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Translation, adaption and psychometric testing of the German version of the Organizational Readiness for Implementing Change measure (ORIC)

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034380
Article Type:	Original research
Date Submitted by the Author:	17-Sep-2019
Complete List of Authors:	Lindig, Anja; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Hahlweg, Pola; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Christalle, Eva; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Scholl, Isabelle; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology
Keywords:	Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-making, Measurement

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3 1 **Translation, adaption and psychometric testing of the German version of the Organizational**
4
5 2 **Readiness for Implementing Change measure (ORIC)**

6
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49 25 Word count: 3844
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3 31 **ABSTRACT**

4
5 32 **Objectives** to translate the measure Organizational Readiness for Implementing Change (ORIC) into
6
7 33 German, adapt it for the context of SDM, and assess its psychometric properties.

8
9 34 **Design** psychometric study based on secondary analysis of baseline data from a SDM implementation
10
11 35 study.

12
13 36 **Setting** Three departments within one academic cancer center in Hamburg, Germany

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15 37 **Participants** For comprehensibility assessment of the translated ORIC version we conducted cognitive
16
17 38 interviews with n=11 healthcare professionals (HCPs). Afterwards, n=230 HCPs filled out the measure.

18
19 39 **Primary and Secondary Outcome Measures** The original English version of the ORIC was translated into
20
21 40 German using a team translation protocol. Based on comprehensibility assessment via cognitive interviews
22
23 41 with HCPs, the translated version was revised. For psychometric evaluation we conducted a secondary
24
25 42 analysis of baseline data from a SDM implementation study. We analyzed acceptance (response rate),
26
27 43 structural validity (exploratory factor analysis (EFA), confirmatory factor analysis (CFA)), item
28
29 44 characteristics (item difficulties, corrected item-total correlations, inter-item correlations), and reliability
30
31 45 (Cronbach's α).

32
33 46 **Results** Translation and cognitive testing of the ORIC was successful except for item 10, which showed
34
35 47 low comprehensibility. Response rate was > 97%. Structural validity analysis provided a one factorial
36
37 48 structure. Item difficulties ranged between 55.98 and 65.32, corrected item-total-correlation ranged
38
39 49 between .66 and .74, inter-item correlations ranged between .43 and .72, and Cronbach's α was .93.

40
41 50 **Conclusions** The translated and adapted German ORIC is a highly accepted and reliable measure with
42
43 51 satisfying psychometric properties and a one factorial structure. To increase comprehensibility and
44
45 52 therefore content validity of the measure we suggest to remove item 10. The German ORIC can be used
46
47 53 to analyze organizational readiness for change as a precursor for implementation success of various
48
49 54 interventions.

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53 56 **Keywords:**
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55 57 Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-
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57 58 making, Measurement
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ARTICLE SUMMARY**Strengths and limitations of this study**

- Appropriate qualitative methods were used to provide a German version of the ORIC which is comprehensible to healthcare professionals (HCPs).
- The sample size was large enough to robustly perform the psychometric analyses on the German version of the ORIC measure.
- Due to the design of the study as a secondary analysis, it was not possible to calculate some psychometric parameters.
- Data was collected at a single academic cancer center. Thus, psychometric properties of the German ORIC need replication in other settings.

INTRODUCTION

Implementing interventions in healthcare systems is an important and widely discussed topic [1–3] and often mediated by public policies, market forces, or new technologies [4]. The intention to implement new interventions might be to reduce costs, improve quality, increase efficiency, or patient satisfaction [5]. Nevertheless, implementing change in healthcare organizations can be challenging [6–10].

In the German healthcare system, the implementation of shared decision-making (SDM) has received much attention [11]. SDM can be described as an interactional process on the basis of information exchange. Patients and healthcare professionals (HCPs) are equally and actively involved and jointly responsible for the decision [12–14]. SDM has been supported by health policy [15–17] and research [18–21] during the last decades. However, SDM is currently not widely implemented in the German healthcare system [11,22–24].

When implementing SDM or other interventions in organizations, several barriers on different levels of the organization (individual members of the organization, teams, organizational setting, wider environment) need consideration [1,5–7,10,25–28]. Barriers for implementing SDM in the clinical setting often address both the organizational setting (e.g. lack of resources and lack of management support) and the individual level (e.g. resistance to change or negative attitudes towards SDM) [7,10,11,29–31].

When implementing SDM or other interventions in healthcare systems, the clinical members' perspective on organizational readiness for change is a critical precursor to successfully implement empirical

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2
3 91 knowledge [5,28,32–34]. Armenakis et al. [35] describes organizational readiness for change as the degree
4
5 92 to which organizational members are prepared to participate in change processes. This is characterized by
6
7 93 the belief that the change is needed and that the organization is capable of changing. Weiner et al. [36]
8
9 94 differentiate between change commitment, where organizational members have positive attitudes towards
10
11 95 implementing a change, and change efficiency, where they belief in capability to change. If readiness for
12
13 96 change is high, organizational members invest more in the change effort and exhibit greater persistence to
14
15 97 overcome obstacles and setbacks [36,37].

16 98 To analyze effects on change implementation success and to find suitable strategies to best implement
17
18 99 changes, specific measures for assessing organizational readiness for change are needed [5]. However,
19
20 100 only a few validated measures exist [5,38–40] and none were available in German. One of those measures
21
22 101 is the Organizational Readiness for Implementing Change (ORIC) [39]. The ORIC is the only available
23
24 102 measure that is brief, easy to administer and theoretically grounded [36]. It was previously translated into
25
26 103 Danish and French [41,42]. The ORIC has been psychometrically tested, revealing good acceptability
27
28 104 (response rate > 72%), good reliability (Cronbach's $\alpha > .80$) and good validity with a two factor structure
29
30 105 [39,41,42]. Due to the described properties, the ORIC seemed well-suited to measure organizational
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32 106 readiness for implementing SDM in Germany [5,39,43].

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34 107 Therefore, the aim of the study was to translate the ORIC into German, adapt it for the context of SDM, and
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36 108 assess its psychometric properties.

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39 110 **METHODS**

40 111 **Measure**

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42 112 The ORIC measures organizational readiness for implementing change. It uses a 5-point Likert scale
43
44 113 ranging from 0 „disagree“ to 4 „agree“ [39]. In the original English version, two subscales were described:
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46 114 „change commitment“ (items 1 to 5) and “change efficiency” (items 6 to 10). Sum scores were calculated
47
48 115 for both subscales separately with higher scores indicating higher organizational readiness for change. By
49
50 116 using the phrases “to implement this change” or “implementing this change”, the original scale does not
51
52 117 specify, which change is addressed. The items can be specified to adapt to a specific research question
53
54 118 and an introductory description can be added [36,41] . English items are displayed in Table 5.

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56 119

57 120 **Translation**

1
2
3 121 Translation followed the team translation protocol TRAPD (Translation, Review, Adjudication, Pretesting
4
5 122 and Documentation) [44]. First, two team members (AL, SZ, cp. list of abbreviations) proficient in German
6
7 123 and English independently translated the original ORIC into German. Second, a third bilingual team
8
9 124 member (IS) suggested a third version based on the first two translations. Finally, we discussed all versions
10
11 125 until reaching consensus on a final version. To find consensus on item 10 we additionally consulted an
12
13 126 official translator (MM, cp. list of abbreviations) and an additional team member (PH).

14
15 127

16 128 **Assessment of comprehensibility as part of content validity and subsequent adaption of the scale**

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18 129 Content validity is the degree to which the content of the measure and its items is adequately reflecting the
19
20 130 measured construct [45]. According to the COSMIN criteria (Consensus-based Standards for the selection
21
22 131 of health Measurement Instruments) [46], content validity includes the relevance of the items and scales,
23
24 132 their comprehensiveness, and comprehensibility. As this study aimed at testing the translation of an existing
25
26 133 measure, we focused on assessment of comprehensibility, which includes that items are appropriately
27
28 134 worded and understood by participants as intended.

29
30 135 To do so, we conducted two rounds of cognitive interviews with a convenience sample of HCPs (nurses,
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32 136 physicians, and psychooncologists), working in a comprehensive cancer center in Germany. Two female
33
34 137 psychologists experienced in interviewing (AL, PH) conducted the interviews. A compensation fee of 25
35
36 138 Euro was offered to the participants. We developed an interview guide based on recommendations of Willis
37
38 139 et al. [47] and conducted interviews until reaching theoretical saturation. Interviews were audio-recorded
39
40 140 and transcribed verbatim. After each round of cognitive interviews, we extracted and discussed comments
41
42 141 and suggestions from the transcripts (AL, PH, IS) and adapted the German ORIC scale accordingly. As a
43
44 142 further step to enhance comprehensibility, we discussed the items in the study team (AL, PH, IS, SZ, cp.
45
46 143 list of abbreviations), with a second bilingual researcher in the field (DF, cp. list of abbreviations), the original
47
48 144 author (CS, cp. list of abbreviations) as well as French (MR, cp. list of abbreviations) and Norwegian
49
50 145 researchers (AH, cp. list of abbreviations) who have been working on translations of the ORIC into their
51
52 146 languages.

53 147 We calculated descriptive statistics of demographic characteristics of participants using SPSS (IBM SPSS
54
55 148 Statistics, Version 23).

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57 149

58 150 **Psychometric evaluation**

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3 151 **Data collection.** The psychometric evaluation of the ORIC measure is a secondary analysis of data
4
5 152 gathered in a SDM implementation study [48]. Data from baseline assessment of the SDM implementation
6
7 153 study were included. The ORIC was part of a three-page questionnaire measuring HCPs' attitudes
8
9 154 regarding SDM and its implementation. Besides the ORIC, it contained the Control Preference Scale [49]
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11 155 and the IcanSDM [50], demographic questions (e.g. gender, age, profession, work experience) as well as
12
13 156 several self-generated questions [51]. Results of these additional measures will be published as part of the
14
15 157 primary evaluation of the SDM implementation study.

16
17 158 Participants were physicians and nurses, who worked at one of three departments within the University
18
19 159 Cancer Center Hamburg at the University Medical Center Hamburg-Eppendorf. Eligible HPCs were
20
21 160 identified through employee lists provided by department managers. The measure was handed out either
22
23 161 (1) by a member of the study team (e.g. during a regular physician meeting), (2) by the supervising nurses,
24
25 162 or (3) via employees' mailboxes. Participants returned the questionnaire personally to a study team member
26
27 163 or by mail.

28 164 Data were entered into SPSS (IBM SPSS Statistics, Version 23) including blinded double entry of 20% of
29
30 165 the data for quality control.

31
32 166 **Data Analysis.** Descriptive statistics were calculated for demographic characteristics. Cases were
33
34 167 excluded if more than 30% of the ORIC items were missing. For all other cases, missing data were replaced
35
36 168 with item means. We evaluated the response rate and therefore the acceptance of the measure by
37
38 169 calculating frequencies of missing data per item. For analysis of acceptance, we also included the cases
39
40 170 with more than 30% of ORIC items missing.

41
42 171 We a priori hypothesized to replicate the two-dimensional structure of the original English ORIC version.
43
44 172 Two factors "change commitment" (item 1 to 5) and "change efficiency" (item 6 to 10) were postulated.
45
46 173 Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were
47
48 174 performed to test prerequisites for factor analysis [52,53]. A confirmatory factor analysis (CFA) with
49
50 175 Maximum Likelihood Estimates and two factors was applied for the whole data set as a first step. Because
51
52 176 the two-factor model could not be confirmed, the data set was randomized and split into two subsets (each
53
54 177 n=115). An exploratory factor analysis (EFA) with orthogonal varimax rotation and extraction of components
55
56 178 with eigenvalues > 1 was applied for the first subset. A CFA was again calculated for the second subset. A
57
58 179 range of global goodness of fit indices were used to assess the degree to which observed data were
59
60 180 accounted for by the proposed models: discrepancy chi-squared statistic (χ^2), degree of freedom (df),

181 normed chi-squared statistic (χ^2/df), comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean
 182 square error of approximation (RMSEA) as well as Akaike Information Criterion (AIC) and Parsimonious
 183 Normed Fit Index (PNFI) for analysing model complexity. Established rules to estimate the model fit were
 184 used [54–57].

185 Item analysis was performed for the one-factor model. It included calculation of item means and standard
 186 deviation as well as observation of floor and ceiling effects [58], calculation of corrected item-total
 187 correlations [52,59], inter-item correlations [52,59], and item difficulties [53]. Internal consistency of the
 188 scale was assessed by Cronbach's alpha coefficient (α) [53,59,60]. For a detailed overview on performed
 189 data analyses see Table 1.

190 Because of low content validity of item 10, the use of item 10 for the German ORIC needs to be evaluated.
 191 Therefore, we also conducted psychometric analysis (EFA with varimax rotation and extraction of
 192 components with eigenvalues > 1 , corrected item-total correlations, Cronbach's α , and goodness of fit
 193 indexes) for the 9-item version of the ORIC (see Supplementary File 1).

194 Analysis of demographic data, analysis of response rate, item analysis and EFA were performed using
 195 SPSS (IBM SPSS Statistics, Version 23). CFA and calculation of model fit indices were performed using
 196 Amos (IBM SPSS Amos 22.0.0).

198 Table 1: Psychometric analyses conducted.

Psychometric measure	Criteria
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity	These tests ensure that correlations between variables can be accounted for by a smaller set of factors [53]. KMO value should be higher than .05 and Bartlett's test value should be less than .05 to fulfil the criteria for calculating a factor analysis [53,54].
Analysis of frequencies for item response distributions	Floor and ceiling effects were assumed present if more than 15% of participants choose the lowest or highest possible score [59].
Corrected item-total correlations	If items correlate with the total score of above .30, they measure the same underlying concept. Items with lower correlations should be removed because they do not add exploratory power to the measure [53,60].
Item difficulties	Item difficulties are calculated by dividing item means by the maximal value of the answer range (0-4) and multiplying it with 100. Item difficulty should be near to 50%, and items should not differ much in their difficulty level [54].

Inter-item correlations	Inter-item correlations ensure association between items. High inter-item correlations of above .80 indicate that items ask the same questions and might be redundant [53,60].
Cronbach's α	Cronbach's α is a measure for reliability and internal consistency. A value of at least .70 is acceptable and higher coefficients indicate a more stable measure [53,54,61].
Normed chi-squared statistic (Chi ² /df)	Chi ² /df is an indicator for model fit, dependent on sample size and should be as small as possible. A ratio between 2 and 3 indicate a good data fit [55].
Comparative fit indexes (CFI)	CFIs is an indicator for model fit. It ranges from 0 to 1 and higher values indicate better fit. Values above .95 indicate a good model fit [58,62].
Tucker-Lewis Index (TLI)	TLI is an indicator for model fit. It corrects for complexity of the model and is sensitive to small sample sizes. Values above .95 indicate good fit [56].
Root mean square error of approximation (RMSEA)	RMSEA is an absolut index which describes closeness to fit. Values below .05 indicate a good fit, values between .05 and .08 indicate an adequate fit, values between .08 and 1 indicate a moderate fit and values above 1 are unacceptable [63].
Akaike Information Criterion (AIC)	AIC is a parsimony model fit index. It can be used to compare fit of competing models with smaller values indicating better fit [55,58].
Parsimonious Normed Fit Index (PNFI)	PNFI is a parsimony model fit index. It ranges between 0 and 1 and higher values indicate a more parsimonious fit [55]. No threshold levels are recommended and it has to be analysed in combination with other goodness of fit indices [58].

199

200 Patient and public involvement

201 The measure ORIC preliminary addresses HCPs, therefore physicians, nurses and psychooncologists were
 202 involved in the adaption of the measure by taking part in cognitive interviews. Our cooperation partner
 203 as well as stakeholders of the three participating clinics (physicians and nurses) supported the recruitment
 204 process by handing over surveys to their colleagues or supporting us to reach eligible participants. Patients
 205 were not involved in this study.

206

207 RESULTS

208 Translation

209 We adapted the ORIC to fit our research question of SDM implementation. Therefore "to implement this
 210 change" / "implementing this change" was rephrased into "to implement shared decision-making" /
 211 "implementing shared decision-making". Additionally we added an introductory description. Within the first

1
2
3 212 round of discussion, we reached consensus for items 1 to 9. We struggled to translate the phrase “manage
4
5 213 the politics” in item 10 into German. Therefore, we discussed item 10 with additional colleagues (cp.
6
7 214 methods section) until consensus was found.
8
9 215

216 **Assessment of comprehensibility as part of content validity and subsequent adaption of the scale**

12 217 To test the German ORIC for comprehensibility, cognitive interviews with N=11 participants (nurses,
13
14 218 physicians, and psychooncologists) were conducted. Cognitive interviews lasted about one hour. For
15
16 219 demographic data of participants see Table A in Supplementary File 2.

18 220 After two rounds of cognitive interviews and slight modifications of single words or phrases, items 1 to 9
19
20 221 were well understood by all participants. Item 10 could not be translated successfully. After the first round
21
22 222 of cognitive interviews with n=7, we adapted item 10 after discussions within the study team (AL, PH, IS)
23
24 223 as well as with other international researchers working with the ORIC (CS, AH, MR, cp. list of abbreviations).

26 224 A second round of cognitive interviews with n=4 showed that comprehension of the German translation of
27
28 225 the phrase “manage the politics” did not picture the correct English meaning. We therefore involved another
29
30 226 bilingual SDM implementation researcher (DF, cp. list of abbreviations). We found consensus for an
31
32 227 adapted version of item 10 but it was still not satisfying from the study team and experts view. Item 10 was
33
34 228 found to have low comprehensibility as part of content validity according to COSMIN criteria [46]. The final
35
36 229 German ORIC measure, used in this study, is presented in Supplementary File 3.

37 230 During cognitive interviews some nurses reported that they had not heard about the term “shared decision-
38
39 231 making” (German: “Partizipative Entscheidungsfindung”) prior to participation. Thus, we provided a
40
41 232 definition of SDM in the introduction part of the questionnaire within the SDM implementation study.
42
43 233

234 **Psychometric evaluation**

47 235 **Sample characteristics.** Data of 235 HCPs were available for this secondary analysis. Five cases were
48
49 236 excluded (except for assessment of response rate), because all items of the ORIC were missing. For all
50
51 237 other cases <30% of the items were missing. Thus, data of 230 HCPs could be included into analysis.

52 238 Table 2 provides an overview of demographic characteristics of participants. Most of the 230 HCPs were
53
54 239 between 31 and 40 years old (36.96%), female (70.43%), worked as a nurse (56.96%), and had a work
55
56 240 experience of < 5 years (43.91%).
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58 241
59
60

242 Table 2: Demographic characteristics of participants (n=230).

		N	%
Age	< 30 years	72	31.3
	31-40 years	85	36.96
	41-50 years	42	18.26
	> 50 years	26	11.30
	Missings	5	2.17
Gender	Female	162	70.43
	Male	59	25.65
	Different gender or preferred not to answer questions	5	2.1
	Missings	4	1.74
Profession	Nurse	131	56.96
	Junior physician	69	30.00
	Senior physician	27	11.74
	Missings	3	1.30
Work experience in healthcare	< 5 years	101	43.91
	5-10 years	48	20.87
	11-20 years	46	20.00
	> 20 years	28	12.17
	Missings	7	3.04

243
244
245 **Structural validity.** KMO measure was .933 and Barlett's test of sphericity yielded $X^2 = 1485.11$, $p < .001$,
246 indicating that a factor analysis of the data was appropriate. CFA for the hypothesised two-factor model
247 showed a high correlation of .87 between the two components (see Supplementary File 4). Therefore, we
248 postulated a one factorial structure and conducted a post-hoc EFA. Since the main component explains
249 67% of the variance, a one-factor model was assumed (see Table 3). The factor loading for the first
250 component is shown in Table B of Supplementary File 2.

252 Table 3: Results of EFA.

	Eigenvalue		
	Total	% of variance	Cumulative %
Component 1	6.72	67.23	67.23
Component 2	0.83	8.30	75.53
Component 3	0.47	4.75	80.28
Component 4	0.41	4.08	84.36
Component 5	0.39	3.91	88.28
Component 6	0.32	3.24	91.52
Component 7	0.27	2.74	94.26
Component 8	0.23	2.34	96.60
Component 9	0.17	1.74	98.35
Component 10	0.16	1.65	100.00

253 Notes: Eigenvalues of the ten components of the German ORIC, percentage of explained variance, and cumulative percentage of explained variance of each component. For EFA, half of the data set (n=115) was used.

254
 255 A CFA was performed again with the one-factor model to analyse its fit indices. Indices of the two-factor
 256 model and the one-factor model are compared in Table 4.

257

258 Table 4: Fit indices of two calculated models for factor analysis of the German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
Two-factor model	81.71*	34	2.40	.968	.947	.078	143.71	.585
One-factor model	77.19*	35	2.20	.928	.907	.103	117.19	.682

Notes: Two-factor model was calculated for the whole data set (n=230): factor 1 includes item 1 to 5, factor 2 includes item 6 to 10; One-factor model was calculated for half of the data set (n=115): includes items 1 to 10.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

259
 260
 261 Results of factor analysis for the 9-item version of the ORIC (without item 10) were similar. For the 9-item
 262 version also, a one-factor model was assumed by exploratory factor analysis. Goodness of fit indices of the
 263 one-factor model of the 9-item ORIC version showed similar values compared to the 10-item ORIC version
 264 (see Supplementary File 1).

265
 266 **Analysis of the ORIC items and reliability.** Table 5 shows response distribution, means, standard
 267 deviations, acceptance, corrected item-total correlation and item difficulty of the ten items. Means range
 268 between 2.24 (item 9) and 2.61 (item 5). Most people responded in the middle of the scale with a slight shift
 269 to more agreement. Missing values for items 1 to 9 ranged from four to six. For item 10, nine missing values
 270 were found. Taking all items into account, more than 97% of the measure were answered. Corrected item-
 271 total correlations ranged from .66 (item 9) to .74 (item 3), and item difficulties ranged from 55.98 (item 9) to
 272 65.32 (item 5). Inter-item correlations range from .434 (item2/item9) to .723 (item3/item 5) (see Table C of
 273 Supplementary File 2). Internal consistency yielded a Cronbach's α of .93.

274 Results of reliability and item analysis of the 9-item ORIC version were similar to results for the 10-item
 275 version (see Supplementary File 2).

276

277

278 Table 5: Response distribution, means, standard deviation, acceptance, discrimination and item difficulty of the German ORIC.

