative allows subjects to choose standard-of-care, current treatment, or no treatment  
350 rather than the hypothetical alternatives included in a conjoint analysis task. When subjects  
351 choose an opt-out alternative for a specific task, researchers learn nothing about subjects'  
352 relative preferences for the hypothetical alternatives presented in the task. Therefore, while  
353 including an opt-out alternative often may provide a more realistic scenario for subjects to  
354 evaluate, it also introduces additional challenges in the design and analysis of the study. An  
355 alternative to including an opt-out selection in each conjoint analysis task is to include an opt-  
356 out choice in a *separate question following* each conjoint task. That is, subjects who select  
357 alternative A in a forced-choice question, are offered A or opt-out in a follow-up question.  
358 Including an opt-out question in a follow-up task increases the length and difficulty of the  
359 survey instrument, but provides the researcher with a more complete set of preference data.

### 360 5) Preference Elicitation

361 The aim of conjoint analysis is to measure preferences, so it is important to ask “**Were**  
362 **preferences elicited credibly?**”

363 There are multiple question formats that can be used in preference-elicitation studies.  
364 Researchers should ensure that the elicitation format used in a conjoint analysis study is  
365 appropriate to answer the research questions the study is designed to answer. The most  
366 appropriate elicitation format may differ for choice experiments that evaluate a new drug,  
367 health service, or public health program. In addition, data generated using different question  
368 formats will require different methods of statistical analysis.

369 In a discrete-choice experiment or forced-choice conjoint analysis study, each task  
370 includes two profiles. Each profile is defined by a set of attribute levels between which  
371 subjects are asked to choose. Alternative question formats include ratings or rankings.  
372 Ratings and rankings provide more information about preferences than choice formats.

373 Ratings indicate intensity of preference for one profile relative to another, possibly including  
374 indifference, and rankings indicate the position of multiple alternative profiles relative to each  
375 other.

#### 376 *6) Instrument design*

377 Conjoint analysis data collection instruments are surveys. The development of a data  
378 collection instrument should follow established, good survey research principles. Therefore, it  
379 is important to ask, “**Was the data collection instrument designed appropriately?**”

380 It is important to elicit subject-specific health and socio-demographic information to test  
381 for systematic differences in preferences based on these characteristics (e.g., attitudinal,  
382 health history/status, and treatment experience). Patients’ health status may influence their  
383 preferences in a systematic way and so may reduce the generalizability of the findings (32).  
384 Moreover, it is also important to describe all attributes and levels thoroughly and consistently to  
385 ensure that all subjects are evaluating the same task and not making unobservable  
386 assumptions about the attributes and levels in a given profile. For example, different subjects  
387 may have quite different outcomes in mind for symptom levels described simply as mild,  
388 moderate, and severe.

389 Because conjoint analysis tasks often are complex and cognitively burdensome,  
390 potential measurement error may be a serious concern (35). Measurement error may be  
391 introduced by the order in which attributes are presented, the question order, or the number of  
392 attributes and levels. Work by Kjaer and colleagues (36), for example, suggests participants  
393 can show a differential sensitivity to price depending on where the cost attribute occurs in the  
394 profile. Varying the order of attributes may be prudent. Randomising the order of questions is  
395 good practice.

396 Finally, it is important to test the final questionnaire with respondents using both small  
397 cognitive debriefing interviews and a quantitative pilot. The cognitive debriefing will identify  
398 areas of misunderstanding or common errors as well as to whether the survey is too lengthy.  
399 It will also test whether participants understand the instructions and feel the questions are  
400 appropriate. The larger pilot allows for consistency or rationality tests and can give estimates  
401 of coefficient size and direction.

#### 402 *7) Data collection*

403 Given that conjoint analysis is an empirical method, it is important to ask, “**Was the**  
404 **data collection plan appropriate?**”

405 Sample-size calculations represent a challenge in conjoint analysis. Minimum sample  
406 size depends on a number of criteria, including the question format, the complexity of the

407 choice task, the desired precision of the results, and the need to conduct subgroup analyses  
408 (28). Researchers commonly apply rules of thumb based on the number of attribute levels  
409 (33). Simulation techniques, which have been used in EQ-5 D valuation work, could potentially  
410 be used to guide sample-size evaluations (34). Sample-size estimation for conjoint analysis  
411 requires further work because it is an important criterion for grant awarding bodies and ethics  
412 committees.

