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Elicitation of a Norwegian EQ-5D-5L Value Set for Hypothetical and Experience-based Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol

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3 **1 Elicitation of a Norwegian EQ-5D-5L Value Set for Hypothetical and Experience-based**
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5 **2 Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol**
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46 21 Word count: 3447
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51 **23 Abstract**

52
53 24 **Introduction** Norway is one of several European countries that lacks a national value set and
54
55 25 hence scoring algorithm for the EQ-5D. Recent studies have found differences between
56
57 26 countries in terms of health values or preferences for health states described by instruments
58
59 27 such as the EQ-5D. The project aims to model a national EQ-5D-5L value set based on values

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3 28 elicited from a representative sample of the Norwegian adult general population in terms of
4
5 29 age, sex, and level of education. Using a sampling strategy that supports the collection of
6
7 30 values for both hypothetical and experienced health states, the study will have the additional
8
9 31 aim of assessing the feasibility of collecting experience-based values as part of a general
10
11 32 population valuation study, and statistically comparing values given.
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13
14

15 33 **Methods and analysis** Multi-stage random sampling and quota-sampling will be used to
16
17 34 ensure representativeness. To increase the number of valuations of experienced health states,
18
19 35 those with less than perfect health will be over-sampled, increasing the total number of
20
21 36 interviews from 1000 to 1500. Values for EQ-5D-5L health states will be obtained through
22
23 37 computer assisted face-to-face, one-to-one interviews including the use of composite time
24
25 38 trade-off (cTTO) and discrete choice experiments (DCE). The latest protocol for valuation
26
27 39 will be followed, using EuroQol Portable Valuation Technology (EQ-PVT). Health state
28
29 40 values for all EQ-5D-5L health states will be estimated through statistical modelling of the
30
31 41 survey data. Sampling weights will compensate for the over-sampling of those in less than
32
33 42 perfect health in the final national value set.
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40 43 **Ethics and dissemination** The study has been reviewed and found to be outside of the scope
41
42 44 of the ethics committee thus not in need of ethical approval. The findings of this study will be
43
44 45 disseminated through peer-reviewed publications, conference presentations, and condensed
45
46 46 summaries for key stakeholders and partners in the field.
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49

50 47 **Keywords:** Utilities, Health state valuation, EQ-5D, Time trade-off, QALY
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48 **Article summary**

49 Strengths and limitations of this study

- 50 • This is the first Norwegian valuation study with cTTO and DCE undertaken on a scale
51 large enough to meet the recommendations of the most recent EQ-5D protocol.
- 52 • Data collection complying to the most recent EQ-5D protocol, with the additional aim
53 of comparing valuations of hypothetical and experience-based health states.
- 54 • Sampling strategy designed specifically to both ensure representativeness of the final
55 sample according to geographical region, age, sex and educational level and increase
56 the number of experience-based valuations.

58 **Introduction**

59 Economic evaluation undertaken by the Norwegian Institute of Public Health and the
60 Norwegian Medicine Agency increasingly informs decisions about the introduction of new
61 drugs and other health technologies in Norway [1, 2]. The Norheim Committee [3] and
62 Magnussen Working Group [4] proposed methods to enhance the quality of economic
63 evaluation, thereby further strengthening the role of economic evaluation in decision-making.
64 The Ministry of Health followed up these proposals in a 2016 White Paper to Parliament on
65 principles for priority setting in health care [5].

66
67 Given the increasing reliance on and impact of economic evaluation, it is important that the
68 methods it incorporates, including cost-utility analysis, are consistent with societal values
69 regarding publicly financed health care. Economic evaluation, when taking into account
70 societal values, often takes the form of cost-utility analyses with the estimation of the
71 incremental cost per Quality Adjusted Life Year (QALY) gained [6]. QALY takes the integral
72 of health-related quality of life (HRQoL) over time, with HRQoL represented on a scale

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3 73 where 1 indicates a preference equal to that for full health and 0 implying a health state for
4
5 74 which preferences do not change with additional time (i.e. preferentially equivalent to not
6
7 75 being alive). Values are typically derived using surveys in which respondents consider the
8
9
10 76 relative undesirability of different health states described using instruments such as the EQ-
11
12 77 5D. After assigning values to health states, QALYs are calculated by multiplying the health
13
14 78 state value by the length of time spent in each. Evaluation of alternative technologies then
15
16 79 involves comparison of incremental QALYs gained over incremental costs for new vs.
17
18 80 existing technologies. Technologies are compared in terms of their cost per QALY gained at
19
20 81 the margin, with priority given to the most cost-effective technologies which maximizes
21
22 82 health gains within a fixed budget [7].
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26 83
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28 84 Several instruments are available to calculate QALYs, of which the EQ-5D is by far the most
29
30 85 widely applied both internationally and in Norway [8-10]. The EQ-5D is available in over 170
31
32 86 languages and national value sets and normative data exist for over 20 countries [11-25]. It is
33
34 87 brief, widely tested, and includes five important aspects of health (mobility, self-care, usual
35
36 88 activities, pain/discomfort and anxiety/depression), with the most recent version having five
37
38 89 levels from no problems to severe problems. The EQ-5D is considered highly acceptable to
39
40 90 most patient groups and feasible for application where a short-form general measure of health
41
42 91 is required. The instrument has had widespread application in research including clinical
43
44 92 trials, population health surveys and more recently as a health care quality indicator as part of
45
46 93 the National Health Service for England and Wales Patient Reported Outcomes Measures
47
48 94 (PROMs) programme [26, 27] and in the Norwegian [28-31] and Swedish National Quality
49
50 95 Registries (NQR) [32]. Registry use of EQ-5D in Norway is likely to increase given the
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52 96 national agreement that the Norwegian Public Health Institute secured in 2018 with EuroQol,
53
54 97 the foundation that owns the EQ-5D family of instruments [12].
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5 99 The Norwegian Medicines Agency recommends the use of EQ-5D in all technology
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7
8 100 assessments and the use of a -5L tariff for studies where the -5L version has been used [2].
9
10 101 The 2018 Agency guidelines presently recommend the use of the EQ-5D-5L tariff for
11
12 102 England [15] where EQ-5D-5L has been used. The English tariff has since been critically
13
14 103 reviewed following concerns with data quality [33], in which serious deficiencies were
15
16 104 revealed. Following these concerns, and in contrast to recommendations of the Norwegian
17
18 105 Medicines Agency, NICE continues to recommend the use of the -3L tariff over the -5L tariff,
19
20 106 with -5L values mapped onto -3L where needed [34].
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23 107
24
25 108 Recent cross-national comparisons of national EQ-5D-5L value sets suggest that there might
26
27 109 be substantial differences across countries [13, 35] with culture and values having a role [36].
28
29 110 Values for health for the five-level version of the EQ-5D, that are representative for the
30
31 111 Norwegian general population, will enhance the validity and legitimacy of economic
32
33 112 evaluation in Norway
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35 113
36
37 114 Following recommendations that economic evaluation should include societal preferences,
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39 115 existing EQ-5D value sets are largely based on the general population valuing hypothetical
40
41 116 health states. In recent years, this approach has been criticised, with some arguing that the
42
43 117 general population lack adequate experience or knowledge of health states they are asked to
44
45 118 value [37, 38]. An alternative approach involves individuals valuing their own health state to
46
47 119 give experience-based values. Sweden's Dental and Pharmaceutical Benefits Agency has
48
49 120 stated that experience-based values are preferred [39]. Arguably, patients have a better
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51 121 understanding of the consequences of reduced health on quality of life [38, 40-42]. On the
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53 122 other hand, they may have trouble imagining life in full health or may underreport impact of
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3 123 disease due to adaptation or changes in expectations over time. Experience-based valuations,
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5 124 if elicited from representative samples of the general population, may however be suitable for
6
7 125 inclusion as societal values. The feasibility of collecting such values and the assessment of
8
9 126 how those with less than perfect health value their current health state are new areas for
10
11 127 research into health state preferences and valuation.
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16
17 129 The aim of the project is to derive a Norwegian EQ-5D-5L value set representative of the age,
18
19 130 sex and level of education composition in the Norwegian adult general population.
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21 131 Furthermore, the study design will permit comparisons of experience-based vs. hypothetical
22
23 132 health state valuation.
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26 133

28 134 **Methods and analysis**

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31 135 Values for EQ-5D-5L health states will be obtained by electronic data collection including
32
33 136 computer assisted face-to-face, one-to-one interviews and the use of composite time trade-off
34
35 137 (cTTO) and discrete choice experiments (DCE) [43, 44]. The latest EQ-5D-5L protocol [43-
36
37 138 45] will be followed including EuroQol Portable Valuation Technology (EQ-PVT).
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40 139

42 140 *Sampling*

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45 141 Respondents must be aged 18 years or older, resident in Norway, and proficient in
46
47 142 Norwegian. Following EQ-VT protocol, sample size is set to a minimum of 1000 individuals
48
49 143 with each valuing 10 health states which gives the recommended 10,000 responses [44]. An
50
51 144 additional 500 interviews based on the oversampling those with less than perfect health will
52
53 145 increase the number of valuations of experienced health states.
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3 147 Norway is a Northern European country with a population of slightly more than 5 million, and
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5 148 a universal health care system. The population covers a comparatively large land mass and for
6
7 149 many there may be several hours travel time by car to the nearest hospital or large city.
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10 150 Urbanisation has further contributed to variation in demographic characteristics at the regional
11
12 151 level. These factors combined with local culture, politics and tradition mean that geographical
13
14 152 considerations are important to the design of the study.
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18
19 154 The study will use a combination of multistage random sampling of data collection locations
20
21 155 and quota sampling on the individual level, ensuring representativeness according to
22
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24 156 geography, age, sex and educational level. The first stage of sampling will be of geographical
25
26 157 areas of acute care hospital catchment within each region. Norway has four main regions
27

28 158 (north, central, west and south-east), with more than half the population residing in the south-
29
30 159 eastern region of Norway. The catchment areas served by the 54 acute care hospitals cover all
31

32
33 160 Norwegian residents (see Figure 1). They vary considerably in the number of residents that
34

35 161 they serve, from 15,000 up to 500,000 residents. One acute care hospital will be randomly
36

37 162 selected from each region with the exception of the south east, where three will be randomly
38

39
40 163 selected to account for the disproportionate number of people residing in this region. Hospital
41

42 164 catchment areas within each region will be sampled with proportional allocation, ensuring
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44 165 equal probability proportionate to the number of people residing in each area within the
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46
47 166 region.
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51 168 Within each sampled geographical area, the possible locations for data collection will
52

53
54 169 constitute the sample frame for the second stage of sampling (Table 1). Locations will include
55

56 170 public places (e.g. public libraries, town halls), workplaces, recreational organisations (e.g.
57

58 171 sports clubs), and healthcare providers (hospitals, rehabilitation institutions). The bodies
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1
2
3 172 concerned must be willing to grant the study permission for data collection, and cooperate
4
5 173 with provision of a suitable space for completion of the interviews. The locations will act as
6
7 174 clusters of possible respondents, stratified into groups based on the characteristics of target
8
9 175 respondents, e.g. age and educational level. Stratification will increase homogeneity per
10
11 176 cluster and ensure the representation of specific groups less likely to participate including
12
13 177 those with poorer health, lower socio-economic status, or faced with time constraints,
14
15 178 including young children or full-time employment [46]. Locations within each group in the
16
17 179 sample frame will be randomly selected. The number of locations selected within each sample
18
19 180 frame will be based on the size of the area and quotas.
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26 181
27 182 Within each catchment area and at the respondent level, quota sampling according to age, sex
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29 183 and level of education will be applied (see Table 2 and 3). The total 1300-1500 respondent
30
31 184 quota will first be allocated to each region proportionate to the number of people residing in
32
33 185 each region. For the three regions where only one hospital catchment area is sampled, the
34
35 186 quota for each of these hospital catchment areas will correspond to the regional quota. In the
36
37 187 south-eastern region, the regional quota is further allocated to each hospital catchment area
38
39 188 proportionate to the number of people residing in each of these areas. To increase the number
40
41 189 of respondents who value experienced states of reduced health, a third of the quota per area
42
43 190 will comprise those with reduced health. The remaining two thirds of the quota is allocated to
44
45 191 groups according to gender, age group (young adults: age 18-34, middle-aged adults: age 35-
46
47 192 64, elderly: age 65+) and level of education (lower education: No higher than high school
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49 193 education, higher education: bachelor, masters or PhD) equivalent to the distribution of these
50
51 194 attributes in the respective region. The quotas for each group are calculated using
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53 195 microdata.no, a national platform giving researchers instant access to national registries for
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55 196 which Statistics Norway has processing authority, such as the Norwegian National Registry,
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3 197 National Education Database, labour market data, register for Personal Tax Payers and FD-
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5 198 Trygd (event history database) [47].
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10 200 The study will largely rely on recruitment of potential participants by contacts at each
11
12 201 sampled location, but will also invite individuals at each location to volunteer for
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14 202 participation. To enhance participation, the project will be publicised in local newspapers and
15
16 203 social media a week in advance of data collection. In addition to the recruitment of
17
18 204 respondents through locations, potential respondents will be able to contact the project group
19
20 205 for more information about the study and enquire about participation. Potential respondents
21
22 206 will be informed of a gift incentive. Cash has been found to be more effective than other
23
24 207 incentives for increasing response rates [48, 49] and thus following the interview, respondents
25
26 208 will receive a cash card equivalent to 30 Euros.
27
28
29 209 The recruitment strategy will be piloted in the catchment area sampled closest to Oslo.
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32 210 Necessary adjustments will follow before data collection in the rest of the country.
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36 212 *Interviewer training*

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38 213 Interviewers with Masters education level, or equivalent will receive training in accordance
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40 214 with guidelines and recommendations given by the EuroQol Foundation, with initial training
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42 215 prior to, and revised training after, the first phase of data collection [50]. Based on existing
43
44 216 studies and recommendations from EuroQol (Elly Stolk, personal communication), six to
45
46 217 twelve interviewers are required.
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51 219 EQ-PVT QC reports will help monitor progress and data quality [42, 43]. The reports include
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53 220 assessments of protocol compliance, face validity of data collected and value distributions per
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55 221 interviewer. Interviewers not meeting pre-defined standards are flagged, recommended for
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3 222 retraining and ultimately excluded. Evaluation of the data collected and interviewer
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5 223 performance will be regularly discussed in face-to-face group meetings throughout data
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7 224 collection. QC reports have been found to further the homogeneity of interviewer
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9 225 performance and reduce protocol violations and the number of inconsistent responses[51].
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14 227 *EuroQol Valuation Technology*

16 228 EQ-VT was developed to meet the challenges involved with valuation of the -5L version of
17 229 the EQ-5D, with emphasis on improving data quality and cross-country comparability [43] .
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20 230 The standard protocol includes digital representation of visual aids to assist the respondent
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23 231 throughout the interview (see Figures 2 and 3 from the EQ-VT software package). The study
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26 232 will use the portable version of the software, EQ-PVT, which for the respondent has the same
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29 233 functionality and for the most part resembles the standard EQ-VT software package.
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32 234

