

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email editorial.bmjopen@bmj.com

BMJ Open

Barriers and facilitators to Orthopaedic Surgeons' uptake of decision aids for Total Knee Arthroplasty: A qualitative study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018614
Article Type:	Research
Date Submitted by the Author:	10-Jul-2017
Complete List of Authors:	Bunzli, Samantha; The University of Melbourne, Department of Surgery, St Vincent's Hospital Melbourne Nelson, Elizabeth ; St Vincent's Hospital, Melbourne, Department of Orthopaedics Scott, Anthony; The University of Melbourne, Melbourne Institute of Applied Economic and Social Research French, Simon; Queen's University, School of Rehabilitation Therapy; Monash University, School of Public Health and Preventive Medicine Choong, Peter; University of Melbourne, Surgery; St Vincent's Hospital, Orthopaedics Dowsey, Michelle; University of Melbourne, Department of Surgery, St Vincent's Hospital, Melbourne
Primary Subject Heading:	Evidence based practice
Secondary Subject Heading:	Qualitative research
Keywords:	Knee < ORTHOPAEDIC & TRAUMA SURGERY, QUALITATIVE RESEARCH, Total Knee Arthroplasty, Decision aids, Implementation

SCHOLARONE™
Manuscripts

1
2
3 **1 Barriers and facilitators to Orthopaedic Surgeons' uptake of decision aids for Total**
4 **2 Knee Arthroplasty: A qualitative study**
5
6 **3**

7 4 * Samantha Bunzli. The University of Melbourne, Department of Surgery, St. Vincent's
8 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
9 Victoria, Australia. Email: sbunzli@unimelb.edu.au
10 6

11 7
12 8 Elizabeth Nelson. Department of Orthopaedics, St Vincent's Hospital. 41 Victoria
13 Parade, Fitzroy, Melbourne 3065 Australia. Email: elizabeth.nelson@svha.org.au
14 9

15 10
16 11 Anthony Scott. Melbourne Institute of Applied Economic and Social Research, The
17 University of Melbourne. Level 5, Faculty of Business and Economics Building, 111
18 Barry Street, Melbourne 3010 Victoria, Australia. Email: a.scott@unimelb.edu.au
19 14

20 15 Simon French. School of Rehabilitation Therapy, Faculty of Health Sciences, Louise D.
21 Acton Building, Room 222. Queen's University, 99 University Ave, Kingston, ON K7L
22 3N6. Canada. Email: simon.french@queensu.ca
23 17

24 18
25 19 Peter Choong. The University of Melbourne, Department of Surgery, St. Vincent's
26 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
27 Victoria, Australia. Email: pchoong@unimelb.edu.au
28 21

29 22
30 23 Michelle Dowsey. The University of Melbourne, Department of Surgery, St. Vincent's
31 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
32 Victoria, Australia. Email: mmdowsey@unimelb.edu.au
33 25

34 26
35 27
36 28 * Corresponding author
37

38 29
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **Abstract**
4

5
6 *Objectives:* The demand for Total Knee Arthroplasty (TKA) will soon outstrip supply. It
7
8 is imperative to reserve TKA for those most likely to benefit. Decision aids can help
9
10 surgeons select appropriate candidates for surgery, but their uptake has been low. The
11
12 aim of this study was to explore the barriers and facilitators to decision aid uptake among
13
14 Orthopaedic Surgeons. *Design:* A qualitative study involving face-to-face interviews.
15
16 Questions were constructed on the Theoretical Domains Framework to systematically
17
18 explore barriers and facilitators. *Setting:* One tertiary hospital in Australia. *Participants:*
19
20 Twenty Orthopaedic Surgeons performing TKA. *Outcome measures:* Beliefs underlying
21
22 similar interview responses were identified and grouped together as themes describing
23
24 relevant barriers and facilitators to uptake of decision aids. *Results:* While prioritising
25
26 their clinical acumen, surgeons believed a decision aid could enhance communication and
27
28 patient informed consent. Barriers identified included the perception that one's patient
29
30 outcomes were already optimal; a perceived lack of non-operative alternatives for the
31
32 management of end-stage osteoarthritis; concerns about mandatory cut-offs for patient-
33
34 centred care, and concerns about the medico-legal implications of using a decision aid.
35
36 *Conclusions:* Multifaceted implementation interventions are required to ensure that
37
38 Orthopaedic Surgeons are ready, willing and able to use a TKA decision aid.
39
40 Audit/feedback to address current decision-making biases such as overconfidence may
41
42 enhance readiness to uptake. Policy changes and/or incentives may enhance willingness
43
44 to uptake. Finally, the design/implementation of effective non-operative treatments may
45
46 enhance ability to uptake by ensuring that surgeons have the resources they need to carry
47
48 out decisions.
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 53
4
56 54 **Strengths and limitations of the study**7
8 55 • Very few qualitative studies involving Orthopaedic Surgeons have been published
9
10 56 in the literature.11
12 57 • This study took place in one of the largest arthroplasty clinics in Australia. All
13
14 58 twenty surgeons performing TKA in this hospital participated in a one-to-one
15
16 59 interview.17
18
19
20 60 • A theoretical framework was used to systematically explore the barriers and
21
22 61 facilitators to uptake of a decision aid by Orthopaedic Surgeons.23
24
25 62 • Consistent findings are documented between this single site study and international
26
27 63 surveys of surgeon' attitudes.28
29
30 64 • Beliefs and attitudes are distinct from actual behaviour, and therefore the themes
31
32 65 elicited in this study do not provide evidence of the actual influences on uptake of a
33
34 66 decision aid.35
36
37 67
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **68 Background**
4