413 Conjoint analysis surveys can be administered in many different ways including mail  
414 surveys using a paper-and-pencil survey instrument (22), non-mediated paper-and-pencil  
415 surveys completed at a finite set of study sites (37), electronic administration at a finite set of  
416 study sites using a PC (38), or electronic administration over the Internet (39). The complexity  
417 of most conjoint analysis questions probably precludes the use of telephone-based data  
418 collection unless the survey instrument is mailed to subjects in advance. Interviewer-led  
419 administration of the survey may improve the quality of data because the interviewer can  
420 recognize if more explanation is needed, more fully explain the task, and answer some  
421 questions (without leading the participant in any way).

422 However, interviewers may introduce to bias because participants may feel they need to  
423 produce socially desirable answers or believe that their answers could influence their future  
424 care. McColl & Fayers (40) provide a review of administration methods. Participants should  
425 provide consent according to human-subjects regulations. They should also be informed that  
426 the choices they are presented with are not necessarily choices that are available to them.

427 Subject recruitment must be consistent with the study objectives. Specifically, the  
428 sample of subjects must be reflective of those people whose preferences we aim to elicit and  
429 generalize. For example, if we wish to quantify the preferences of women with metastatic  
430 breast cancer then the sample should be drawn from this population. However, it is often  
431 difficult or costly to generate a sufficiently large sample of respondents from a narrowly defined  
432 population. Therefore, it may be reasonable to elicit preferences from not only a sample with a  
433 specific medical condition, but also from a sample of people at risk for the specific medical  
434 condition or who have a milder form of the condition. It may be reasonable to include women  
435 with localized tumors of the breast who can reasonably conceive of developing more advanced  
436 breast cancer. Where this is done, it needs to be made explicit. In addition, appropriate  
437 statistical controls used to account for variations in health status.

438 International studies present their own challenges to survey research. It is important to  
439 ensure that appropriate translation and cultural adaptation of the survey takes place if it is used  
440 in multiple countries. Methods used in developing patient reported outcomes instruments

441 should be sufficient (41). Additional testing may be necessary to ensure that the attributes,  
442 levels and tasks are acceptable in each country. In particular, the salient cost range may vary  
443 between countries.

444 Furthermore, those who design and conduct conjoint analysis studies should consider  
445 the participants and whether there are any issues which would affect their ability to complete  
446 the survey. Conjoint analysis studies can be cognitively complex to complete. Some patient  
447 groups who have known cognitive function problems – such as people with neurological  
448 diseases – may not be able to complete the tasks. In general, it is good practice to simplify the  
449 tasks as much as possible without compromising accuracy or completeness. To minimize the  
450 effect of educational attainment, it is good survey research practice to keep the level of  
451 language at the 6<sup>th</sup> grade level.

452 It is important to describe the subject-specific health and demographic characteristics of  
453 the sample and compare these characteristics to the population to which you wish to  
454 generalize. Reviewers and readers inevitably will question whether you have inadvertently  
455 captured the views of more highly educated, more proactive patients (such as those who  
456 participate in patient advocacy groups) or patients with higher-than-average incomes.

457 Finally, any study that includes human subjects should clearly report that approval was  
458 obtained from the appropriate institutional regulatory board and describe consent procedures,  
459 if required. It also is important to report any respondent incentives or compensation, especially  
460 if these could have influenced respondents' participation in any way.

#### 461 *8) Statistical analyses*

462 Conjoint analysis data and the modeling of preferences can require some complex  
463 statistical methods. It is vital to ask **“Were statistical analyses and model estimation  
464 appropriate?”**

465 There are several objectives to analyzing stated-preference data. First, one wants to  
466 estimate the strength of preference for the attributes and attribute levels included in the survey.  
467 Another might be in estimating how preferences vary by individual subject characteristics. For  
468 policy analysis, one might be in calculating how choice probabilities vary with changes in  
469 attributes or attribute levels, or in calculating secondary estimates of money equivalence  
470 (WTP) (42), risk equivalence (maximum acceptable risk (MAR)) (43), or time equivalence for  
471 various changes in attributes or attribute levels (44).