33 235 The interview starts with administration of the EQ-5D-5L questionnaire followed by
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36 236 background questions for the respondents age, sex and experience with serious illness. Next,
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39 237 composite time trade-off (cTTO) is administered, beginning with four practice states: a
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42 238 wheelchair example and introduction to both the “better than dead” and “worse than dead”
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44

45 239 part of the task, followed by three states described with the EQ-5D-5L descriptive system,
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47

48 240 selected to reflect a mild, a moderate, and a severe health state. These exercises familiarise the
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50

51 241 respondent with the cTTO, the concept of health states worse than death and the use of lead-
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54 242 time in the cTTO for the valuation of such states.
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58 244 Respondents are randomized to one of 10 TTO blocks of EQ-5D-5L health states, each
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61 245 consisting of 10 health states, one of which is always the worst state (level 5 on each
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63

64 246 dimension, state 55555), and one among the 5 mildest states (11112, 11121, 11211, 12111,
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3 247 and 21111), for a total of 86 unique EQ-5D-5L health states for direct valuation [11]. In this
4
5 248 study, respondents describing their own health as having at least one problem on one
6
7 249 dimension will be administered their own health state as an additional 11th state during the
8
9 250 cTTO part of the interview, allowing for comparison of values assigned to experienced and
10
11 251 hypothetical health states. Respondents will be given the opportunity to review their responses
12
13 252 in a feedback module (see Figure 4), where individual task responses can be removed. Upon
14
15 253 completion of the TTO tasks, respondents are randomized to one of 28 state pair blocks for
16
17 254 discrete choices, each block consisting of seven state pairs. In both the TTO and DCE parts of
18
19 255 the interview, the order of presentation is randomized.
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26 257 The interview ends with further background questions specific to this study relating to
27
28 258 variables known to be associated with valuations of health states including caregiver status,
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30 259 educational level and marital status, [52-55]. The influence of such variables will be assessed
31
32 260 in the final value set.
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37 261 *Analysis*

38 262
39 263 The demographic characteristics and health status of respondents will be assessed and
40
41 264 compared to national data. Health state values for EQ-5D-5L will be estimated through
42
43 265 statistical modelling of the survey data in R. To compensate for the over-sampling of those in
44
45 266 less than perfect health, sampling weights will be used when estimating health state values.
46
47 267 Respondents will be asked if they have been admitted to hospital in the last year, and weights
48
49 268 will be used to reflect the number of individuals in the population admitted to hospital in the
50
51 269 last year. The EQ-5D protocols are not prescriptive with regard to modelling and approaches
52
53 270 will depend on the characteristics of the data obtained [44]. Following previous research,
54
55 271 different models will be assessed including the either the cTTO data, or combining the cTTO
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3 272 and DCE data in a hybrid model, and the results compared for adequacy with those for
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5 273 existing national value sets [14-25]. Subgroup analysis will identify variables contributing to
6
7 274 health state valuation in the Norwegian population. Valuation of health states defined as
8
9 275 respondents “own health today” will be compared with that of values estimated for the same
10
11 276 health states by the general population. In addition, all experienced-based valuations by those
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13 277 with serious illness and/or less than perfect health will be compared to valuations based on the
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15 278 total general population sample and, given sufficient data, those without experience of serious
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17 279 illness and/or with perfect health today.
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280

281 *Strengths and limitations*

282 This is the first Norwegian valuation study with cTTO and DCE undertaken on a scale large
283 enough to meet the most recent EQ-5D protocol. The study intends to complete 1500 face-to-
284 face computer-assisted interviews across a country with a relatively dispersed population of
285 citizens and potentially large geographical distances between them. Data collection will take
286 place from October to December 2019 and February to May 2020, and involves a small
287 number of interviewers working intensively over two three-month periods.
288

289

289 Both their duration and magnitude of the tasks involved makes the interview demanding. It is
290 important that the data collection is cost-effective, which includes considerations of data
291 quality, representativeness and total number of valuations. Given the strategy of sampling
292 locations and organisations rather than individuals, the assessment of its effectiveness in terms
293 of number and representativeness of respondents will be important following the initial data
294 collection period. Poor recruitment and data collection in remote geographical locations will
295 be costly. The number of respondents per location will be monitored throughout data
296 collection. Adaptive sampling will allow for inclusion of additional locations where response
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3 297 rates are low and quotas are not met. Additional locations will be chosen at random from the
4
5 298 predefined frame of possible locations within the selected geographical area.
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10 300 Due to the need for extensive training, interview experience, and understanding of the task,
11
12 301 only six to twelve interviewers will be included. This will give more control over the data
13
14 302 collection and the quality of the data collected. However, this and potential costs saved in
15
16 303 terms of interviewer recruitment, training and travel costs, must be balanced against the
17
18 304 increased impact of any loss of interviewers through illness or resignation during the data
19
20 305 collection period. Norway has a harsh winter climate and interviews will take place outside
21
22 306 the winter months, serving to reduce the risk of travel delays and interviewer illness. NIPH
23
24 307 has several experienced interviewers familiar with the study who will be able to complete
25
26 308 training and contribute to data collection where needed.
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31 309
32
33 310 The main justification for the strategy of sampling stratified locations and the use of quotas on
34
35 311 the respondent level is to ensure representativeness of the final sample according to
36
37 312 geographical region, age, sex and educational level. A third of the total quota will be used to
38
39 313 recruit those with less than perfect health, through locations such as hospitals and
40
41 314 rehabilitation centres. Locations will also be selected to directly seek out others who are
42
43 315 typically harder to reach and are less likely to participate in research studies, such as those
44
45 316 with reduced health or with young children. Studies have found that some attributes, such as
46
47 317 marital and caregiver status/having young children, may influence the respondents response to
48
49 318 the task, such as their willingness to trade time in the TTO task, despite showing similar
50
51 319 preferences for given health states when using other types of valuation tasks [52, 54]. Hence,
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53 320 it is important that respondents with such attributes are included in the study and locations
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55 321 such as day care facilities for young children have been selected to facilitate this. Questions
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3 322 relating to these attributes will be included in the background questions closing the interview,
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5 323 and as such will allow for sub-group analysis of the effect of these attributes on the valuation
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7 324 of health in the Norwegian sample.
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10 325
11
12 326 The EQ-5D is widely used in Norway. A national EQ-5D-5L value set and scoring algorithm
13
14 327 is highly anticipated and will enhance the validity of economic evaluation in Norway. To
15
16 328 date, Norwegian EQ-5D users have largely relied on the EQ-5D-3L scoring algorithm from
17
18 329 the UK [11], with a crosswalk-based approach [56] for studies that have used the five-level
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20 330 version. Crosswalk-based approaches have several limitations related to issues with data
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22 331 dependency and differences in scale range, and are an interim solution pending a national 5L
23
24 332 value set [56-58]. The proposed study will derive a value set for the EQ-5D that builds on
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26 333 important developments, including health states described within the new five-level version,
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28 334 EQ-VT protocol and a sampling and recruitment strategy designed to give representativeness
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31 335 for Norway.
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40 338 **Ethics and dissemination**

41
42 339 The study was reviewed by The Regional Health Authority Research Ethics Committee and
43
44 340 found to be outside of the scope of the ethics committee thus not in need of ethical approval.
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46 341 All study participants will give informed consent.
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53 343 The final scoring algorithm will contribute to the quality and relevance of the results of EQ-
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55 344 5D applications in Norway, and it is highly likely that, when available, the EQ-5D-5L with a
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57 345 Norwegian scoring algorithm will be the recommended instrument of choice for future
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59 346 economic evaluations undertaken in Norway by the pharmaceutical industry and other

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3 347 important users. Application of the same instrument and scoring across the health services and
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5 348 industry will further enhance decision-making relating to scarce health care resources.
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7 349 Moreover, scores based on Norwegian preferences will further enhance the appropriateness of
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9 the EQ-5D in clinical and health services research and quality indicators work, including the
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11 the EQ-5D in clinical and health services research and quality indicators work, including the
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13 351 Norwegian medical registers [12].
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15 352
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17 353 The study results will be published in peer-review scientific journals and presented at
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19 354 appropriate forums, including national and international conferences. Condensed summaries
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21 355 and presentations will be given to key stakeholders and partners in the field, including
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23 356 research centres that widely use the EQ-5D in clinical, health services and health economics
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26 357 research in Norway.
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29 358 **List of abbreviations**

31 359	EQ-VT	EuroQol Valuation Technology
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34 360	cTTO	Composite time trade-off
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37 361	DCE	Discrete choice experiments
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40 362	QALY	Quality Adjusted Life Year
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43 363	PROMs	Patient Reported Outcomes Measures
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46 364	NQR	National Quality Registries
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49 365	NICE	National Institute for Health and Care Excellence
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52 366	QC	Quality control software included in the EQ-VT software
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369 **Declarations**

370 **Competing interests**

371 The authors have no competing interests.

372 **Availability of data and material**

373 Not applicable.

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377 **Author contributions**

378 AMG conceived the study and secured funding. All authors participated in its design. TMH
379 and AMG contributed to drafting and revising the manuscript. All authors have read and
380 approved the final version.

381 **Patient and Public Involvement**

382 Patients and members of the public were not invited to comment on the study design. Patients
383 and members of the public were not invited to contribute to the writing or editing of this
384 document for readability or accuracy.

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512 **Tables**

513 Table 1: Locations for recruitment of participants, by age group and health status

Healthy				Reduced health
Young	Middle-aged	Elderly	All ages	All ages
Places of higher education	Workplaces	Eldery homes	Public library	Hospitals
Child daycare facilities	Recreational organisations (sports teams)	Recreational organisations (choirs)	Town hall	Rehabilitation centres
Social welfare*	Social welfare*	Community volunteer centres		
	Adult education*			

514 *Locations chosen to increase participation of those with lower socio-economic status

515 Table 2: Example sampling of hospital catchment areas and quotas per catchment area

Region	Population in region	Catchment area	Population in catchment area	Quota per catchment area
Northern	381907	Hospital 1	130000	140
Central	560690	Hospital 2	60000	205
Western	843899	Hospital 3	330000	309
South-Eastern	2299890	Hospital 4	500000	448
South-Eastern	'	Hospital 5	160000	143
South-Eastern	'	Hospital 6	280000	251

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517 Table 3: Example of quotas within a sampled catchment area based on the composition of sex,
 518 age and educational level in the general population of the respective region (source: Official
 519 statistics for 2017 generated from microdata.no). Example given sampling scenario and
 520 catchment area for Hospital 1 in Table 2.

Sex	Highest attained educational level	Age groups							Total quota per sex and educational level
		18-24	25-34	35-44	45-54	55-64	65-74	75+	
Male	Primary or secondary	8	9	8	9	9	7	5	56
	Tertiary	1	3	3	3	3	2	1	16
Female	Primary or secondary	7	6	5	7	8	8	7	47
	Tertiary	1	5	5	5	3	2	1	22
Total quota per age group		17	22	22	25	22	18	14	140

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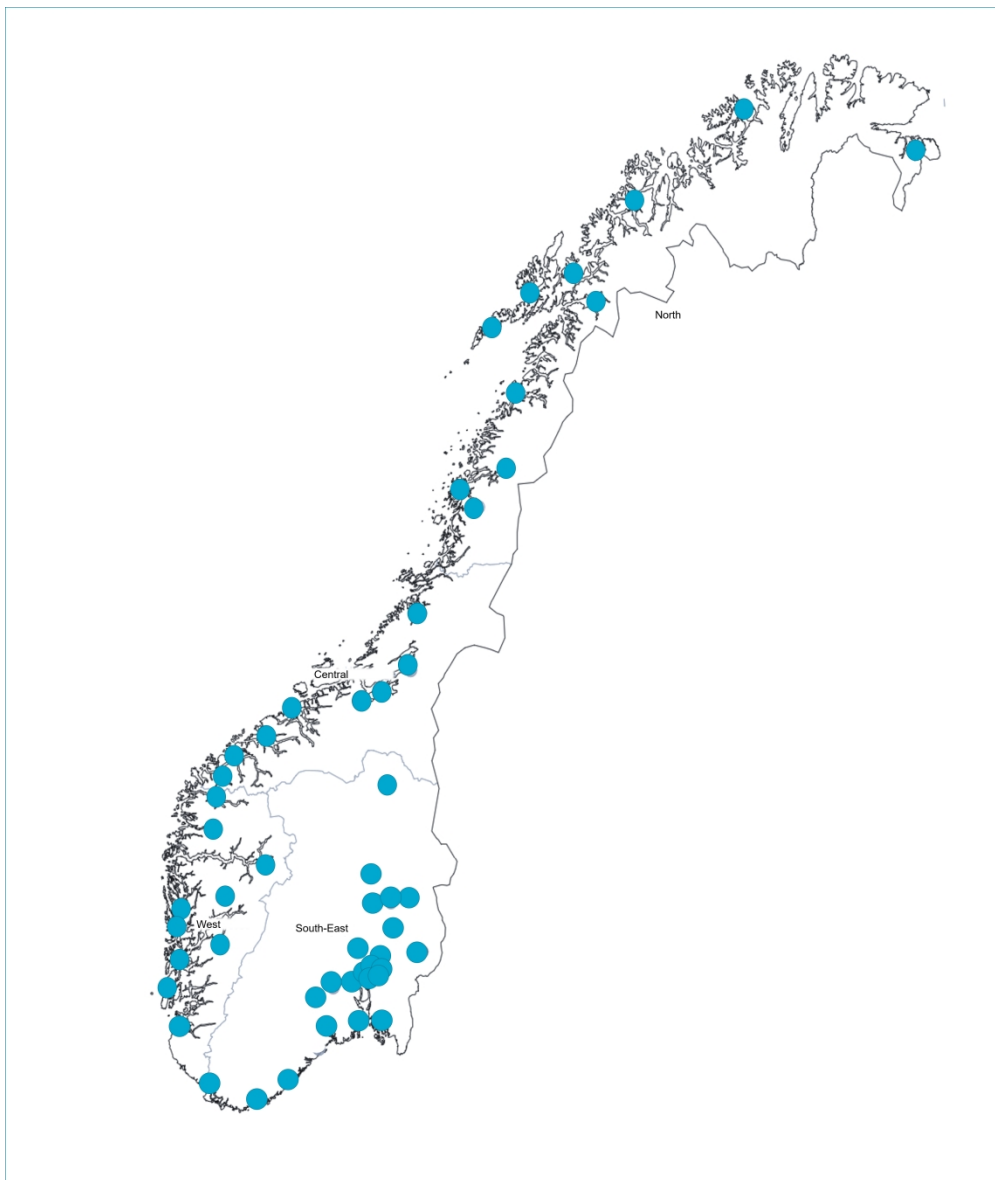