5
6 69 Up to one quarter of Total Knee Arthroplasties (TKA) are performed on inappropriate
7
8 70 candidates according to evidence-based criteria¹ and a similar proportion experience
9
10 71 minimal clinical benefit from surgery.² To reduce expenditure, optimize the utilization of
11
12 72 resources, and avoid unnecessary pain and suffering, it is important to reserve TKA for
13
14 73 those who will derive a clinically meaningful improvement in pain and function.
15
16
17
18
19

20 75 At present, indications for TKA vary widely.^{3 4} While the degree osteoarthritis (OA)
21
22 76 severity, pain severity and the impact of pain, are key indicators for TKA, surgeons'
23
24 77 consideration of other evidence-based indicators such as psychosocial factors remains
25
26 78 varied.⁵ Observations of orthopaedic consultations suggest that other 'unstated factors'
27
28 79 may also influence clinical judgments such as the surgeons' beliefs in their own ability to
29
30 80 conduct surgery and their 'instincts' about the patients ability to cope with pain.⁶
31
32
33
34
35

36 82 In recent years there has been a move towards a model of shared decision-making in
37
38 83 Orthopaedics as part of informed consent.^{7 8} This model implies that surgeons have a duty
39
40 84 to inform patients about the benefits and harms of TKA and the likelihood of their
41
42 85 occurrence, supporting them to arrive at an informed, shared decision. Evidence suggests
43
44 86 that there is often a lack of time during the clinical encounter for patients to consider or
45
46 87 discuss all available treatment options and arrive at a decision congruent with their own
47
48 88 preferences.⁹
49
50
51
52

53 89
54
55
56
57
58
59
60

1
2
3 90 To help address variations in clinical judgments and promote shared decision-making,
4
5 91 decision aids may be useful.^{10 11} Decision aids can be designed to estimate important,
6
7
8 92 patient-specific risks of responding to surgery, based on independent prognostic
9
10 93 correlates of post-TKA response such as body mass index, degree of OA severity, pre-
11
12 94 operative pain, function and mental health.¹² Similar aids have been found to predict
13
14 95 outcomes in other areas of medicine with superior accuracy to clinical judgments alone.¹³
15
16
17 96 ¹⁴ Decision aids have improved patient knowledge and confidence in decisions,¹⁵ and
18
19 97 have even been found to reduce the rate of surgical procedures.¹⁶
20
21
22 98
23
24 99 Orthopaedic Surgeons recognize the need for an aid to support their decision making for
25
26 100 TKA and optimize communication with patients.^{5 17} However, the uptake of decision aids
27
28 101 amongst surgeons has been low.⁸ A number of factors can influence uptake of a decision
29
30 102 aid, and the success of implementation efforts depends on the careful assessment of the
31
32 103 barriers to, and facilitators of, uptake.¹⁸ The implementation literature advocates the use
33
34 104 of theory to ensure the systematic identification of such factors and inform the design of
35
36 105 interventions to address them.¹⁹ Using theory not only increases the likelihood of
37
38 106 behavior change,²⁰ but also provides a basis for better understanding the processes
39
40 107 underpinning behavior change.²¹ To date, studies of decision-making amongst
41
42 108 Orthopaedic Surgeons have been few and atheoretical^{5 6 22} and the barriers and facilitators
43
44 109 of uptake of decision aids for TKA have not been rigorously explored.^{8 17}
45
46
47
48
49
50
51
52

110

111 **Methods**

112

1
2
3 113 **Aim and Design:**
4
5

6 114
7

8 115 The aim of this theoretically-informed qualitative study was to explore the barriers and
9
10 116 facilitators to uptake of a TKA decision aid through structured one-to-one interviews with
11
12 117 Orthopaedic Surgeons.
13

14
15 118

16
17 119 **Participants:**
18

19
20 120

21
22 121 All Orthopaedic Surgeons and Registrars performing TKA at one tertiary teaching
23
24 122 hospital in Australia were eligible. Eligible candidates received the study details via
25
26 123 email from an institutional administration officer, and were invited to contact the
27
28 124 researchers to arrange an interview at a time and place suitable to them.
29
30

31
32 125

33
34 126 **Data collection:**
35

36 127
37

38 128 The Theoretical Domains Framework (TDF)²³ was selected as a comprehensive and
39
40 129 validated framework for determining barriers and facilitators related to the
41
42 130 implementation of best practice and clinicians' behavior change. The TDF was developed
43
44 131 by implementation scientists to synthesise existing behavior change theories into a single
45
46 132 framework. A six-stage consensus approach resulted in the identification of 12 theoretical
47
48 133 'domains' describing possible mediators of behavior change.²³ A subsequent validation
49
50 134 study²¹ revised the original TDF to 14 domains: Knowledge; Skills; Social/professional
51
52
53 135 role and identity; Beliefs about capabilities; Optimism; Beliefs about consequences;
54
55
56
57
58
59
60