472 Theoretically valid and unbiased preference estimates depend on model specifications  
473 that are consistent with the underlying utility theory used to elicit preferences and with the  
474 particular features of the response and profile variables. Forced-choice conjoint analyses,

475 discrete-choice experiments, and rating studies lend themselves to analysis using stochastic  
476 utility maximization theory. Analysis of rating or card-sort data should use ordered-probit or  
477 ranked-logit regression methods, although some published studies have used ordinary least  
478 squares regression.

479 In most conjoint analyses, multiple responses are obtained from each subject. In these  
480 cases, researchers should ensure that the statistical analysis of the data accounts for within-  
481 subject correlation. Ignoring the fact that each subject provides multiple responses can result  
482 in biased preference estimates. Thus, researchers who estimate these models should test that  
483 the data being analyzed is consistent with the assumptions required for the model being  
484 employed.

485 Researchers must determine whether to model attribute levels as continuous or  
486 categorical. If attribute levels are specified as continuous, researchers must determine the  
487 appropriate functional form for each continuous variable. Categorical models avoid imposing  
488 any functional form on preference weights and provide a validity check on the correct ordering  
489 of naturally ordered attribute levels. In addition, researchers should determine whether  
490 categorical attribute levels are specified as dummy variables or effects-coded variables. When  
491 effects coding is used, zero corresponds to the mean effect for each attribute, rather than the  
492 combination of all the omitted categories, and the parameter for the omitted category is the  
493 negative sum of the included-category parameters. Hensher et al. (13) explain why effects  
494 coding is statistically superior for choice models.

495 Researchers also should account for differences in preferences that arise from  
496 differences in individual characteristics such as age, income, education, and gender by  
497 interacting individual characteristics with attributes included in the conjoint analysis questions  
498 or by conducting split-sample analyses. Latent-class models allow the data to determine the  
499 optimal division of observations into groups with similar preferences (28).

## 500 *9) Results and conclusions*

501 Researchers often are tempted to make inferences and predictions that go beyond what  
502 the data and methods can support, so it always is important to ask, “**Were the results and**  
503 **conclusions valid?**”

504 Evaluating the validity of results and conclusions requires consideration of the research  
505 question as well as other aspects of the design and analysis. The results should present the  
506 statistical findings in the context of the research question and should be presented in sufficient  
507 detail. The results should state which attributes/levels (and interaction terms, if relevant)  
508 included in the conjoint analysis task were or were not significant and report uncertainty

509 associated with estimates. Findings should be interpreted in the context of the choice being  
510 considered.

511 For example, in the multiple-sclerosis example, the results could indicate that the rate of  
512 relapse was a significant attribute and a negative coefficient might imply higher rates of relapse  
513 were less preferred. If attributes/levels were found to be non-significant in the statistical  
514 analysis, these findings should also be clearly stated in the results. Results also should provide  
515 interpretation of the relative value of specific attributes, such as how the acceptable waiting  
516 time for non-emergency surgery varies with the rate of surgical errors (i.e., the marginal  
517 willingness-to-wait for a reduced rate(s) of surgical errors). Statistical uncertainty should be  
518 reported in a manner consistent with the type of model selected. If alternative model  
519 specifications were tested, the results of these alternative analyses should be described if not  
520 presented in full.

521 Limitations of the study and the potential effect(s) of these limitations on results should  
522 be clearly identified in the discussion section. Limitations can arise from selection of attributes  
523 and/or levels, such as simplifications adopted during survey development in order to generate  
524 a feasible design, possible correlation among selected attributes, and other design features  
525 such as the inclusion or exclusion of an opt-out option. Assumptions underlying the analytic  
526 approach also may affect interpretation of results and should be discussed. If the study  
527 population is not representative of the population, this may limit generalizability of findings and  
528 any extrapolation of results beyond the study population should be qualified and discussed.

529 The conclusion section should identify key findings of the study in the context of the  
530 original research question. A key element of any research study is to provide a relevant  
531 framework for interpreting the results: whether the results are consistent with or differ from  
532 existing studies in the literature and how this study extends existing research should be clearly  
533 identified and discussed.