Items	Disagree N (%)	Somewhat Disagree N (%)	Neither Agree nor Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Mean (SD)	Acceptance (Response in %)*	Item discrimination (corrected item-total correlation)	Item difficulty
1 People who work here are committed to implementing shared decision-making.	1 (0.4)	22 (9.6)	109 (47.0)	73 (30.9)	25 (10.9)	2.42 (.826)	97.43	.744	60.58
2 People who work here will do whatever it takes to implement shared decision-making.	4 (1.7)	37 (16.1)	103 (44.8)	68 (29.6)	18 (7.4)	2.25 (.878)	98.29	.689	56.36
3 People who work here want to implement shared decision-making.	0 (0.0)	15 (6.5)	107 (46.5)	84 (35.7)	24 (10.4)	2.50 (.768)	97.43	.774	62.61
4 People who work here are determined to implement shared decision-making.	2 (9.0)	38 (16.5)	107 (46.5)	67 (29.1)	16 (7.0)	2.25 (.843)	98.29	.758	56.19
5 People who work here are motivated to implement shared decision-making.	1 (0.4)	16 (7.0)	85 (37.0)	97 (42.2)	31 (13.5)	2.61 (.821)	98.29	.764	65.32
6 People who work here feel confident that they can handle the challenges that might arise in implementing shared decision-making.	2 (0.9)	20 (8.7)	93 (40.4)	93 (40.4)	22 (9.6)	2.49 (.819)	98.29	.760	62.28
7 People who work here feel confident that they can keep track of progress in implementing shared decision-making.	1 (0.4)	26 (11.3)	93 (40.4)	92 (40.0)	18 (7.8)	2.43 (.811)	98.29	.725	60.87
8 People who work here feel confident that they can coordinate tasks so that implementation goes smoothly.	5 (2.2)	24 (10.4)	107 (46.5)	78 (33.5)	16 (6.5)	2.32 (.833)	99.56	.697	58.13
9 People who work here feel confident that the organization can support people as they adjust to shared decision-making.	6 (2.6)	43 (18.7)	89 (38.7)	74 (32.2)	18 (7.8)	2.24 (.934)	97.86	.665	55.98
10 People who work here feel confident that they can manage the politics of implementing shared decision-making.	3 (1.3)	24 (10.04)	122 (50.9)	65 (28.3)	16 (7.0)	2.29 (.796)	96.15	.714	57.44

Notes: Items could be answered on a 5-step Likert scale rating from 0 „disagree” to 4 „agree”. SD = standard deviation. * For calculation of response rate, four additional cases were included because these participants only skipped the ORIC but filled out the rest of the questionnaire.

279

280 **DISCUSSION**

281 The original English ORIC measure is a brief measure with good psychometric properties [39], which were
282 confirmed in Danish [41] and French [42] validation studies. We chose the ORIC to assess organizational
283 readiness for implementing SDM in a implementation study in a hospital setting in Germany [48]. As a first
284 step, the study at hand aimed to translate the ORIC into German, adapt it for the context of SDM, and
285 assess its psychometric properties.

287 **Assessment of comprehensibility as part of content validity**

288 Items 1 to 9 could be translated and adapted successfully. Feedback by participants, members of the study
289 team, and external experts as well as response rates suggest that item 10 could not be translated
290 satisfyingly and comprehensibility of this item is low [46]. A reason might be the translation of the phrase
291 “manage the politics” into “Machenschaften”. We assume that the term “manage the politics” has a strong
292 cultural connotation because no equivalent phrase in German language exists. The German phrase
293 “Machenschaften” might be confusing for some participants and they decided to rather skip the item. Ruest
294 et al. [42], who translated the English ORIC into French, also identified several differences in cultural
295 concepts during their adaptation process but could translate all items successfully. They concluded that
296 limitations in linguistic validation could decrease comparability of psychometric results of the translated
297 measure. In our sample, item 10 comes along with similar and inconspicuous item characteristics compared
298 to other items. When repeating factor and item analyses for the 9-item ORIC version including only item 1
299 to 9, very similar results were observed compared to the 10-item version. Thus, we would recommend to
300 use the 9-item ORIC version to increase comprehensibility and therefore content validity of the scale.

302 **Structural validity**

303 We could not confirm the two-factor structure of the English and the translated Danish and French versions
304 of ORIC [39,41,42]. Results of EFA indicated a one-factor structure while the two-factor model showed
305 better fit indices. Both models have acceptable values for χ^2/df [54] and CFI [57,61] but only the two-
306 factor model has acceptable values for TLI [55] and RMSEA [62]. When involving parsimony of the models
307 by calculating AIC and PNFI, the one-factor model fits better to the data [54,57]. Therefore, the more
308 parsimonious one-factor model should be preferred.

310 **Analysis of ORIC items and reliability**

311 Missing value rates for single items and the overall measure were quite low. Therefore, the German version
312 of the ORIC was found to be a well-accepted measure. Observations of floor and ceiling effects, corrected
313 item-total correlations, item difficulties, and inter-item correlations met the criteria for good quality of
314 measures [52,53,58–60]. Cronbach's α ($\alpha=.93$) suggest excellent reliability [52,53,60].
315 According to Streiner and Norman [53] a Cronbach's α above .90 might also indicate item redundancy. On
316 the other hand, inter-item correlations of the German ORIC are in an acceptable range and all items seem
317 to add additional information to the underlying concept [52,59]. In implementation research there is a need
318 for preferably brief measures, which can be applied in diverse settings with high work-load. Thus, future
319 research could investigate the possibility to further reduce the number of items.

320

321 **Strength and Limitations**

322 This study has some limitations. First, several psychometric parameters are not analysable because of the
323 secondary analysis. Due to the design of the study, it was not possible to calculate e.g. convergent or
324 divergent validity yet. Second, we applied the ORIC only in three departments of one University Medical
325 Center in Germany. Further validation in different organizational settings is needed to ensure
326 generalizability.

327 A major strength of this study is that we provided the first measure to assess organizational readiness for
328 change in German language for use in implementation studies. Furthermore, we assessed the ORIC in a
329 large sample including physicians and nurses.

330

331 **CONCLUSION**

332 Organizational readiness is a crucial indicator to successfully implement change and a possible barrier if
333 missing. For implementation studies, it is essential to measure organizational readiness with valid and
334 reliable measures. We provide the first German measure for organizational readiness for implementing
335 change. The German ORIC is a brief measure and highly accepted. We found satisfying psychometric
336 properties in a German hospital setting. To increase content validity of the measure, we suggest to leave
337 out item 10. As the ORIC targets the attitude of organizational members, it can detect reduced or missing
338 readiness for implementing a change on the individuals' level. Therefore, the German ORIC can be used

1
2
3 339 to analyse organizational readiness as a possible barrier for implementing various interventions in the
4
5 340 healthcare setting.
6

7 341

8
9 342 **LIST OF ABBREVIATIONS**

10 343 AH: Anne Haugstvedt

11
12 344 AIC: Akaike Information Criterion

13
14 345 AL: Anja Lindig

15
16 346 AMOS: Analysis of Moment Structure, Statistical Package for the Social Sciences, International Business
17
18 347 Machines Corporation

19
20 348 χ^2 : Discrepancy chi-squared statistic

21
22 349 χ^2/df : Normed chi-squared statistic

23
24 350 CFI: Confirmatory fit index

25
26 351 CS: Christopher M. Shea

27
28 352 Df: Degree of freedom

29
30 353 DF: Dominick Frosch

31
32 354 EC: Eva Christalle

33
34 355 HCP: Healthcare professional

35
36 356 IS: Isabelle Scholl

37
38 357 KMO: Kaiser-Meyer-Olkin criterion

39
40 358 MM: Marcel Machalski

41
42 359 MR: Mélanie Ruest

43
44 360 ORIC: Organizational Readiness for Implementing Change

45
46 361 PH: Pola Hahlweg

47
48 362 PNFI: Parsimonious Normed Fit Index

49
50 363 RMSEA: Root mean square error of approximation

51
52 364 SDM: Shared decision-making

53
54 365 SPSS: Statistical Package for the Social Sciences, International Business Machines Corporation

55
56 366 SZ: Stefan Zeh

57
58 367 TLI: Tucker-Lewis Index

59
60 368 TRAPD: Translation, Review, Adjudication, Pretesting, Documentation

369

370 DECLARATIONS**371 Ethics approval and consent to participate**

372 The study was approved by the Ethics Committee of the Medical Association Hamburg (Germany, study
373 ID PV5368). The study was carried out in accordance to the latest version of the Helsinki Declaration of the
374 World Medical Association. Principles of good clinical practice were respected. Data protection
375 requirements were met. Study participation was voluntary. A waiver of consent for HCPs was obtained from
376 the Ethics Committee, as proposed by current statements on ethical designs of implementation research
377 [63]. HCPs were able to decline participation in the study.

378

379 Funding

380 This study is funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, grant
381 number 232160533).

382

383 Competing interests

384 PH gave one scientific presentation on shared decision-making during a lunch symposium, for which she
385 received compensation and travel compensation from GlaxoSmithKline GmbH in 2018. AL, EC and IS
386 declared to not have any competing interests.

387

388 Author contributions

389 AL, PH and IS made substantial contributions to the design and preparation of the study. AL and PH
390 collected the data. AL conducted the analysis in collaboration with EC. All authors contributed to the
391 interpretation of results. AL drafted the manuscript and PH, IS and EC were involved in critically revising
392 the manuscript for important intellectual content. All authors gave final approval of the version to be
393 published.

394

395 Checklist for reporting statement

396 To report the results of this validation study, we used the Authors Guidelines for Reporting Scale
397 Development and Validation Results by Cabrera-Nguyen [64]. The Checklist can be found in
398 Supplementary File 5.

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3 3994
5 400 **Patient consent form**6
7 401 Not applicable8
9 40210
11 403 **Data sharing statement**12
13 404 The dataset collected and analyzed during this study is available from the corresponding author on
14 405 reasonable request.15
16 40617
18 407 **Acknowledgements**19
20 408 We thank our student assistants Anastasia Izotova, Sophia Schulte and Nicolai Pergande for their help
21 409 preparing the study and the analysis. We thank Stefan Zeh for his part the team translation process. We
22 410 thank Dominick Frosch, Anne Haugstvedt, Marcel Machalski, Mélanie Ruest and Christopher M. Shea for
23 411 helpful comments and suggestions in the translation and adaption process of item 10. We also would like
24 412 to thank Christopher M. Shea for giving the opportunity to translate the ORIC into German and to use it in
25 413 our implementation study.26
27 41428
29 415 **Supplementary Files**30
31 416 Supplementary File 1: Results of psychometric analysis of the 9-item German ORIC version: Factor
32 417 analysis, corrected item-total correlations, Cronbach's α 33
34 418 Supplementary File 2: Additional tables for psychometric evaluation of the 10-item ORIC version35
36 419 Supplementary File 3: Organizational Readiness for Implementing Change (ORIC) – German version37
38 420 Supplementary File 4: Confirmatory factor analysis model of the 10-item German ORIC39
40 421 Supplementary File 5: Reporting Checklist: Authors Guidelines for Reporting Scale Development and
41 422 Validation Results by Cabrera-Nguyen [64]42
43 42344
45 424 **REFERENCES**46
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3 **1 Supplementary File 1: Results of psychometric analysis of the 9-item German ORIC: Factor**
4 **analysis, corrected item-total correlations, Cronbach's α**
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9 **4 Structural validity**

10 To get information about the factorial structure of the 9-item German ORIC, an exploratory factor
11 analysis was conducted. KMO measure was .926 and Barlett's test of sphericity was significant ($X^2 =$
12 1302.78, $p < .001$), indicating that a factor analysis of the data was appropriate to observe data. Table
13 A shows results of the exploratory factor analysis. Since the main component explains 66% of the
14 variance, a one-factor model could be assumed. The factor loading for the first component can be
15 observed in table B.
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24 Table A: Results of exploratory factor analysis of the 9-item German ORIC.
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	Eigenvalue		
	Total	% of variance	Cumulative %
Component 1	6.02	66.85	66.85
Component 2	0.802	8.91	75.76
Component 3	0.472	5.25	81.01
Component 4	0.392	4.35	85.37
Component 5	0.366	4.06	89.43
Component 6	0.304	3.38	92.81
Component 7	0.250	2.78	95.59
Component 8	0.232	2.57	98.16
Component 9	0.165	1.84	100.00

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37 Notes: Eigenvalues of the nine components of the German ORIC, percentage
38 of explained variance and cumulative percentage of explained variance of
39 each component. For EFA, the sample was split and $n=115$.
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43 Table B: Factor loadings on the first component.
44

	Component 1
Item 1	0.860
Item 2	0.856
Item 3	0.837
Item 4	0.836
Item 5	0.835
Item 6	0.799
Item 7	0.797
Item 8	0.791
Item 9	0.739

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55 Notes: For EFA, the sample was
56 split and $n=115$.
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17 A confirmatory factor analysis was performed with the one-factor model to analyse its fit indices. Indices
 18 of the one-factor model are presented in table C.

20 Table C: Fit indices of the one-factor model of the 9-item German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
One-factor model	56.04	27	2.08	.945	.927	.097	92.04	.676

Notes: One-factor model (including a split data set of n=115): includes items 1 to 9.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

22 Descriptive analysis of items of the 9-item ORIC version and reliability analysis

23 Table D shows the corrected item-total correlation. Corrected item-total correlation ranged from .665
 24 (item 9) to .744 (item 3).

26 Table D: Discrimination of the nine items of the German ORIC.

	Item discrimination (corrected item-total correlation)
Item 1	.747
Item 2	.696
Item 3	.777
Item 4	.760
Item 5	.762
Item 6	.759
Item 7	.720
Item 8	.691
Item 9	.638

Notes: Items could be answered on a
 5-step Likert scale rating from 0 „
 disagree“ to 4 „agree“.

28
 29
 30 Cronbach's α with $\alpha = .924$ showed the measure to reach excellent reliability.

1
2
3 **1 Supplementary File 2: Additional tables for psychometric evaluation of 10-item ORIC version**
4
5
6

7 **3 Table A: Demographic data of participants of cognitive interviews (n=11).**
8

		Frequencies for n=11
Age	< 30 years	1
	31-40 years	3
	41-50 years	3
	> 50 years	4
Gender	Female	9
	Male	2
Profession*	Nurse	8
	Physician	2
	Psychooncologist	3
Work experience in health care	> 5 years	3
	5-10 years	4
	11-20 years	3
	> 20 years	1

24 **4** * multiple answers possible
25 **5**

26
27 **6 Table B: Factor loadings on the first component.**
28

	Component 1
Item 1	0.790
Item 2	0.788
Item 3	0.833
Item 4	0.846
Item 5	0.831
Item 6	0.851
Item 7	0.839
Item 8	0.800
Item 9	0.754
Item 10	0.860

39
40 **7** For EFA, the sample was split and n=115.
41 **8**

42
43 **9 Table C: Inter-item correlation matrix for the German ORIC.**
44

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Item 1	1.000	.634	.650	.611	.652	.587	.558	.538	.507	.542
Item 2	.634	1.000	.586	.681	.607	.518	.504	.485	.434	.478
Item 3	.650	.586	1.000	.673	.723	.636	.600	.558	.492	.560
Item 4	.611	.681	.673	1.000	.675	.588	.531	.541	.512	.551
Item 5	.652	.607	.723	.675	1.000	.622	.621	.466	.474	.578
Item 6	.587	.518	.636	.588	.622	1.000	.677	.590	.588	.573
Item 7	.558	.504	.600	.531	.621	.677	1.000	.612	.491	.567
Item 8	.538	.485	.558	.541	.466	.590	.612	1.000	.611	.560
Item 9	.507	.434	.492	.512	.474	.588	.491	.611	1.000	.659
Item 10	.542	.478	.560	.551	.578	.573	.567	.560	.659	1.000

56
57 **10**
58
59
60

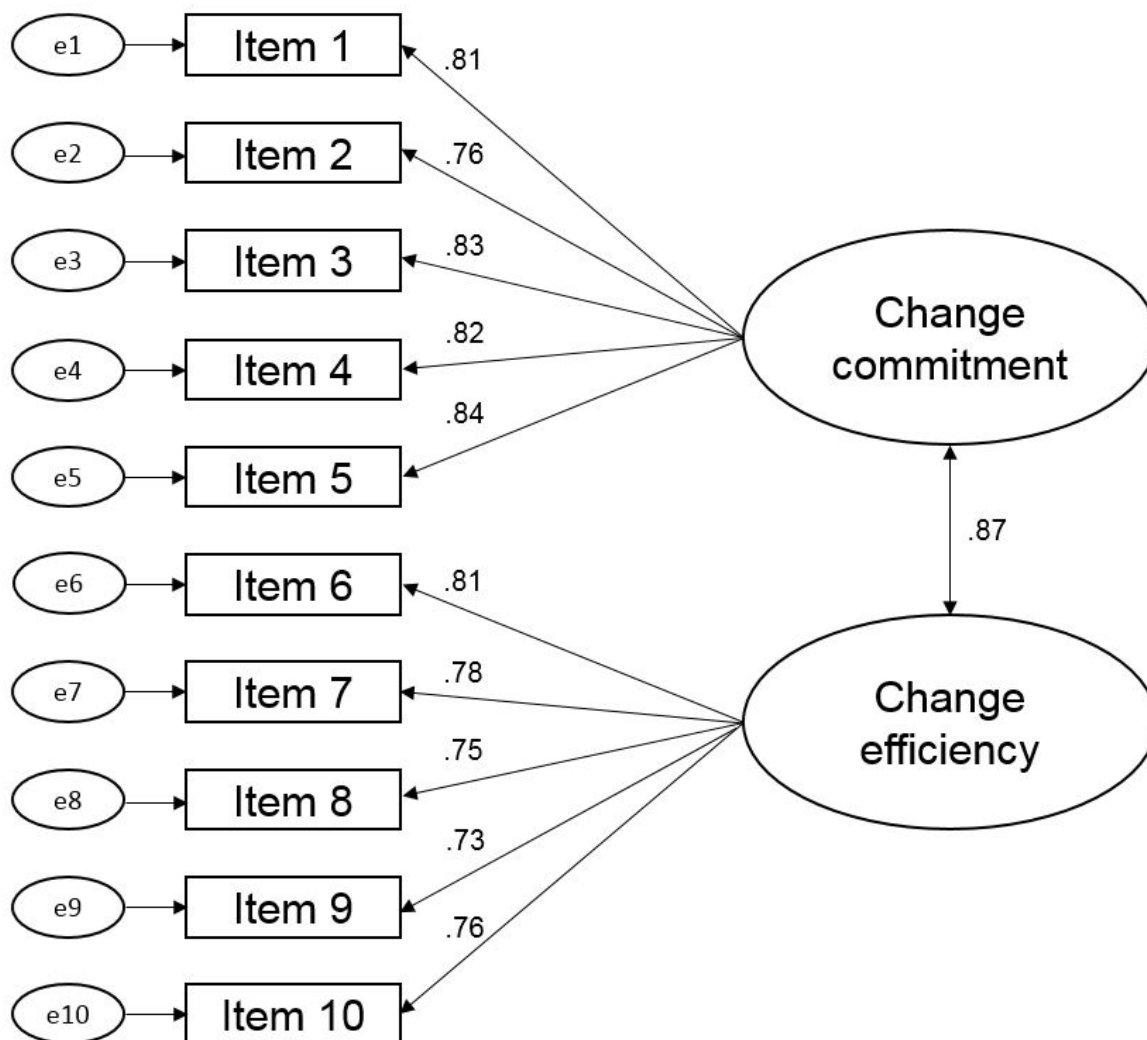
1
2
3 **1 Supplementary File 3: Organizational Readiness for Implementing Change (ORIC) – German**
4 **2 version**
5
6
7

8 Bitte geben Sie an, wie sehr Sie den folgenden Aussagen zur Umsetzung von partizipativer
9 Entscheidungsfindung an Ihrem aktuellen Arbeitsplatz zustimmen. Falls partizipative
10 Entscheidungsfindung aktuell nicht umgesetzt wird, wie wäre es im Falle der Umsetzung?
11
12

		stimme nicht zu	stimme eher nicht zu	teils teils	stimme eher zu	stimme zu
17	1					
18		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19		Personen, die hier arbeiten, zeigen hohes Engagement bei der Umsetzung von partizipativer Entscheidungsfindung.				
21	2					
22		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23		Personen, die hier arbeiten, werden tun, was auch immer nötig ist, um partizipative Entscheidungsfindung umzusetzen.				
25	3					
26		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27		Personen, die hier arbeiten, wollen partizipative Entscheidungsfindung umsetzen.				
28	4					
29		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30		Personen, die hier arbeiten, sind fest entschlossen, partizipative Entscheidungsfindung umzusetzen.				
32	5					
33		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34		Personen, die hier arbeiten, sind motiviert, partizipative Entscheidungsfindung umzusetzen.				
36	6					
37		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38		Eventuell entstehen bei der Umsetzung von partizipativer Entscheidungsfindung Herausforderungen. Personen, die hier arbeiten, sind zuversichtlich, diese zu meistern.				
41	7					
42		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43		Personen, die hier arbeiten, sind zuversichtlich, dass sie den Verlauf der Umsetzung von partizipativer Entscheidungsfindung überblicken können.				
46	8					
47		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48		Personen, die hier arbeiten, sind zuversichtlich, dass sie Aufgaben so koordinieren können, dass die Umsetzung reibungslos abläuft.				
51	9					
52		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53		Personen, die hier arbeiten, sind zuversichtlich, dass die Klinik sie dabei unterstützen kann, partizipative Entscheidungsfindung umzusetzen.				
55	10					
56		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57		Personen, die hier arbeiten, sind zuversichtlich, Machenschaften bei der Umsetzung von partizipativer Entscheidungsfindung bewältigen zu können.				
58						
59						
60						

10

Supplementary File 4: Confirmatory factor analysis model of the 10-item German ORIC



1 **Supplementary File 5: Checklist for reporting standards. Authors guideline for Scale**2 **Development and validation results by Cabrera-Nguyen [1].**