1
2
3 136 Reinforcement; Intentions; Goals; Memory, attention and decision processes;
4
5
6 137 Environmental context and resources, Social influences; Emotions; and Behavioural
7
8 138 regulation. The revised TDF, used in this study, has explained implementation problems
9
10 139 and informed the development of theory-informed behavior change interventions.²⁴⁻²⁶
11

12
13 140

14
15 141 Interview questions were developed for each domain of the TDF with the advice of
16
17 142 content experts in the TDF (SF), orthopaedic surgery (MD) and decision-making
18
19 143 processes (AS), and in consultation with the literature.²⁷ In the first part of the interview,
20
21 144 questions aimed to elicit current decision-making processes and biases. In the second
22
23 145 part, questions aimed to identify beliefs and attitudes towards decision aids and factors
24
25 146 that may influence decisions to use one. Table 1 presents the interview schedule.
26
27

28
29 147

30
31
32 148 [Insert Table 1]
33

34
35 149

36
37 150 The interviewer (SB), a female post-doctoral researcher with methodological expertise in
38
39 151 qualitative research, had no previous relationship with the participants and no affiliation
40
41 152 with the hospital. Data saturation was considered complete when the beliefs and attitudes
42
43 153 of all 20 surgeons working in this setting had been elicited. Face-to-face interviews were
44
45 154 conducted with 18 participants in a private office; phone interviews were conducted with
46
47 155 two participants. Interviews lasted 20-30 minutes. Nineteen interviews were audio
48
49 156 recorded and transcribed verbatim. One participant did not wish the interview to be
50
51 157 recorded, therefore hand-written notes were made during the interview. Participant
52
53 158 anonymity was ensured at all times. All transcripts were de-identified prior to data
54
55
56
57
58
59
60

1
2
3 159 analysis. All participants had the opportunity to review the study findings during a
4
5
6 160 presentation at a scheduled surgical meeting. There was consensus agreement with the
7
8 161 researchers' interpretations and no adjustments were made to the study themes.
9

10
11 162

12
13 **Analysis:**

14
15 164

16
17 165 Adopting an implementation approach,²⁵ three stages of data analysis were conducted
18
19
20 166 involving deductive and inductive coding. In the first stage (deductive coding), two
21
22 167 researchers (SB, EN) independently coded interview transcripts into the 14 TDF
23
24 168 domains. Definitions for each domain were derived from the literature¹⁸ and adapted to
25
26
27 169 the study context. Each response or utterance could only be classified into one domain.
28
29 170 Pilot coding was performed in which the two researchers independently applied the
30
31
32 171 coding framework to two transcripts. Inter-coder comparisons resulted in refinement of
33
34 172 domain definitions (see Additional file 1). This process was conducted three times, until
35
36
37 173 the two researchers were confident that all relevant raw data could be clearly classified
38
39 174 into one domain using the refined coding framework.

40
41 175

42
43 176 The two researchers then independently applied the refined coding framework to all 20
44
45
46 177 transcripts. Inter-coder consistency (i.e. the consistency with which each researcher
47
48 178 coded the same statement into the same domain) was calculated using a Kappa statistic.
49
50
51 179 Disagreements were discussed and consensus reached in each instance. Coded raw data
52
53 180 was uploaded into a qualitative data sorting software (Codesort²⁸) to facilitate further
54
55
56 181 analysis.
57
58
59
60

1
2
3 182
4
5
6 183

7 In the second stage of analysis (inductive coding), one researcher (SB) generated belief
8 statements based on responses within each domain of the TDF. These belief statements
9
10 184 provided detail about the potential influence the domain had on the surgeon's clinical
11 185 behaviour. The belief statement was worded such that it could describe multiple
12 186 responses from different participants. Belief statements were reviewed by two further
13 187 researchers (EN, MD) to check that they remained grounded in the raw data.
14 188
15
16
17
18
19
20 189

21
22 190 In the third stage of analysis, the domains most relevant to surgeon's behaviour were
23 191 identified through group discussion. Relevancy was determined by: 1. Frequency of
24 192 beliefs across transcripts and/or 2. The perceived strength of beliefs in influencing
25 193 behaviour. To illustrate, the belief statement: 'I think that the percentage of my patients
26 194 who achieve clinically meaningful improvement is higher than that reported in the
27 195 literature' appeared in 17/20 transcripts and was considered to have a strong influence on
28 196 surgeon's clinical behaviour, implying that behaviour change was unlikely if surgeons
29 197 consider that their patients' outcomes are already optimised. 'Knowledge' was therefore
30 198 identified as a relevant domain. Where the researchers considered that beliefs within and
31 199 between domains represented similar barriers/facilitators, these were grouped into
32 200 themes. We calculated frequencies of beliefs to provide the reader with a better
33 201 understanding of the raw data and to assist us in identifying 'relevant' domains of the
34 202 TDF. However, readers should be cognisant that the absence of a belief in a transcript is
35 203 not the same as a lack of endorsement.
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54

55 204
56
57
58
59
60

1
2
3 205 **Results**
4

5
6 206

7
8 207 **Participants:**
9

10
11 208

12
13 209 Aggregate data describing the demographics of the sample is provided to protect
14
15 210 individual anonymity. The sample comprised of 15 Consultant surgeons and five
16
17 211 Registrars. The surgeons' total experience performing TKA ranged from six months to 30
18
19 212 years (mean \pm SD, 12.9 \pm 9.3) and the number of TKAs performed each month ranged
20
21 213 from less than one to 12 (mean \pm SD, 5.9 \pm 3.0).
22
23
24