#### 534 *10) Study presentation*

535 Finally, when evaluating a conjoint analysis study, the researcher should ask, “**Was the**  
536 **study well and completely presented?**”

537 The study’s importance and context must be adequately motivated so as to answer the  
538 “so what” question. The key background literature should be cited to place the study in an  
539 appropriate clinical or health policy context and to identify gaps in current knowledge that are  
540 important to researchers or decision-makers. The specific contribution of the study in terms of  
541 innovative methods or an important application should be clearly stated at the end of the  
542 introduction.

543           The text describing the study should be worded and structured appropriately for the  
544 target journal and audience. Journals vary in both the type of reviewers, as well as the  
545 eventual readers. In general, the use of jargon should be minimized. Acronyms and technical  
546 language, (e.g., “importance weights” and “fractional factorial design”), should be clearly  
547 defined with any alternative terms included with the definition. A journal such as *Value in*  
548 *Health* has reviewers and readers who are familiar with conjoint analysis methodology. This is  
549 unlikely in the case of a clinically-focused journal.

550           Moreover, conjoint analysis is a relatively new area of research. The use of technical  
551 terms is not always consistent among authors. For example, results might be referred to as  
552 “importance weights” or “preference weights”. Such inconsistencies are confusing to reviewers  
553 and readers. Because there are no standardized rules for constructing a conjoint analysis  
554 survey and there are a large number of possible experimental designs, the methods and  
555 rationale for the study design must be adequately described. This includes the qualitative  
556 research conducted to identify the attributes and levels, the experimental design to create the  
557 tasks, and the methods used to analyze the results. The matrix of attributes and levels and the  
558 final survey instrument should be submitted for review along with the paper.

559           It is not possible for a reviewer to provide a meaningful review of a conjoint analysis  
560 paper without seeing the format and framing of the questions that generated the data. The  
561 properties of the experimental design should be described to provide a context for the  
562 strengths and limitations of the survey results. For example, if the experimental design does  
563 not allow interactions to be tested (a main effects design); this assumption should be clearly  
564 disclosed in describing the methods.

565           Finally, the discussion section should focus on both the innovative features of the paper  
566 and the implications of the results for the target audience. The unique contributions of the  
567 study should be discussed and compared in the context of the current state of knowledge  
568 based on the published literature and health policy climate. However, as with all research,  
569 authors must be careful not to overstate the importance of their findings. Because conjoint  
570 analyses in health are published in different types of journals and may use different  
571 terminology, it is important for authors to ensure that what may appear to be novel has not  
572 been conducted previously. In addition, it is important that authors inform readers that the  
573 results of a conjoint analysis often provide *estimates* of the value or importance of attributes to  
574 subjects, but often do not, in and of themselves, predict future behavior or health outcomes.

575           As with all studies, the findings should be evaluated with respect to the research  
576 question that the study was designed to answer and the hypotheses to be tested in the study.

577 If the target audience is a clinical one, the conclusions of the paper should focus on the clinical  
578 implications of the study findings. For example, the results can be translated into simple  
579 statements about their possible impact on physician practice. Alternatively, if a study was  
580 designed to inform health policy, the findings about public, patient or provider preferences can  
581 be translated into suggestions for increasing the appropriate use of health care services, e.g.,  
582 in a conjoint analysis of colorectal cancer screening tests, the findings were translated into  
583 changes in the rates of uptake of colorectal cancer screening based on the mix of alternative  
584 screening tests offered (45).

## 585 **Conclusions**

586 This report presents a checklist for good research practices for health applications of  
587 conjoint analysis based on the discussions and experience of the task force members. It is  
588 important to note that these recommendations *relate to the questions raised as part of the*  
589 *Checklist and not the answers*. Given that conjoint analysis is an extremely flexible tool and  
590 represents an interdisciplinary approach to understanding the preferences of patients and  
591 other stakeholders, it is unlikely that any consensus on best methods can be reached. Such  
592 variation in methods is not unique to conjoint analysis. For example, there is a hearty debate  
593 concerning risk-adjustment methods in outcomes research. Furthermore, unlike cost-  
594 effectiveness analysis where a global view of health care interventions is taken, conjoint  
595 analysis aims to be both specific and descriptive. We believe that a “reference case” for  
596 conjoint analysis is neither necessary nor likely to emerge.