Figure 1: Hospitals with Acute Care Function in Norway

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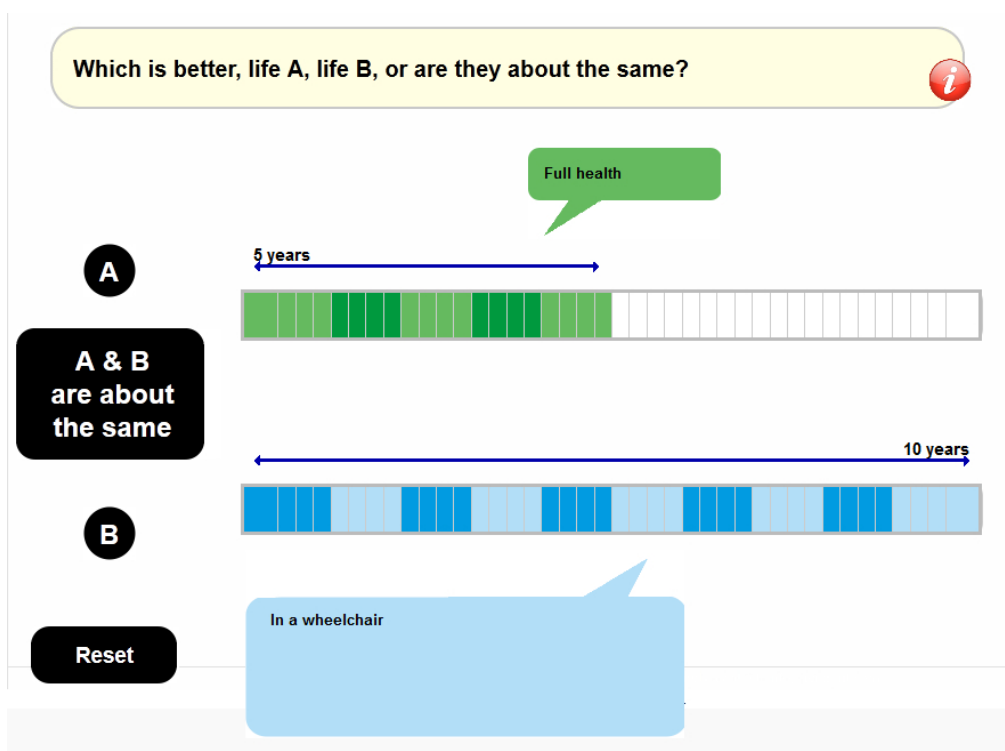


Figure 2: Screenshot of visual aid for cTTO task in EQ-VT (source: EuroQol Foundation)

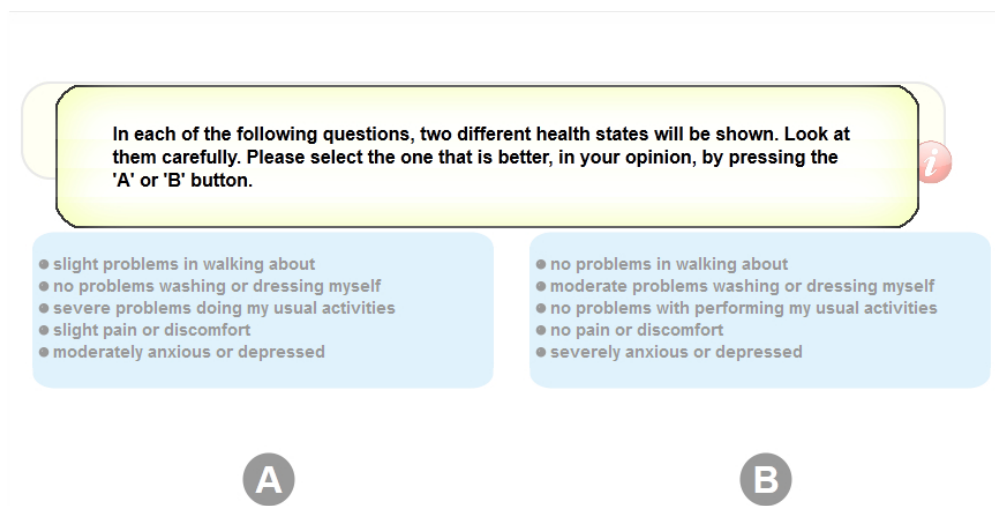


Figure 3: Screenshot of visual aid for DCE task in EQ-VT (source: EuroQoI Foundation)

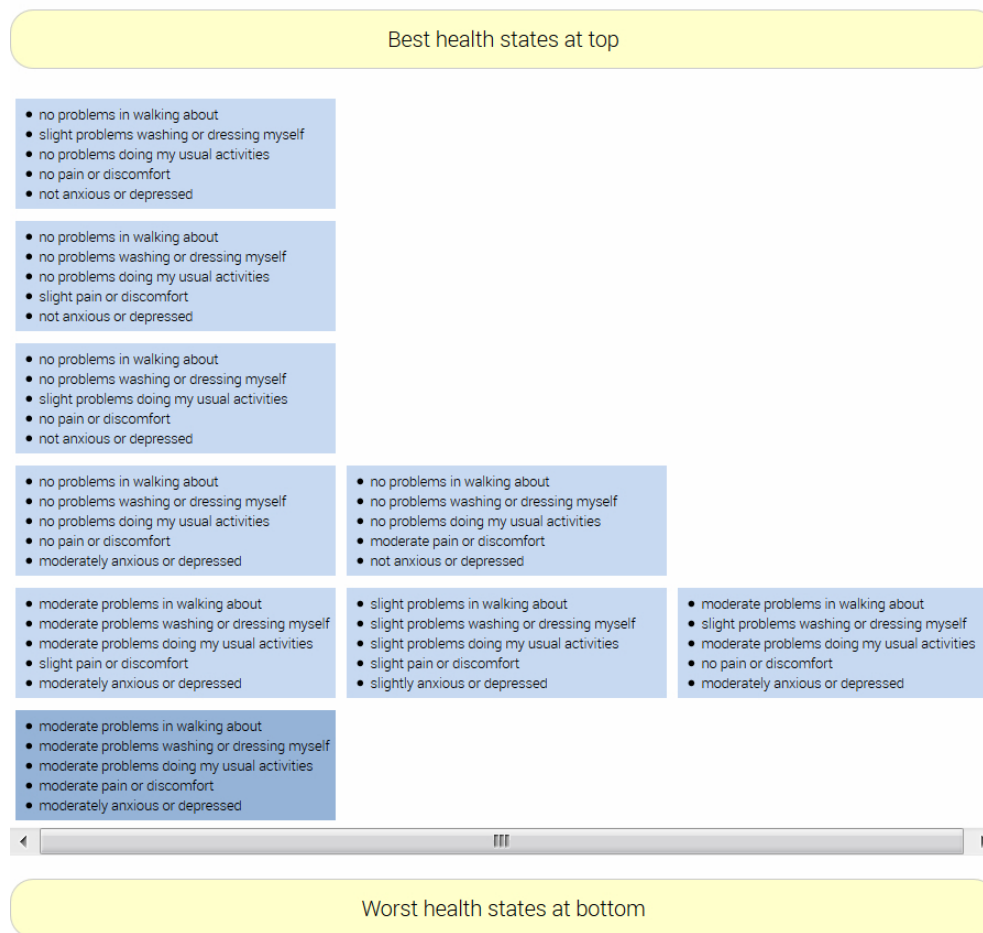


Figure 4: Screenshot of the feedback module in EQ-VT (source: EuroQol Foundation)

BMJ Open

Elicitation of Norwegian EQ-5D-5L Values for Hypothetical and Experience-based Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol

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3 **1 Elicitation of Norwegian EQ-5D-5L Values for Hypothetical and Experience-based**
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5 **2 Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol**
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46 21 Word count: 3872
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51 **23 Abstract**

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53 24 **Introduction** Norway is one of several European countries that lacks a national value set and
54
55 25 scoring algorithm for the EQ-5D. Recent studies have found differences between countries in
56
57 26 terms of health values or preferences for health states described by instruments such as the
58
59 27 EQ-5D. The project aims to model a national value set for the five level version of the EQ-5D

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3 28 (EQ-5D-5L) based on values elicited from a representative sample of the Norwegian adult
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5 29 general population in terms of region, age, sex, and level of education. Using a sampling
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7 30 strategy supporting the collection of values for both hypothetical and experienced health
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9 31 states, the study will have the additional aim of assessing the feasibility of collecting
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11 32 experience-based values in accordance with the latest EQ-5D valuation study protocol, and
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13 33 comparing values with those given for hypothetical health states.
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18 34 **Methods and analysis** Multi-stage random sampling and quota-sampling will contribute to
19
20 35 representativeness. To increase the number of valuations of experienced health states, those
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22 36 with less than perfect health will be over-sampled, increasing the total number of interviews
23
24 37 from 1000 to 1300–1500. The most recent EQ-5D valuation protocol will be followed which
25
26 38 includes computer assisted face-to-face, one-to-one interviews and use of composite time
27
28 39 trade-off (cTTO) and discrete choice experiments (DCE).
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33 40 **Ethics and dissemination** The study has been reviewed and found to be outside of the scope
34
35 41 of the ethics committee and thus not in need of ethical approval. The study findings study will
36
37 42 be disseminated through peer-reviewed publications, conference presentations, and
38
39 43 summaries for key stakeholders and partners in the field. The scoring algorithms will be
40
41 44 available for widely used statistical software.
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46 45 **Keywords:** Utilities, Health state valuation, EQ-5D, Time trade-off, QALY
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49 46 **Article summary**

50 47 **Strengths and limitations of this study**

- 51 48 • This is the first Norwegian valuation study with cTTO (composite time trade-off) and
52 49 DCE (discrete choice experiment) undertaken on a scale large enough to meet the
53 50 recommendations of the most recent EQ-5D protocol.
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- 51 • Sampling strategy designed to both ensure representativeness of the final sample
52 according to geographical region, age, sex and educational level and increase the
53 number of experience-based valuations.
- 54 • Data collection restricted to EuroQol protocol, primarily developed for hypothetical
55 health state valuation, but with the additional aim of collecting experience-based
56 valuations. Study design does not allow for the assessment of methods other than
57 those described in the EQ-VT protocol.
- 58 • Restricted samples for comparisons of experience-based valuations.
- 59 • High respondent burden experienced in interviews limits the scope for addressing
60 additional methodological questions.

62 **Introduction**

63 Economic evaluation undertaken by the Norwegian Institute of Public Health and the
64 Norwegian Medicine Agency increasingly informs decisions about the introduction of new
65 drugs and other health technologies in Norway [1, 2]. The Norheim Committee [3] and
66 Magnussen Working Group [4] proposed methods to enhance the quality of economic
67 evaluation, thereby further strengthening the role of economic evaluation in decision-making.
68 The Ministry of Health followed up these proposals in a 2016 White Paper to Parliament on
69 principles for priority setting in health care [5].

70
71 Given the important role and impact of economic evaluation, it is important that the methods
72 it incorporates, including cost-utility analysis, are consistent with societal values regarding
73 publicly financed health care. Economic evaluation, when taking into account societal values,
74 often takes the form of cost-utility analyses with the estimation of the incremental cost per
75 Quality Adjusted Life Year (QALY) gained [6]. QALY takes the integral of health-related

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3 76 quality of life (HRQoL) over time, with HRQoL represented on a scale where 1 indicates a
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5 77 preference equal to that for full health and 0 implies a health state equal to that of being dead.
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7 78 Values are typically derived using general population surveys where respondents consider the
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10 79 relative undesirability of different health states described using instruments such as the EQ-
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12 80 5D [7]. After assigning values to health states described by an instrument, QALYs are
13
14 81 calculated by multiplying the health state value by the length of time spent in each. Evaluation
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16 82 of alternative technologies then involves comparison of incremental QALYs gained over
17
18 83 incremental costs for new vs. existing technologies.
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24 85 Several instruments are available to calculate QALYs, of which the EQ-5D is by far the most
25
26 86 widely applied both internationally and in Norway [8-10]. The EQ-5D™, a trade mark of the
27
28 87 EuroQol Research Foundation, is available in over 150 languages [11] in the self-complete
29
30 88 paper version [12], and national value sets and normative data exist for over 20 countries [7,
31
32 89 13-25]. It is brief, widely tested, and includes five important aspects of health (mobility, self-
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34 90 care, usual activities, pain/discomfort and anxiety/depression), with the most recent version
35
36 91 having five levels (5L) from no problems to severe problems. The EQ-5D is considered
37
38 92 highly acceptable to most patient groups and feasible for application where a short-form
39
40 93 general measure of health is required. The instrument has had widespread application in
41
42 94 research including clinical trials, population health surveys, in both Norwegian [26] and
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44 95 Swedish National Quality Registries (NQR) [27], and more recently as a health care quality
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46 96 indicator as part of the National Health Service for England and Wales Patient Reported
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48 97 Outcomes Measures (PROMs) programme [14].
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56 99 The Norwegian Medicines Agency recommends the use of EQ-5D in all technology
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58 100 assessments and the use of a 5L tariff for studies where the 5L version has been used [2]. In
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3 101 the absence of a Norwegian tariff, the 2018 Agency guidelines currently recommend the use
4
5 102 of the EQ-5D-5L tariff for England [14] where EQ-5D-5L has been used. However, criticism
6
7 103 has been levelled at the English tariff including concerns with data quality in which serious
8
9 104 deficiencies were revealed [28]. The English 5L tariff followed an early protocol, which has
10
11 105 since been updated with the aim of improving data quality and interview techniques.
12
13 106 Following these concerns, and in contrast to recommendations of the Norwegian Medicines
14
15 107 Agency, NICE continues to recommend the use of the 3L tariff over the 5L tariff, with 5L
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17 108 values mapped onto 3L where appropriate [29].
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24 110 The EQ-5D is widely used in Norway, including the national quality registers where it is the
25
26 111 most widely used patient-reported outcome measure. A national EQ-5D-5L value set and
27
28 112 scoring algorithm is highly anticipated and will enhance the validity of economic evaluation
29
30 113 in Norway. Norwegian EQ-5D users have largely relied on the EQ-5D-3L scoring algorithm
31
32 114 from the UK [30], with a crosswalk-based approach [31] for studies that have used the 5L
33
34 115 version. Crosswalk-based approaches have several limitations related to issues with data
35
36 116 dependency and differences in scale range, and are an interim solution pending a national 5L
37
38 117 value set [31-33]. Cross-national comparisons of national EQ-5D-5L value sets also suggest
39
40 118 that there might be substantial differences across countries [13, 34] with culture and values
41
42 119 having a role [35]. Values for health for the 5L version of the EQ-5D, that are representative
43
44 120 for the Norwegian general population, will enhance the validity and legitimacy of economic
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46 121 evaluation in Norway.
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53 123 With few exceptions [36-38], existing EQ-5D value sets are based on the general population
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55 124 valuing hypothetical health states, which follows recommendations that economic evaluation
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57 125 should include societal preferences [39]. In recent years there has been some criticism
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3 126 levelled at this approach, questioning the validity of health state valuations from a general
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5 127 population lacking the adequate experience or knowledge of the health states, which they
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8 128 value in the form of hypothetical health states [40, 41]. An alternative approach, as
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10 129 recommended by Sweden's Dental and Pharmaceutical Benefits Agency [42], involves
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12 130 individuals valuing their own health state to give experience-based values or basing their
13
14 131 valuations on other forms of experience. The debate on whether to use hypothetical or
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16
17 132 experience-based values is to a certain extent a normative issue, relating to what we aim to
18
19 133 maximize [43]. However, there are a number of empirical questions pertaining to experience-
20
21 134 based values. Arguably, patients have a better understanding of the consequences of reduced
22
23 135 health on quality of life [41, 44-46]. On the other hand, they may have trouble imagining life
24
25 136 in full health, may underreport impact of disease due to adaptation or changes in expectations
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28 137 over time [44, 47], or may be less inclined to value their current health state as a state that is
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30 138 worse than being dead. Experience-based valuations, if better understood and elicited from
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33 139 representative samples of the general population may however be suitable for inclusion as
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35 140 societal values. The feasibility of collecting experience-based values, the assessment of how
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37 141 those with less than perfect health value their current health state and other health states in
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40 142 general, and how different forms of experience may influence health state valuations, are new
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42 143 areas for research to which this study will contribute [48].
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47 145 The project will derive a Norwegian EQ-5D-5L value set representative of region, age, sex
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49 146 and level of education composition in the Norwegian adult general population. Furthermore,
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51 147 the study will allow for comparisons of experience-based and hypothetical health state
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53 148 valuation.
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150 **Methods and analysis**

151 Values for EQ-5D-5L health states will be obtained by electronic data collection including
152 computer assisted face-to-face, one-to-one interviews and the use of composite time trade-off
153 (cTTO) and discrete choice experiments (DCE) [49, 50]. The latest EQ-5D-5L protocol will
154 be followed including EuroQol Valuation Technology (EQ-VT).