25 214

26
27 215 **Inter-rater reliability:**
28

29
30 216

31
32 217 Across the 20 interview transcripts, 628 utterances were coded into the 14 domains.
33
34 218 There was good inter-coder reliability across all interviews and domains (Kappa = 0.74
35
36 219 Standard error Kappa \pm 0.02)
37
38

39 220

40
41 221 **Relevant domains:**
42

43
44 222

45
46 223 Eleven TDF domains were identified as relevant: Knowledge; Behavioural regulation;
47
48 224 Memory attention and decision processes; Beliefs about capabilities; Skills; Goals;
49
50 225 Social/Professional role and identity; Intention; Beliefs about consequences;
51
52 226 Environmental context; and Reinforcement. Table 2 presents the relevant domains, with
53
54 227 specific belief statements supported by example quotes.
55
56
57
58
59
60

1
2
3 228
4
5

6 229 [Insert Table 2]
7
8

9 230
10

11 231 **Themes identified:**
12

13 232
14

15 233 1. Knowledge of one's own patient outcomes
16

17 234 (Relevant TDF domains: Goals; Knowledge; Behavioural regulation; and Beliefs about
18
19 235 capabilities)
20
21

22 236
23

24 237 All participants stated their goal was to optimise outcomes for their patients:
25
26

27 238
28

29 239 *"Ultimately, we will always do our best for the patient" (024)*
30
31

32 240
33

34 241 While almost all participants (n=19) were aware of the literature that up to 20 per cent of
35
36 242 patients undergoing TKA have no clinically meaningful improvement from surgery, most
37
38 243 believed that this percentage was significantly lower in the patients they operated on:
39
40

41 244
42

43 245 *"I don't count it, but you get an impression. Around 10 per cent of my patients would be*
44
45 246 *saying they are not entirely satisfied by surgery" (016)*
46
47

48 247
49

50
51 248 All participants based this estimation on patient presentations at post-surgical follow-up
52
53 249 appointments. However, participants acknowledged the 'rose-coloured glasses' they saw
54
55
56
57
58
59
60

1
2
3 250 their patients through, citing the subtleties of rapport that made patients less likely to
4
5
6 251 report dissatisfaction with surgery:
7

8 252

9
10 253 *“To please you, patients often say it is doing better than it really is. So I would think my*
11
12 254 *outcomes are better than 20 per cent, but I am aware of the glasses that I see it through*
13
14 255 *as well as what patients might tell me” (014)*
15
16

17 256

18
19
20 257 Participants recognised that patients with poor post-surgical outcomes may be less likely
21
22 258 to attend follow-up appointments, choosing to seek care elsewhere. Many participants
23
24 259 reported that tracking long-term patient outcomes through an existing joint registry could
25
26 260 counter-act this, providing a mechanism for them to reflect on any discrepancies between
27
28 261 their perceived and actual clinical outcomes:
29
30

31 262

32
33
34 263 *“If patients choose not to come back, the only way you have got to track them is looking*
35
36 264 *at your results from the registry. But I want to know the answers to the clinical questions*
37
38 265 *– are you happy? Is your pain better than it was pre-op? How you ask the question*
39
40 266 *matters” (028)*
41
42

43 267

44
45
46 268 Indeed, a key problem identified by many participants was how to define clinically
47
48 269 meaningful improvement. Several participants emphasised the importance of ‘asking the
49
50 270 right question in the right way’:
51

52 271
53
54
55
56
57
58
59
60

1
2
3 272 *“If you received feedback that the rate of clinically meaningful improvement reported by*
4
5
6 273 *your patients is not as high as you think it should be, I would want to check who is asking*
7
8 274 *the questions, what they are asking and how they are asking it” (023)*
9

10 275

11
12 276 *“To me a good result is: they are going to have some intermittent ache in the knee,*
13
14
15 277 *they’re not going to be able to kneel or squat. Others on some assessment scale might*
16
17 278 *consider that a failure. So you have get those parameters right” (010)*
18
19

20 279

21
22 280 The discrepancy between participants’ perceptions of clinically meaningful improvement
23
24 281 and that of their patients was commonly attributed to mis-matched surgeon-patient pre-
25
26
27 282 surgical expectations of TKA. Participants’ reported their expectations of TKA to be a
28
29 283 resolution of joint pathology with some corresponding improvement in pain. While
30
31 284 disease and pain severity were key considerations in surgical decision-making, all
32
33 285 participants acknowledged that patient expectations were important:
34
35

36 286

37
38
39 287 *“At the end of the day if there is a pathology that can be deleted by surgery and the*
40
41 288 *patient accepts some improvement then that means that the surgery will happen” (025)*
42

43 289

44
45
46 290 *“If the patients’ expectations are not meeting mine, I won’t do the operation because*
47
48 291 *then the patient isn’t happy and sometimes they have 2/10 pain and they are not happy”*
49
50 292 *(013)*
51

52 293

53
54
55 294 2. Reliance on ‘clinical intuition’
56
57
58
59
60

1
2
3 295

4
5 296 (Relevant TDF domains: Memory, attention and decision processes; and Skills)