	Guidelines by Cabrera-Nguyen [1]	Transfer to our study
1	Precisely define the target construct.	See page 3 and 4 (Introduction section)
2	Justify the need for your new measure. For example, if measures of the construct exist in the literature, explain the value added by your new scale. How might the new measure enhance the substantive knowledge base or social work practice?	See page 3 and 4 (Introduction section)
3	Indicate that you have submitted your initial pool of items to expert review (Worthington & Whittaker, 2006). Report (a) the number of items in the preliminary pool; (b) the number of expert reviewers and their qualifications; and (c) any major changes to your initial item pool following the review (e.g., a substantial decrease in the number of items, changes to the original item response format, overhaul of item pool due to experts' assessment regarding content validity).	See page 4 and 5 (Methods section: Measure, Translation, Assessment of comprehensibility and adaption of the scale) and page 8 and 9 (Results section: Translation, Assessment of comprehensibility and adaption of the scale)
4	Report the name and version of the statistical software package used for all analyses.	See page 5 to 7 (Methods section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation)
5	Identify and justify the sampling strategy (e.g., convenience, snowball) and sampling frame. Report standard sample demographic characteristics as well as other salient sample characteristics.	See page 5 and 6 (Methods section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation) and page 8 to 10 (Results section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation) and Additional file 3
6	Discuss relevant data preparation and screening procedures. For instance, do the data meet the appropriate assumptions for factor analysis? If not, what actions were taken? Report tests of factorability if appropriate (e.g., report Bartlett's test of sphericity).	See page 9 and 10 (Results section: Psychometric evaluation)
7	Provide all dates of data collection.	See page 8 to 12 (Results section)
8	Avoid use of principal components analysis (PCA) as a precursor to CFA (Costello & Osborne, 2005; Worthington & Whittaker, 2006). Instead, start with EFA to assess the underlying factor structure and refine the item pool. EFA should be followed by CFA using a different sample (or samples) to evaluate the EFA-informed a priori theory about the measure's factor-structure and psychometric properties. (Costello & Osborne, 2005; Henson & Roberts, 2006; Worthington & Whittaker, 2006). For CFA, authors	An a priori hypothesized model for CFA was specified based on the original measures structure. The model could not be confirmed and an EFA was calculated afterwards. The same data set was used for EFA and CFA. For more

	should specify an a priori hypothesized model and a priori competing models (Jackson, Gillaspay, & Purc-Stephenson, 2009).	information see page 6 and 7 (Results section).
9	Guidelines for reporting EFA results.	
	How large is a sample? One common rule of thumb is to ensure a person-to-item ratio of 10:1. Another rule of thumb is that N= 300 is usually acceptable (Worthington & Whittaker, 2006). However, some researchers have criticized these sample size rules of thumb, noting the appropriate sample size is dependent on the features of the gathered data. These researchers recommend obtaining the largest possible sample because the adequacy of the sample size cannot be determined until after the data have been analyzed (Henson & Roberts, 2006).	Sample size is n=115, person-to-item ratio 11.5:1 (see page 6: Methods section, Psychometric analysis)
	Run EFA . . . or not. Run a preliminary EFA to determine if further data collection is required based on the following criteria: (a) If communalities are greater than .50 or there are 10:1 items per factor with factor loadings of roughly .4 , then a sample size of 150 to 200 is likely to be adequate; (b) If communalities are all at least .60 or there are a minimum of 4:1 items per factor with factor loadings above .6 , then even smaller sample sizes may suffice; (Worthington & Whittaker, 2006). Report if additional data collection was necessary due to inadequate sample size. If so, report the new participants' sociodemographic characteristics and test for differences between groups using standard statistical procedures (e.g., ttests).	EFA communalities are all above .70, therefore the sample size of n=115 can be determined as adequate and no additional data collection was necessary. For more information, see Additional file 3).
	Give EFA details. Report the specific rotation strategy used (e.g. varimax, geomin). Justify the decision to use an orthogonal or oblique solution. One recommendation is to always begin with an oblique rotation, empirically assess factor intercorrelations, and report them before deciding upon a final rotation solution (Henson & Roberts, 2006; Worthington &Whittaker, 2006). Some researchers argue oblique rotation is always the best approach because (a) factor intercorrelations are the norm in social sciences and (b) both approaches yield the same result if the factors happen to be uncorrelated (Costello & Osborne, 2005). Conversely, other researchers contend that orthogonal rotation is preferable because fewer parameters are estimated—orthogonal rotation is more parsimonious and amenable to replication (Henson &Roberts, 2006). Similarly, some researchers warn against relying on a statistical software package's default settings to determine the appropriate type of oblique rotation (Henson & Roberts, 2006; Worthington &Whittaker, 2006). Others state that doing so is —finell (Costello & Osborne, 2005, p.3). Given the lack of consensus, it is probably best to describe what you do and defend your approach on substantive grounds, if possible.	See page 6 and 7 (Methods section: Psychometric evaluation)
	Report the whole factor pattern/structure. Always report the whole factor pattern/structure matrix, including all of the items in the analysis. It is recommended that authors report	See page 10 (Results section: Psychometric evaluation) and Additional file 3

	<p>this information in a chart following the example provided by Henson and Roberts (2006) on page 411.</p>	
	<p>Criteria for deleting (crossloaded) items. Report any deleted items and the criteria used for deletion. Crossloading items with values $\geq .32$ on at least two factors should generally be candidates for deletion, especially if there are other items with factor loadings of .50 or greater (Costello & Osborne, 2005). Rerun the EFA each time an item is deleted.</p>	<p>No crossloading items could be observed, so item deletion was not necessary.</p>
	<p>Criteria for number of factors. Report the number of factors retained and justify this decision using multiple criteria (eigenvalue > 1, scree test, parallel analysis, rejection of a factor with fewer than 3 items, etc). Reporting the eigenvalue > 1 rule alone is inadequate because it has been shown to among the least accurate criteria for assessing factor retention (Costello & Osborne, 2005; Henson & Roberts, 2006)</p>	<p>See page 6 and 7 (Methods section: Psychometric evaluation)</p>
	<p>Explained variance. Report the variance explained by the factors.</p>	<p>See page 10 (Results section: Psychometric evaluation) and Additional file 3</p>
	<p>In general, describe your decisions.</p>	<p>See page 10 (Results section: Psychometric evaluation) and Additional file 3</p>
10	<p>Guidelines for reporting CFA results.</p>	
	<p>Describe and justify the theoretical model. Report hypothesized factor structure. Provide theoretical and empirical justification (e.g., results of preliminary EFAs) for your hypothesis. In addition, report a priori competing models.</p>	<p>See page 6 and 7 (Methods section: Psychometric evaluation)</p>
	<p>Describe the parameterization. Provide a comprehensive description of the a priori parameter specification. Identify fixed parameters, free parameters, and constrained parameters. For example, indicate if you freed the errors of any items to correlate.</p>	<p>One factor loading was constrained to equal 1, the corresponding intercept was constrained equal to zero. The other factor loadings and intercepts were estimated. Errors of items were not freed to correlate.</p>
	<p>Include a figure. Include a figure of each CFA model being tested using Kline's (2005) graphical conventions if feasible.</p>	<p>See Additional file 5</p>
	<p>Identification. Demonstrate model identification (e.g., $df > 0$; scaling of factors; assess and report the $-t$-rule; the two-indicator rule). Necessary and sufficient conditions for model identification may vary for certain types of CFA models. When in doubt, authors should consult Brown's (2006) CFA text or Kline's (2005) SEM text for guidance.</p>	<p>See page 10 and 11 (Results section: Psychometric evaluation)</p>
	<p>Select an estimator based on distributional patterns and assumptions. Report the estimator used (e.g., ML, WLSMV) and justify your choice based on distributional</p>	<p>See page 6 (Methods section: Psychometric evaluation)</p>

	assumptions. It is not appropriate to report that you relied on your statistical software's default setting.	
	Use multiple fit indices. After estimating a model, always report multiple fit indices (e.g., model X ² , df, p, CFI/TLI, RMSEA, SRMR). Report all appropriate fit indices, not just those favorable to your hypotheses (Jackson et al., 2009). For example, do not report acceptable CFI and TLI scores while omitting a relevant fit index with a suboptimal value.	See page 6 and 7 (Methods section: Psychometric evaluation) and page 10 and 11 (Results section: Psychometric evaluation)
	What is acceptable fit? For model fit indices, authors should generally use the cut-off values recommended by Hu and Bentler (1999) and endorsed by Brown (2006), assuming ML estimation: a. CFI/TLI ≥ .95 b. RMSEA ≤ .06 c. SRMR ≤ .08	See page 8 (Methods section: Psychometric evaluation)
	Localized strain? When reporting model fit, include an assessment for localized areas of strain by examining standardized residuals. Standardized residuals greater than 1.96 (for p < .05) indicate areas of strain (Harrington, 2009). Report the absence of localized strain, if appropriate; otherwise, note localized areas of strain by reporting the relevant standardized residuals.	Standardized residuals do not indicate localized strains.
	Parameter estimates and SEs. When reporting factor loadings and other parameter estimates, always report the unstandardized estimates, their p values, and the standard errors. In addition, include the standardized estimates when appropriate. Be sure to report all parameter estimates, even those that are non significant (Brown, 2006; Jackson et al., 2009).	See Additional file 5
	Assessing the validity of the factor solution. Comment on the new measure's convergent and discriminant validity based on parameter estimates. For instance, factor correlations ≥ .80 may indicate poor discriminant validity (Brown, 2006). In addition, strong factor loadings that do not crossload may indicate good convergent validity. One rule of thumb is that factor loadings < .40 are weak and factor loadings ≥ .60 are strong (Garson, 2010).	Exploratory factor analysis revealed a one-factor model, so there are no factor correlations.
	Other measures. Report squared multiple correlations and comment on the measure's reliability (e.g., report Raykov's Rho if appropriate)	See page 11 (Results section: Psychometric analysis)
	Respecification: Caution! Report any post-hoc respecifications to improve model fit based on modification indices. Justify the respecifications on theoretical or conceptual grounds (Jackson et al., 2009). Respecification to allow for correlated errors is not supportable without strong pragmatic justification (e.g., items contain similar words or phrases). Note that respecification precludes comparing the model with your a priori specified competing models. Report improvements in appropriate model fit indices for respecified models (e.g., chi-square difference test)	No respecifications to improve model fit were applied.
10	Describe the matrix (or matrices) you analysed (e.g., covariance, correlation). Include matrices in the manuscript	See Additional file 3

	if feasible; otherwise, indicate these data are available upon request.	
11	Report the amount of missing data and describe how missing data were handled. For a review of practices for handling missing data, see Sterne and colleagues (2009), Rose and Fraser (2008), and Horton and Kleinman (2007). Provide a rationale for your approach to handling missing data. Authors are encouraged to consider using multiple imputation or model estimation with full-information maximum likelihood (FIML; Rose & Fraser, 2008).	See page 6 (Methods section: Psychometric evaluation) and page 11 (Results section: Psychometric evaluation)
12	Compare your CFA model with the alternative or competing models. Do competing models fit the data better or worse than your model (e.g., does your four-factor model of acculturation fit the data better than a two-factor model or a one-factor model)? Identify the preferable model based on appropriate fit statistics (e.g. chi-square difference test for nested models, Akaike information criterion for non-nested models), parsimony, and relevant theory	See page 13 (Discussions sections)
13	Include your scale (items and response options) in an appendix.	See Additional file 2
14	Report how methodological limitations may have impacted findings regarding your measure's psychometric properties (e.g., note potential repercussions of suboptimal sampling techniques, discuss implications of using listwise deletion to handle missing data instead of multiple imputation or FIML).	See page 14 (Discussions sections)
15	Discuss directions for future research (e.g., if appropriate, testing your scale for measurement invariance by conducting CFA on different populations).	See page 13 and 14 (Discussions sections)

1 Cabrera-Nguyen P. Author Guidelines for Reporting Scale Development and Validation Results. *J Soc Social Work Res*. University of Chicago Press Chicago, IL 2010;1:99–103.

BMJ Open

Translation and psychometric evaluation of the German version of the Organizational Readiness for Implementing Change measure (ORIC) – a cross-sectional study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034380.R1
Article Type:	Original research
Date Submitted by the Author:	26-Feb-2020
Complete List of Authors:	Lindig, Anja; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Hahlweg, Pola; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Christalle, Eva; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Scholl, Isabelle; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology
Primary Subject Heading:	Research methods
Secondary Subject Heading:	Communication, Evidence based practice, Patient-centred medicine
Keywords:	Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-making, Measurement

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3 1 **Translation and psychometric evaluation of the German version of the Organizational Readiness**
4
5 2 **for Implementing Change measure (ORIC) – a cross-sectional study**

6
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49 25 Word count: 4186
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51 26
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1
2
3 31 **ABSTRACT**

4
5 32 **Objectives:** To translate the measure Organizational Readiness for Implementing Change (ORIC) into
6
7 33 German and assess its psychometric properties.

8
9 34 **Design:** Cross-sectional psychometric study based on secondary analysis of baseline data from a shared
10
11 35 decision-making (SDM) implementation study.

12
13 36 **Setting:** Three departments within one academic cancer center in Hamburg, Germany.

14
15 37 **Participants:** For comprehensibility assessment of the translated ORIC version, we conducted cognitive
16
17 38 interviews with n=11 healthcare professionals (HCPs). Afterwards, n=230 HCPs filled out the measure.

18
19 39 **Primary and Secondary Outcome Measures:** The original English version of the ORIC was translated
20
21 40 into German using a team translation protocol. Based on comprehensibility assessment via cognitive
22
23 41 interviews with HCPs, the translated version was revised. We analyzed acceptance (completion rate),
24
25 42 factorial structure (exploratory factor analysis (EFA), confirmatory factor analysis (CFA), model fit), item
26
27 43 characteristics (item difficulties, corrected item-total correlations, inter-item correlations), and internal
28
29 44 consistency (Cronbach's α).

30
31 45 **Results:** Translation and cognitive testing of the ORIC was successful except for item 10, which showed
32
33 46 low comprehensibility as part of content validity in cognitive interviews. Completion rate was > 97%. EFA
34
35 47 and CFA provided a one-factorial structure. Item difficulties ranged between 55.98 and 65.32, corrected
36
37 48 item-total-correlation ranged between .665 and .774, inter-item correlations ranged between .434 and .723,
38
39 49 and Cronbach's α was .93.

40
41 50 **Conclusions:** The German ORIC is a reliable measure with high completion rates and satisfying
42
43 51 psychometric properties. A one-factorial structure of the German ORIC was confirmed. Item 10 showed
44
45 52 limited comprehensibility and therefore reduces content validity of the measure. The German ORIC can be
46
47 53 used to analyze organizational readiness for change as a precursor for implementation success of various
48
49 54 interventions.

50
51 55
52
53 56 **Keywords:**
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55 57 Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-
56
57 58 making, Measurement
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60 60

61 **ARTICLE SUMMARY**

62 **Strengths and limitations of this study**

- 63 • Appropriate qualitative methods were used to provide a German version of the ORIC to be
64 assessed for healthcare professionals (HCPs).
- 65 • The sample size was large enough to robustly perform the psychometric analyses on the German
66 version of the ORIC measure.
- 67 • Due to the design of the study as a secondary analysis, it was not possible to calculate
68 psychometric parameters like convergent and divergent validity.
- 69 • Data were collected at a single academic cancer center in the context of a shared decision-making
70 implementation study. Thus, psychometric properties of the German ORIC need replication in other
71 settings.

73 **INTRODUCTION**

74 Implementing interventions in healthcare systems is an important and widely discussed topic [1–3] and
75 often mediated by public policies, market forces, or new technologies [4]. The intention to implement new
76 interventions might be to reduce costs, improve quality, increase efficacy or patient satisfaction [5].
77 Nevertheless, implementing change in healthcare organizations can be challenging [6–10]. In the German
78 healthcare system, the implementation of shared decision-making (SDM) has received much attention [11].
79 SDM can be described as an interactional process on the basis of information exchange. Patients and
80 healthcare professionals (HCPs) are equally and actively involved and jointly responsible for the decision
81 [12–14]. This is especially important in situations with complex treatment options and high impact on
82 patients' quality of life [15]. Patients want to be actively involved in decision-making [16] and benefit from
83 SDM by developing better knowledge about their disease and treatment options, better risk perception, and
84 less insecurity and decisional conflict [17,18]. SDM has been supported by health policy [19–21] and
85 research [22–25] over the last decades. However, SDM is currently not routinely implemented in the
86 German healthcare system [11,26–28].

87 When implementing SDM or other interventions in organizations, several barriers on different levels of the
88 organization (i.e., individual members of the organization, teams, organizational setting, system level) need
89 consideration [1,5–7,10,29–32]. Barriers for implementing SDM in the clinical setting often address both
90 the organizational setting (e.g. lack of resources and lack of management support) and the individual level

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2
3 91 (e.g. resistance to change or negative attitudes towards SDM) [7,10,11,33–35]. When implementing SDM
4
5 92 or other interventions in healthcare systems, the clinical employees' perspective on organizational
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7 93 readiness for change is a critical precursor for successful implementation [5,32,36–38]. Armenakis et al.
8
9 94 [39] describe organizational readiness for change as the degree to which organizational members are
10
11 95 prepared to participate in change processes. This is characterized by the belief that the change is needed
12
13 96 and that the organization is capable of changing. In their theory of organizational readiness for change,
14
15 97 Weiner et al. [40] differentiate between change commitment (i.e., organizational members' attitudes
16
17 98 towards implementing a change) and change efficacy (i.e., organizational members' belief in their capability
18
19 99 to implement a change). If readiness for change is high, organizational members invest more in the change
20
21 100 effort and exhibit greater persistence to overcome barriers and setbacks [40,41].

22 101 To analyze effects of organizational readiness on implementation success, specific measures for assessing
23
24 102 organizational readiness for change are needed [5]. However, only a few validated measures exist [5,42–
25
26 103 44] and none were available in German. One of those measures is the Organizational Readiness for
27
28 104 Implementing Change (ORIC) [43]. The ORIC is brief, easy to administer, and theoretically and
29
30 105 psychometrically well-grounded [40]. It was previously translated into Danish and French [45,46]. The ORIC
31
32 106 has been psychometrically tested, revealing a completion rate of > 72%, a Cronbach's α of > .80 and two
33
34 107 correlating factors [43,45,46]. Due to the described properties, the ORIC seemed well-suited to measure
35
36 108 organizational readiness for implementing SDM in Germany [5,43,47].

37 109 Therefore, the aim of the study was to translate the measure ORIC into German and assess its
38
39 110 psychometric properties.

41 111

43 112 **METHODS**

45 113 **Measure**

47 114 The ORIC measures organizational readiness for implementing change. It uses a 5-point Likert scale
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49 115 ranging from „disagree“ to „agree“ [43]. In the original English version, two subscales were described based
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51 116 on Weiner et al. [40]: „change commitment“ (items 1 to 5) and “change efficacy” (items 6 to 10). Sum scores
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53 117 were calculated for both subscales separately with higher scores indicating higher organizational readiness
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55 118 for change. By using the phrases “to implement this change” or “implementing this change”, the original
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57 119 scale does not specify which change is addressed. The items can be specified to adapt to a specific

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3 120 research question and a survey instruction can be added [40,45]. The English items are displayed in the
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5 121 results section.

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9 123 **Translation**
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11 124 Translation followed the team translation protocol TRAPD (Translation, Review, Adjudication, Pretesting
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13 125 and Documentation), a method with growing recognition within translation research [48]. Thereby an
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15 126 optimal translation is facilitated by discussions between members of the translation team with different
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17 127 expertise in translation. First, two team members (AL, SZ, cp. list of abbreviations) proficient in German
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19 128 and English, but little experienced in survey translation, independently translated the original ORIC into
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21 129 German. Second, a third bilingual team member (IS) with experience in survey translation, reviewed both
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23 130 versions and suggested a third version based on the first two translations. Finally, IS, AL, and SZ discussed
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25 131 all versions until reaching consensus on a final version. To find consensus on item 10 we additionally
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27 132 consulted an official translator (MM, cp. list of abbreviations) and an additional team member (PH), who is
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29 133 proficient in German and English and experienced in translation. During the translation process, we
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31 134 changed the phrases “to implement this change” and “implementing this change” into “to implement shared
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33 135 decision-making” and “implementing shared decision-making” to address our specific research question.
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35 136 Additionally, we added a survey instruction in German which motivated participants to think about the clinic,
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37 137 they are working in, when answering the item.

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41 139 **Assessment of comprehensibility as part of content validity and subsequent adaptation of the scale**
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43 140 Content validity is the degree to which the content of the measure and its items adequately reflect the
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45 141 measured construct [49]. According to the COSMIN criteria (Consensus-based standards for the selection
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47 142 of health measurement instruments) [50], content validity includes the relevance of the items and scales,
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49 143 their comprehensiveness, and comprehensibility. As this study aimed to evaluate the translation of an
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51 144 existing measure, we focused on the assessment of comprehensibility (i.e., items being appropriately
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53 145 worded and understood by participants as intended).

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55 146 To do so, we conducted two rounds of cognitive interviews with a convenience sample of HCPs (nurses,
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57 147 physicians, and psychooncologists), working in a comprehensive cancer center in Germany. Two female
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59 148 researchers and psychologists experienced in interviewing (AL, PH) conducted the interviews. We
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149 developed an interview guide based on recommendations by Willis et al. [51]. We used verbal probing

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3 150 techniques like comprehension probes (e.g. "What does the term 'organization' mean to you?") and
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5 151 paraphrasing (e.g. "Can you repeat this sentence in your own words?"). We conducted interviews until
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7 152 reaching theoretical saturation. Interviews were audio-recorded and transcribed verbatim. After the first
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9 153 round of cognitive interviews, we extracted and discussed comments and suggestions from the transcripts
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11 154 (AL, PH, IS). As a further step to enhance comprehensibility, we discussed the items with the original author
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13 155 (CS, cp. list of abbreviations) as well as French (MR, cp. list of abbreviations) and Norwegian researchers
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15 156 (AH, cp. list of abbreviations), who translated the ORIC into their languages. We adapted items of the
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17 157 German ORIC, which were not well understood by participants of the first round of cognitive interviews,
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19 158 according to these discussions. We tested these items in a second round of cognitive interviews. After the
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21 159 second round, we discussed further adaptations of the items and involved another bilingual researcher in the
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23 160 field (DF, cp. list of abbreviations).
24
25 161 We calculated descriptive statistics of participants' demographic characteristics using SPSS (IBM SPSS
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27 162 Statistics, Version 23).
28
29 163

164 **Psychometric evaluation**

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32 165 **Data collection.** For psychometric evaluation of the ORIC measure we conducted a secondary analysis of
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34 166 cross-sectional data gathered in a SDM implementation study [52]. Data from baseline assessment of the
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36 167 SDM implementation study were included. The ORIC was the last questionnaire of a three-page survey
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38 168 measuring HCPs' attitudes regarding SDM and its implementation. Besides the ORIC, it contained the
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40 169 Control Preference Scale [53] and the IcanSDM [54], demographic questions (e.g. gender, age, profession,
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42 170 work experience) as well as several questions that have been used in previous studies in cancer care [55].
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44 171 Results of these additional measures will be published as part of the primary evaluation of the SDM
45
46 172 implementation study [52].
47
48 173 Participants were part of a convenience sample of physicians and nurses. Since this is a secondary
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50 174 analysis, inclusion criteria were identical to inclusion criteria of the SDM implementation study [52]. We
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52 175 included physicians and nurses who worked at one of three departments within the University Cancer
53
54 176 Center Hamburg at the University Medical Center Hamburg-Eppendorf during baseline evaluation of the
55
56 177 SDM implementation study [52]. Eligible HCPs were identified through employee lists provided by
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58 178 department managers. The measure was handed out to eligible HCPs either (1) by a member of our study
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3 179 team (e.g. during a regular physician meeting), (2) by the supervising nurses, or (3) via employees'
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5 180 mailboxes. Participants returned the questionnaire personally to a study team member or by mail.