156 *Sampling*

157 Respondents must be aged 18 years or older, resident in Norway and proficient in Norwegian.
158 Following EQ-VT (EuroQol Valuation Technology) protocol, sample size is set to a minimum
159 of 1000 individuals with each valuing 10 health states, which gives the recommended 10,000
160 responses [50]. Additional 300-500 interviews, based on the oversampling of those with less
161 than perfect health, will increase the number of valuations of experienced health states.

162
163 Norway is a Northern European country with a population of slightly more than 5 million, and
164 a universal health care system. The population covers a comparatively large land mass, and
165 for many there may be several hours travel time to the nearest hospital or large city.
166 Urbanisation has further contributed to variation in demographic characteristics at the regional
167 level. These factors combined with local culture, politics and traditions mean that
168 geographical considerations are important to the design of the study.

169
170 The study will use a combination of multistage random sampling and quota sampling ensuring
171 representativeness according to geography, age, sex and educational level. The first stage of
172 sampling will be of geographical areas, here defined as municipalities within each acute care
173 hospital catchment area. Norway's four regional health authorities include Northern, Central,
174 Western and South-Eastern, with more than half the population residing in the South-Eastern

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3 175 health region. The catchment areas served by the 54 acute care hospitals cover all Norwegian
4
5 176 residents (see Figure 1). They vary considerably in the number of residents that they serve,
6
7 177 from 15,000 up to 500,000 residents. One acute care hospital will be randomly selected from
8
9 178 each health region with the exception of the South-Eastern region, where three will be
10
11 179 randomly selected to account for the disproportionate number of people residing in this
12
13 180 region. Hospital catchment areas within each region will be sampled with proportional
14
15 181 allocation, ensuring equal probability proportionate to the number of people residing in each
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17 182 area within the region.
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24 184 Within each sampled geographical area, the possible locations for data collection will
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26 185 constitute the sample frame for the second stage of sampling (Table 1). Locations will include
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28 186 public places (e.g. public libraries, town halls), workplaces, recreational organisations (e.g.
29
30 187 sports clubs), and healthcare providers (e.g. hospitals, rehabilitation institutions). The bodies
31
32 188 concerned must be willing to grant the study permission for data collection and cooperate
33
34 189 with provision of a suitable space for completion of the interviews. The locations will act as
35
36 190 clusters of possible respondents, stratified into groups based on the characteristics of target
37
38 191 respondents, e.g. age and educational level. Stratification will increase homogeneity per
39
40 192 cluster and ensure the representation of specific groups less likely to participate including
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42 193 those with poorer health, lower socio-economic status, or faced with time constraints,
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44 194 including those with young children or in full-time employment [51]. Locations within each
45
46 195 group in the sample frame will be randomly selected. The number of locations selected within
47
48 196 each sample frame will be based on the size of the area and quotas. Response rates,
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50 197 recruitment and data quality will be assessed for the different location strata and compared
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52 198 across catchment areas.
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3 200 Within each catchment area and at the respondent level, quota sampling will be applied
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5 201 according to age, sex and level of education (see Table 2 and 3). The total quota will first be
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7 202 allocated to each region proportionate to the number of people residing in each region. For the
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9 203 three regions with one sampled hospital catchment area, the quota for each of these hospital
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11 204 catchment areas will correspond to the regional quota. In the South-Eastern region, the
12
13 205 regional quota is further allocated to each hospital catchment area proportionate to the number
14
15 206 of people residing in each of these areas. The quota is then allocated to groups according to
16
17 207 gender, age group (young adults: age 18-34, middle-aged adults: age 35-64, elderly: age 65+)
18
19 208 and level of education (lower education, no higher than high school education, higher
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21 209 education - bachelor, masters or PhD) equivalent to the distribution of these attributes in the
22
23 210 respective regions. The quotas for each group are calculated using data available from
24
25 211 <http://microdata.no> (see Table 4), a national platform in Norway giving researchers direct
26
27 212 access to national registries for which Statistics Norway has processing authority, such as the
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29 213 Norwegian National Registry, National Education Database, labour market data, register for
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31 214 Personal Tax Payers and FD-Trygd (event history database) [52].
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40 216 The study will largely rely on recruitment of potential participants by contact persons at each
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42 217 sampled location. Contact persons will assist in identifying and recruiting potential
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44 218 respondents to the study. Prior to data collection, contact persons will receive information and
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46 219 materials for publication in local newspapers and social media designed to enhance
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48 220 participation. In addition to the recruitment of respondents through locations, potential
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50 221 respondents will be able to contact the project group for more information about the study and
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52 222 enquire about participation. Potential respondents will be informed of a gift incentive. Cash
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54 223 has been found to be more effective than other incentives for increasing response rates and
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56 224 following the interview, respondents will receive a cash card equivalent to 30 Euros.
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5 226 Data collection will take place from November 2019 to June 2020. Depending on the final
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8 227 sampling, and with an estimate of a minimum of four interviews per interviewer per day, a
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10 228 minimum of 55-80 working days are required for data collection. The recruitment strategy
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12 229 will be piloted in the catchment area sampled closest to Oslo. Necessary adjustments will
13
14 230 follow before data collection proceeds in the rest of the country.
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19 232 *Interviewer training*

21 233 Interviewers with Masters education level or equivalent will receive training in accordance
22
23 234 with EuroQol Foundation guidelines and recommendations, with initial training prior to, and
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25 235 revised training after, the first phase of data collection [53]. Based on existing studies and
26
27 236 recommendations from EuroQol (Elly Stolk, personal communication), eight to twelve
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29 237 interviewers are required.
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35 239 Quality control (QC) reports will help monitor progress and data quality throughout [54, 55].
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37 240 The reports will include assessments of protocol compliance, face validity of data collected
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39 241 and value distributions per interviewer. QC reports have been found to further the
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41 242 homogeneity of interviewer performance and reduce protocol violations and the number of
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43 243 inconsistent responses [54]. Interviewers not meeting pre-defined standards will be flagged,
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45 244 recommended for retraining and ultimately excluded. Evaluation of the data collected and
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47 245 interviewer performance will be regularly discussed with interviewers in face-to-face group
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49 246 meetings throughout data collection, and with EuroQol contact persons.
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56 248 *EuroQol Valuation Technology*

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3 249 EQ-VT was developed to meet the challenges involved with valuation of the 5L version of the
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5 250 EQ-5D, with emphasis on improving data quality and cross-country comparability [49]. The
6
7 251 standard protocol includes digital representation of visual aids to assist the respondent
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9 252 throughout the interview (see Figures 2 and 3). The study will use the portable version of the
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11 253 software, EQ-PVT, which for the respondent has the same functionality and for the most part
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13 254 resembles the standard EQ-VT software package.
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19 256 The interview will start with administration of the EQ-5D-5L questionnaire, including the
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21 257 visual analogue scale (VAS), followed by background questions for age, sex and experience
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23 258 with serious illness. Next, composite time trade-off (cTTO) is administered, beginning with
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25 259 an explanation of the task demonstrated with “the wheelchair example” including the “worse
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27 260 than dead” part of the task. This is followed by practice tasks for three states described with
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29 261 the EQ-5D-5L descriptive system, selected to reflect a mild, moderate, and severe health state,
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31 262 to familiarise the respondent further with the cTTO, the concept of health states worse than
32
33 263 being dead and the use of lead-time in the cTTO for the valuation of such states. Lastly,
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35 264 respondents are administered their current health state as a cTTO task, allowing for the
36
37 265 comparison of how respondents value their own health state with both cTTO and VAS.
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44 267 Respondents are randomized to one of 10 TTO blocks of EQ-5D-5L health states, each
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46 268 consisting of 10 health states, one of which is always the worst state (level 5 on each
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48 269 dimension, state 55555), and one among the 5 mildest states (11112, 11121, 11211, 12111,
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50 270 and 21111), for a total of 86 unique EQ-5D-5L health states for direct valuation [49].
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53 271 Respondents get the opportunity to review their responses in a feedback module (see Figure
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55 272 4), where individual task responses can be removed. Upon completion of the TTO tasks,
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57 273 respondents are randomized to one of 28 state pair blocks for discrete choices, each block
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3 274 consisting of seven state pairs. In both the TTO and DCE parts of the interview, the order of
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5 275 presentation is randomized. The randomized TTO and DCE tasks do not explicitly include a
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7 276 valuation of the respondents own health state, however respondents can by chance be
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10 277 presented their own health state as a choice, in which case the task will be completed as
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12 278 normal.

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17 280 The interview ends with further background questions specific to this study relating to
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19 281 variables known to be associated with valuations of health states including caregiver status,
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21 282 educational level and marital status, [56-59]. The influence of such variables will be assessed
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23 283 for the final value set.

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27 28 285 *Analysis*

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30 286 The demographic characteristics and health status, i.e. EQ-5D-5L profile, of respondents will
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32 287 be assessed and compared to national data. Parallel to this study, the Norwegian Institute of
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34 288 Public Health (NIPH) has initiated data collection for a postal survey assessing the health
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36 289 status of the Norwegian population using the EQ-5D-5L, allowing for comparison of the
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38 290 health status of study populations. Health state values for EQ-5D-5L will be estimated
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40 291 through statistical modelling of the survey data. The EQ-5D protocols are not prescriptive
41
42 292 with regard to modelling and approaches will depend on the characteristics of the data
43
44 293 obtained [50]. Following previous research, different models will be assessed including either
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46 294 the cTTO data, or combining the cTTO and DCE data in a hybrid model, and the results
47
48 295 compared for adequacy with those for existing national value sets [14-25]. Modelling of
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50 296 values for the national value set will exclude valuations from respondents recruited from
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52 297 locations specifically for the collection of experience-based values and the valuations of
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54 298 respondents' own health state. Subgroup analysis will identify variables contributing to health
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3 299 state valuation in the Norwegian population. Values for health states defined as respondents'
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5 300 "own health today" will be compared with values estimated for the same health states by the
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7 301 general population. In addition, all experienced-based valuations by those with serious illness
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9 302 and/or less than perfect health will be compared to valuations based on the total general
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11 303 population sample and, given sufficient data, those without experience of serious illness
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13 304 and/or with perfect health today. To assess experience-based valuations, and explore both the
14
15 305 wider and more narrow concepts of experience-based valuations [48], three potential profiles
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17 306 will be assessed; 1) respondents' valuation of own health state, 2) valuations given by
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19 307 respondents recruited from locations specifically chosen to target those with poorer health, i.e.
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21 308 health services, 3) valuations given by respondents who have indicated that they have
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23 309 experience with serious illness.
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311 *Patient and Public Involvement*

312 Patients and members of the public were not invited to comment on the study design or
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34
35 313 contribute to the writing or editing of this document for readability or accuracy.
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316 *Strengths and limitations*

317 This is the first Norwegian valuation study with both cTTO and DCE undertaken on a scale
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47 318 large enough to meet the most recent EQ-5D protocol. The study intends to complete 1300-
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50 319 1500 face-to-face computer-assisted interviews across a country with a relatively dispersed
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52 320 population of citizens and large geographical distances between them. Data collection
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54 321 involves a small number of interviewers working over an eight-month period.
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3 323 Both the duration and magnitude of the tasks involved make the interview demanding. It is
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5 324 important that data collection is cost-effective, which includes considerations of data quality,
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7 325 representativeness and total number of valuations. Given the strategy of sampling locations
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9 326 and organisations rather than individuals, the assessment of its effectiveness in terms of
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11 327 number and representativeness of respondents will be important following the initial data
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13 328 collection period. Poor recruitment and data collection in remote geographical locations will
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15 329 be costly. The number and characteristics of respondents per location will be monitored
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17 330 throughout data collection. Adaptive sampling will allow for inclusion of additional locations
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19 331 where response rates are low and quotas are not met. Additional locations will be chosen at
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21 332 random from the predefined frame of possible locations within the selected geographical area.
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25 334 Due to the need for extensive training, interview experience, and understanding of the task,
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27 335 only eight to twelve interviewers will be included. This will give more control over the data
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29 336 collection and the quality of the data collected. However, this and potential costs saved in
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31 337 terms of interviewer recruitment, training and travel costs, must be balanced against the
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33 338 increased impact of any loss of interviewers through illness or resignation during data
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35 339 collection. Norway has a harsh winter climate and apart from the Southern and Eastern
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37 340 region, where the interviewers are based, the interviews will primarily take place outside the
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39 341 winter months to reduce the risk of travel delays and interviewer illness. The NIPH, which is
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41 342 conducting the research, has several experienced interviewers familiar with the study who will
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43 343 be able to complete training and contribute to data collection if needed.
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54 345 The main justification for the strategy of sampling stratified locations and the use of quotas on
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56 346 the respondent level is to ensure representativeness of the final sample according to
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58 347 geographical region, age, sex and educational level. An additional quota will be used to
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3 348 recruit those with less than perfect health, through locations such as hospitals and
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5 349 rehabilitation centres. Locations will also be selected to directly seek out others who are
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8 350 typically harder to reach and are less likely to participate in research studies, such as those
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10 351 with different ethnic backgrounds or with young children. Studies have found that some
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12 352 attributes, such as marital and caregiver status/having young children, may influence the
13
14 353 respondents response to the task, such as their willingness to trade time in the TTO task,
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16 354 despite showing similar preferences for given health states when using other types of
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18 355 valuation tasks [56, 58]. Hence, it is important that respondents with such attributes are
19
20 356 included in the study and locations such as day care facilities for young children and primary
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22 357 schools will be selected to facilitate this. Questions relating to these attributes will be included
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24 358 in the background questions closing the interview, and as such will allow for sub-group
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26 359 analysis of the effect of these attributes on the valuation of health in the Norwegian sample.
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33 361 The derivation of values based on experienced health states is a recent development in the
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35 362 field of health state valuation [48]. In recent years, there have been major developments in the
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37 363 field of standardised protocols for health state valuation, including EuroQol EQ-VT. Such
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39 364 standardisation is a long way off for experienced health state valuation and, as was the case
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41 365 for hypothetical health state valuation up until the last decade, there is considerable variation
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43 366 in the choice of methods [60]. In Norway and other countries, the feasibility of collecting such
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45 367 data is still in its infancy, including choice of sampling strategies, recruitment and how to
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47 368 minimise respondent burden. This study builds on existing methodology in the form of EQ-
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49 369 VT protocol, to assess the feasibility of recruiting potential respondents (including from
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51 370 health care settings) for experience-based health state valuation, respondent burden in the
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53 371 form of completed interviews and data quality. The study design is constrained by the EQ-VT
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55 372 protocol, but the results of the study will inform the development of more appropriate
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3 373 methodology in the future. Furthermore, the design will allow the comparison of results with
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5 374 those for hypothetical health state valuation.
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14 378 **Ethics and dissemination**