6
7
8 297

9
10 298 For many participants, the accurate assessment of patient expectations presented a
11
12 299 challenge. While the physical aspects of the clinical assessment were routine skills that
13
14 300 all participants believed they had mastered well, many junior and senior surgeons
15
16 301 reported difficulties assessing the psychological aspects of the patients' presentation:

17
18
19
20 302

21
22 303 *"It is patient factors more than anything else. Because it is very easy to look at xrays and*
23
24 304 *use the Kellgren-Lawrence scale: one to four for disease severity. There is not much of*
25
26 305 *an argument over that. It's about the patient factors, the psychology and behavioural*
27
28 306 *aspects of it which you want reassurance for"* (016)

29
30
31
32 307

33
34 308 Only a few participants were aware of any validated tools to assess pre-surgical patient
35
36 309 predictive factors. Only one participant had prior knowledge of a decision aid but had not
37
38 310 used it. Participants relied on their 'clinical intuition' for patients who were less likely to
39
40 311 do well, developing a 'gut-feeling' for patients over time:

41
42
43
44 312

45
46 313 *"You spend all your life looking at patients and assessing them and you start to develop a*
47
48 314 *bit of a gut feeling as to what might be happening. Sometimes you sit in front a patient*
49
50 315 *and think: I know you are telling me this, but I know something else is happening"* (015)

51
52
53 316

54
55 317 3. The role of aids in supporting clinical decision-making

1
2
3 318
4

5 319 (Relevant TDF domains: Intention; Reinforcement)
6
7

8 320
9

10 321 Fifteen participants believed an aid would support decision-making, like a ‘barometer’ or
11
12 322 weather app to forecast outcomes, particularly in patients they were unsure about:
13

14 323

15
16
17 324 *“I don’t think it would really influence my surgical decision-making, I think it would*
18
19 325 *more affirm my decision to not offer a patient an operation” (029)*
20
21

22 326

23
24 327 *“If I think they are OK and they score badly I will relook at it and say why is that? Am I*
25
26 328 *missing something obvious? But at the end of the day if an aid says one thing and my sniff*
27

28 329 *test says there is something not right, I’m still following my nose” (010)*
29
30

31 330
32

33
34 331 Participants believed an aid would be insensitive to nuances at an individual level and
35
36 332 could therefore not replace their clinical acumen:
37

38 333

39
40 334 *“Not every tool is perfect and it may not capture every patient... the danger is we may*
41
42 335 *end up refusing to do something because of an aid and therefore patients may not receive*
43
44 336 *the appropriate treatment. Nothing is 100 per cent so you have to expect some patients*
45
46 337 *would fall through the cracks” (019)*
47
48

49 338
50

51
52
53 339 All participants expected to be provided with evidence that a decision aid had been
54
55 340 rigorously validated and shown to have high specificity and sensitivity before considering
56
57
58
59
60

1
2
3 341 using it. Participants were more likely to trust this evidence if it came from their own
4
5 342 institution:

6
7
8 343

9
10 344 *“I think people are mistrustful of things that come out of other institutions but I would*
11
12 345 *trust that a study from [the Department] would be a rigorous design. If the results*
13
14 346 *showed an aid was valid, I guess I would be prepared to try it and see whether I thought*
15
16 347 *it was valid in my hands, in my practice” (026)*
17

18
19
20 348

21
22 349 Indeed, half of the participants reported that evidence supporting the validity of a
23
24 350 decision aid would not be sufficient to convince them to use it. Instead they suggested
25
26 351 that they would need to see how an aid correlated with their own clinical decision-
27
28 352 making:

29
30
31 353

32
33 354 *“I never trust evidence because you only have to go to Dr x ...even in research there’s a*
34
35 355 *lot of doubtful stuff... I know we have got to be evidenced-based but the evidence may*
36
37 356 *apply to a certain situation in a certain individual at a period in time and there is always*
38
39 357 *variations or exceptions around that. So I would try and correlate them in my own mind*
40
41 358 *and if after a while I’m seeing well that person is a bit odd and they are scoring badly on*
42
43 359 *the aid, well ok, this has legs.” (010)*
44
45

46
47
48 360

49
50 361 4. Implications of a decision aid for patient-surgeon communication and shared decision-
51
52 362 making
53

54
55 363
56
57
58
59
60

1
2
3 364 (Relevant TDF domains: Beliefs about consequences; Memory, attention and decision
4
5 365 processes)
6
7

8 366

9
10 367 Participants perceived that a decision aid would give them an evidence-based approach
11
12 368 for saying ‘no’ to patients, particularly for those participants who reported difficulties
13
14 369 declining surgery:
15

16
17 370

18
19
20 371 *“I think that the main benefit of an aid would be making the patient understand if I am*
21
22 372 *saying no to the surgery it’s not because I don’t like him or her, it’s because there is data*
23
24 373 *written black on white that they are not going to do well...It will not just be my gut*
25
26 374 *feeling. I can give them data and say “sorry it’s written here. It’s not me it’s the*
27
28 375 *computer. So it backs up what I am saying” (013)*
29

30
31 376

32
33
34 377 Many participants believed an aid could be an important component of informed consent,
35
36 378 providing patients with objective data on their likely risk outcomes, enabling them to
37
38 379 have the appropriate expectations to weigh up the risk and benefits of surgery for
39
40 380 themselves. In this way, some participants saw a decision aid as a valuable support to
41
42 381 shared decision-making:
43