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7 181 Data were entered into SPSS (IBM SPSS Statistics, Version 23) including blinded double entry of 20% of
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9 182 the data for quality control.

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11 183 **Patient and public involvement.** The measure ORIC preliminary addresses HCPs, therefore physicians,
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13 184 nurses and psychooncologists were involved in the adaptation of the measure by taking part in cognitive
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15 185 interviews. Patients were not involved in this study.

16
17 186 **Data Analyses.** Descriptive statistics were calculated for demographic characteristics. Cases were
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19 187 excluded if more than 30% of the ORIC items were missing [56]. For all other cases, missing data were
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21 188 replaced with item means. We evaluated the completion rate and therefore the acceptance of the measure
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23 189 by calculating frequencies of missing data per item as well as for the overall measure. For this analysis, we
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25 190 also included cases with more than 30% of ORIC items missing because these values are part of
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27 191 completion rate and relevant for interpretation of acceptance.

28
29 192 We a priori hypothesized to replicate the theory-based two-dimensional structure of the original English
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31 193 ORIC version. Two correlating factors "change commitment" (item 1 to 5) and "change efficacy" (item 6 to
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33 194 10) were postulated. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of
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35 195 sphericity were performed to test prerequisites for factor analysis [57,58]. A confirmatory factor analysis
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37 196 (CFA) with Maximum Likelihood Estimates and two factors was applied for the whole data set as a first
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39 197 step. Because the two-factor model could not be confirmed, we decided to calculate an exploratory factor
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41 198 analysis (EFA) and afterwards an additional CFA to check for model fit. It is recommended to not calculate
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43 199 EFA and CFA with the same data set so the data set was randomized by AL and split into two subsets
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45 200 [59,60]. The first 115 randomized cases including all data of participants were added to EFA, the second
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47 201 115 cases were added to CFA. An EFA with oblique rotation was calculated for the first subset. The non-
48
49 202 orthogonal rotation was chosen according to Weiner et al. [40]. In their theory, organizational readiness for
50
51 203 change consists of two interrelated dimensions, therefore the two factors are expected to be correlated.
52
53 204 Analogue to analyses done by authors of the English ORIC [43,61], we extracted components based on
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55 205 parallel analysis. The criterion of parallel analysis was shown to be superior to other statistic criteria like
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57 206 the Kaiser criterion [62,63]. It compares the eigenvalues of the data to the eigenvalues based on random
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59 207 data with equivalent sample size and number of variables and chooses only factors with eigenvalues higher
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208 than for random data [61,62]. A CFA was calculated for the second subset. A range of global goodness of

209 fit indices were used to assess the degree to which observed data were accounted for by the proposed
 210 models: discrepancy chi-squared statistic (χ^2), degree of freedom (df), normed chi-squared statistic
 211 (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation
 212 (RMSEA) as well as Akaike Information Criterion (AIC) and Parsimonious Normed Fit Index (PNFI) for
 213 analysing model complexity. Established rules to estimate the model fit were used [64–67].

214 Item analyses was performed for the one-factor model. It included calculation of item means and standard
 215 deviation as well as observation of floor and ceiling effects [68], calculation of corrected item-total
 216 correlations [57,69], inter-item correlations [57,69], and item difficulties [58]. Internal consistency of the
 217 scale was assessed by Cronbach's alpha coefficient (α) [58,69,70]. For a detailed overview on performed
 218 data analyses, see Table 1.

219 During the translation process and cognitive interviews we found low content validity for item 10 (see results
 220 section), therefore the use of item 10 for the German ORIC needs to be evaluated. Accordingly, we also
 221 conducted psychometric analyses (EFA with oblique rotation and extraction of components based on
 222 parallel analysis, corrected item-total correlations, Cronbach's α , and goodness of fit indexes) for the 9-item
 223 version of the ORIC.

224 Analysis of demographic data, analysis of completion rate, item analysis and EFA were performed using
 225 SPSS (IBM SPSS Statistics, Version 23). CFA and calculation of model fit indices were performed using
 226 Amos (IBM SPSS Amos 22.0.0).

227

228 Table 1: Psychometric analyses conducted.

Psychometric measure	Criteria
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity	These tests ensure that correlations between variables can be accounted for by a smaller set of factors [57]. KMO value should be higher than .05 and Bartlett's test value should be less than .05 to fulfil the criteria for calculating a factor analysis [57,58].
Normed chi-squared statistic (χ^2/df)	χ^2/df is an indicator for model fit, dependent on sample size and should be as small as possible. A ratio between 2 and 3 indicate a good data fit [64].
Comparative fit indexes (CFI)	CFIs is an indicator for model fit. It ranges from 0 to 1 and higher values indicate better fit. Values above .95 indicate a good model fit [67,71].
Tucker-Lewis Index (TLI)	TLI is an indicator for model fit. It corrects for complexity of the model and is sensitive to small sample sizes. Values above .95 indicate good fit [65].

Root mean square error of approximation (RMSEA)	RMSEA is an absolute index which describes closeness to fit. Values below .05 indicate a good fit, values between .05 and .08 indicate an adequate fit, values between .08 and 1 indicate a moderate fit and values above 1 are unacceptable [72].
Akaike Information Criterion (AIC)	AIC is a parsimony model fit index. It can be used to compare fit of competing models with smaller values indicating better fit [64,67].
Parsimonious Normed Fit Index (PNFI)	PNFI is a parsimony model fit index. It ranges between 0 and 1 and higher values indicate a more parsimonious fit [64]. No threshold levels are recommended and it has to be analysed in combination with other goodness of fit indices [67].
Analysis of frequencies for item response distributions	Floor and ceiling effects were assumed present if more than 15% of participants choose the lowest or highest possible score [68].
Corrected item-total correlations	If items correlate with the total score of above .30, they measure the same underlying concept. Items with lower correlations should be removed because they do not add exploratory power to the measure [57,69].
Item difficulties	Item difficulties are calculated by dividing item means by the maximal value of the answer range (0-4) and multiplying it with 100. Item difficulty should be near to 50%, and items should not differ much in their difficulty level [58].
Inter-item correlations	Inter-item correlations ensure association between items. High inter-item correlations of above .80 indicate that items ask the same questions and might be redundant [57,69].
Cronbach's α	Cronbach's α is a measure for reliability and internal consistency. A value of at least .70 is acceptable and higher coefficients indicate a more stable measure [57,58,70].

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230

231 **RESULTS**232 **Translation**

233 Both translators (AL and SZ) and the reviewer (IS) did not differ much in their translations of items 2 to 5
 234 and items 8. Greater translation differences were found for items 1, 6, 7, 9, and 10, mainly related to
 235 differences in sentence structure or single words. Within the first round of team discussion, we reached
 236 consensus for items 2 to 9, the translation of the response scale and the survey introduction. For item 1 we
 237 suggested two versions to be further tested in subsequent cognitive interviews. We struggled to translate
 238 the phrase "manage the politics" in item 10 into German. Therefore, we discussed item 10 with additional
 239 colleagues (cp. methods section) until consensus was found.

240

241 **Assessment of comprehensibility as part of content validity and subsequent adaptation of the scale**

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3 242 To test the German ORIC for comprehensibility, cognitive interviews with n=11 participants (nurses,
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5 243 physicians, and psychooncologists) were conducted. Cognitive interviews lasted about one hour. For
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7 244 demographic data of participants see Table A in Supplementary File 1.

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9 245 After the first round of cognitive interviews (n=7), no changes have to be made to the response scale as
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11 246 well as for item 2 to 5 and 8 because these items were already well understood by participants. Participants
12
13 247 made some minor suggestions for modifications for the introductory description and items 1 and 6.
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15 248 Additionally, some participants did not understand the correct meaning of items 7, 9 and 10 in general or
16
17 249 of single words or phrases of these items. After discussions and modifications of these items, we tested
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19 250 alternative versions of the survey introduction, for items 1, 6, 9 and 10 as well as two alternative versions
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21 251 of item 7. After the second round of cognitive interviews (n=4), items 1, 6 and 9 were now understood well
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23 252 by all participants. We had to slightly modify the survey introduction again and decided to use the version
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25 253 of item 7 which was understood best. After all, item 10 could not be translated successfully. Both rounds of
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27 254 cognitive interviews showed that comprehension of the German translation of the phrase “manage the
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29 255 politics” did not picture the correct English meaning. So in a next step we consulted with DF (cp. list of
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31 256 abbreviations) and reached consensus on a final version. Nevertheless, the final version of item 10 was
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33 257 still not satisfying from the study team and experts view. Item 10 was found to have low comprehensibility
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35 258 as part of content validity according to COSMIN criteria [50]. The final German ORIC measure, used in this
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37 259 study, is presented in Supplementary File 2.

38 260 During cognitive interviews some nurses reported that they had not heard about the term “shared decision-
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40 261 making” (German: “Partizipative Entscheidungsfindung”) prior to participation. Thus, we provided a
41
42 262 definition of SDM in the introduction part of the questionnaire within the SDM implementation study [52].

43 263

45 264 **Psychometric evaluation**

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47 265 **Sample characteristics.** Data of 235 HCPs were available for this secondary analysis. In line with
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49 266 recommendations of Bannon [56], five cases (0.02% of all cases) were excluded (except for assessment
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51 267 of completion rate), because all items of the ORIC were missing. Missing values were replaced by means
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53 268 and data of 230 HCPs could be included into analyses.

54
55 269 Table 2 provides an overview of participants’ demographic characteristics. Most of the 230 HCPs were
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57 270 between 31 and 40 years old (37.0%), female (70.4%), worked as a nurse (57.0%), and had a work
58
59 271 experience of < 5 years (43.9%).

272

273 Table 2: Demographic characteristics of participants (n=230).

		N	%
Age	< 30 years	72	31.3
	31-40 years	85	37.0
	41-50 years	42	18.3
	> 50 years	26	11.3
	Missings	5	2.2
Gender	Female	162	70.4
	Male	59	25.7
	Different gender or preferred not to answer this question	5	2.1
	Missings	4	1.7
Profession	Nurse	131	57.0
	Junior physician	69	30.0
	Senior physician	27	11.7
	Missings	3	1.3
Work experience in healthcare	< 5 years	101	43.9
	5-10 years	48	20.9
	11-20 years	46	20.0
	> 20 years	28	12.2
	Missings	7	3.0

274

275

276 **Factor analysis.** Sample size was large enough (>100) to allow factor analysis [50], even for a split data
 277 set with n=115. Furthermore, there were no outliers and values were approximately normally distributed.
 278 KMO measure was .933 and Barlett's test of sphericity yielded $X^2 = 1485.11$, $p < .001$. This indicates that
 279 a factor analysis of the data was appropriate [57,58]. CFA for the hypothesised two-factor model showed a
 280 high correlation of .87 between the two components (see Supplementary File 3). Therefore, we postulated
 281 a one-factorial structure and conducted a post-hoc EFA. As shown in Table 3, only the first component had
 282 an eigenvalue higher than 95% percentile of the eigenvalues of corresponding random data and the main
 283 component explains 67.23% of the variance. Thus, according to parallel analysis, a one-factor model was
 284 assumed. The factor loadings for the first component were above 0.754 for all items (see Table B of
 285 Supplementary File 1).

286

287 Table 3: Results of EFA with oblique rotation and parallel analysis: eigenvalues of the ten components of
 288 the German ORIC and eigenvalues for corresponding random data.

	Eigenvalues			Eigenvalues for random data	
	Total	% of variance	Cumulative %	Means	95% percentile
Component 1	6.72	67.23	67.23	1.49	1.65
Component 2	0.83	8.30	75.53	1.33	1.44
Component 3	0.47	4.75	80.28	1.21	1.30
Component 4	0.41	4.08	84.36	1.11	1.19

Component 5	0.39	3.91	88.28	1.02	1.08
Component 6	0.32	3.24	91.52	0.93	1.00
Component 7	0.27	2.74	94.26	0.85	0.92
Component 8	0.23	2.34	96.60	0.77	0.84
Component 9	0.17	1.74	98.35	0.68	0.75
Component 10	0.16	1.65	100.00	0.58	0.66

Notes: For EFA, half of the data set (n=115) was used.

289
290 A second CFA was performed with the one-factor model to analyse its fit indices. Indices of the two-factor
291 model and the one-factor model are compared in Table 4.

292

293 Table 4: Fit indices of two calculated models for factor analysis of the German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
Two-factor model	81.71*	34	2.40	.968	.947	.078	143.71	.585
One-factor model	77.19*	35	2.20	.928	.907	.103	117.19	.682

Notes: Two-factor model was calculated for the whole data set (n=230): factor 1 includes item 1 to 5, factor 2 includes item 6 to 10; One-factor model was calculated for half of the data set (n=115): includes items 1 to 10.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

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296 Results of factor analysis for the 9-item version of the ORIC (without item 10) were similar. Also for the 9-
297 item version, a one-factor model was assumed by exploratory factor analysis. Only the first component had
298 an eigenvalue higher than 95% percentile of the eigenvalues of corresponding random data and the main
299 component explains 66.85% of the variance. Factor loadings of the first component are above 0.739 for all
300 items (see Supplementary File 4, Table A and B). Goodness of fit indices of the one-factor model of the 9-
301 item ORIC version showed similar values compared to the 10-item ORIC version (see Supplementary File
302 4, Table C).

303
304 **Analysis of the ORIC items and internal consistency.** Table 5 shows response distribution, means,
305 standard deviations, acceptance, corrected item-total correlation, and item difficulty of the ten items. Means
306 ranged between 2.24 (item 9) and 2.61 (item 5). Most participants responded in the middle of the scale with
307 a slight shift to more agreement. For items 1 to 9 between four and six missing values could be detected.
308 For item 10, nine missing values were found. Taking all items into account, more than 97% of the measure
309 were answered. Corrected item-total correlations ranged from .665 (item 9) to .774 (item 3), item difficulties

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3 310 from 55.98 (item 9) to 65.32 (item 5), and inter-item correlations from .434 (item2/item9) to .723 (item3/item
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5 311 5) (see Table C of Supplementary File 1). Internal consistency yielded a Cronbach's α of .93.
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7 312 Additionally, corrected item-total correlations and internal consistency were calculated for the 9-item ORIC
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9 313 version (see Supplementary File 4, Table D). They were similar to the results for the 10-item version with
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11 314 corrected item-total correlations between .638 (item 9) and .777 (item 3) and a Cronbach's α of .92.
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317 Table 5: Response distribution, means, standard deviation, acceptance, discrimination and item difficulty of the German ORIC.

Items	Disagree N (%)	Somewhat Disagree N (%)	Neither Agree nor Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Mean (SD)	Acceptance (Comple- tion rate in %)*	Item discrimination (corrected item-total correlation)	Item difficulty
1 People who work here are committed to implementing shared decision-making.	1 (0.4)	22 (9.6)	109 (47.0)	73 (30.9)	25 (10.9)	2.42 (.826)	97.43	.744	60.58
2 People who work here will do whatever it takes to implement shared decision-making.	4 (1.7)	37 (16.1)	103 (44.8)	68 (29.6)	18 (7.4)	2.25 (.878)	98.29	.689	56.36
3 People who work here want to implement shared decision-making.	0 (0.0)	15 (6.5)	107 (46.5)	84 (35.7)	24 (10.4)	2.50 (.768)	97.43	.774	62.61
4 People who work here are determined to implement shared decision-making.	2 (9.0)	38 (16.5)	107 (46.5)	67 (29.1)	16 (7.0)	2.25 (.843)	98.29	.758	56.19
5 People who work here are motivated to implement shared decision-making.	1 (0.4)	16 (7.0)	85 (37.0)	97 (42.2)	31 (13.5)	2.61 (.821)	98.29	.764	65.32
6 People who work here feel confident that they can handle the challenges that might arise in implementing shared decision-making.	2 (0.9)	20 (8.7)	93 (40.4)	93 (40.4)	22 (9.6)	2.49 (.819)	98.29	.760	62.28
7 People who work here feel confident that they can keep track of progress in implementing shared decision-making.	1 (0.4)	26 (11.3)	93 (40.4)	92 (40.0)	18 (7.8)	2.43 (.811)	98.29	.725	60.87
8 People who work here feel confident that they can coordinate tasks so that implementation goes smoothly.	5 (2.2)	24 (10.4)	107 (46.5)	78 (33.5)	16 (6.5)	2.32 (.833)	99.56	.697	58.13
9 People who work here feel confident that the organization can support people as they adjust to shared decision-making.	6 (2.6)	43 (18.7)	89 (38.7)	74 (32.2)	18 (7.8)	2.24 (.934)	97.86	.665	55.98
10 People who work here feel confident that they can manage the politics of implementing shared decision-making.	3 (1.3)	24 (10.04)	122 (50.9)	65 (28.3)	16 (7.0)	2.29 (.796)	96.15	.714	57.44

Notes: Items could be answered on a 5-step Likert scale rating from 0 „disagree“ to 4 „agree“. SD = standard deviation. * For calculation of completion rate, five additional cases were included because these participants only skipped the ORIC but filled out the rest of the survey.

318

319 **DISCUSSION**

320 The original English ORIC measure is a brief measure with good psychometric properties [43], which were
321 confirmed in Danish [45] and French [46] validation studies. The study at hand aimed to translate the ORIC
322 into German and assess its psychometric properties.

323 324 **Translation and assessment of comprehensibility as part of content validity**

325 Items 1 to 9 could be translated and adapted successfully after two rounds of cognitive interviews and
326 several rounds of discussions within the study team and with external experts. The translation team quickly
327 reached consensus for items 2 to 5 and 8. These items were also well understood by all participants within
328 the first round of cognitive interviews. For items 1, 6, 7 and 9, the translation process was more complex
329 and several adaptations and discussions were necessary. Feedback by participants, members of the study
330 team, and external experts as well as completion rates suggest that comprehensibility of item 10 seems to
331 be low [50]. This might be due to the translation of the phrase “manage the politics” into “Machenschaften”.
332 The term “manage the politics” seems to have a strong cultural connotation and no equivalent phrase in
333 German language exists. The German term “Machenschaften” might have a different connotation as the
334 English phrase and might lead to skipping the item. Ruest et al. [46], who translated the English ORIC into
335 French, also identified several differences in cultural concepts during their adaptation process, but could
336 translate all items successfully. They concluded that limitations in linguistic validation could decrease
337 comparability of psychometric results of the translated measure. However, item 10 showed similar and
338 inconspicuous item characteristics compared to other items in our sample. When repeating factor and item
339 analyses for the 9-item ORIC version including only item 1 to 9, very similar results were observed
340 compared to the 10-item version. To increase comprehensibility and thereby content validity of the scale,
341 the use of the 9-item German ORIC might be a solution and should be evaluated in future studies.

342 343 **Factor analysis**

344 We a priori hypothesized a two-factorial structure of the German ORIC, because Shea et al. [43] described
345 correlations between the two theory-based factors “change commitment” and “change efficacy” of .56 to
346 .60. However, we found much higher factor correlations of 0.87. Results of the subsequent EFA clearly
347 indicated a one-factorial structure. Thus, we could not confirm the two-factor structure of the English and
348 the translated Danish and French versions of ORIC [43,45,46]. When comparing the two models, both

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3 349 models have acceptable values for χ^2/df [64] and CFI [67,71], but only the two-factor model has
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5 350 acceptable values for TLI [65] and RMSEA [72]. When involving parsimony of the models by calculating
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7 351 AIC and PNFI, the one-factor model fits better to the data [64,67]. Therefore, we prefer the more
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9 352 parsimonious one-factor model. These differences to previous validation studies might be a consequence
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11 353 of diverse cultural connotations of the ORIC items in different languages, caused by the adaption to the
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13 354 context of SDM, or due to specific characteristics of the participating clinics.
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16 356 **Analysis of ORIC items and internal consistency**

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18 357 Since the ORIC was presented as the last measure in a three-page survey, missing values might indicate
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20 358 respondent fatigue. However, missing value rates for single items and the overall measure were quite low
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22 359 and the German ORIC was found to be a well-accepted measure. There were no floor or ceiling effects.
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24 360 Corrected item-total correlations of above .66 indicate that all items measure the same underlying concept
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26 361 [57,69]. Criteria for good item difficulties are met since item difficulties are near to 50% and do not differ
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28 362 much from each other [58]. Inter-item correlations are below .80, indicating that items add additional
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30 363 information and are not redundant [57,69]. Cronbach's α ($\alpha=.93$) suggest excellent internal consistency
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32 364 [57,58,70]. In summary, item analysis and internal consistency of the German ORIC suggest good quality
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34 365 of the measure.

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36 366 Nevertheless, according to Streiner and Norman [58] a Cronbach's α above .90 might also indicate item
37
38 367 redundancy. On the other hand, inter-item correlations and corrected item-total correlations are in an
39
40 368 acceptable range [57,69]. In implementation research there is a need for preferably brief measures, which
41
42 369 can be applied in diverse settings with high work-load. Thus, future research could investigate the possibility
43
44 370 to further reduce the number of items.

45 371

46 47 372 **Strength and Limitations**

48
49 373 This study has some limitations. First, several psychometric parameters are not analysable because this
50
51 374 study was a secondary analysis of cross-sectional data. It was not possible to calculate e.g. convergent or
52
53 375 divergent validity yet. Second, we applied the ORIC only in three departments of one University Medical
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55 376 Center in Germany. Further validation in different organizational settings is needed to ensure
56
57 377 generalizability. Third, for this psychometric evaluation we used a German ORIC, which we adapted and
58
59 378 specified for the context of SDM implementation. Our results might not be generalizable for other
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3 379 interventions in other organizations. Fourth, although SDM was not implemented to the participating clinics
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5 380 before, there might be participants who were more familiar with the concept of SDM than others. Fifth, item
6
7 381 10 was again slightly changed after finishing cognitive interviews. This item was not finally tested for
8
9 382 comprehensibility.

10
11 383 A major strength of this study is that we provided the first measure to assess organizational readiness for
12
13 384 change in German language for use in implementation studies. We conducted an elaborated translation
14
15 385 procedure, which was recommended for survey translations. We furthermore used a qualitative approach
16
17 386 to explore comprehensibility including discussions with international colleagues and experts outside of the
18
19 387 study team. Furthermore, we assessed the ORIC in a sample including physicians and nurses which was
20
21 388 large enough to robustly perform the psychometric analysis on the German version of the ORIC measure.

22 389

23 24 390 **CONCLUSION**

25
26 391 Organizational readiness is a crucial indicator to successfully implement change and a possible barrier if
27
28 392 missing. For implementation studies, it is essential to measure organizational readiness with valid and
29
30 393 reliable measures. We provide the first German measure for organizational readiness for implementing
31
32 394 change and validated it for the context of SDM implementation. The German ORIC is a brief measure with
33
34 395 a high completion rate. We found satisfying psychometric properties in a German hospital setting. To
35
36 396 increase content validity of the measure, the use of a 9-item German ORIC (without item 10) should be
37
38 397 evaluated in future studies. As the ORIC targets the attitude of organizational members, it can detect
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40 398 reduced or missing readiness for implementing a change on the individuals' level. Therefore, the German
41
42 399 ORIC can be used to analyse organizational readiness as a possible barrier for implementing various
43
44 400 interventions in organizations.