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17 379 The study was reviewed by The Regional Health Authority Research Ethics Committee and
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19 380 found to be outside of the scope of the ethics committee thus not in need of ethical approval.
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21 381 All study participants will give informed consent.
22
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24 382 The final scoring algorithm will contribute to the quality and relevance of the results of EQ-
25
26 383 5D applications in Norway, and it is highly likely that, when available, the EQ-5D-5L with a
27
28 384 Norwegian scoring algorithm will be the recommended instrument of choice for future
29
30 385 economic evaluations undertaken in Norway by the pharmaceutical industry and other
31
32 386 important users. Application of the same instrument and scoring across the health services and
33
34 387 industry will further enhance decision-making relating to scarce health care resources.
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36 388 Moreover, scores based on Norwegian preferences will further enhance the appropriateness of
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38 389 the EQ-5D in clinical and health services research and quality indicators work, including the
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40 390 national quality registers.
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47 392 The study results will be published in peer-review scientific journals, presented at appropriate
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49 393 forums, including national and international conferences, and scoring algorithms made
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51 394 publicly available for R, Stata and other widely used statistical software. Presentations will be
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53 395 given to users of the research, including research centres that widely use the EQ-5D in
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55 396 clinical, health services and health economics research in Norway.
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4 398 **List of abbreviations**

5 399 EQ-VT EuroQol Valuation Technology

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8 400 cTTO Composite time trade-off

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11 401 DCE Discrete choice experiments

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14 402 QALY Quality Adjusted Life Year

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17 403 PROMs Patient Reported Outcomes Measures

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20 404 NQR National Quality Registries

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23 405 NICE National Institute for Health and Care Excellence

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26 406 NIPH Norwegian Institute of Public Health

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29 407 QC Quality control software included in the EQ-VT software

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38 410 **Declarations**

39 411 **Competing interests**

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42 412 The authors have no competing interests.

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45 413 **Availability of data and material**

46
47
48 414 Not applicable.

49
50
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52
53
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55
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57
58 418 Institute of Public Health.
59
60

419 Author contributions

420 AG conceived the study and secured funding. TMH, YH and AG designed the study. LA, KR
 421 and KS commented and recommended revisions. . TMH and AG drafted and revised the
 422 manuscript. YH, LA, KR and KS have read and approved the final version. All authors agree
 423 to be accountable for all aspects of the work.

424

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556 Tables

557 Table 1: Locations for recruitment of participants, by age group and health status

Healthy	Reduced health
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Young	Middle-aged	Elderly	All ages	All ages
Places of higher education	Workplaces	Eldery homes	Public library	Hospitals
Child daycare facilities/ Primary schools	Recreational organisations (sports teams)	Recreational organisations (choirs/orchestras)	Town hall	Rehabilitation centres
Social welfare*	Social welfare* Adult education*	Community volunteer centres		Health centres

558 *Locations chosen to increase participation of those with lower socio-economic status

559 Table 2: Example sampling of hospital catchment areas and quotas per catchment area

Region	Population in region	Catchment area	Population in catchment area	Quota per catchment area
Northern	381907	Hospital 1	130000	140
Central	560690	Hospital 2	60000	205
Western	843899	Hospital 3	330000	309
South-Eastern	2299890	Hospital 4	500000	448
South-Eastern	“	Hospital 5	160000	143
South-Eastern	“	Hospital 6	280000	251

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561 Table 3: Example of quotas within a sampled catchment area based on the composition of sex,
562 age and educational level in the general population of the respective region (source: Official
563 statistics for 2017 generated from microdata.no). Example given sampling scenario and
564 catchment area for Hospital 1 in Table 2.

Sex	Highest attained educational level	Age groups							Total quota per sex and educational level
		18-24	25-34	35-44	45-54	55-64	65-74	75+	
Male	Primary or secondary	8	9	8	9	9	7	5	56
	Tertiary	1	3	3	3	3	2	1	16
Female	Primary or secondary	7	6	5	7	8	8	7	47
	Tertiary	1	5	5	5	3	2	1	22
Total quota per age group		17	22	22	25	22	18	14	140

565

566 Table 4. Reference data for the calculation of quotas, data for 2018 (<http://microdata.no>,
567 Statistics Norway, data accessed: 12.03.2019)

Region	Sex	Highest attained educational level	Age group						
			18-24	25-34	35-44	45-54	55-64	65-74	75+

South-Eastern region	Male	Primary or secondary	117 220	130 448	133 470	143 252	119 278	94 473	62 167
		Tertiary	13 603	72 661	77 273	66 785	51 553	40 368	19 650
	Female	Primary or secondary	100 571	94 904	99 033	120 226	114 228	107 739	103 859
		Tertiary	24 196	104 395	101 833	79 908	55 565	34 126	17 126
Western region	Male	Primary or secondary	48 863	54 616	52 141	54 172	44 925	34 032	23 977
		Tertiary	5 129	26 041	27 176	21 446	17 552	12 302	5 291
	Female	Primary or secondary	40 743	35 932	34 778	42 701	40 672	36 866	38 127
		Tertiary	9 928	39 550	36 796	27 107	18 494	9 777	4 750
Central region	Male	Primary or secondary	32 425	33 771	32 095	36 110	32 525	26 289	18 441
		Tertiary	3 674	15 730	15 703	13 497	11 291	8 664	3 521
	Female	Primary or secondary	26 707	21 526	21 130	28 292	29 998	28 218	28 275
		Tertiary	6 456	23 177	22 577	18 320	12 267	6 980	3 024
Northern region	Male	Primary or secondary	22 976	23 320	21 793	25 812	23 582	20 282	13 464
		Tertiary	1 736	7 895	8 724	9 427	7 450	5 273	1 845
	Female	Primary or secondary	18 357	15 382	14 562	19 478	20 589	20 492	19 767
		Tertiary	3 470	13 212	14 402	13 721	8 872	4 300	1 707

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569 **Figures**

570

571 Figure 1: Hospitals with Acute Care Function in Norway

572 Figure 2: Screenshot of visual aid for cTTO task in EQ-VT

573 Figure 3: Screenshot of visual aid for DCE task in EQ-VT

574 Figure 4: Screenshot of the feedback module in EQ-VT

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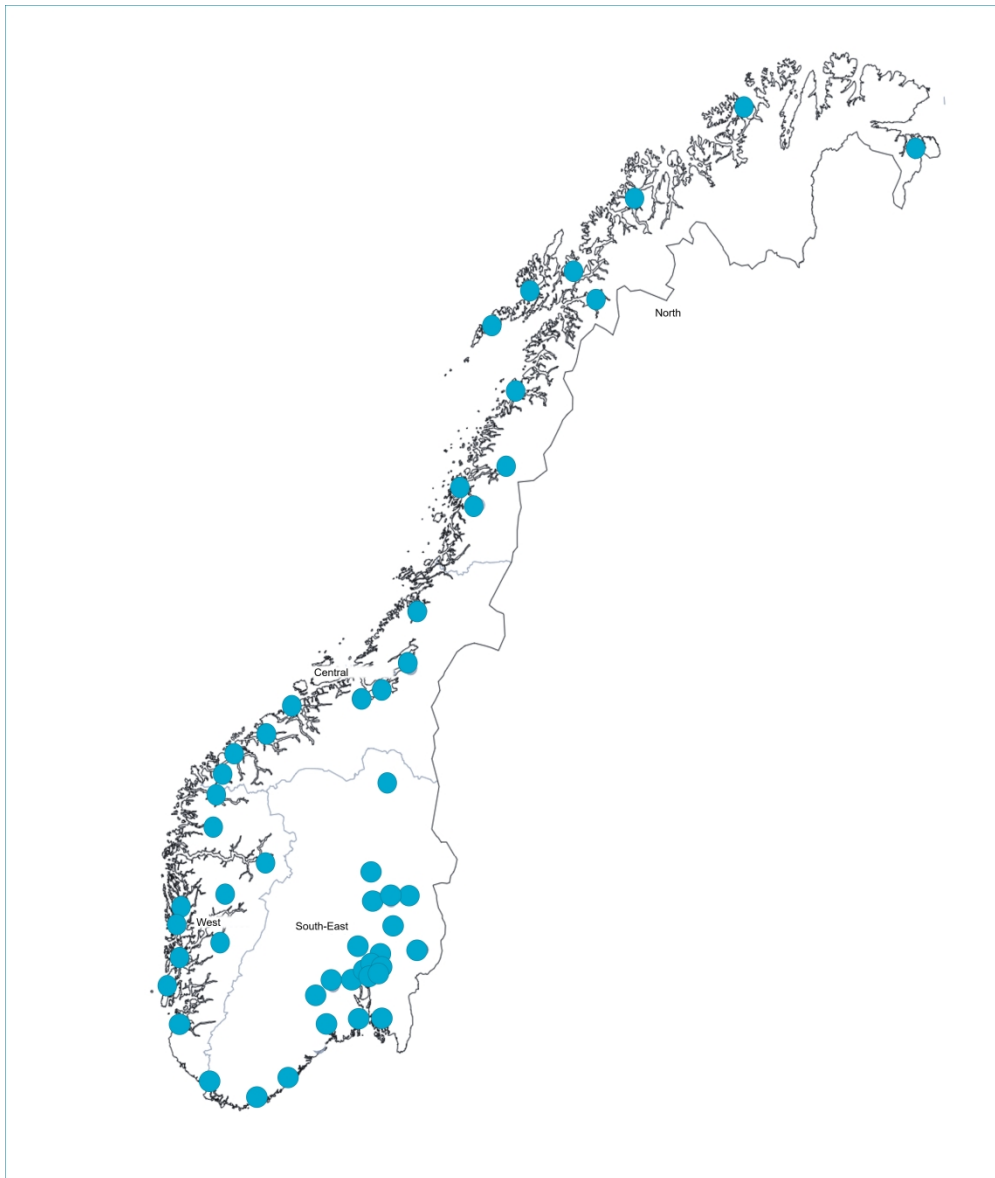


Figure 1: Hospitals with Acute Care Function in Norway

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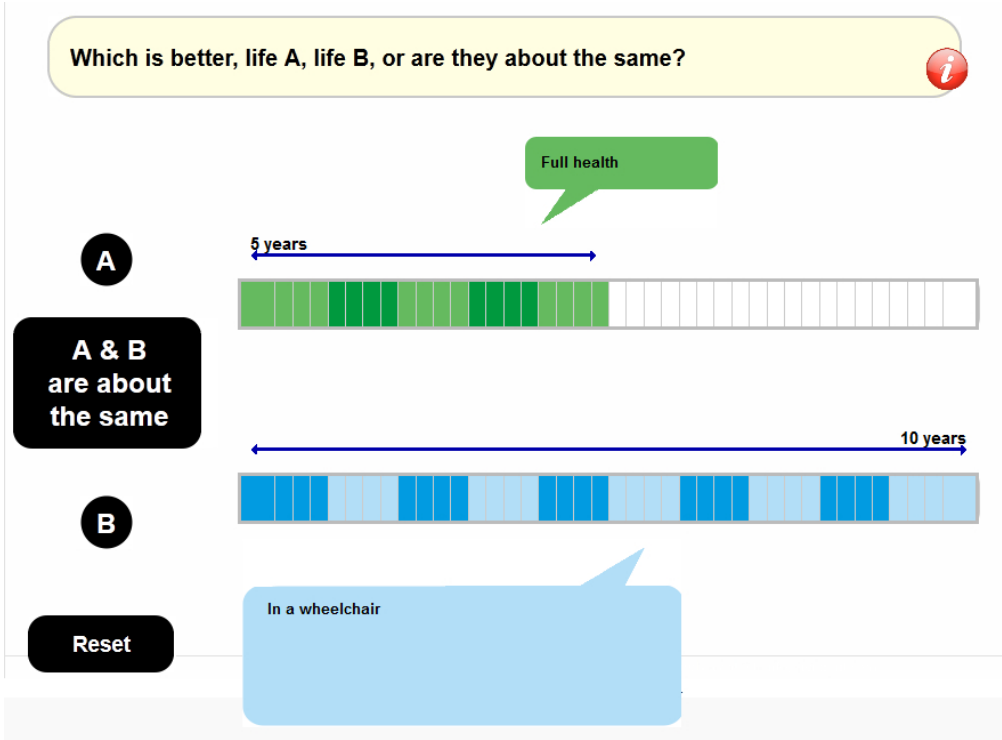


Figure 2: Screenshot of visual aid for cTTO task in EQ-VT (source: EuroQol Foundation)

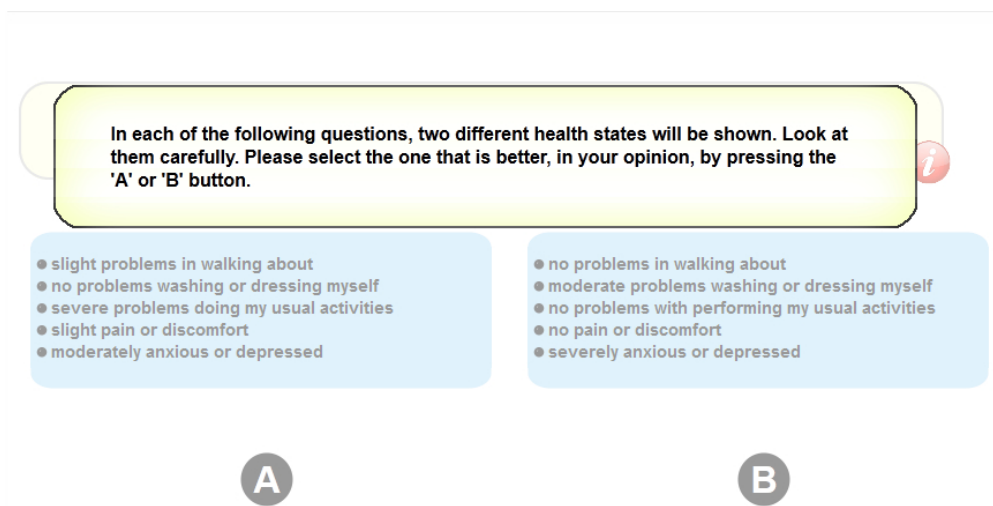


Figure 3: Screenshot of visual aid for DCE task in EQ-VT (source: EuroQoI Foundation)