44
45 382

46
47
48 383 *“It comes back down to getting patient consent, as part of that I would incorporate it into*
49
50 384 *my consent form and say preoperatively you have a fifty-fifty chance and that has been*
51
52 385 *discussed with a validated tool. If the patient wishes to go ahead, they can make that*
53
54 386 *informed decision” (021)*
55
56
57
58
59
60

1
2
3 387

4
5 388 Participants were divided in their responses when asked how they would feel about
6
7
8 389 operating if a decision aid predicted a patient had a 50 per cent chance of not responding
9
10
11 390 to TKA. While half agreed with the statement above that decisions to proceed would
12
13 391 need to be shared with the patient:

14
15 392

16
17 393 *“A patient may be so severely impacted that a one in two shot is worth it...it is totally*
18
19
20 394 *patient dependent” (023)*

21
22 395

23
24 396 The other half reported they would not consider surgery unless there was a greater than
25
26
27 397 80 per cent chance of responding:

28
29 398

30
31 399 *“You have got to be 95 per cent and above. I wouldn’t accept anything less than that. I*
32
33
34 400 *wouldn’t offer the operation. It is too big an operation, too big a deal, too big a cost”*
35
36 401 *(024)*

37
38 402

39
40
41 403 5. Ethical and legal concerns about decision aids

42
43 404

44
45 405 (Relevant TDF domain: Beliefs about consequences)

46
47 406

48
49
50 407 A few participants had serious medico-legal concerns about documenting a specific risk
51
52
53 408 value in patient records, and believed that such information would have to be deliberately
54
55 409 withheld from patients in case it fell into the ‘wrong’ hands:

1
2
3 410
4
5
6 411

7 “You have to think of the medico-legal implications of a patient having a risk value
8 documented in their notes. If they don’t have a good result and then lawyers look through
9 and say you had this validated tool and you still went ahead, where would we lie medico-
10 legally?” (024)
11
12
13
14
15
16 415

17 416 While a few participants believed it would be unethical *not* to use a decision aid if it had
18 been shown to improve patient outcomes, others were concerned about the ethical
19 implications of a tool if imposed cut-offs were used to deny patients surgery:
20
21
22 418

23
24
25 419

26
27 420 “I guess the ethicists would say you are denying patient-centred care, so that is where
28 there is a potential for a can of worms” (021)
29
30
31
32 422

33
34 423 “I don’t think it can become compulsory because it takes away patient-centred care”
35 (025)
36
37 424
38
39 425

40
41 426 6. Available resources and organisational culture as barriers to uptake
42
43 427

44
45
46 428 (Relevant TDF domains: Environmental context and resources; Beliefs about
47 consequences and Social/Professional role and identity)
48
49 429
50
51 430

52
53 431 Almost all participants expressed concerns about making an aid compulsory and
54 imposing mandatory cut-off levels. While many recognised that implementing an aid in
55
56 432
57
58
59
60

1
2
3 433 this way would have the potential to improve the use of valuable resources and save
4
5 434 costs:

6
7
8 435

9
10 436 *“If you could use the tool to triage patients and push them some where else, it would be*
11
12 437 *more effective for the patient and there would be cost savings for the hospital and the*
13
14 438 *community” (016)*

15
16
17
18 439

19
20 440 Several participants commented that mandatory cut-offs would only be possible if an
21
22 441 effective, non-operative alternative was made available for patients that were denied
23
24 442 surgery. A lack of effective surgical alternatives was seen as a key barrier:

25
26
27 443

28
29 444 *“You have to be able to say ‘although we don’t think you would benefit from surgery,*
30
31 445 *we’re going to put you in this intense physiotherapy program with dieticians to improve*
32
33 446 *your knee pain’. They need to be offered something. The problem is these things are*
34
35 447 *available at an individual component level ... but I don’t think there is anything formally*
36
37 448 *put in place that patients can be referred from arthroplasty clinics into these programs”*
38
39 449 *(029)*

40
41
42
43 450

44
45
46 451 Most participants perceived that the logistics of agreeing on a cut-off value for acceptable
47
48 452 risk, and the threat to surgeons’ professional identity as a patient-centred practitioner,
49
50 453 were insurmountable barriers to imposing mandatory cut-offs:

51
52
53 454
54
55
56
57
58
59
60

1
2
3 455 *“A lot of surgeons would say in their hands they will get better results, that is just an*
4
5
6 456 *inherent bias associated with surgical procedures and surgeons themselves so it would be*
7
8 457 *hard to agree on a level” (019)*
9

10 458

11
12 459 *“Surgeons wouldn’t care if it was compulsory to use an aid, as long as they didn’t have*
13
14
15 460 *to do any work. Making it compulsory to follow it would be dangerous. Because we’re all*
16
17 461 *individuals, what you are doing is taking the human experience aspect of the consultation*
18
19 462 *out and then you turn us into proceduralists that just look at a tick box and operate on*
20
21 463 *someone” (016)*
22
23

24 464

25
26
27 465 7. Format and content of a decision aid
28

29 466

30
31 467 (Relevant TDF domain: Environmental context and resources)
32
33

34 468

35
36 469 Finally, participants did not believe it would be difficult to physically integrate an aid
37
38 470 into clinical practice. An electronic or online format was seen as the most likely way an
39
40 471 aid could be implemented, particularly given the strict time constraints placed on
41
42 472 outpatient clinics:
43
44