45 401

46 47 402 **LIST OF ABBREVIATIONS**

48
49 403 AH: Anne Haugstvedt

50
51 404 AIC: Akaike Information Criterion

52
53 405 AL: Anja Lindig

54
55 406 AMOS: Analysis of Moment Structure, Statistical Package for the Social Sciences, International Business
56
57 407 Machines Corporation

58
59 408 χ^2 : Discrepancy chi-squared statistic

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3 409 Chi²/df: Normed chi-squared statistic
4
5 410 CFI: Confirmatory fit index
6
7 411 CS: Christopher M. Shea
8
9 412 Df: Degree of freedom
10
11 413 DF: Dominick Frosch
12
13 414 EC: Eva Christalle
14
15 415 HCP: Healthcare professional
16
17 416 IS: Isabelle Scholl
18
19 417 KMO: Kaiser-Meyer-Olkin criterion
20
21 418 MM: Marcel Machalski
22
23 419 MR: Mélanie Ruest
24
25 420 ORIC: Organizational Readiness for Implementing Change
26
27 421 PH: Pola Hahlweg
28
29 422 PNFI: Parsimonious Normed Fit Index
30
31 423 RMSEA: Root mean square error of approximation
32
33 424 SDM: Shared decision-making
34
35 425 SPSS: Statistical Package for the Social Sciences, International Business Machines Corporation
36
37 426 SZ: Stefan Zeh
38
39 427 TLI: Tucker-Lewis Index
40
41 428 TRAPD: Translation, Review, Adjudication, Pretesting, Documentation
42

430 **DECLARATIONS**

431 **Ethics approval and consent to participate**

432 The study was approved by the Ethics Committee of the Medical Association Hamburg (Germany, study
433 ID PV5368). The study was carried out in accordance to the latest version of the Helsinki Declaration of the
434 World Medical Association. Principles of good clinical practice were respected. Data protection
435 requirements were met. Study participation was voluntary. A waiver of consent for HCPs was obtained from
436 the Ethics Committee, as proposed by current statements on ethical designs of implementation research
437 [73]. HCPs were able to decline participation in the study.

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1
2
3 439 **Funding**

4
5 440 This study is funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, grant
6
7 441 number 232160533).

8
9 442
10
11 443 **Competing interests**
12
13 444 PH gave one scientific presentation on shared decision-making during a lunch symposium, for which she
14
15 445 received compensation and travel compensation from GlaxoSmithKline GmbH in 2018. AL, EC and IS
16
17 446 declared to not have any competing interests.

18 447
19
20 448 **Author contributions**
21
22 449 AL, PH and IS made substantial contributions to the design and preparation of the study. AL and PH
23
24 450 collected the data. AL conducted the analysis in collaboration with EC. All authors contributed to the
25
26 451 interpretation of results. AL drafted the manuscript and PH, IS and EC were involved in critically revising
27
28 452 the manuscript for important intellectual content. All authors gave final approval of the version to be
29
30 453 published.

31 454
32
33 455 **Checklist for reporting statement**
34
35 456 To report the results of this validation study, we used the Authors' Guidelines for Reporting Scale
36
37 457 Development and Validation Results by Cabrera-Nguyen.

38
39 458
40
41 459 **Patient consent form**
42
43 460 Not applicable

44
45 461
46
47 462 **Data sharing statement**
48
49 463 The dataset collected and analyzed during this study is available from the corresponding author on
50
51 464 reasonable request.

52 465
53
54 466 **Acknowledgements**
55
56 467 We thank our student assistants Anastasia Izotova, Sophia Schulte and Nicolai Pergande for their help
57
58 468 preparing the study and the analysis. We thank Stefan Zeh for his part the team translation process. We
59
60

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2
3 469 thank Dominick Frosch, Anne Haugstvedt, Marcel Machalski, Mélanie Ruest and Christopher M. Shea for
4
5 470 helpful comments and suggestions in the translation and adaptation process of item 10. We also would like
6
7 471 to thank Christopher M. Shea for giving the opportunity to translate the ORIC into German and to use it in
8
9 472 our implementation study.

10
11 473
12
13 474 **Supplementary Files**
14
15 475 Supplementary File 1: Additional tables for psychometric evaluation of the 10-item ORIC version
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17 476 Supplementary File 2: Organizational Readiness for Implementing Change (ORIC) – German version
18
19 477 Supplementary File 3: Confirmatory factor analysis model of the 10-item German ORIC
20
21 478 Supplementary File 4: Results of psychometric evaluation of the 9-item German ORIC version
22
23 479 Supplementary File 5: Reporting Checklist: Authors Guidelines for Reporting Scale Development and
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25 480 Validation Results

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28 482 **REFERENCES**
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3 **1 Supplementary File 1: Additional tables for psychometric evaluation of 10-item ORIC version**
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3 Table A: Demographic data of participants of cognitive interviews (n=11).
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		Frequencies for n=11
Age	< 30 years	1
	31-40 years	3
	41-50 years	3
	> 50 years	4
Gender	Female	9
	Male	2
Profession*	Nurse	8
	Physician	2
	Psychooncologist	3
Work experience in health care	> 5 years	3
	5-10 years	4
	11-20 years	3
	> 20 years	1

4 * multiple answers possible
5
6

6 Table B: Factor loadings on the first component.
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	Component 1
Item 1	0.790
Item 2	0.788
Item 3	0.833
Item 4	0.846
Item 5	0.831
Item 6	0.851
Item 7	0.839
Item 8	0.800
Item 9	0.754
Item 10	0.860

7 For EFA, the sample was split and n=115.
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9 Table C: Inter-item correlation matrix for the German ORIC.
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11

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Item 1	1.000	.634	.650	.611	.652	.587	.558	.538	.507	.542
Item 2	.634	1.000	.586	.681	.607	.518	.504	.485	.434	.478
Item 3	.650	.586	1.000	.673	.723	.636	.600	.558	.492	.560
Item 4	.611	.681	.673	1.000	.675	.588	.531	.541	.512	.551
Item 5	.652	.607	.723	.675	1.000	.622	.621	.466	.474	.578
Item 6	.587	.518	.636	.588	.622	1.000	.677	.590	.588	.573
Item 7	.558	.504	.600	.531	.621	.677	1.000	.612	.491	.567
Item 8	.538	.485	.558	.541	.466	.590	.612	1.000	.611	.560
Item 9	.507	.434	.492	.512	.474	.588	.491	.611	1.000	.659
Item 10	.542	.478	.560	.551	.578	.573	.567	.560	.659	1.000

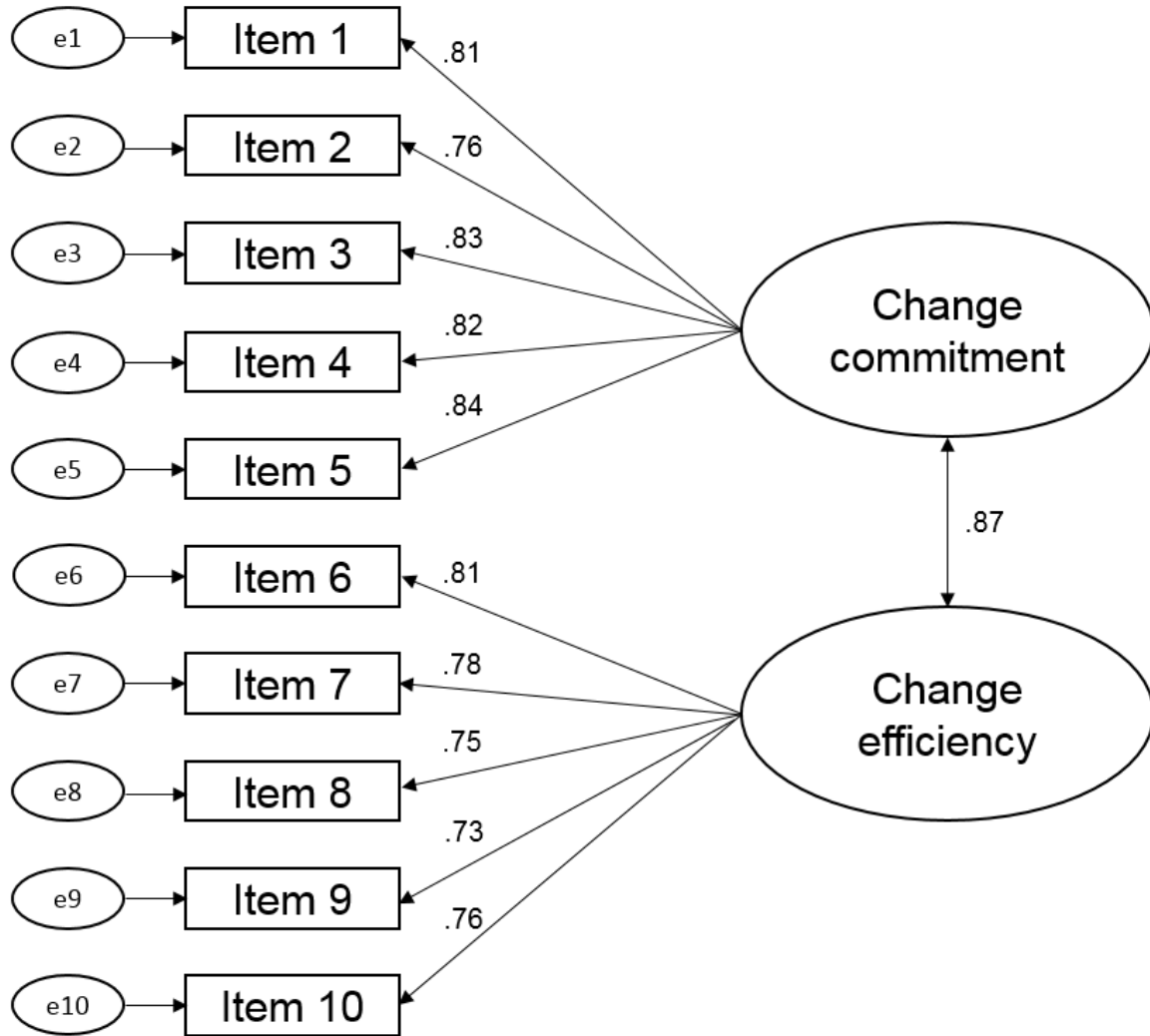
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Supplementary File 2: Organizational Readiness for Implementing Change (ORIC) – German version

Bitte geben Sie an, wie sehr Sie den folgenden Aussagen zur Umsetzung von partizipativer Entscheidungsfindung an Ihrem aktuellen Arbeitsplatz zustimmen. Falls partizipative Entscheidungsfindung aktuell nicht umgesetzt wird, wie wäre es im Falle der Umsetzung?

		stimme nicht zu	stimme eher nicht zu	teils teils	stimme eher zu	stimme zu
1	Personen, die hier arbeiten, zeigen hohes Engagement bei der Umsetzung von partizipativer Entscheidungsfindung.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Personen, die hier arbeiten, werden tun, was auch immer nötig ist, um partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Personen, die hier arbeiten, wollen partizipative Entscheidungsfindung umsetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Personen, die hier arbeiten, sind fest entschlossen, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Personen, die hier arbeiten, sind motiviert, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	Eventuell entstehen bei der Umsetzung von partizipativer Entscheidungsfindung Herausforderungen. Personen, die hier arbeiten, sind zuversichtlich, diese zu meistern.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Personen, die hier arbeiten, sind zuversichtlich, dass sie den Verlauf der Umsetzung von partizipativer Entscheidungsfindung überblicken können.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Personen, die hier arbeiten, sind zuversichtlich, dass sie Aufgaben so koordinieren können, dass die Umsetzung reibungslos abläuft.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	Personen, die hier arbeiten, sind zuversichtlich, dass die Klinik sie dabei unterstützen kann, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	Personen, die hier arbeiten, sind zuversichtlich, Machenschaften bei der Umsetzung von partizipativer Entscheidungsfindung bewältigen zu können.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Supplementary File 3: Confirmatory factor analysis model of the 10-item German ORIC



1 Supplementary File 4: Results of psychometric evaluation of the 9-item German ORIC version:

2 Factor analysis, corrected item-total correlations, Cronbach's α

4 Factor analysis

5 To get information about the factorial structure of the 9-item German ORIC, an exploratory factor
6 analysis was conducted. KMO measure was .926 and Barlett's test of sphericity was significant ($X^2 =$
7 1302.78, $p < .001$), indicating that a factor analysis of the data was appropriate to observe data. Table
8 A shows results of the exploratory factor analysis. Since the main component explains 66% of the
9 variance, a one-factor model could be assumed. The factor loading for the first component can be
10 observed in table B.

12 Table A: Results of exploratory factor analysis of the 9-item German ORIC with oblique rotation and
13 parallel analysis: eigenvalues of the ten components of the German ORIC and eigenvalues for
14 corresponding random data.

	Eigenvalue			Eigenvalues for random data	
	Total	% of variance	Cumulative %	Means	95% percentile
Component 1	6.02	66.85	66.85	1.45	1.59
Component 2	0.802	8.91	75.76	1.29	1.39
Component 3	0.472	5.25	81.01	1.17	1.25
Component 4	0.392	4.35	85.37	1.07	1.14
Component 5	0.366	4.06	89.43	0.98	1.05
Component 6	0.304	3.38	92.81	0.89	0.96
Component 7	0.250	2.78	95.59	0.81	0.87
Component 8	0.232	2.57	98.16	0.71	0.79
Component 9	0.165	1.84	100.00	0.61	0.69

Notes: For EFA, half of the data set (n=115) was used.

17 Table B: Factor loadings on the first component.

	Component 1
Item 1	0.860
Item 2	0.856
Item 3	0.837
Item 4	0.836
Item 5	0.835
Item 6	0.799
Item 7	0.797
Item 8	0.791
Item 9	0.739

Notes: For EFA, the sample was split and n=115.

19 A confirmatory factor analysis was performed with the one-factor model to analyse its fit indices. Indices
 20 of the one-factor model are presented in table C.

22 Table C: Fit indices of the one-factor model of the 9-item German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
One-factor model	56.04	27	2.08	.945	.927	.097	92.04	.676

Notes: One-factor model (including a split data set of n=115): includes items 1 to 9.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

24 Corrected item-total correlations and Cronbach's α of the 9-item ORIC version

25 Table D shows the corrected item-total correlation. Corrected item-total correlation ranged from .665
 26 (item 9) to .744 (item 3).

28 Table D: Discrimination of the nine items of the German ORIC.

	Item discrimination ²⁹ (corrected item-total correlation)
Item 1	.747
Item 2	.696
Item 3	.777
Item 4	.760
Item 5	.762
Item 6	.759
Item 7	.720
Item 8	.691
Item 9	.638

Notes: Items could be answered on a 5-step Likert scale rating from 0 „disagree“ to 4 „agree“.

32 Cronbach's α with $\alpha = .924$ showed the measure to reach excellent reliability.

1 **Supplementary File 5: Checklist for reporting standards. Authors' guideline for Scale**2 **Development and validation results by Cabrera-Nguyen.**

	Guidelines by Cabrera-Nguyen [1]	Transfer to our study
1	Precisely define the target construct.	See page 3 and 4 (Introduction section)
2	Justify the need for your new measure. For example, if measures of the construct exist in the literature, explain the value added by your new scale. How might the new measure enhance the substantive knowledge base or social work practice?	See page 4 (Introduction section)
3	Indicate that you have submitted your initial pool of items to expert review (Worthington & Whittaker, 2006). Report (a) the number of items in the preliminary pool; (b) the number of expert reviewers and their qualifications; and (c) any major changes to your initial item pool following the review (e.g., a substantial decrease in the number of items, changes to the original item response format, overhaul of item pool due to experts' assessment regarding content validity).	See page 5 and 6 (Methods section: Measure, Translation, Assessment of comprehensibility and adaption of the scale) and page 9 and 10 (Results section: Translation, Assessment of comprehensibility and adaption of the scale)
4	Report the name and version of the statistical software package used for all analyses.	See page 6 to 8 (Methods section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation)
5	Identify and justify the sampling strategy (e.g., convenience, snowball) and sampling frame. Report standard sample demographic characteristics as well as other salient sample characteristics.	See page 6 and 7 (Methods section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation) and page 8 to 10 (Results section: Assessment of comprehensibility and adaption of the scale, Psychometric evaluation) and Additional file 3
6	Discuss relevant data preparation and screening procedures. For instance, do the data meet the appropriate assumptions for factor analysis? If not, what actions were taken? Report tests of factorability if appropriate (e.g., report Bartlett's test of sphericity).	See page 10 to 12 (Results section: Psychometric evaluation)
7	Provide all dates of data collection.	See page 9 to 13 (Results section)
8	Avoid use of principal components analysis (PCA) as a precursor to CFA (Costello & Osborne, 2005; Worthington & Whittaker, 2006). Instead, start with EFA to assess the underlying factor structure and refine the item pool. EFA should be followed by CFA using a different sample (or samples) to evaluate the EFA-informed a priori theory about the measure's factor-structure and psychometric properties. (Costello & Osborne, 2005; Henson & Roberts, 2006; Worthington & Whittaker, 2006). For CFA, authors	An a priori hypothesized model for CFA was specified based on the original measures structure. The model could not be confirmed and an EFA was calculated afterwards. The same data set was used for EFA and CFA. For more

	should specify an a priori hypothesized model and a priori competing models (Jackson, Gillaspay, & Purc-Stephenson, 2009).	information see page 10 to 12 (Results section).
9	<p>Guidelines for reporting EFA results.</p> <p>How large is a sample? One common rule of thumb is to ensure a person-to-item ratio of 10:1. Another rule of thumb is that $N = 300$ is usually acceptable (Worthington & Whittaker, 2006). However, some researchers have criticized these sample size rules of thumb, noting the appropriate sample size is dependent on the features of the gathered data. These researchers recommend obtaining the largest possible sample because the adequacy of the sample size cannot be determined until after the data have been analyzed (Henson & Roberts, 2006).</p> <p>Run EFA . . . or not. Run a preliminary EFA to determine if further data collection is required based on the following criteria: (a) If communalities are greater than .50 or there are 10:1 items per factor with factor loadings of roughly .4, then a sample size of 150 to 200 is likely to be adequate; (b) If communalities are all at least .60 or there are a minimum of 4:1 items per factor with factor loadings above .6, then even smaller sample sizes may suffice; (Worthington & Whittaker, 2006). Report if additional data collection was necessary due to inadequate sample size. If so, report the new participants' sociodemographic characteristics and test for differences between groups using standard statistical procedures (e.g., t-tests).</p> <p>Give EFA details. Report the specific rotation strategy used (e.g. varimax, geomin). Justify the decision to use an orthogonal or oblique solution. One recommendation is to always begin with an oblique rotation, empirically assess factor intercorrelations, and report them before deciding upon a final rotation solution (Henson & Roberts, 2006; Worthington & Whittaker, 2006). Some researchers argue oblique rotation is always the best approach because (a) factor intercorrelations are the norm in social sciences and (b) both approaches yield the same result if the factors happen to be uncorrelated (Costello & Osborne, 2005). Conversely, other researchers contend that orthogonal rotation is preferable because fewer parameters are estimated—orthogonal rotation is more parsimonious and amenable to replication (Henson & Roberts, 2006). Similarly, some researchers warn against relying on a statistical software package's default settings to determine the appropriate type of oblique rotation (Henson & Roberts, 2006; Worthington & Whittaker, 2006). Others state that doing so is fine (Costello & Osborne, 2005, p.3). Given the lack of consensus, it is probably best to describe what you do and defend your approach on substantive grounds, if possible.</p> <p>Report the whole factor pattern/structure. Always report the whole factor pattern/structure matrix, including all of the items in the analysis. It is recommended that authors report</p>	<p>Sample size is $n=115$, person-to-item ratio 11.5:1 (see page 7: Methods section, Psychometric analysis)</p> <p>EFA communalities are all above .70, therefore the sample size of $n=115$ can be determined as adequate and no additional data collection was necessary. For more information, see Supplementary File1).</p> <p>See page 6 to 8 (Methods section: Psychometric evaluation)</p> <p>See page 10 to 12 (Results section: Psychometric evaluation) and Supplementary File 1</p>

	<p>this information in a chart following the example provided by Henson and Roberts (2006) on page 411.</p>	
	<p>Criteria for deleting (crossloaded) items. Report any deleted items and the criteria used for deletion. Crossloading items with values $\geq .32$ on at least two factors should generally be candidates for deletion, especially if there are other items with factor loadings of .50 or greater (Costello & Osborne, 2005). Rerun the EFA each time an item is deleted.</p>	<p>No crossloading items could be observed, so item deletion was not necessary.</p>
	<p>Criteria for number of factors. Report the number of factors retained and justify this decision using multiple criteria (eigenvalue > 1, scree test, parallel analysis, rejection of a factor with fewer than 3 items, etc). Reporting the eigenvalue > 1 rule alone is inadequate because it has been shown to among the least accurate criteria for assessing factor retention (Costello & Osborne, 2005; Henson & Roberts, 2006)</p>	<p>See page 6 to 8 (Methods section: Psychometric evaluation)</p>
	<p>Explained variance. Report the variance explained by the factors.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation) and Supplementary File 1</p>
	<p>In general, describe your decisions.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation) and Supplementary File 1</p>
10	<p>Guidelines for reporting CFA results.</p>	
	<p>Describe and justify the theoretical model. Report hypothesized factor structure. Provide theoretical and empirical justification (e.g., results of preliminary EFAs) for your hypothesis. In addition, report a priori competing models.</p>	<p>See page 6 to 8 (Methods section: Psychometric evaluation)</p>
	<p>Describe the parameterization. Provide a comprehensive description of the a priori parameter specification. Identify fixed parameters, free parameters, and constrained parameters. For example, indicate if you freed the errors of any items to correlate.</p>	<p>One factor loading was constrained to equal 1, the corresponding intercept was constrained equal to zero. The other factor loadings and intercepts were estimated. Errors of items were not freed to correlate.</p>
	<p>Include a figure. Include a figure of each CFA model being tested using Kline's (2005) graphical conventions if feasible.</p>	<p>See Supplementary File 3</p>
	<p>Identification. Demonstrate model identification (e.g., $df > 0$; scaling of factors; assess and report the —t-rule; the two-indicator rule). Necessary and sufficient conditions for model identification may vary for certain types of CFA models. When in doubt, authors should consult Brown's (2006) CFA text or Kline's (2005) SEM text for guidance.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation)</p>
	<p>Select an estimator based on distributional patterns and assumptions. Report the estimator used (e.g., ML,</p>	<p>See page 6 (Methods section: Psychometric evaluation)</p>