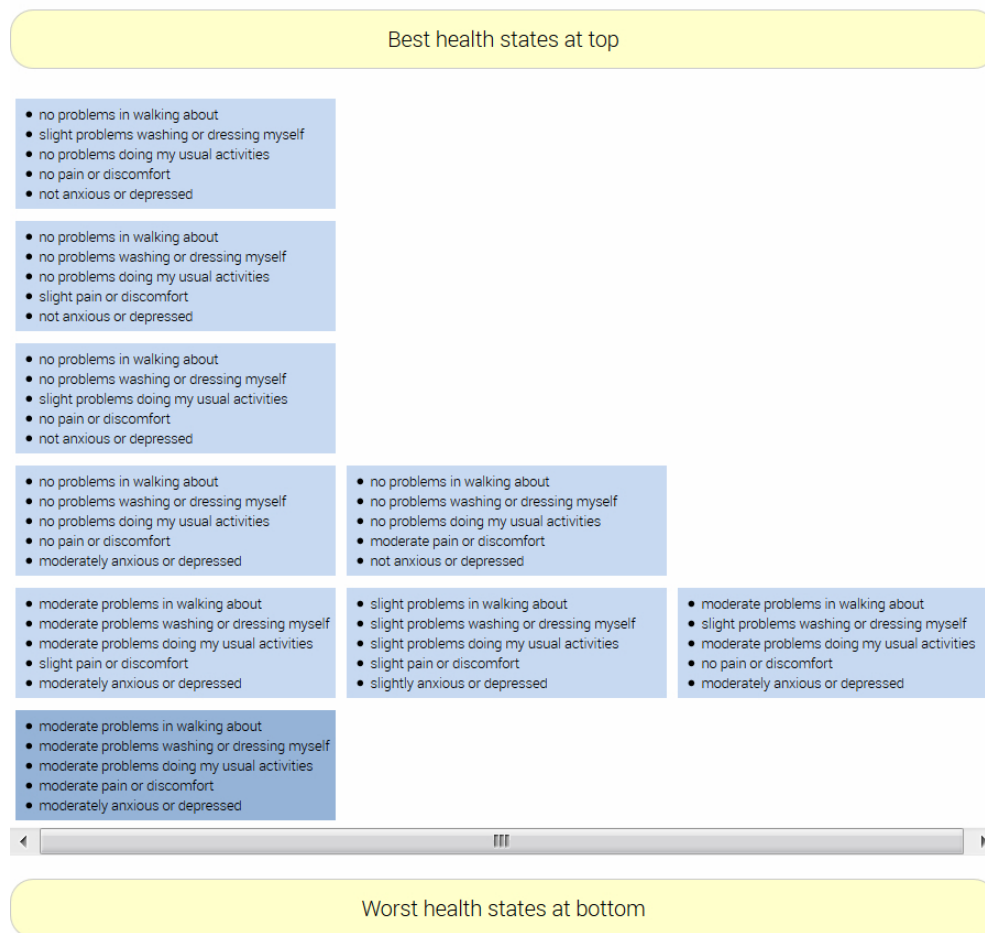


Figure 4: Screenshot of the feedback module in EQ-VT (source: EuroQol Foundation)

BMJ Open

Elicitation of Norwegian EQ-5D-5L Values for Hypothetical and Experience-based Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol

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Keywords:	Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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3 **1 Elicitation of Norwegian EQ-5D-5L Values for Hypothetical and Experience-based**
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5 **2 Health States Based on the EuroQol Valuation Technology (EQ-VT) Protocol**
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46 21 Word count: 3872
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51 **23 Abstract**

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53 24 **Introduction** Norway is one of several European countries that lacks a national value set and
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55 25 scoring algorithm for the EQ-5D. Recent studies have found differences between countries in
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57 26 terms of health values or preferences for health states described by instruments such as the
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59 27 EQ-5D. The project aims to model a national value set for the five level version of the EQ-5D

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3 28 (EQ-5D-5L) based on values elicited from a representative sample of the Norwegian adult
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5 29 general population in terms of region, age, sex, and level of education. Using a sampling
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7 30 strategy supporting the collection of values for both hypothetical and experienced health
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9 31 states, the study will have the additional aim of assessing the feasibility of collecting
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11 32 experience-based values in accordance with the latest EQ-5D valuation study protocol, and
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13 33 comparing values with those given for hypothetical health states.
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18 34 **Methods and analysis** Multi-stage random sampling and quota-sampling will contribute to
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20 35 representativeness. To increase the number of valuations of experienced health states, those
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22 36 with less than perfect health will be over-sampled, increasing the total number of interviews
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24 37 from 1000 to 1300–1500. The most recent EQ-5D valuation protocol will be followed which
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26 38 includes computer assisted face-to-face, one-to-one interviews and use of composite time
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28 39 trade-off (cTTO) and discrete choice experiments (DCE).
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33 40 **Ethics and dissemination** The study has been reviewed and found to be outside of the scope
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35 41 of the ethics committee and thus not in need of ethical approval. The study findings study will
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37 42 be disseminated through peer-reviewed publications, conference presentations, and
38
39 43 summaries for key stakeholders and partners in the field. The scoring algorithms will be
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41 44 available for widely used statistical software.
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46 45 **Keywords:** Utilities, Health state valuation, EQ-5D, Time trade-off, QALY
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49 46 **Article summary**

50 47 **Strengths and limitations of this study**

- 51 48 • This is the first Norwegian valuation study with cTTO (composite time trade-off) and
52 49 DCE (discrete choice experiment) undertaken on a scale large enough to meet the
53 50 recommendations of the most recent EQ-5D protocol.
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- 51 • Sampling strategy designed to both ensure representativeness of the final sample
52 according to geographical region, age, sex and educational level and increase the
53 number of experience-based valuations.
- 54 • Data collection restricted to EuroQol protocol, primarily developed for hypothetical
55 health state valuation, but with the additional aim of collecting experience-based
56 valuations. Study design does not allow for the assessment of methods other than
57 those described in the EQ-VT protocol.
- 58 • Restricted samples for comparisons of experience-based valuations.
- 59 • High respondent burden experienced in interviews limits the scope for addressing
60 additional methodological questions.

62 **Introduction**

63 Economic evaluation undertaken by the Norwegian Institute of Public Health and the
64 Norwegian Medicine Agency increasingly informs decisions about the introduction of new
65 drugs and other health technologies in Norway [1, 2]. The Norheim Committee [3] and
66 Magnussen Working Group [4] proposed methods to enhance the quality of economic
67 evaluation, thereby further strengthening the role of economic evaluation in decision-making.
68 The Ministry of Health followed up these proposals in a 2016 White Paper to Parliament on
69 principles for priority setting in health care [5].

70
71 Given the important role and impact of economic evaluation, it is important that the methods
72 it incorporates, including cost-utility analysis, are consistent with societal values regarding
73 publicly financed health care. Economic evaluation, when taking into account societal values,
74 often takes the form of cost-utility analyses with the estimation of the incremental cost per
75 Quality Adjusted Life Year (QALY) gained [6]. QALY takes the integral of health-related

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3 76 quality of life (HRQoL) over time, with HRQoL represented on a scale where 1 indicates a
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5 77 preference equal to that for full health and 0 implies a health state equal to that of being dead.
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7 78 Values are typically derived using general population surveys where respondents consider the
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10 79 relative undesirability of different health states described using instruments such as the EQ-
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12 80 5D [7]. After assigning values to health states described by an instrument, QALYs are
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14 81 calculated by multiplying the health state value by the length of time spent in each. Evaluation
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16 82 of alternative technologies then involves comparison of incremental QALYs gained over
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18 83 incremental costs for new vs. existing technologies.
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24 85 Several instruments are available to calculate QALYs, of which the EQ-5D is by far the most
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26 86 widely applied both internationally and in Norway [8-10]. The EQ-5D™, a trade mark of the
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28 87 EuroQol Research Foundation, is available in over 150 languages [11] in the self-complete
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30 88 paper version [12], and national value sets and normative data exist for over 20 countries [7,
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32 89 13-25]. It is brief, widely tested, and includes five important aspects of health (mobility, self-
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34 90 care, usual activities, pain/discomfort and anxiety/depression), with the most recent version
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36 91 having five levels (5L) from no problems to severe problems. The EQ-5D is considered
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38 92 highly acceptable to most patient groups and feasible for application where a short-form
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40 93 general measure of health is required. The instrument has had widespread application in
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42 94 research including clinical trials, population health surveys, in both Norwegian [26] and
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44 95 Swedish National Quality Registries (NQR) [27], and more recently as a health care quality
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46 96 indicator as part of the National Health Service for England and Wales Patient Reported
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48 97 Outcomes Measures (PROMs) programme [14].
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56 99 The Norwegian Medicines Agency recommends the use of EQ-5D in all technology
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58 100 assessments and the use of a 5L tariff for studies where the 5L version has been used [2]. In
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3 101 the absence of a Norwegian tariff, the 2018 Agency guidelines currently recommend the use
4
5 102 of the EQ-5D-5L tariff for England [14] where EQ-5D-5L has been used. However, criticism
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7 103 has been levelled at the English tariff including concerns with data quality in which serious
8
9 104 deficiencies were revealed [28]. The English 5L tariff followed an early protocol, which has
10
11 105 since been updated with the aim of improving data quality and interview techniques.
12
13 106 Following these concerns, and in contrast to recommendations of the Norwegian Medicines
14
15 107 Agency, NICE continues to recommend the use of the 3L tariff over the 5L tariff, with 5L
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17 108 values mapped onto 3L where appropriate [29].
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24 110 The EQ-5D is widely used in Norway, including the national quality registers where it is the
25
26 111 most widely used patient-reported outcome measure. A national EQ-5D-5L value set and
27
28 112 scoring algorithm is highly anticipated and will enhance the validity of economic evaluation
29
30 113 in Norway. Norwegian EQ-5D users have largely relied on the EQ-5D-3L scoring algorithm
31
32 114 from the UK [30], with a crosswalk-based approach [31] for studies that have used the 5L
33
34 115 version. Crosswalk-based approaches have several limitations related to issues with data
35
36 116 dependency and differences in scale range, and are an interim solution pending a national 5L
37
38 117 value set [31-33]. Cross-national comparisons of national EQ-5D-5L value sets also suggest
39
40 118 that there might be substantial differences across countries [13, 34] with culture and values
41
42 119 having a role [35]. Values for health for the 5L version of the EQ-5D, that are representative
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44 120 for the Norwegian general population, will enhance the validity and legitimacy of economic
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46 121 evaluation in Norway.
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53 123 With few exceptions [36-38], existing EQ-5D value sets are based on the general population
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55 124 valuing hypothetical health states, which follows recommendations that economic evaluation
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57 125 should include societal preferences [39]. In recent years there has been some criticism
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3 126 levelled at this approach, questioning the validity of health state valuations from a general
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5 127 population lacking the adequate experience or knowledge of the health states, which they
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8 128 value in the form of hypothetical health states [40, 41]. An alternative approach, as
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10 129 recommended by Sweden's Dental and Pharmaceutical Benefits Agency [42], involves
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12 130 individuals valuing their own health state to give experience-based values or basing their
13
14 131 valuations on other forms of experience. The debate on whether to use hypothetical or
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17 132 experience-based values is to a certain extent a normative issue, relating to what we aim to
18
19 133 maximize [43]. However, there are a number of empirical questions pertaining to experience-
20
21 134 based values. Arguably, patients have a better understanding of the consequences of reduced
22
23 135 health on quality of life [41, 44-46]. On the other hand, they may have trouble imagining life
24
25 136 in full health, may underreport impact of disease due to adaptation or changes in expectations
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27
28 137 over time [44, 47], or may be less inclined to value their current health state as a state that is
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30 138 worse than being dead. Experience-based valuations, if better understood and elicited from
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33 139 representative samples of the general population may however be suitable for inclusion as
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35 140 societal values. The feasibility of collecting experience-based values, the assessment of how
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37 141 those with less than perfect health value their current health state and other health states in
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40 142 general, and how different forms of experience may influence health state valuations, are new
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42 143 areas for research to which this study will contribute [48].
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47 145 The project will derive a Norwegian EQ-5D-5L value set representative of region, age, sex
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49 146 and level of education composition in the Norwegian adult general population. Furthermore,
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51 147 the study will allow for comparisons of experience-based and hypothetical health state
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53 148 valuation.
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150 **Methods and analysis**

151 Values for EQ-5D-5L health states will be obtained by electronic data collection including
152 computer assisted face-to-face, one-to-one interviews and the use of composite time trade-off
153 (cTTO) and discrete choice experiments (DCE) [49, 50]. The latest EQ-5D-5L protocol will
154 be followed including EuroQol Valuation Technology (EQ-VT).

156 *Sampling*

157 Respondents must be aged 18 years or older, resident in Norway and proficient in Norwegian.
158 Following EQ-VT (EuroQol Valuation Technology) protocol, sample size is set to a minimum
159 of 1000 individuals with each valuing 10 health states, which gives the recommended 10,000
160 responses [50]. Additional 300-500 interviews, based on the oversampling of those with less
161 than perfect health, will increase the number of valuations of experienced health states.

162
163 Norway is a Northern European country with a population of slightly more than 5 million, and
164 a universal health care system. The population covers a comparatively large land mass, and
165 for many there may be several hours travel time to the nearest hospital or large city.

166 Urbanisation has further contributed to variation in demographic characteristics at the regional
167 level. These factors combined with local culture, politics and traditions mean that
168 geographical considerations are important to the design of the study.