45 473

46
47
48 474 *“I can imagine something working on the phone, an app. Simple and intuitive - so you*
49
50 475 *put in a little info - BMI, age, degree of arthritis etc... tick tick tick. And then it gives you*
51
52 476 *the number, bang” (013)*
53
54

55 477
56
57
58
59
60

1
2
3 478 Most believed that an aid would be best used within the patient-surgeon consultation:
4
5

6 479
7

8 480 *“I think it’s something that should be done by the surgeon. It is also part of the process*

9
10 481 *where the surgeon gets to know the patient as well - not just their xrays and physical*

11
12 482 *examination but also their psychosocial situation” (019)*
13
14

15 483
16

17 484 While others suggested that an aid could be designed for patients to use on their own or

18
19 485 with a support network to save time in the clinical consultation:
20
21

22 486
23

24 487 *“A lot of patients look on my website. You could have a thing on your website saying:*

25
26 488 *‘sometimes patients with certain problems may not be appropriate for a TKA, this test*

27
28 489 *can give you a rough idea of your likely success rate’. You could put it out there before*

29
30 490 *they even come to see you. ‘Is this operation for you?’ type of thing” (028)*
31
32

33 491
34
35

36 492 **Irrelevant domains:**
37

38 493
39

40
41 494 Three domains were not considered to have a salient influence on the target behaviour.
42

43 495 These were: Optimism, Emotion and Social Influences. Optimism was closely connected
44

45 496 to the domain Reinforcement i.e. surgeons reported being neither optimistic nor
46

47 497 pessimistic about the utility of an aid until they had seen evidence of its effectiveness.
48

49 498 The Emotion domain did not appear relevant as described by one surgeon: “I am not
50

51 499 worried about the implications of a tool. Knee replacement is wellness surgery, in the
52

53 500 worst case scenario they don't get a new knee”. The Social Influence of patients did not
54
55
56
57
58
59
60

1
2
3 501 appear relevant as surgeons believed patients were accustomed to filling out
4
5 502 questionnaires. While surgeons were more likely to trust an aid if it had been developed
6
7
8 503 by their peers, they preferred to test the tool ‘in their own hands’ and therefore the Social
9
10 504 Influences of other surgeons using an aid appeared limited.

11
12
13 505

14
15 506 **Discussion**

16
17 507

18
19
20 508 These findings have implications for the future design and implementation of decision
21
22 509 aids into surgical clinical practice. It is possible that current decision-making biases may
23
24 510 be key barriers to uptake. Surgical decision-making involves the consideration of the
25
26 511 risks versus benefits of surgery.²⁹ In this study, participants expressed confidence in their
27
28 512 ability to successfully remove diseased tissue and correct joint deformity, and the
29
30 513 likelihood of some corresponding improvement in pain severity was perceived to be high.
31
32 514 At the same time, participants perceived that the risk their patients would not respond to
33
34 515 TKA was low. One potential explanation for this is an apparent lack of clarity around the
35
36 516 definition of ‘clinically meaningful improvement’ and ‘non-response’. The literature
37
38 517 suggests that patients’ perceptions of ‘clinically meaningful improvement’ depend on
39
40 518 their satisfaction with improvements in pain and function, closely linked to their
41
42 519 expectations of surgery.³⁰ In contrast, the surgeons in this study believed that a resolution
43
44 520 in joint pathology and some corresponding improvement pain could be considered
45
46 521 ‘meaningful improvement’. This lack of clarity is important, as surgeons who believe that
47
48 522 their patient outcomes are already optimised may be less motivated to use a decision aid.
49
50
51
52
53
54
55
56
57
58
59
60

523

1
2
3 524 Another explanation may be that surgeons in this sample exhibited an over-confidence
4
5
6 525 bias. Indeed, most participants believed their own patient outcomes were better than that
7
8 526 reported in the literature. While it is possible that this belief is accurate and outcomes
9
10 527 amongst this sample of surgeons are indeed above average, similar observations were
11
12 528 made in a survey study involving 700 Orthopaedic Surgeons in Europe and North
13
14 529 America.³¹ In that study, 83 per cent of surgeons surveyed considered themselves to be
15
16
17 530 above average diagnosticians; 74 per cent believed they were above average surgeons and
18
19 531 25 per cent believed they were in the top five per cent of surgeons.³¹ This over-
20
21 532 confidence bias may lead to a confirmation bias in which surgeons only notice things that
22
23 533 agree with their point of view and are less attentive to alternative viewpoints due to
24
25
26 534 cognitive dissonance.³² A confirmation bias can have consequences for the uptake of a
27
28 535 decision aid as surgeons may be less likely to consider evidence that contradicts their
29
30
31 536 clinical experience.