	WLSMV) and justify your choice based on distributional assumptions. It is not appropriate to report that you relied on your statistical software's default setting.	
	Use multiple fit indices. After estimating a model, always report multiple fit indices (e.g., model χ^2 , df, p, CFI/TLI, RMSEA, SRMR). Report all appropriate fit indices, not just those favorable to your hypotheses (Jackson et al., 2009). For example, do not report acceptable CFI and TLI scores while omitting a relevant fit index with a suboptimal value.	See page 8 (Methods section: Psychometric evaluation) and page 10 and 11 (Results section: Psychometric evaluation)
	What is acceptable fit? For model fit indices, authors should generally use the cut-off values recommended by Hu and Bentler (1999) and endorsed by Brown (2006), assuming ML estimation: a. CFI/TLI $\geq .95$ b. RMSEA $\leq .06$ c. SRMR $\leq .08$	See page 9, Table 1 (Methods section: Psychometric evaluation)
	Localized strain? When reporting model fit, include an assessment for localized areas of strain by examining standardized residuals. Standardized residuals greater than 1.96 (for $p < .05$) indicate areas of strain (Harrington, 2009). Report the absence of localized strain, if appropriate; otherwise, note localized areas of strain by reporting the relevant standardized residuals.	Standardized residuals do not indicate localized strains.
	Parameter estimates and SEs. When reporting factor loadings and other parameter estimates, always report the unstandardized estimates, their p values, and the standard errors. In addition, include the standardized estimates when appropriate. Be sure to report all parameter estimates, even those that are non significant (Brown, 2006; Jackson et al., 2009).	See Supplementary File 3
	Assessing the validity of the factor solution. Comment on the new measure's convergent and discriminant validity based on parameter estimates. For instance, factor correlations $\geq .80$ may indicate poor discriminant validity (Brown, 2006). In addition, strong factor loadings that do not crossload may indicate good convergent validity. One rule of thumb is that factor loadings $< .40$ are weak and factor loadings $\geq .60$ are strong (Garson, 2010).	Exploratory factor analysis revealed a one-factor model, so there are no factor correlations.
	Other measures. Report squared multiple correlations and comment on the measure's reliability (e.g., report Raykov's Rho if appropriate)	See page 10 to 12 (Results section: Psychometric analysis)
	Respecification: Caution! Report any post-hoc respecifications to improve model fit based on modification indices. Justify the respecifications on theoretical or conceptual grounds (Jackson et al., 2009). Respecification to allow for correlated errors is not supportable without strong pragmatic justification (e.g., items contain similar words or phrases). Note that respecification precludes comparing the model with your a priori specified competing models. Report improvements in appropriate model fit indices for respecified models (e.g., chi-square difference test)	No respecifications to improve model fit were applied.
10	Describe the matrix (or matrices) you analysed (e.g., covariance, correlation). Include matrices in the manuscript	See Supplementary File 1

	if feasible; otherwise, indicate these data are available upon request.	
11	Report the amount of missing data and describe how missing data were handled. For a review of practices for handling missing data, see Sterne and colleagues (2009), Rose and Fraser (2008), and Horton and Kleinman (2007). Provide a rationale for your approach to handling missing data. Authors are encouraged to consider using multiple imputation or model estimation with full-information maximum likelihood (FIML; Rose & Fraser, 2008).	See page 7 (Methods section: Psychometric evaluation) and page 10 (Results section: Psychometric evaluation)
12	Compare your CFA model with the alternative or competing models. Do competing models fit the data better or worse than your model (e.g., does your four-factor model of acculturation fit the data better than a two-factor model or a one-factor model)? Identify the preferable model based on appropriate fit statistics (e.g. chi-square difference test for nested models, Akaike information criterion for non-nested models), parsimony, and relevant theory	See page 15 and 16 (Discussions sections)
13	Include your scale (items and response options) in an appendix.	See Supplementary File 2
14	Report how methodological limitations may have impacted findings regarding your measure's psychometric properties (e.g., note potential repercussions of suboptimal sampling techniques, discuss implications of using listwise deletion to handle missing data instead of multiple imputation or FIML).	See page 16 and 17 (Discussions sections)
15	Discuss directions for future research (e.g., if appropriate, testing your scale for measurement invariance by conducting CFA on different populations).	See page 16 and 17 (Discussions sections)

1 Cabrera-Nguyen P. Author Guidelines for Reporting Scale Development and Validation Results in the *J Soc Social Work Res* 2010;1:99–103.

BMJ Open

Translation and psychometric evaluation of the German version of the Organizational Readiness for Implementing Change measure (ORIC) – a cross-sectional study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034380.R2
Article Type:	Original research
Date Submitted by the Author:	01-Apr-2020
Complete List of Authors:	Lindig, Anja; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Hahlweg, Pola; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Christalle, Eva; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology Scholl, Isabelle; University Medical Center Hamburg-Eppendorf, Department of Medical Psychology
Primary Subject Heading:	Research methods
Secondary Subject Heading:	Communication, Evidence based practice, Patient-centred medicine
Keywords:	Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-making, Measurement

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3 1 **Translation and psychometric evaluation of the German version of the Organizational Readiness**
4
5 2 **for Implementing Change measure (ORIC) – a cross-sectional study**

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49 25 Word count: 4186
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2
3 31 **ABSTRACT**

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5 32 **Objectives:** To translate the Organizational Readiness for Implementing Change (ORIC) measure into
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7 33 German and assess its psychometric properties.

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9 34 **Design:** Cross-sectional psychometric study based on secondary analysis of baseline data from a shared
10
11 35 decision-making implementation study.

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13 36 **Setting:** Three departments within one academic cancer center in Hamburg, Germany.

14
15 37 **Participants:** For comprehensibility assessment of the translated ORIC version, we conducted cognitive
16
17 38 interviews with healthcare professionals (HCPs, n=11). Afterwards, HCPs (n=230) filled out the measure.

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19 39 **Primary and Secondary Outcome Measures:** The original English version of the ORIC was translated
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21 40 into German using a team translation protocol. Based on comprehensibility assessment via cognitive
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23 41 interviews with HCPs, the translated version was revised. We analyzed acceptance (completion rate),
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25 42 factorial structure (exploratory factor analysis (EFA), confirmatory factor analysis (CFA), model fit), item
26
27 43 characteristics (item difficulties, corrected item-total correlations, inter-item correlations), and internal
28
29 44 consistency (Cronbach's α).

30
31 45 **Results:** Translation and cognitive testing of the German ORIC was successful except for item 10, which
32
33 46 showed low comprehensibility as part of content validity in cognitive interviews. Completion rate was > 97%.
34
35 47 EFA and CFA provided a one-factorial structure. Item difficulties ranged between 55.98 and 65.32,
36
37 48 corrected item-total-correlation ranged between .665 and .774, inter-item correlations ranged between .434
38
39 49 and .723, and Cronbach's α was .93.

40
41 50 **Conclusions:** The German ORIC is a reliable measure with high completion rates and satisfying
42
43 51 psychometric properties. A one-factorial structure of the German ORIC was confirmed. Item 10 showed
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45 52 limited comprehensibility and therefore reduces content validity of the measure. The German ORIC can be
46
47 53 used to analyze organizational readiness for change as a precursor for implementation success of various
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49 54 interventions.

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53 56 **Keywords:**
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55 57 Organizational readiness for change, Psychometrics, Translation, Implementation, Shared decision-
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57 58 making, Measurement
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61 **ARTICLE SUMMARY**

62 **Strengths and limitations of this study**

- 63 • Appropriate qualitative methods were used to provide a German version of the ORIC to be
64 assessed for healthcare professionals (HCPs).
- 65 • The sample size was large enough to robustly perform the psychometric analyses on the German
66 version of the ORIC measure.
- 67 • Due to the design of the study as a secondary analysis, it was not possible to calculate
68 psychometric parameters like convergent and divergent validity.
- 69 • Data were collected at a single academic cancer center in the context of a shared decision-making
70 implementation study. Thus, psychometric properties of the German ORIC need replication in other
71 settings.

73 **INTRODUCTION**

74 Implementing interventions in healthcare systems is an important and widely discussed topic [1–3] and
75 often mediated by public policies, market forces, or new technologies [4]. The intention to implement new
76 interventions might be to reduce costs, improve quality, increase efficacy or patient satisfaction [5].
77 Nevertheless, implementing change in healthcare organizations can be challenging [6–10]. In the German
78 healthcare system, the implementation of shared decision-making (SDM) has received much attention [11].
79 SDM can be described as an interactional process on the basis of information exchange. Patients and
80 healthcare professionals (HCPs) are equally and actively involved and jointly responsible for the decision
81 [12–14]. This is especially important in situations with complex treatment options and high impact on
82 patients' quality of life [15]. Patients want to be actively involved in decision-making [16] and benefit from
83 SDM by developing better knowledge about their disease and treatment options, better risk perception, and
84 less insecurity and decisional conflict [17,18]. SDM has been supported by health policy [19–21] and
85 research [22–25] over the last decades. However, SDM is currently not routinely implemented in the
86 German healthcare system [11,26–28].

87 When implementing SDM or other interventions in organizations, several barriers on different levels of the
88 organization (i.e., individual level, group level, organizational and system level) need to be considered
89 [1,5–7,10,29–32]. Barriers for implementing SDM in the clinical setting often address both the
90 organizational setting (e.g. lack of resources and lack of management support) and the individual level (e.g.

1
2
3 91 resistance to change or negative attitudes towards SDM) [7,10,11,33–35]. When implementing SDM or
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5 92 other interventions in healthcare systems, the clinical employees' perspective on organizational readiness
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7 93 for change is a critical precursor for successful implementation [5,32,36–38]. Armenakis et al. [39] describe
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9 94 organizational readiness for change as the degree to which organizational members are prepared to
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11 95 participate in change processes. This is characterized by the belief that the change is needed and that the
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13 96 organization is capable of changing. In their theory of organizational readiness for change, Weiner et al.
14
15 97 [40] differentiate between change commitment (i.e., organizational members' attitudes towards
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17 98 implementing a change) and change efficacy (i.e., organizational members' belief in their capability to
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19 99 implement a change). If readiness for change is high, organizational members invest more in the change
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21 100 effort and exhibit greater persistence to overcome barriers and setbacks [40,41].

22 101 To analyze effects of organizational readiness on implementation success, specific measures for assessing
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24 102 organizational readiness for change are needed [5]. However, only a few validated measures exist [5,42–
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26 103 44] and none were available in German. One of those measures is the Organizational Readiness for
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28 104 Implementing Change (ORIC) [43]. The ORIC is brief, easy to administer, and theoretically and
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30 105 psychometrically well-grounded [40]. It was previously translated into Danish and French [45,46]. The ORIC
31
32 106 has been psychometrically tested, revealing a completion rate of more than 72%, a Cronbach's α of above
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34 107 .80 and two correlating factors [43,45,46]. Due to the described properties, the ORIC seemed well-suited
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36 108 to measure organizational readiness for implementing SDM in Germany [5,43,47].

37 109 Therefore, the aim of the study was to translate the ORIC measure into German and assess its
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39 110 psychometric properties.

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43 112 **METHODS**

45 113 **Measure**

47 114 The ORIC measures organizational readiness for implementing change. It uses a 5-point Likert scale
48
49 115 ranging from „disagree“ to „agree“ [43]. In the original English version, two subscales were described based
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51 116 on Weiner et al. [40]: „change commitment“ (items 1 to 5) and “change efficacy” (items 6 to 10). Sum scores
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53 117 were calculated for both subscales separately with higher scores indicating higher organizational readiness
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55 118 for change. By using the phrases “to implement this change” or “implementing this change”, the original
56
57 119 scale does not specify which change is addressed. The items can be specified to adapt to a specific

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2
3 120 research question and a survey instruction can be added [40,45]. The English items are displayed in the
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5 121 results section.

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7 122
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9 123 **Translation**
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11 124 Translation followed the team translation protocol TRAPD (Translation, Review, Adjudication, Pretesting
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13 125 and Documentation), a method with growing recognition within translation research [48–52]. Thereby an
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15 126 optimal translation is facilitated by discussions between members of the translation team with different
16
17 127 expertise in translation. First, two team members (AL, SZ, cp. list of abbreviations) proficient in German
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19 128 and English, but little experienced in survey translation, independently translated the original ORIC into
20
21 129 German. Second, a third bilingual team member (IS) with experience in survey translation, reviewed both
22
23 130 versions and suggested a third version based on the first two translations. Finally, IS, AL, and SZ discussed
24
25 131 all versions until reaching consensus on a final version. To find consensus on item 10 we additionally
26
27 132 consulted an official translator (MM, cp. list of abbreviations) and an additional team member (PH), who is
28
29 133 proficient in German and English and experienced in translation. During the translation process, we
30
31 134 changed the phrases “to implement this change” and “implementing this change” into “to implement shared
32
33 135 decision-making” and “implementing shared decision-making” to address our specific research question.
34
35 136 Additionally, we added a survey instruction in German which motivated participants to think about the clinic,
36
37 137 they are working in, when answering the item. As a next step we pretested the translated measure by
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39 138 conducting cognitive interviews and thereby assessed comprehensibility as part of content validity.

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41 139
42 140 **Assessment of comprehensibility as part of content validity and subsequent adaptation of the scale**

43 141 Content validity is the degree to which the content of the measure and its items adequately reflect the
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45 142 measured construct [53]. According to the COSMIN criteria (Consensus-based standards for the selection
46
47 143 of health measurement instruments) [54], content validity includes the relevance of the items and scales,
48
49 144 their comprehensiveness, and comprehensibility. As this study aimed to evaluate the translation of an
50
51 145 existing measure, we focused on the assessment of comprehensibility (i.e., items being appropriately
52
53 146 worded and understood by participants as intended).

54
55 147 To do so, we conducted two rounds of cognitive interviews with a convenience sample of HCPs (nurses,
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57 148 physicians, and psychooncologists), working in a comprehensive cancer center in Germany. Two female
58
59 149 researchers and psychologists experienced in interviewing (AL, PH) conducted the interviews. We
60

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3 150 developed an interview guide based on recommendations by Willis et al. [55]. We used verbal probing
4
5 151 techniques like comprehension probes (e.g. "What does the term 'organization' mean to you?") and
6
7 152 paraphrasing (e.g. "Can you repeat this sentence in your own words?"). We conducted interviews until
8
9 153 reaching theoretical saturation. Interviews were audio-recorded and transcribed verbatim. After the first
10
11 154 round of cognitive interviews, we extracted and discussed comments and suggestions from the transcripts
12
13 155 (AL, PH, IS). As a further step to enhance comprehensibility, we discussed the items with the original author
14
15 156 (CS, cp. list of abbreviations) as well as French (MR, cp. list of abbreviations) and Norwegian researchers
16
17 157 (AH, cp. list of abbreviations), who translated the ORIC into their languages. We adapted items of the
18
19 158 German ORIC, which were not well understood by participants of the first round of cognitive interviews,
20
21 159 according to these discussions. We tested these items in a second round of cognitive interviews. After the
22
23 160 second round, we discussed further adaptations of the items and involved another bilingual researcher in
24
25 161 the field (DF, cp. list of abbreviations).
26
27 162 We calculated descriptive statistics of participants' demographic characteristics using SPSS (IBM SPSS
28
29 163 Statistics, Version 23).
30
31 164

32 165 **Psychometric evaluation**

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34 166 **Data collection.** For psychometric evaluation of the ORIC measure we conducted a secondary analysis of
35
36 167 cross-sectional data gathered in a SDM implementation study [56]. Data from baseline assessment of the
37
38 168 SDM implementation study were included. The ORIC was the last questionnaire of a three-page survey
39
40 169 measuring HCPs' attitudes regarding SDM and its implementation. Besides the ORIC, it contained the
41
42 170 Control Preference Scale [57] and the IcanSDM [58], demographic questions (e.g. gender, age, profession,
43
44 171 work experience) as well as several questions that have been used in previous studies in cancer care [59].
45
46 172 Results of these additional measures will be published as part of the primary evaluation of the SDM
47
48 173 implementation study [56].
49
50 174 Participants were part of a convenience sample of physicians and nurses. Since this is a secondary
51
52 175 analysis, inclusion criteria were identical to inclusion criteria of the SDM implementation study [56]. We
53
54 176 included physicians and nurses who worked at one of three departments within the University Cancer
55
56 177 Center Hamburg at the University Medical Center Hamburg-Eppendorf during baseline evaluation of the
57
58 178 SDM implementation study [56]. Eligible HCPs were identified through employee lists provided by
59
60 179 department managers. The measure was handed out to eligible HCPs either (1) by a member of our study

1
2
3 180 team (e.g. during a regular physician meeting), (2) by the supervising nurses, or (3) via employees'
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5 181 mailboxes. Participants returned the questionnaire personally to a study team member or by mail.

6
7 182 Data were entered into SPSS (IBM SPSS Statistics, Version 23) including blinded double entry of 20% of
8
9 183 the data for quality control.

10
11 184 **Patient and public involvement.** The ORIC measure preliminary addresses HCPs. Physicians, nurses
12
13 185 and psychooncologists were involved in the adaptation of the measure by taking part in cognitive interviews.
14
15 186 Patients were not involved in this study.

16
17 187 **Data Analyses.** Descriptive statistics were calculated for demographic characteristics. Cases were
18
19 188 excluded if more than 30% of the ORIC items were missing [60]. For all other cases, missing data were
20
21 189 replaced with item means. We evaluated the completion rate and therefore the acceptance of the measure
22
23 190 by calculating frequencies of missing data per item as well as for the overall measure. For this analysis, we
24
25 191 also included cases with more than 30% of ORIC items missing because these values are part of
26
27 192 completion rate and relevant for interpretation of acceptance.

28
29 193 We a priori hypothesized to replicate the theory-based two-dimensional structure of the original English
30
31 194 ORIC version. Two correlating factors "change commitment" (item 1 to 5) and "change efficacy" (item 6 to
32
33 195 10) were postulated. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of
34
35 196 sphericity were performed to test prerequisites for factor analysis [61,62]. A confirmatory factor analysis
36
37 197 (CFA) with Maximum Likelihood Estimates and two factors was applied for the whole data set as a first
38
39 198 step. Because the two-factor model could not be confirmed, we decided to calculate an exploratory factor
40
41 199 analysis (EFA) and afterwards an additional CFA to check for model fit. It is recommended to not calculate
42
43 200 EFA and CFA with the same data set so the data set was randomized by AL and split into two subsets
44
45 201 [63,64]. The first 115 randomized cases including all data of participants were added to EFA, the second
46
47 202 115 cases were added to CFA. An EFA with oblique rotation was calculated for the first subset. The non-
48
49 203 orthogonal rotation was chosen according to Weiner et al. [40]. In their theory, organizational readiness for
50
51 204 change consists of two interrelated dimensions, therefore the two factors are expected to be correlated.
52
53 205 Analogue to analyses done by authors of the English ORIC [43,65], we extracted components based on
54
55 206 parallel analysis. The criterion of parallel analysis was shown to be superior to other statistic criteria like
56
57 207 the Kaiser criterion [66,67]. It compares the eigenvalues of the data to the eigenvalues based on random
58
59 208 data with equivalent sample size and number of variables and chooses only factors with eigenvalues higher
60
209 than for random data [65,66]. A CFA was calculated for the second subset. A range of global goodness of

210 fit indices were used to assess the degree to which observed data were accounted for by the proposed
 211 models: discrepancy chi-squared statistic (χ^2), degree of freedom (df), normed chi-squared statistic
 212 (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation
 213 (RMSEA) as well as Akaike Information Criterion (AIC) and Parsimonious Normed Fit Index (PNFI) for
 214 analysing model complexity. Established rules to estimate the model fit were used [68–71].

215 Item analyses was performed for the one-factor model. It included calculation of item means and standard
 216 deviation as well as observation of floor and ceiling effects [72], calculation of corrected item-total
 217 correlations [61,73], inter-item correlations [61,73], and item difficulties [62]. Internal consistency of the
 218 scale was assessed by Cronbach's alpha coefficient (α) [62,73,74]. For a detailed overview on performed
 219 data analyses, see Table 1.

220 During the translation process and cognitive interviews we found low content validity for item 10 (see results
 221 section). Thus, the use of item 10 for the German ORIC needs to be evaluated. Accordingly, we also
 222 conducted psychometric analyses (EFA with oblique rotation and extraction of components based on
 223 parallel analysis, corrected item-total correlations, Cronbach's α , and goodness of fit indexes) for the 9-item
 224 version of the ORIC.

225 Analysis of demographic data, analysis of completion rate, item analysis and EFA were performed using
 226 SPSS (IBM SPSS Statistics, Version 23). CFA and calculation of model fit indices were performed using
 227 Amos (IBM SPSS Amos 22.0.0).

228

229 Table 1: Psychometric analyses conducted.

Psychometric measure	Criteria
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity	These tests ensure that correlations between variables can be accounted for by a smaller set of factors [61]. KMO value should be higher than .05 and Bartlett's test value should be less than .05 to fulfil the criteria for calculating a factor analysis [61,62].
Normed chi-squared statistic (χ^2/df)	χ^2/df is an indicator for model fit, dependent on sample size and should be as small as possible. A ratio between 2 and 3 indicate a good data fit [68].
Comparative fit indexes (CFI)	CFIs is an indicator for model fit. It ranges from 0 to 1 and higher values indicate better fit. Values above .95 indicate a good model fit [71,75].
Tucker-Lewis Index (TLI)	TLI is an indicator for model fit. It corrects for complexity of the model and is sensitive to small sample sizes. Values above .95 indicate good fit [69].

Root mean square error of approximation (RMSEA)	RMSEA is an absolute index which describes closeness to fit. Values below .05 indicate a good fit, values between .05 and .08 indicate an adequate fit, values between .08 and 1 indicate a moderate fit and values above 1 are unacceptable [76].
Akaike Information Criterion (AIC)	AIC is a parsimony model fit index. It can be used to compare fit of competing models with smaller values indicating better fit [68,71].
Parsimonious Normed Fit Index (PNFI)	PNFI is a parsimony model fit index. It ranges between 0 and 1 and higher values indicate a more parsimonious fit [68]. No threshold levels are recommended and it has to be analyzed in combination with other goodness of fit indices [71].
Analysis of frequencies for item response distributions	Floor and ceiling effects were assumed present if more than 15% of participants choose the lowest or highest possible score [72].
Corrected item-total correlations	If items correlate with the total score of above .30, they measure the same underlying concept. Items with lower correlations should be removed because they do not add exploratory power to the measure [61,73].
Item difficulties	Item difficulties are calculated by dividing item means by the maximal value of the answer range (0-4) and multiplying it with 100. Item difficulty should be near to 50%, and items should not differ much in their difficulty level [62].
Inter-item correlations	Inter-item correlations ensure association between items. High inter-item correlations of above .80 indicate that items ask the same questions and might be redundant [61,73].
Cronbach's α	Cronbach's α is a measure for reliability and internal consistency. A value of at least .70 is acceptable and higher coefficients indicate a more stable measure [61,62,74].