169
170 The study will use a combination of multistage random sampling and quota sampling ensuring
171 representativeness according to geography, age, sex and educational level. The first stage of
172 sampling will be of geographical areas, here defined as municipalities within each acute care
173 hospital catchment area. Norway's four regional health authorities include Northern, Central,
174 Western and South-Eastern, with more than half the population residing in the South-Eastern

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3 175 health region. The catchment areas served by the 54 acute care hospitals cover all Norwegian
4
5 176 residents (see Figure 1). They vary considerably in the number of residents that they serve,
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7 177 from 15,000 up to 500,000 residents. One acute care hospital will be randomly selected from
8
9 178 each health region with the exception of the South-Eastern region, where three will be
10
11 179 randomly selected to account for the disproportionate number of people residing in this
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13 180 region. Hospital catchment areas within each region will be sampled with proportional
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15 181 allocation, ensuring equal probability proportionate to the number of people residing in each
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17 182 area within the region.
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24 184 Within each sampled geographical area, the possible locations for data collection will
25
26 185 constitute the sample frame for the second stage of sampling (Table 1). Locations will include
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28 186 public places (e.g. public libraries, town halls), workplaces, recreational organisations (e.g.
29
30 187 sports clubs), and healthcare providers (e.g. hospitals, rehabilitation institutions). The bodies
31
32 188 concerned must be willing to grant the study permission for data collection and cooperate
33
34 189 with provision of a suitable space for completion of the interviews. The locations will act as
35
36 190 clusters of possible respondents, stratified into groups based on the characteristics of target
37
38 191 respondents, e.g. age and educational level. Stratification will increase homogeneity per
39
40 192 cluster and ensure the representation of specific groups less likely to participate including
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42 193 those with poorer health, lower socio-economic status, or faced with time constraints,
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44 194 including those with young children or in full-time employment [51]. Locations within each
45
46 195 group in the sample frame will be randomly selected. The number of locations selected within
47
48 196 each sample frame will be based on the size of the area and quotas. Response rates,
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50 197 recruitment and data quality will be assessed for the different location strata and compared
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52 198 across catchment areas.
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3 200 Within each catchment area and at the respondent level, quota sampling will be applied
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5 201 according to age, sex and level of education (see Table 2 and 3). The total quota will first be
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7 202 allocated to each region proportionate to the number of people residing in each region. For the
8
9 203 three regions with one sampled hospital catchment area, the quota for each of these hospital
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11 204 catchment areas will correspond to the regional quota. In the South-Eastern region, the
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13 205 regional quota is further allocated to each hospital catchment area proportionate to the number
14
15 206 of people residing in each of these areas. The quota is then allocated to groups according to
16
17 207 gender, age group (young adults: age 18-34, middle-aged adults: age 35-64, elderly: age 65+)
18
19 208 and level of education (lower education, no higher than high school education, higher
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21 209 education - bachelor, masters or PhD) equivalent to the distribution of these attributes in the
22
23 210 respective regions. The quotas for each group are calculated using data available from
24
25 211 <http://microdata.no> (see Table 4), a national platform in Norway giving researchers direct
26
27 212 access to national registries for which Statistics Norway has processing authority, such as the
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29 213 Norwegian National Registry, National Education Database, labour market data, register for
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31 214 Personal Tax Payers and FD-Trygd (event history database) [52].
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40 216 The study will largely rely on recruitment of potential participants by contact persons at each
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42 217 sampled location. Contact persons will assist in identifying and recruiting potential
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44 218 respondents to the study. Prior to data collection, contact persons will receive information and
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46 219 materials for publication in local newspapers and social media designed to enhance
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48 220 participation. In addition to the recruitment of respondents through locations, potential
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50 221 respondents will be able to contact the project group for more information about the study and
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52 222 enquire about participation. Potential respondents will be informed of a gift incentive. Cash
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54 223 has been found to be more effective than other incentives for increasing response rates and
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56 224 following the interview, respondents will receive a cash card equivalent to 30 Euros.
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5 226 Data collection will take place from November 2019 to June 2020. Depending on the final
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8 227 sampling, and with an estimate of a minimum of four interviews per interviewer per day, a
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10 228 minimum of 55-80 working days are required for data collection. The recruitment strategy
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12 229 will be piloted in the catchment area sampled closest to Oslo. Necessary adjustments will
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14 230 follow before data collection proceeds in the rest of the country.
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19 232 *Interviewer training*

21 233 Interviewers with Masters education level or equivalent will receive training in accordance
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23 234 with EuroQol Foundation guidelines and recommendations, with initial training prior to, and
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25 235 revised training after, the first phase of data collection [53]. Based on existing studies and
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27 236 recommendations from EuroQol (Elly Stolk, personal communication), eight to twelve
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29 237 interviewers are required.
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35 239 Quality control (QC) reports will help monitor progress and data quality throughout [54, 55].
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37 240 The reports will include assessments of protocol compliance, face validity of data collected
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39 241 and value distributions per interviewer. QC reports have been found to further the
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41 242 homogeneity of interviewer performance and reduce protocol violations and the number of
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43 243 inconsistent responses [54]. Interviewers not meeting pre-defined standards will be flagged,
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45 244 recommended for retraining and ultimately excluded. Evaluation of the data collected and
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47 245 interviewer performance will be regularly discussed with interviewers in face-to-face group
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49 246 meetings throughout data collection, and with EuroQol contact persons.
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56 248 *EuroQol Valuation Technology*

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3 249 EQ-VT was developed to meet the challenges involved with valuation of the 5L version of the
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5 250 EQ-5D, with emphasis on improving data quality and cross-country comparability [49]. The
6
7 251 standard protocol includes digital representation of visual aids to assist the respondent
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10 252 throughout the interview (see Figures 2 and 3). The study will use the portable version of the
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12 253 software, EQ-PVT, which for the respondent has the same functionality and for the most part
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14 254 resembles the standard EQ-VT software package.
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19 256 The interview will start with administration of the EQ-5D-5L questionnaire, including the
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21 257 visual analogue scale (VAS), followed by background questions for age, sex and experience
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23 258 with serious illness. Next, composite time trade-off (cTTO) is administered, beginning with
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25 259 an explanation of the task demonstrated with “the wheelchair example” including the “worse
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27 260 than dead” part of the task. This is followed by practice tasks for three states described with
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29 261 the EQ-5D-5L descriptive system, selected to reflect a mild, moderate, and severe health state,
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31 262 to familiarise the respondent further with the cTTO, the concept of health states worse than
32
33 263 being dead and the use of lead-time in the cTTO for the valuation of such states. Lastly,
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35 264 respondents are administered their current health state as a cTTO task, allowing for the
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37 265 comparison of how respondents value their own health state with both cTTO and VAS.
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44 267 Respondents are randomized to one of 10 TTO blocks of EQ-5D-5L health states, each
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46 268 consisting of 10 health states, one of which is always the worst state (level 5 on each
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48 269 dimension, state 55555), and one among the 5 mildest states (11112, 11121, 11211, 12111,
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50 270 and 21111), for a total of 86 unique EQ-5D-5L health states for direct valuation [49].
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53 271 Respondents get the opportunity to review their responses in a feedback module (see Figure
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55 272 4), where individual task responses can be removed. Upon completion of the TTO tasks,
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57 273 respondents are randomized to one of 28 state pair blocks for discrete choices, each block
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3 274 consisting of seven state pairs. In both the TTO and DCE parts of the interview, the order of
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5 275 presentation is randomized. The randomized TTO and DCE tasks do not explicitly include a
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7 276 valuation of the respondents own health state, however respondents can by chance be
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10 277 presented their own health state as a choice, in which case the task will be completed as
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12 278 normal.

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17 280 The interview ends with further background questions specific to this study relating to
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19 281 variables known to be associated with valuations of health states including caregiver status,
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21 282 educational level and marital status, [56-59]. The influence of such variables will be assessed
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23 283 for the final value set.

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27 28 285 *Analysis*

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30 286 The demographic characteristics and health status, i.e. EQ-5D-5L profile, of respondents will
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32 287 be assessed and compared to national data. Parallel to this study, the Norwegian Institute of
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34 288 Public Health (NIPH) has initiated data collection for a postal survey assessing the health
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36 289 status of the Norwegian population using the EQ-5D-5L, allowing for comparison of the
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38 290 health status of study populations. Health state values for EQ-5D-5L will be estimated
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40 291 through statistical modelling of the survey data. The EQ-5D protocols are not prescriptive
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42 292 with regard to modelling and approaches will depend on the characteristics of the data
43
44 293 obtained [50]. Following previous research, different models will be assessed including either
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46 294 the cTTO data, or combining the cTTO and DCE data in a hybrid model, and the results
47
48 295 compared for adequacy with those for existing national value sets [14-25]. Modelling of
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50 296 values for the national value set will exclude valuations from respondents recruited from
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52 297 locations specifically for the collection of experience-based values and the valuations of
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54 298 respondents' own health state. Subgroup analysis will identify variables contributing to health
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3 299 state valuation in the Norwegian population. Values for health states defined as respondents'
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5 300 "own health today" will be compared with values estimated for the same health states by the
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7 301 general population. In addition, all experienced-based valuations by those with serious illness
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9 302 and/or less than perfect health will be compared to valuations based on the total general
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11 303 population sample and, given sufficient data, those without experience of serious illness
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13 304 and/or with perfect health today. To assess experience-based valuations, and explore both the
14
15 305 wider and more narrow concepts of experience-based valuations [48], three potential profiles
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17 306 will be assessed; 1) respondents' valuation of own health state, 2) valuations given by
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19 307 respondents recruited from locations specifically chosen to target those with poorer health, i.e.
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21 308 health services, 3) valuations given by respondents who have indicated that they have
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23 309 experience with serious illness.
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311 *Patient and Public Involvement*

312 Patients and members of the public were not invited to comment on the study design or
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34
35 313 contribute to the writing or editing of this document for readability or accuracy.
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316 *Strengths and limitations*

317 This is the first Norwegian valuation study with both cTTO and DCE undertaken on a scale
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45 318 large enough to meet the most recent EQ-5D protocol. The study intends to complete 1300-
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50 319 1500 face-to-face computer-assisted interviews across a country with a relatively dispersed
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52 320 population of citizens and large geographical distances between them. Data collection
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54 321 involves a small number of interviewers working over an eight-month period.
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3 323 Both the duration and magnitude of the tasks involved make the interview demanding. It is
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5 324 important that data collection is cost-effective, which includes considerations of data quality,
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7 325 representativeness and total number of valuations. Given the strategy of sampling locations
8
9 326 and organisations rather than individuals, the assessment of its effectiveness in terms of
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11 327 number and representativeness of respondents will be important following the initial data
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13 328 collection period. Poor recruitment and data collection in remote geographical locations will
14
15 329 be costly. The number and characteristics of respondents per location will be monitored
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17 330 throughout data collection. Adaptive sampling will allow for inclusion of additional locations
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19 331 where response rates are low and quotas are not met. Additional locations will be chosen at
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21 332 random from the predefined frame of possible locations within the selected geographical area.
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25 334 Due to the need for extensive training, interview experience, and understanding of the task,
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27 335 only eight to twelve interviewers will be included. This will give more control over the data
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29 336 collection and the quality of the data collected. However, this and potential costs saved in
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31 337 terms of interviewer recruitment, training and travel costs, must be balanced against the
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33 338 increased impact of any loss of interviewers through illness or resignation during data
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35 339 collection. Norway has a harsh winter climate and apart from the Southern and Eastern
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37 340 region, where the interviewers are based, the interviews will primarily take place outside the
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39 341 winter months to reduce the risk of travel delays and interviewer illness. The NIPH, which is
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41 342 conducting the research, has several experienced interviewers familiar with the study who will
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43 343 be able to complete training and contribute to data collection if needed.
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54 345 The main justification for the strategy of sampling stratified locations and the use of quotas on
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56 346 the respondent level is to ensure representativeness of the final sample according to
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58 347 geographical region, age, sex and educational level. An additional quota will be used to
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3 348 recruit those with less than perfect health, through locations such as hospitals and
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5 349 rehabilitation centres. Locations will also be selected to directly seek out others who are
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8 350 typically harder to reach and are less likely to participate in research studies, such as those
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10 351 with different ethnic backgrounds or with young children. Studies have found that some
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12 352 attributes, such as marital and caregiver status/having young children, may influence the
13
14 353 respondents response to the task, such as their willingness to trade time in the TTO task,
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17 354 despite showing similar preferences for given health states when using other types of
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19 355 valuation tasks [56, 58]. Hence, it is important that respondents with such attributes are
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21 356 included in the study and locations such as day care facilities for young children and primary
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23 357 schools will be selected to facilitate this. Questions relating to these attributes will be included
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26 358 in the background questions closing the interview, and as such will allow for sub-group
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28 359 analysis of the effect of these attributes on the valuation of health in the Norwegian sample.
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33 361 The derivation of values based on experienced health states is a recent development in the
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35 362 field of health state valuation [48]. In recent years, there have been major developments in the
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37 363 field of standardised protocols for health state valuation, including EuroQol EQ-VT. Such
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39 364 standardisation is a long way off for experienced health state valuation and, as was the case
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42 365 for hypothetical health state valuation up until the last decade, there is considerable variation
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44 366 in the choice of methods [60]. In Norway and other countries, the feasibility of collecting such
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47 367 data is still in its infancy, including choice of sampling strategies, recruitment and how to
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49 368 minimise respondent burden. This study builds on existing methodology in the form of EQ-
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51 369 VT protocol, to assess the feasibility of recruiting potential respondents (including from
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53 370 health care settings) for experience-based health state valuation, respondent burden in the
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55 371 form of completed interviews and data quality. The study design is constrained by the EQ-VT
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58 372 protocol, but the results of the study will inform the development of more appropriate
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3 373 methodology in the future. Furthermore, the design will allow the comparison of results with
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5 374 those for hypothetical health state valuation.
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14 378 **Ethics and dissemination**

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17 379 The study was reviewed by The Regional Health Authority Research Ethics Committee and
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19 380 found to be outside of the scope of the ethics committee thus not in need of ethical approval.
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21 381 All study participants will give informed consent.
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24 382 The final scoring algorithm will contribute to the quality and relevance of the results of EQ-
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26 383 5D applications in Norway, and it is highly likely that, when available, the EQ-5D-5L with a
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28 384 Norwegian scoring algorithm will be the recommended instrument of choice for future
29
30 385 economic evaluations undertaken in Norway by the pharmaceutical industry and other
31
32 386 important users. Application of the same instrument and scoring across the health services and
33
34 387 industry will further enhance decision-making relating to scarce health care resources.
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36 388 Moreover, scores based on Norwegian preferences will further enhance the appropriateness of
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38 389 the EQ-5D in clinical and health services research and quality indicators work, including the
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40 390 national quality registers.
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47 392 The study results will be published in peer-review scientific journals, presented at appropriate
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49 393 forums, including national and international conferences, and scoring algorithms made
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51 394 publicly available for R, Stata and other widely used statistical software. Presentations will be
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53 395 given to users of the research, including research centres that widely use the EQ-5D in
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55 396 clinical, health services and health economics research in Norway.
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4 398 **List of abbreviations**

5 399 EQ-VT EuroQol Valuation Technology

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8 400 cTTO Composite time trade-off

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11 401 DCE Discrete choice experiments

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14 402 QALY Quality Adjusted Life Year

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17 403 PROMs Patient Reported Outcomes Measures

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20 404 NQR National Quality Registries

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23 405 NICE National Institute for Health and Care Excellence

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26 406 NIPH Norwegian Institute of Public Health

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29 407 QC Quality control software included in the EQ-VT software

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38 410 **Declarations**

39 411 **Competing interests**

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42 412 The authors have no competing interests.

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45 413 **Availability of data and material**

46
47
48 414 Not applicable.

49
50
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52
53
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57
58 418 Institute of Public Health.
59
60

419 Author contributions

420 AG conceived the study and secured funding. TMH, YH and AG designed the study. LA, KR
 421 and KS commented and recommended revisions. . TMH and AG drafted and revised the
 422 manuscript. YH, LA, KR and KS have read and approved the final version. All authors agree
 423 to be accountable for all aspects of the work.