597 Future work of the ISPOR Conjoint Analysis Good Research Practices Task Force will  
598 focus on specific good research practice recommendations for the design, analysis, and  
599 interpretation of conjoint analysis.

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**Table 1 – A Checklist for Conjoint Analysis Applications in Health**

<p><b>Was a well-defined research question stated and is conjoint analysis an appropriate method for answering it?</b></p> <p>1.1. Was a well-defined research question and/or testable hypothesis articulated?</p> <p>1.2. Was the study perspective described and the study placed in any particular decision-making or policy context?</p> <p>1.3. What is the justification for using conjoint analysis to answer the research question?</p> <p><b>2. Were the attributes and attribute levels and supported by evidence?</b></p> <p>2.1. Were all important and relevant attributes identified (that is, supported by literature reviews, focus groups, or other scientific methods)?</p> <p>2.2. Was the choice of included attributes justified and consistent with theory?</p> <p>2.3. Were the range, description and number of levels for each included attribute justified?</p> <p><b>3. Was the construction of the conjoint tasks appropriate?</b></p> <p>3.1. Was the number of attributes in each conjoint task justified (that is, full profile or partial profile)?</p>	<p><b>6. Was the data-collection instrument designed appropriately?</b></p> <p>6.1. Was appropriate information about respondents collected (such as socio-demographic, attitudinal, health history/status, and treatment experience)?</p> <p>6.2. Were the attributes adequately described and was necessary contextual information provided?</p> <p>6.3. Was the level of burden of the data-collection instrument appropriate? Were respondents informed, encouraged, and motivated?</p> <p><b>7. Was the data collection plan appropriate?</b></p> <p>7.1. Was the sampling strategy justified (for example, sample size, stratification, and recruitment)?</p> <p>7.2. Was the mode of administration justified and appropriate (for example, face-to-face, pen-and-paper, web-based)?</p> <p>7.3. Were human-subjects considerations addressed (for example, recruitment, information and/or consent, compensation)?</p> <p><b>8. Were statistical analyses and</b></p>
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<p>3.2. Was the number of profiles or alternatives in each conjoint task justified?</p> <p>3.3. Was the number of conjoint tasks included in the data-collection instrument appropriate?</p> <p><b>4. Was the choice of experimental design justified and evaluated?</b></p> <p>4.1. Was the choice of experimental design justified? Were alternative experimental designs considered?</p> <p>4.2. Were the properties of the experimental design evaluated?</p> <p>4.3. Was (should) an opt-out or a status-quo alternative (be) included?</p> <p><b>5. Were preferences elicited credibly?</b></p> <p>5.1. Were the conjoint tasks sufficiently motivated and explained?</p> <p>5.2. Was an appropriate elicitation format (that is, rating, ranking, or choice) used? Also, did (should) the elicitation format allow for indifference?</p> <p>5.3. In addition to preference elicitation, did the conjoint tasks include other questions (e.g., strength of preference, confidence in response,</p>	<p><b>model estimation appropriate?</b></p> <p>8.1. Were respondent characteristics examined and tested?</p> <p>8.2. Was the quality of the responses examined (for example, rationality, validity, reliability)?</p> <p>8.3. Was multivariate analysis conducted appropriately? Were issues of clustering and sub-groups handled appropriately?</p> <p><b>9. Were the results and conclusions valid?</b></p> <p>9.1. Did results reflect testable hypotheses and account for statistical uncertainty?</p> <p>9.2. Were conclusions supported by the evidence and compared to existing findings in the literature?</p> <p>9.3. Were study limitations and generalizability adequately discussed?</p> <p><b>10. Was the study presented well and completely?</b></p> <p>10.1. Was the study importance and research context adequately motivated?</p> <p>10.2. Were the study methods explained and the data-collection instrument adequately described and/or illustrated?</p> <p>10.3. Were the implications of</p>
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other methods)?	the study stated and understandable to a wide audience?
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Figure 1: A Checklist for Conjoint Analysis Applications in Health

**A Checklist for Conjoint Analysis Applications in Health**