230

231

232 **RESULTS**

233 To report the results of this validation study, we used the Authors' Guidelines for Reporting Scale
234 Development and Validation Results by Cabrera-Nguyen (see Supplementary File 1).

235

236 **Translation**

237 Both translators (AL and SZ) and the reviewer (IS) did not differ much in their translations of items 2 to 5
238 and 8 as well as the response scale. For these items and the response scale, only the choice of single
239 words differed without differences in meaning. Greater translation differences were found for items 1, 6, 7,
240 9, and 10. For item 1, the word "committed" was differently translated. For items 6 and 7, differences were
241 found in the translation of the phrase "feel confident" and the sentence structure. For item 9, differences
242 mainly addressed translation of the phrases "feel confident" and "adjust to this change". For item 10,

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3 243 differences occurred in the translation of the term “manage the politics” and the sentence structure. Within
4
5 244 the first round of team discussion, we reached consensus for items 2 to 9, the translation of the response
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7 245 scale and the survey introduction. For item 1 we suggested two versions to be further tested in subsequent
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9 246 cognitive interviews. We struggled to translate the phrase “manage the politics” in item 10 into German.
10
11 247 Therefore, we discussed item 10 with additional colleagues (cp. methods section) until consensus was
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13 248 found.

14
15 249

16 250 **Assessment of comprehensibility as part of content validity and subsequent adaptation of the scale**

17
18 251 To test the German ORIC for comprehensibility, cognitive interviews with n=11 participants (nurses,
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20 252 physicians, and psychooncologists) were conducted. Cognitive interviews lasted about one hour. For
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22 253 demographic data of participants see Table A in Supplementary File 2.

23
24 254 After the first round of cognitive interviews (n=7), no changes have to be made to the response scale as
25
26 255 well as for items 2 to 5 and 8 because these items were already well understood by participants. Participants
27
28 256 made some minor suggestions for modifications for the introductory description and items 1 and 6.
29
30 257 Additionally, some participants did not understand the correct meaning of items 7, 9 and 10 in general or
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32 258 of single words or phrases of these items. After discussions and modifications of these items, we tested
33
34 259 alternative versions of the survey introduction, for items 1, 6, 9 and 10 as well as two alternative versions
35
36 260 of item 7. After the second round of cognitive interviews (n=4), items 1, 6 and 9 were now understood well
37
38 261 by all participants. We had to slightly modify the survey introduction again and decided to use the version
39
40 262 of item 7 which was understood best. After all, item 10 could not be translated successfully. Both rounds of
41
42 263 cognitive interviews showed that comprehension of the German translation of the phrase “manage the
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44 264 politics” did not picture the correct English meaning. Thus, in a next step we consulted with DF (cp. list of
45
46 265 abbreviations) and reached consensus on a final version. Nevertheless, the final version of item 10 was
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48 266 still not satisfying from the study team and experts view. Item 10 was found to have low comprehensibility
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50 267 as part of content validity according to COSMIN criteria [54]. The final German ORIC measure, used in this
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52 268 study, is presented in Supplementary File 3.

53 269 During cognitive interviews some nurses reported that they had not heard about the term “shared decision-
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55 270 making” (German: “Partizipative Entscheidungsfindung”) prior to participation. Thus, we provided a
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57 271 definition of SDM in the introduction part of the questionnaire within the SDM implementation study [56].

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273 **Psychometric evaluation**

274 **Sample characteristics.** Data of 235 HCPs were available for this secondary analysis. In line with
 275 recommendations of Bannan [60], five cases (0.02% of all cases) were excluded (except for assessment
 276 of completion rate), because all items of the ORIC were missing. Missing values were replaced by means
 277 and data of 230 HCPs could be included into analyses.

278 Table 2 provides an overview of participants' demographic characteristics. Most of the 230 HCPs were
 279 between 31 and 40 years old (37.0%), female (70.4%), worked as a nurse (57.0%), and had a work
 280 experience of < 5 years (43.9%).

281

282 Table 2: Demographic characteristics of participants (n=230).

		N	%
Age	< 30 years	72	31.3
	31-40 years	85	37.0
	41-50 years	42	18.3
	> 50 years	26	11.3
	Missings	5	2.2
Gender	Female	162	70.4
	Male	59	25.7
	Different gender or preferred not to answer this question	5	2.1
	Missings	4	1.7
Profession	Nurse	131	57.0
	Junior physician	69	30.0
	Senior physician	27	11.7
	Missings	3	1.3
Work experience in healthcare	< 5 years	101	43.9
	5-10 years	48	20.9
	11-20 years	46	20.0
	> 20 years	28	12.2
	Missings	7	3.0

283

284

285 **Factor analysis.** Requirements for factor analysis were met [54]. Sample size was large enough (>100),
 286 even for a split data set with n=115. Furthermore, no outliers were found and data values were
 287 approximately normally distributed. KMO measure was .933 and Barlett's test of sphericity yielded $X^2 =$
 288 1485.11, $p < .001$. This indicates that a factor analysis of the data was appropriate [61,62]. CFA for the
 289 hypothesised two-factor model showed a high correlation of .87 between the two components (see
 290 Supplementary File 4). Therefore, we postulated a one-factorial structure and conducted a post-hoc EFA.
 291 As shown in Table 3, only the first component had an eigenvalue higher than 95% percentile of the
 292 eigenvalues of corresponding random data and the main component explains 67.23% of the variance.

293 Thus, according to parallel analysis, a one-factor model was assumed. The factor loadings for the first
294 component were above 0.754 for all items (see Table B of Supplementary File 2).

295
296 Table 3: Results of EFA with oblique rotation and parallel analysis: eigenvalues of the ten components of
297 the German ORIC and eigenvalues for corresponding random data.

	Eigenvalues			Eigenvalues for random data	
	Total	% of variance	Cumulative %	Means	95% percentile
Component 1	6.72	67.23	67.23	1.49	1.65
Component 2	0.83	8.30	75.53	1.33	1.44
Component 3	0.47	4.75	80.28	1.21	1.30
Component 4	0.41	4.08	84.36	1.11	1.19
Component 5	0.39	3.91	88.28	1.02	1.08
Component 6	0.32	3.24	91.52	0.93	1.00
Component 7	0.27	2.74	94.26	0.85	0.92
Component 8	0.23	2.34	96.60	0.77	0.84
Component 9	0.17	1.74	98.35	0.68	0.75
Component 10	0.16	1.65	100.00	0.58	0.66

Notes: For EFA, half of the data set (n=115) was used.

298
299 A second CFA was performed with the one-factor model to analyze its fit indices. Indices of the two-factor
300 model and the one-factor model are compared in Table 4.

301
302 Table 4: Fit indices of two calculated models for factor analysis of the German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
Two-factor model	81.71*	34	2.40	.968	.947	.078	143.71	.585
One-factor model	77.19*	35	2.20	.928	.907	.103	117.19	.682

Notes: Two-factor model was calculated for the whole data set (n=230): factor 1 includes item 1 to 5, factor 2 includes item 6 to 10; One-factor model was calculated for half of the data set (n=115): includes items 1 to 10.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

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304
305 Results of factor analysis for the 9-item version of the ORIC (without item 10) were similar. Also for the 9-
306 item version, a one-factor model was assumed by exploratory factor analysis. Only the first component had
307 an eigenvalue higher than 95% percentile of the eigenvalues of corresponding random data and the main
308 component explains 66.85% of the variance. Factor loadings of the first component are above 0.739 for all
309 items (see Supplementary File 5, Tables A and B). Goodness of fit indices of the one-factor model of the

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3 310 9-item ORIC version showed similar values compared to the 10-item ORIC version (see Supplementary
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5 311 File 5, Table C).

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7 312
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9 313 **Analysis of the ORIC items and internal consistency.** Table 5 shows response distribution, means,
10
11 314 standard deviations, acceptance, corrected item-total correlation, and item difficulty of the ten items. Means
12
13 315 ranged between 2.24 (item 9) and 2.61 (item 5). Most participants responded in the middle of the scale with
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15 316 a slight shift to more agreement. For items 1 to 9, between four and six missing values could be detected.
16
17 317 For item 10, nine missing values were found. Taking all items into account, more than 97% of the measure
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19 318 were answered. Corrected item-total correlations ranged from .665 (item 9) to .774 (item 3), item difficulties
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21 319 from 55.98 (item 9) to 65.32 (item 5), and inter-item correlations from .434 (item 2 and item 9) to .723 (item
22
23 320 3 and item 5) (see Table C of Supplementary File 2). Internal consistency yielded a Cronbach's α of .93.
24
25 321 Additionally, corrected item-total correlations and internal consistency were calculated for the 9-item ORIC
26
27 322 version (see Supplementary File 5, Table D). They were similar to the results for the 10-item version with
28
29 323 corrected item-total correlations between .638 (item 9) and .777 (item 3) and a Cronbach's α of .92.

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31 325

326 Table 5: Response distribution, means, standard deviation, acceptance, discrimination and item difficulty of the German ORIC.

Items	Disagree N (%)	Somewhat Disagree N (%)	Neither Agree nor Disagree N (%)	Somewhat Agree N (%)	Agree N (%)	Mean (SD)	Acceptance (Comple- tion rate in %)*	Item discrimination (corrected item-total correlation)	Item difficulty
1 People who work here are committed to implementing shared decision-making.	1 (0.4)	22 (9.6)	109 (47.0)	73 (30.9)	25 (10.9)	2.42 (.826)	97.43	.744	60.58
2 People who work here will do whatever it takes to implement shared decision-making.	4 (1.7)	37 (16.1)	103 (44.8)	68 (29.6)	18 (7.4)	2.25 (.878)	98.29	.689	56.36
3 People who work here want to implement shared decision-making.	0 (0.0)	15 (6.5)	107 (46.5)	84 (35.7)	24 (10.4)	2.50 (.768)	97.43	.774	62.61
4 People who work here are determined to implement shared decision-making.	2 (9.0)	38 (16.5)	107 (46.5)	67 (29.1)	16 (7.0)	2.25 (.843)	98.29	.758	56.19
5 People who work here are motivated to implement shared decision-making.	1 (0.4)	16 (7.0)	85 (37.0)	97 (42.2)	31 (13.5)	2.61 (.821)	98.29	.764	65.32
6 People who work here feel confident that they can handle the challenges that might arise in implementing shared decision-making.	2 (0.9)	20 (8.7)	93 (40.4)	93 (40.4)	22 (9.6)	2.49 (.819)	98.29	.760	62.28
7 People who work here feel confident that they can keep track of progress in implementing shared decision-making.	1 (0.4)	26 (11.3)	93 (40.4)	92 (40.0)	18 (7.8)	2.43 (.811)	98.29	.725	60.87
8 People who work here feel confident that they can coordinate tasks so that implementation goes smoothly.	5 (2.2)	24 (10.4)	107 (46.5)	78 (33.5)	16 (6.5)	2.32 (.833)	99.56	.697	58.13
9 People who work here feel confident that the organization can support people as they adjust to shared decision-making.	6 (2.6)	43 (18.7)	89 (38.7)	74 (32.2)	18 (7.8)	2.24 (.934)	97.86	.665	55.98
10 People who work here feel confident that they can manage the politics of implementing shared decision-making.	3 (1.3)	24 (10.04)	122 (50.9)	65 (28.3)	16 (7.0)	2.29 (.796)	96.15	.714	57.44

Notes: Items could be answered on a 5-step Likert scale rating from 0 „disagree“ to 4 „agree“. SD = standard deviation. * For calculation of completion rate, five additional cases were included because these participants only skipped the ORIC but filled out the rest of the survey.

327

328 **DISCUSSION**

329 The original English ORIC measure is a brief measure with good psychometric properties [43], which were
330 confirmed in Danish [45] and French [46] validation studies. The study at hand aimed to translate the ORIC
331 into German and assess its psychometric properties.

332
333 **Translation and assessment of comprehensibility as part of content validity**
334 Items 1 to 9 were translated and adapted successfully after two rounds of cognitive interviews and several
335 rounds of discussions within the study team and with external experts. The translation team quickly reached
336 consensus for items 2 to 5 and 8. These items were also well understood by all participants within the first
337 round of cognitive interviews. For items 1, 6, 7 and 9, the translation process was more complex and several
338 adaptations and discussions were necessary. Feedback by participants, members of the study team, and
339 external experts as well as completion rates suggest that comprehensibility of item 10 seems to be low [54].
340 This might be due to the translation of the phrase “manage the politics” into “Machenschaften”. The term
341 “manage the politics” seems to have a strong cultural connotation and no equivalent phrase in German
342 language exists. The German term “Machenschaften” might have a different connotation as the English
343 phrase and might lead to skipping the item. Ruest et al. [46], who translated the English ORIC into French,
344 also identified several differences in cultural concepts during their adaptation process, but could translate
345 all items successfully. They concluded that limitations in linguistic validation could decrease comparability
346 of psychometric results of the translated measure. However, item 10 showed similar and inconspicuous
347 item characteristics compared to other items in our sample. When repeating factor and item analyses for
348 the 9-item ORIC version including only item 1 to 9, very similar results were observed compared to the 10-
349 item version. To increase comprehensibility and thereby content validity of the scale, the use of the 9-item
350 German ORIC might be a solution and should be evaluated in future studies.

352 **Factor analysis**

353 We a priori hypothesized a two-factorial structure of the German ORIC, because Shea et al. [43] described
354 correlations between the two theory-based factors “change commitment” and “change efficacy” of .56 to
355 .60. However, we found much higher factor correlations of 0.87. Results of the subsequent EFA clearly
356 indicated a one-factorial structure. Thus, we could not confirm the two-factor structure of the English and
357 the translated Danish and French versions of ORIC [43,45,46]. When comparing the two models, both

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3 358 models have acceptable values for χ^2/df [68] and CFI [71,75], but only the two-factor model has
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5 359 acceptable values for TLI [69] and RMSEA [76]. When involving parsimony of the models by calculating
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7 360 AIC and PNFI, the one-factor model fits better to the data [68,71]. Therefore, we prefer the more
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9 361 parsimonious one-factor model. These differences to previous validation studies might be a consequence
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11 362 of diverse cultural connotations of the ORIC items in different languages, caused by the adaptation to the
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13 363 context of SDM, or due to specific characteristics of the participating clinics.
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16 365 **Analysis of ORIC items and internal consistency**

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18 366 Since the ORIC was presented as the last measure in a three-page survey, missing values might indicate
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20 367 respondent fatigue. However, missing value rates for single items and the overall measure were quite low
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22 368 and the German ORIC was found to be a well-accepted measure. There were no floor or ceiling effects.
23
24 369 Corrected item-total correlations of above .66 indicate that all items measure the same underlying concept
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26 370 [61,73]. Criteria for good item difficulties are met since item difficulties are near to 50% and do not differ
27
28 371 much from each other [62]. Inter-item correlations are below .80, indicating that items add additional
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30 372 information and are not redundant [61,73]. Cronbach's α ($\alpha=.93$) suggest excellent internal consistency
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32 373 [61,62,74]. In summary, item analysis and internal consistency of the German ORIC suggest good quality
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34 374 of the measure.

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36 375 Nevertheless, according to Streiner and Norman [62] a Cronbach's α above .90 might also indicate item
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38 376 redundancy. On the other hand, inter-item correlations and corrected item-total correlations are in an
39
40 377 acceptable range [61,73]. In implementation research there is a need for preferably brief measures, which
41
42 378 can be applied in diverse settings with high work-load. Thus, future research could investigate the possibility
43
44 379 to further reduce the number of items.
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46 380

47 381 **Strengths and Limitations**

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49 382 This study has some limitations. First, several psychometric parameters are not analysable because this
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51 383 study was a secondary analysis of cross-sectional data. It was not possible to calculate e.g. convergent or
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53 384 divergent validity yet. Second, we applied the ORIC only in three departments of one University Medical
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55 385 Center in Germany. Further validation in different organizational settings is needed to ensure
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57 386 generalizability. Third, for this psychometric evaluation we used a German ORIC, which we adapted and
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59 387 specified for the context of SDM implementation. Our results might not be generalizable for other
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3 388 interventions in other organizations. Fourth, although SDM was not implemented to the participating clinics
4
5 389 before, there might be participants who were more familiar with the concept of SDM than others. Fifth, item
6
7 390 10 was again slightly changed after finishing cognitive interviews. This item was not finally tested for
8
9 391 comprehensibility.

10
11 392 A major strength of this study is that we provided the first measure to assess organizational readiness for
12
13 393 change in German language for use in implementation studies. We conducted an elaborated translation
14
15 394 procedure, which was recommended for survey translations. We furthermore used a qualitative approach
16
17 395 to explore comprehensibility including discussions with international colleagues and experts outside of the
18
19 396 study team. Furthermore, we assessed the ORIC in a sample including physicians and nurses which was
20
21 397 large enough to robustly perform the psychometric analysis on the German version of the ORIC measure.

22 398

23 24 399 **CONCLUSION**

25
26 400 Organizational readiness is a crucial indicator to successfully implement change and a possible barrier if
27
28 401 missing. For implementation studies, it is essential to measure organizational readiness with valid and
29
30 402 reliable measures. We provide the first German measure for organizational readiness for implementing
31
32 403 change and validated it for the context of SDM implementation. The German ORIC is a brief measure with
33
34 404 a high completion rate. We found satisfying psychometric properties in a German hospital setting. To
35
36 405 increase content validity of the measure, the use of a 9-item German ORIC (without item 10) should be
37
38 406 evaluated in future studies. As the ORIC targets the attitude of organizational members, it can detect
39
40 407 reduced or missing readiness for implementing a change on the individuals' level. Therefore, the German
41
42 408 ORIC can be used to analyze organizational readiness as a possible barrier for implementing various
43
44 409 interventions in organizations.

45 410

46 47 411 **LIST OF ABBREVIATIONS**

48
49 412 AH: Anne Haugstvedt

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51 413 AIC: Akaike Information Criterion

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53 414 AL: Anja Lindig

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55 415 AMOS: Analysis of Moment Structure, Statistical Package for the Social Sciences, International Business
56
57 416 Machines Corporation

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59 417 χ^2 : Discrepancy chi-squared statistic

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3 418 Chi2/df: Normed chi-squared statistic
4
5 419 CFI: Confirmatory fit index
6
7 420 CS: Christopher M. Shea
8
9 421 Df: Degree of freedom
10
11 422 DF: Dominick Frosch
12
13 423 EC: Eva Christalle
14
15 424 HCP: Healthcare professional
16
17 425 IS: Isabelle Scholl
18
19 426 KMO: Kaiser-Meyer-Olkin criterion
20
21 427 MM: Marcel Machalski
22
23 428 MR: Mélanie Ruest
24
25 429 ORIC: Organizational Readiness for Implementing Change
26
27 430 PH: Pola Hahlweg
28
29 431 PNFI: Parsimonious Normed Fit Index
30
31 432 RMSEA: Root mean square error of approximation
32
33 433 SDM: Shared decision-making
34
35 434 SPSS: Statistical Package for the Social Sciences, International Business Machines Corporation
36
37 435 SZ: Stefan Zeh
38
39 436 TLI: Tucker-Lewis Index
40
41 437 TRAPD: Translation, Review, Adjudication, Pretesting, Documentation
42

439 **DECLARATIONS**

440 **Ethics approval and consent to participate**

441 The study was approved by the Ethics Committee of the Medical Association Hamburg (Germany, study
442 ID PV5368). The study was carried out in accordance to the latest version of the Helsinki Declaration of the
443 World Medical Association. Principles of good clinical practice were respected. Data protection
444 requirements were met. Study participation was voluntary. A waiver of consent for HCPs was obtained from
445 the Ethics Committee, as proposed by current statements on ethical designs of implementation research
446 [77]. HCPs were able to decline participation in the study.

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2
3 448 **Funding**

4
5 449 This study is funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, grant
6
7 450 number 232160533).

8
9 451
10
11 452 **Competing interests**
12
13 453 PH gave one scientific presentation on shared decision-making during a lunch symposium, for which she
14
15 454 received compensation and travel compensation from GlaxoSmithKline GmbH in 2018. AL, EC and IS
16
17 455 declared to not have any competing interests.

18 456
19
20 457 **Author contributions**
21
22 458 AL, PH and IS made substantial contributions to the design and preparation of the study. AL and PH
23
24 459 collected the data. AL conducted the analysis in collaboration with EC. All authors contributed to the
25
26 460 interpretation of results. AL drafted the manuscript and PH, IS and EC were involved in critically revising
27
28 461 the manuscript for important intellectual content. All authors gave final approval of the version to be
29
30 462 published.

31 463
32
33 464 **Checklist for reporting statement**
34
35 465 To report the results of this validation study, we used the Authors' Guidelines for Reporting Scale
36
37 466 Development and Validation Results by Cabrera-Nguyen.

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39 467
40
41 468 **Patient consent form**
42
43 469 Not applicable

44
45 470
46
47 471 **Data sharing statement**
48
49 472 The dataset collected and analyzed during this study is available from the corresponding author on
50
51 473 reasonable request.

52 474
53
54 475 **Acknowledgements**
55
56 476 We thank our student assistants Anastasia Izotova, Sophia Schulte and Nicolai Pergande for their help
57
58 477 preparing the study and the analysis. We thank Stefan Zeh for his part the team translation process. We
59
60

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2
3 478 thank Dominick Frosch, Anne Haugstvedt, Marcel Machalski, Mélanie Ruest and Christopher M. Shea for
4
5 479 helpful comments and suggestions in the translation and adaptation process of item 10. We also would like
6
7 480 to thank Christopher M. Shea for giving the opportunity to translate the ORIC into German and to use it in
8
9 481 our implementation study.