424

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556 Tables

557 Table 1: Locations for recruitment of participants, by age group and health status

Healthy	Reduced health
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Young	Middle-aged	Elderly	All ages	All ages
Places of higher education	Workplaces	Eldery homes	Public library	Hospitals
Child daycare facilities/ Primary schools	Recreational organisations (sports teams)	Recreational organisations (choirs/orchestras)	Town hall	Rehabilitation centres
Social welfare*	Social welfare* Adult education*	Community volunteer centres		Health centres

558 *Locations chosen to increase participation of those with lower socio-economic status

559 Table 2: Example sampling of hospital catchment areas and quotas per catchment area

Region	Population in region	Catchment area	Population in catchment area	Quota per catchment area
Northern	381907	Hospital 1	130000	140
Central	560690	Hospital 2	60000	205
Western	843899	Hospital 3	330000	309
South-Eastern	2299890	Hospital 4	500000	448
South-Eastern	“	Hospital 5	160000	143
South-Eastern	“	Hospital 6	280000	251

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561 Table 3: Example of quotas within a sampled catchment area based on the composition of sex,
562 age and educational level in the general population of the respective region (source: Official
563 statistics for 2017 generated from microdata.no). Example given sampling scenario and
564 catchment area for Hospital 1 in Table 2.

Sex	Highest attained educational level	Age groups							Total quota per sex and educational level
		18-24	25-34	35-44	45-54	55-64	65-74	75+	
Male	Primary or secondary	8	9	8	9	9	7	5	56
	Tertiary	1	3	3	3	3	2	1	16
Female	Primary or secondary	7	6	5	7	8	8	7	47
	Tertiary	1	5	5	5	3	2	1	22
Total quota per age group		17	22	22	25	22	18	14	140

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566 Table 4. Reference data for the calculation of quotas, data for 2018 (<http://microdata.no>,
567 Statistics Norway, data accessed: 12.03.2019)

Region	Sex	Highest attained educational level	Age group						
			18-24	25-34	35-44	45-54	55-64	65-74	75+

South-Eastern region	Male	Primary or secondary	117 220	130 448	133 470	143 252	119 278	94 473	62 167
		Tertiary	13 603	72 661	77 273	66 785	51 553	40 368	19 650
	Female	Primary or secondary	100 571	94 904	99 033	120 226	114 228	107 739	103 859
		Tertiary	24 196	104 395	101 833	79 908	55 565	34 126	17 126
Western region	Male	Primary or secondary	48 863	54 616	52 141	54 172	44 925	34 032	23 977
		Tertiary	5 129	26 041	27 176	21 446	17 552	12 302	5 291
	Female	Primary or secondary	40 743	35 932	34 778	42 701	40 672	36 866	38 127
		Tertiary	9 928	39 550	36 796	27 107	18 494	9 777	4 750
Central region	Male	Primary or secondary	32 425	33 771	32 095	36 110	32 525	26 289	18 441
		Tertiary	3 674	15 730	15 703	13 497	11 291	8 664	3 521
	Female	Primary or secondary	26 707	21 526	21 130	28 292	29 998	28 218	28 275
		Tertiary	6 456	23 177	22 577	18 320	12 267	6 980	3 024
Northern region	Male	Primary or secondary	22 976	23 320	21 793	25 812	23 582	20 282	13 464
		Tertiary	1 736	7 895	8 724	9 427	7 450	5 273	1 845
	Female	Primary or secondary	18 357	15 382	14 562	19 478	20 589	20 492	19 767
		Tertiary	3 470	13 212	14 402	13 721	8 872	4 300	1 707

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569 **Figures**

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571 Figure 1: Hospitals with Acute Care Function in Norway

572 Figure 2: Screenshot of visual aid for cTTO task in EQ-VT

573 Figure 3: Screenshot of visual aid for DCE task in EQ-VT

574 Figure 4: Screenshot of the feedback module in EQ-VT

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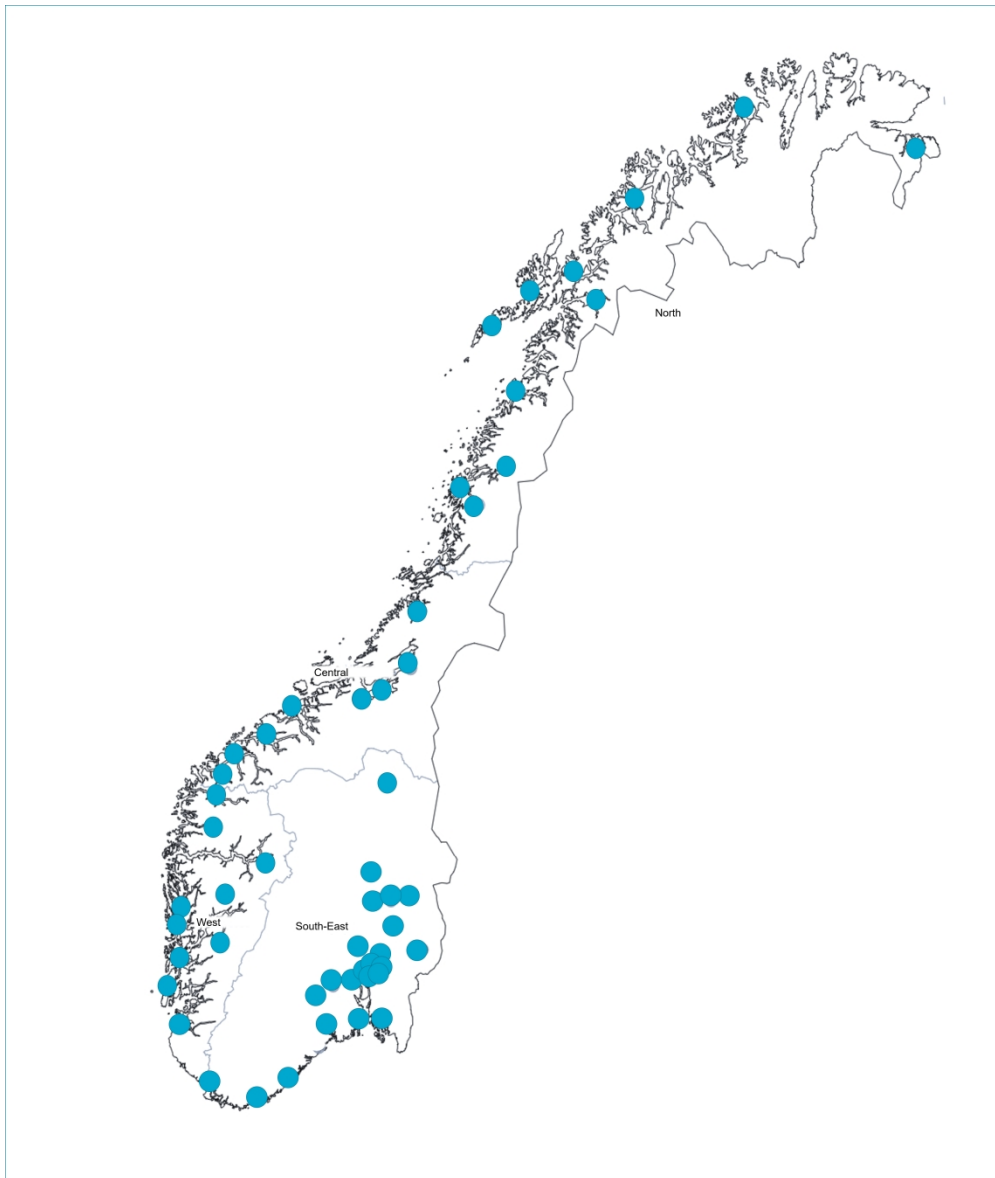


Figure 1: Hospitals with Acute Care Function in Norway

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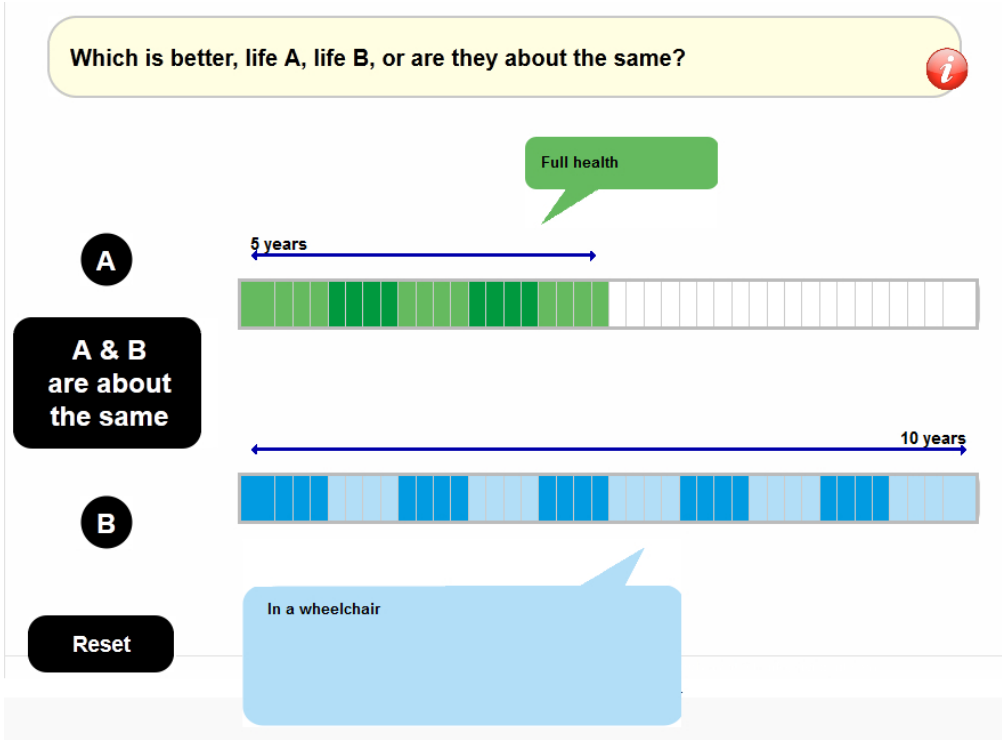


Figure 2: Screenshot of visual aid for cTTO task in EQ-VT (source: EuroQol Foundation)

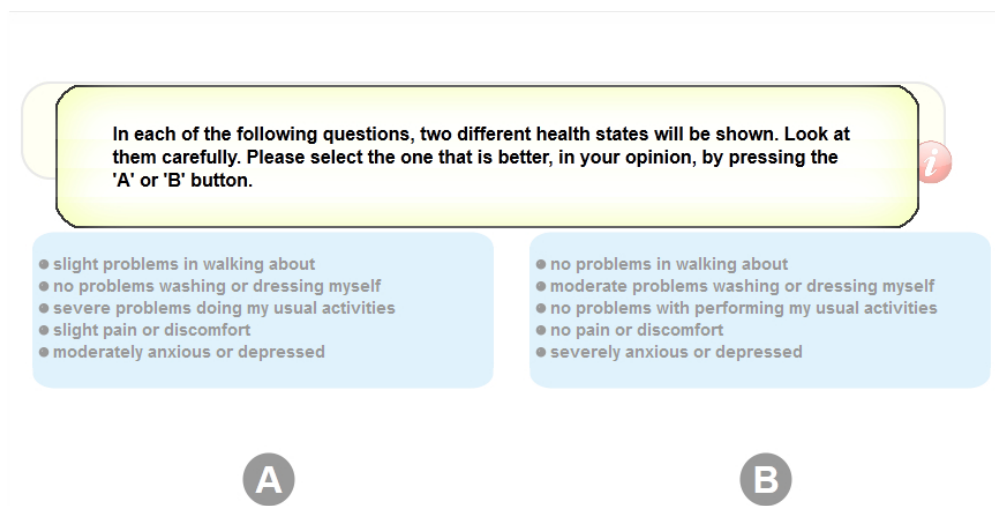


Figure 3: Screenshot of visual aid for DCE task in EQ-VT (source: EuroQoI Foundation)

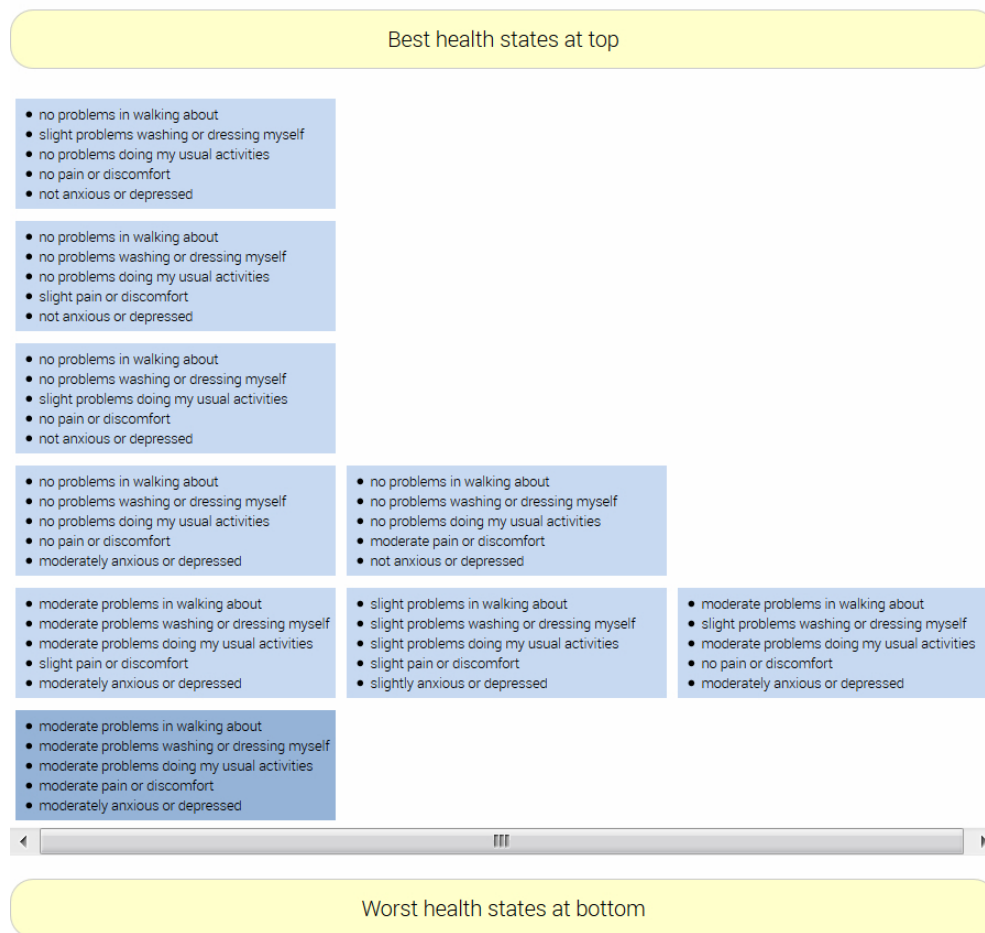


Figure 4: Screenshot of the feedback module in EQ-VT (source: EuroQol Foundation)