10 482

11 483 **Supplementary Files**

12
13
14 484 Supplementary File 1: Reporting Checklist: Authors Guidelines for Reporting Scale Development and
15
16 485 Validation Results

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18 486 Supplementary File 2: Additional tables for psychometric evaluation of the 10-item ORIC version

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20 487 Supplementary File 3: Organizational Readiness for Implementing Change (ORIC) – German version

21
22 488 Supplementary File 4: Confirmatory factor analysis model of the 10-item German ORIC

23
24 489 Supplementary File 5: Results of psychometric evaluation of the 9-item German ORIC version

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For peer review only

1 **Supplementary File 1: Checklist for reporting standards. Authors' guideline for Scale**2 **Development and validation results by Cabrera-Nguyen.**

	Guidelines by Cabrera-Nguyen [1]	Transfer to our study
1	Precisely define the target construct.	See page 3 and 4 (Introduction section)
2	Justify the need for your new measure. For example, if measures of the construct exist in the literature, explain the value added by your new scale. How might the new measure enhance the substantive knowledge base or social work practice?	See page 4 (Introduction section)
3	Indicate that you have submitted your initial pool of items to expert review (Worthington & Whittaker, 2006). Report (a) the number of items in the preliminary pool; (b) the number of expert reviewers and their qualifications; and (c) any major changes to your initial item pool following the review (e.g., a substantial decrease in the number of items, changes to the original item response format, overhaul of item pool due to experts' assessment regarding content validity).	See page 5 and 6 (Methods section: Measure, Translation, Assessment of comprehensibility and adaptation of the scale) and page 9 and 10 (Results section: Translation, Assessment of comprehensibility and adaptation of the scale)
4	Report the name and version of the statistical software package used for all analyses.	See page 6 to 8 (Methods section: Assessment of comprehensibility and adaptation of the scale, Psychometric evaluation)
5	Identify and justify the sampling strategy (e.g., convenience, snowball) and sampling frame. Report standard sample demographic characteristics as well as other salient sample characteristics.	See page 6 and 7 (Methods section: Assessment of comprehensibility and adaptation of the scale, Psychometric evaluation) and page 8 to 10 (Results section: Assessment of comprehensibility and adaptation of the scale, Psychometric evaluation) and Additional file 3
6	Discuss relevant data preparation and screening procedures. For instance, do the data meet the appropriate assumptions for factor analysis? If not, what actions were taken? Report tests of factorability if appropriate (e.g., report Bartlett's test of sphericity).	See page 10 to 12 (Results section: Psychometric evaluation)
7	Provide all dates of data collection.	See page 9 to 13 (Results section)
8	Avoid use of principal components analysis (PCA) as a precursor to CFA (Costello & Osborne, 2005; Worthington & Whittaker, 2006). Instead, start with EFA to assess the underlying factor structure and refine the item pool. EFA should be followed by CFA using a different sample (or samples) to evaluate the EFA-informed a priori theory about the measure's factor-structure and psychometric	An a priori hypothesized model for CFA was specified based on the original measures structure. The model could not be confirmed and an EFA was calculated afterwards. The same data set was used for

	properties. (Costello & Osborne, 2005; Henson & Roberts, 2006; Worthington & Whittaker, 2006). For CFA, authors should specify an a priori hypothesized model and a priori competing models (Jackson, Gillasp, & Purc-Stephenson, 2009).	EFA and CFA. For more information see page 10 to 12 (Results section).
9	<p>Guidelines for reporting EFA results.</p> <p>How large is a sample? One common rule of thumb is to ensure a person-to-item ratio of 10:1. Another rule of thumb is that $N = 300$ is usually acceptable (Worthington & Whittaker, 2006). However, some researchers have criticized these sample size rules of thumb, noting the appropriate sample size is dependent on the features of the gathered data. These researchers recommend obtaining the largest possible sample because the adequacy of the sample size cannot be determined until after the data have been analyzed (Henson & Roberts, 2006).</p> <p>Run EFA . . . or not. Run a preliminary EFA to determine if further data collection is required based on the following criteria: (a) If communalities are greater than .50 or there are 10:1 items per factor with factor loadings of roughly .4, then a sample size of 150 to 200 is likely to be adequate; (b) If communalities are all at least .60 or there are a minimum of 4:1 items per factor with factor loadings above .6, then even smaller sample sizes may suffice; (Worthington & Whittaker, 2006). Report if additional data collection was necessary due to inadequate sample size. If so, report the new participants' sociodemographic characteristics and test for differences between groups using standard statistical procedures (e.g., t-tests).</p> <p>Give EFA details. Report the specific rotation strategy used (e.g. varimax, geomin). Justify the decision to use an orthogonal or oblique solution. One recommendation is to always begin with an oblique rotation, empirically assess factor intercorrelations, and report them before deciding upon a final rotation solution (Henson & Roberts, 2006; Worthington & Whittaker, 2006). Some researchers argue oblique rotation is always the best approach because (a) factor intercorrelations are the norm in social sciences and (b) both approaches yield the same result if the factors happen to be uncorrelated (Costello & Osborne, 2005). Conversely, other researchers contend that orthogonal rotation is preferable because fewer parameters are estimated—orthogonal rotation is more parsimonious and amenable to replication (Henson & Roberts, 2006). Similarly, some researchers warn against relying on a statistical software package's default settings to determine the appropriate type of oblique rotation (Henson & Roberts, 2006; Worthington & Whittaker, 2006). Others state that doing so is fine (Costello & Osborne, 2005, p.3). Given the lack of consensus, it is probably best to describe what you do and defend your approach on substantive grounds, if possible.</p> <p>Report the whole factor pattern/structure. Always report the whole factor pattern/structure matrix, including all of the items in the analysis. It is recommended that authors report</p>	<p>Sample size is $n=115$, person-to-item ratio 11.5:1 (see page 7: Methods section, Psychometric analysis)</p> <p>EFA communalities are all above .70, therefore the sample size of $n=115$ can be determined as adequate and no additional data collection was necessary. For more information, see Supplementary File1).</p> <p>See page 6 to 8 (Methods section: Psychometric evaluation)</p> <p>See page 10 to 12 (Results section: Psychometric</p>

	<p>this information in a chart following the example provided by Henson and Roberts (2006) on page 411.</p>	<p>evaluation) and Supplementary File 1</p>
	<p>Criteria for deleting (crossloaded) items. Report any deleted items and the criteria used for deletion. Crossloading items with values $\geq .32$ on at least two factors should generally be candidates for deletion, especially if there are other items with factor loadings of .50 or greater (Costello & Osborne, 2005). Rerun the EFA each time an item is deleted.</p>	<p>No crossloading items could be observed, so item deletion was not necessary.</p>
	<p>Criteria for number of factors. Report the number of factors retained and justify this decision using multiple criteria (eigenvalue > 1, scree test, parallel analysis, rejection of a factor with fewer than 3 items, etc). Reporting the eigenvalue > 1 rule alone is inadequate because it has been shown to among the least accurate criteria for assessing factor retention (Costello & Osborne, 2005; Henson & Roberts, 2006)</p>	<p>See page 6 to 8 (Methods section: Psychometric evaluation)</p>
	<p>Explained variance. Report the variance explained by the factors.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation) and Supplementary File 1</p>
	<p>In general, describe your decisions.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation) and Supplementary File 1</p>
10	<p>Guidelines for reporting CFA results.</p>	
	<p>Describe and justify the theoretical model. Report hypothesized factor structure. Provide theoretical and empirical justification (e.g., results of preliminary EFAs) for your hypothesis. In addition, report a priori competing models.</p>	<p>See page 6 to 8 (Methods section: Psychometric evaluation)</p>
	<p>Describe the parameterization. Provide a comprehensive description of the a priori parameter specification. Identify fixed parameters, free parameters, and constrained parameters. For example, indicate if you freed the errors of any items to correlate.</p>	<p>One factor loading was constrained to equal 1, the corresponding intercept was constrained equal to zero. The other factor loadings and intercepts were estimated. Errors of items were not freed to correlate.</p>
	<p>Include a figure. Include a figure of each CFA model being tested using Kline's (2005) graphical conventions if feasible.</p>	<p>See Supplementary File 3</p>
	<p>Identification. Demonstrate model identification (e.g., $df > 0$; scaling of factors; assess and report the —t-rule; the two-indicator rule). Necessary and sufficient conditions for model identification may vary for certain types of CFA models. When in doubt, authors should consult Brown's (2006) CFA text or Kline's (2005) SEM text for guidance.</p>	<p>See page 10 to 12 (Results section: Psychometric evaluation)</p>
	<p>Select an estimator based on distributional patterns and assumptions. Report the estimator used (e.g., ML,</p>	<p>See page 6 (Methods section: Psychometric evaluation)</p>

	WLSMV) and justify your choice based on distributional assumptions. It is not appropriate to report that you relied on your statistical software's default setting.	
	Use multiple fit indices. After estimating a model, always report multiple fit indices (e.g., model X ² , df, p, CFI/TLI, RMSEA, SRMR). Report all appropriate fit indices, not just those favorable to your hypotheses (Jackson et al., 2009). For example, do not report acceptable CFI and TLI scores while omitting a relevant fit index with a suboptimal value.	See page 8 (Methods section: Psychometric evaluation) and page 10 and 11 (Results section: Psychometric evaluation)
	What is acceptable fit? For model fit indices, authors should generally use the cut-off values recommended by Hu and Bentler (1999) and endorsed by Brown (2006), assuming ML estimation: a. CFI/TLI ≥ .95 b. RMSEA ≤ .06 c. SRMR ≤ .08	See page 9, Table 1 (Methods section: Psychometric evaluation)
	Localized strain? When reporting model fit, include an assessment for localized areas of strain by examining standardized residuals. Standardized residuals greater than 1.96 (for p < .05) indicate areas of strain (Harrington, 2009). Report the absence of localized strain, if appropriate; otherwise, note localized areas of strain by reporting the relevant standardized residuals.	Standardized residuals do not indicate localized strains.
	Parameter estimates and SEs. When reporting factor loadings and other parameter estimates, always report the unstandardized estimates, their p values, and the standard errors. In addition, include the standardized estimates when appropriate. Be sure to report all parameter estimates, even those that are non significant (Brown, 2006; Jackson et al., 2009).	See Supplementary File 3
	Assessing the validity of the factor solution. Comment on the new measure's convergent and discriminant validity based on parameter estimates. For instance, factor correlations ≥ .80 may indicate poor discriminant validity (Brown, 2006). In addition, strong factor loadings that do not crossload may indicate good convergent validity. One rule of thumb is that factor loadings < .40 are weak and factor loadings ≥ .60 are strong (Garson, 2010).	Exploratory factor analysis revealed a one-factor model, so there are no factor correlations.
	Other measures. Report squared multiple correlations and comment on the measure's reliability (e.g., report Raykov's Rho if appropriate)	See page 10 to 12 (Results section: Psychometric analysis)
	Respecification: Caution! Report any post-hoc respecifications to improve model fit based on modification indices. Justify the respecifications on theoretical or conceptual grounds (Jackson et al., 2009). Respecification to allow for correlated errors is not supportable without strong pragmatic justification (e.g., items contain similar words or phrases). Note that respecification precludes comparing the model with your a priori specified competing models. Report improvements in appropriate model fit indices for respecified models (e.g., chi-square difference test)	No respecifications to improve model fit were applied.
10	Describe the matrix (or matrices) you analyzed (e.g., covariance, correlation). Include matrices in the manuscript	See Supplementary File 1

	if feasible; otherwise, indicate these data are available upon request.	
11	Report the amount of missing data and describe how missing data were handled. For a review of practices for handling missing data, see Sterne and colleagues (2009), Rose and Fraser (2008), and Horton and Kleinman (2007). Provide a rationale for your approach to handling missing data. Authors are encouraged to consider using multiple imputation or model estimation with full-information maximum likelihood (FIML; Rose & Fraser, 2008).	See page 7 (Methods section: Psychometric evaluation) and page 10 (Results section: Psychometric evaluation)
12	Compare your CFA model with the alternative or competing models. Do competing models fit the data better or worse than your model (e.g., does your four-factor model of acculturation fit the data better than a two-factor model or a one-factor model)? Identify the preferable model based on appropriate fit statistics (e.g. chi-square difference test for nested models, Akaike information criterion for non-nested models), parsimony, and relevant theory	See page 15 and 16 (Discussions sections)
13	Include your scale (items and response options) in an appendix.	See Supplementary File 2
14	Report how methodological limitations may have impacted findings regarding your measure's psychometric properties (e.g., note potential repercussions of suboptimal sampling techniques, discuss implications of using listwise deletion to handle missing data instead of multiple imputation or FIML).	See page 16 and 17 (Discussions sections)
15	Discuss directions for future research (e.g., if appropriate, testing your scale for measurement invariance by conducting CFA on different populations).	See page 16 and 17 (Discussions sections)

1 Cabrera-Nguyen P. Author Guidelines for Reporting Scale Development and Validation Results in the *J Soc Social Work Res* 2010;1:99–103.

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3 **1 Supplementary File 2: Additional tables for psychometric evaluation of 10-item ORIC version**
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3 Table A: Demographic data of participants of cognitive interviews (n=11).
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		Frequencies for n=11
Age	< 30 years	1
	31-40 years	3
	41-50 years	3
	> 50 years	4
Gender	Female	9
	Male	2
Profession*	Nurse	8
	Physician	2
	Psychooncologist	3
Work experience in health care	> 5 years	3
	5-10 years	4
	11-20 years	3
	> 20 years	1

4 * multiple answers possible
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6 Table B: Factor loadings on the first component.
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	Component 1
Item 1	0.790
Item 2	0.788
Item 3	0.833
Item 4	0.846
Item 5	0.831
Item 6	0.851
Item 7	0.839
Item 8	0.800
Item 9	0.754
Item 10	0.860

7 For EFA, the sample was split and n=115.
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9 Table C: Inter-item correlation matrix for the German ORIC.
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	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Item 1	1.000	.634	.650	.611	.652	.587	.558	.538	.507	.542
Item 2	.634	1.000	.586	.681	.607	.518	.504	.485	.434	.478
Item 3	.650	.586	1.000	.673	.723	.636	.600	.558	.492	.560
Item 4	.611	.681	.673	1.000	.675	.588	.531	.541	.512	.551
Item 5	.652	.607	.723	.675	1.000	.622	.621	.466	.474	.578
Item 6	.587	.518	.636	.588	.622	1.000	.677	.590	.588	.573
Item 7	.558	.504	.600	.531	.621	.677	1.000	.612	.491	.567
Item 8	.538	.485	.558	.541	.466	.590	.612	1.000	.611	.560
Item 9	.507	.434	.492	.512	.474	.588	.491	.611	1.000	.659
Item 10	.542	.478	.560	.551	.578	.573	.567	.560	.659	1.000

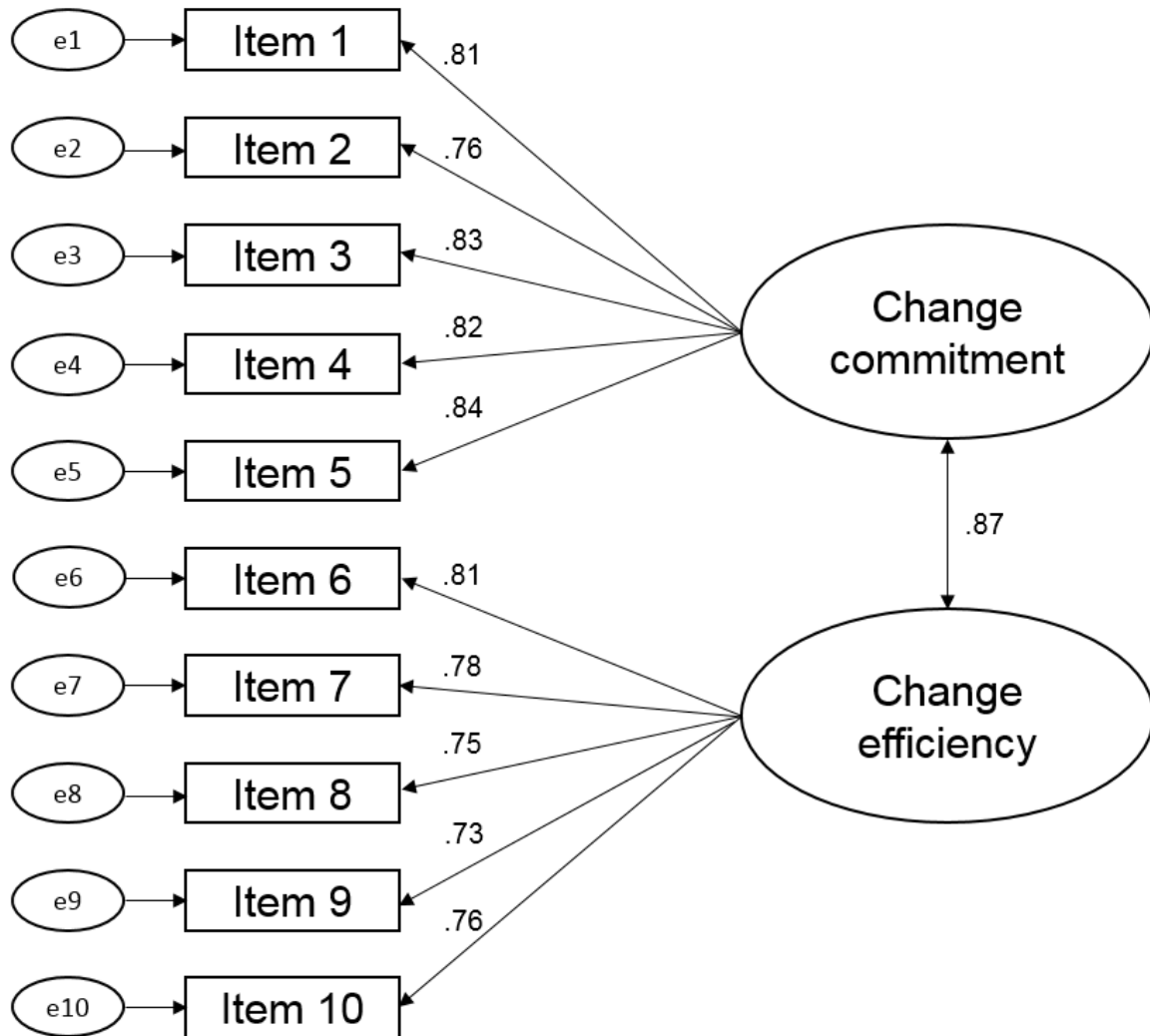
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3 **1 Supplementary File 3: Organizational Readiness for Implementing Change (ORIC) – German**
4 **2 version**
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Bitte geben Sie an, wie sehr Sie den folgenden Aussagen zur Umsetzung von partizipativer Entscheidungsfindung an Ihrem aktuellen Arbeitsplatz zustimmen. Falls partizipative Entscheidungsfindung aktuell nicht umgesetzt wird, wie wäre es im Falle der Umsetzung?

		stimme nicht zu	stimme eher nicht zu	teils teils	stimme eher zu	stimme zu
1	Personen, die hier arbeiten, zeigen hohes Engagement bei der Umsetzung von partizipativer Entscheidungsfindung.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Personen, die hier arbeiten, werden tun, was auch immer nötig ist, um partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Personen, die hier arbeiten, wollen partizipative Entscheidungsfindung umsetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Personen, die hier arbeiten, sind fest entschlossen, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Personen, die hier arbeiten, sind motiviert, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	Eventuell entstehen bei der Umsetzung von partizipativer Entscheidungsfindung Herausforderungen. Personen, die hier arbeiten, sind zuversichtlich, diese zu meistern.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	Personen, die hier arbeiten, sind zuversichtlich, dass sie den Verlauf der Umsetzung von partizipativer Entscheidungsfindung überblicken können.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Personen, die hier arbeiten, sind zuversichtlich, dass sie Aufgaben so koordinieren können, dass die Umsetzung reibungslos abläuft.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	Personen, die hier arbeiten, sind zuversichtlich, dass die Klinik sie dabei unterstützen kann, partizipative Entscheidungsfindung umzusetzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	Personen, die hier arbeiten, sind zuversichtlich, Machenschaften bei der Umsetzung von partizipativer Entscheidungsfindung bewältigen zu können.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Supplementary File 4: Confirmatory factor analysis model of the 10-item German ORIC



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3 **1 Supplementary File 5: Results of psychometric evaluation of the 9-item German ORIC version:**
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5 **2 Factor analysis, corrected item-total correlations, Cronbach's α**
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4 **Factor analysis**

To get information about the factorial structure of the 9-item German ORIC, an exploratory factor analysis was conducted. KMO measure was .926 and Barlett's test of sphericity was significant ($X^2 = 1302.78, p < .001$), indicating that a factor analysis of the data was appropriate to observe data. Table A shows results of the exploratory factor analysis. Since the main component explains 66% of the variance, a one-factor model could be assumed. The factor loading for the first component can be observed in table B.

Table A: Results of exploratory factor analysis of the 9-item German ORIC with oblique rotation and parallel analysis: eigenvalues of the ten components of the German ORIC and eigenvalues for corresponding random data.

	Eigenvalue			Eigenvalues for random data	
	Total	% of variance	Cumulative %	Means	95% percentile
Component 1	6.02	66.85	66.85	1.45	1.59
Component 2	0.802	8.91	75.76	1.29	1.39
Component 3	0.472	5.25	81.01	1.17	1.25
Component 4	0.392	4.35	85.37	1.07	1.14
Component 5	0.366	4.06	89.43	0.98	1.05
Component 6	0.304	3.38	92.81	0.89	0.96
Component 7	0.250	2.78	95.59	0.81	0.87
Component 8	0.232	2.57	98.16	0.71	0.79
Component 9	0.165	1.84	100.00	0.61	0.69

Notes: For EFA, half of the data set (n=115) was used.

Table B: Factor loadings on the first component.

	Component 1
Item 1	0.860
Item 2	0.856
Item 3	0.837
Item 4	0.836
Item 5	0.835
Item 6	0.799
Item 7	0.797
Item 8	0.791
Item 9	0.739

Notes: For EFA, the sample was split and n=115.

19 A confirmatory factor analysis was performed with the one-factor model to analyze its fit indices. Indices
20 of the one-factor model are presented in table C.

22 Table C: Fit indices of the one-factor model of the 9-item German ORIC.

	Chi ² ¹	df ²	Chi ² /df ³	CFI ⁴	TLI ⁵	RMSEA ⁶	AIC ⁷	PNFI ⁸
One-factor model	56.04	27	2.08	.945	.927	.097	92.04	.676

Notes: One-factor model (including a split data set of n=115): includes items 1 to 9.

¹ discrepancy chi-squared statistic, ² degrees of freedom, ³ normed chi-squared statistic, ⁴ comparative fit indexes, ⁵ Tucker-Lewis Index, ⁶ root mean square error of approximation, ⁷ Akaike Information Criterion, ⁸ Parsimonious Normed Fit Index (PNFI). * $p = .000$

24 Corrected item-total correlations and Cronbach's α of the 9-item ORIC version

25 Table D shows the corrected item-total correlation. Corrected item-total correlation ranged from .665
26 (item 9) to .744 (item 3).

28 Table D: Discrimination of the nine items of the German ORIC.

	Item discrimination ²⁹ (corrected item-total correlation)
Item 1	.747
Item 2	.696
Item 3	.777
Item 4	.760
Item 5	.762
Item 6	.759
Item 7	.720
Item 8	.691
Item 9	.638

Notes: Items could be answered on a 5-step Likert scale rating from 0 „disagree“ to 4 „agree“.

32 Cronbach's α with $\alpha = .924$ showed the measure to reach excellent reliability.