32
33
34 537

35
36 538 Surgical decision-making also involves weighing up of the risks versus benefits of non-
37
38 539 operative interventions.²⁹ The participants highlighted a lack of effective non-operative
39
40 540 interventions for end-stage knee OA. A study among Dutch Orthopaedic Surgeons
41
42 541 similarly documented a lack of confidence in the efficacy of non-surgical treatments
43
44 542 associated with a decreased referral rate.³³ Indeed, there is currently a dearth of evidence-
45
46 543 based, non-operative interventions for patients with end-stage knee OA either as an
47
48 544 alternative to surgery or as a definitive management when the patient is deemed
49
50 545 unsuitable for TKA. In the absence of a treatment alternative, surgery with all its risks
51
52
53 546 and costs is often the default intervention. This is an important barrier to uptake as
54
55
56
57
58
59
60

1
2
3 547 evidence suggests surgeons will not use an aid if they do not have the resources to carry
4
5 548 out the decisions,²⁷ or if the aid does not support their own view about effective
6
7
8 549 treatments.³⁴
9

10 550

11
12 551 The participants in this study believed a decision aid could promote shared decision-
13
14 552 making and enhance informed consent for TKA. Similar attitudes towards decision aids
15
16
17 553 were identified in a previous review⁸ and a survey of the wider population of Orthopaedic
18
19 554 Surgeons.¹⁷ It may be that surgeons can be motivated to uptake a decision aid because it
20
21 555 is the ethical thing to do.³⁵ However, our study identified concerns about the ethical
22
23 556 implications of imposing mandatory cut-offs that would determine eligibility for TKA.
24
25
26 557 These concerns may reflect the participants' desire to defend professional discretion and
27
28 558 autonomy. We take the opportunity to emphasise the function of a decision aid is to
29
30 559 support, not replace, clinical decision making. However, concerns were also expressed
31
32 560 about the legal implications of using a decision aid. This finding contrasts with a study
33
34 561 involving US Orthopaedic Surgeons who believed decision aids may reduce litigation
35
36 562 and malpractice insurance premiums by enhancing shared decision-making.³⁶ It may be
37
38 563 that these concerns are unique to the medico-legal context of Australia. Certainly,
39
40 564 surgeons will be less likely to be uptake a tool if they perceive it makes them vulnerable
41
42
43 565 to medico-legal action.
44
45
46
47

48 566

49
50 567 **Implications:**

51
52 568
53
54
55
56
57
58
59
60

1
2
3 569 The Ready, Willing and Able model posits that these three preconditions must be
4
5 570 satisfied before a decision aid will be adopted.³⁷ ‘Ready’ refers to the perceived benefit of
6
7 571 changing the status quo and adopting an aid to support decision-making. ‘Willing’ refers
8
9 572 to the perceived legitimacy of a decision aid and a willingness to overcome objections
10
11 573 and concerns. ‘Able’ refers to the ability to adopt the decision aid given available
12
13 574 resources.³⁸ Implications for enhancing the readiness, willingness and ability of
14
15 575 Australian Orthopaedic Surgeons to uptake a TKA decision aid are described below.
16
17
18
19

20 576
21
22 577 To enhance Readiness to uptake, current decision-making biases may need to be
23
24 578 addressed. Information to counter these biases could be provided through audit and
25
26 579 feedback. Audit and feedback is defined as a ‘summary of the clinical performance of
27
28 580 healthcare provider(s) over a specified period of time’ (p. 5).³⁹ It may be particularly
29
30 581 effective when clinicians’ ability to accurately self-assess is limited.⁴⁰ This assumes that
31
32 582 clinicians are motivated to improve care but lack intention to change current behaviour
33
34 583 because they are unaware of their suboptimal performance. While effect sizes may
35
36 584 depend on the format and context in which feedback is provided, findings from a
37
38 585 Cochrane review suggest that audit and feedback can yield important improvements in
39
40 586 professional practice.³⁹ Clarity and consensus on the definition of ‘clinically meaningful
41
42 587 improvement’ and ‘non-response’ to TKA is likely to influence the success of an audit
43
44 588 and feedback intervention in this context. Future research is needed to explore how audit
45
46 589 and feedback is best delivered in this context including the immediacy and frequency of
47
48 590 feedback, and the potential to incorporate other approaches such as the use of surgeon
49
50 591 incentives.⁴¹
51
52
53
54
55
56
57
58
59
60

1
2
3 592
4
5
6 593

7 To enhance Willingness to uptake, an audit and feedback intervention before and after
8 594 using a decision aid may be necessary for Orthopaedic Surgeons to gain confidence in its
9 legitimacy. The findings suggest that validating a decision aid in large multi-centre trials
10 595 may not be sufficient to encourage uptake, as surgeons believed such trials do not
11 596 account for variations in case load and years of experience. Surgeons perceived
12 597 themselves as not only scientists, but also ‘artists’; believing that surgical success
13 598 depended, in part, on the ‘hands’ that performed it. This suggests that Orthopaedic
14 599 Surgeons may need to be given the opportunity to validate a decision aid ‘in their own
15 600 hands’.
16 601
17
18
19
20
21
22
23
24
25
26
27
28

29 602

30 603 Addressing concerns about the medico-legal implications of a decision aid may also be
31 604 necessary to enhance Willingness to uptake. This may require the consultation of
32 605 multiple stakeholders including policy makers, lawyers and institutional administration
33 606 before the implementation of a decision aid. Legislative changes in the United States
34 607 have recognised decision aids as a higher standard of informed consent⁷ and in the United
35 608 Kingdom, incentives to use decision aids are being developed.⁸ There is evidence that
36 609 mandating the use of a decision aid as a requirement for gaining informed consent results
37 610 in significantly improved patient-outcomes including a reduction in the rate of TKA by
38 611 38 per cent in a six-month period.⁴² Future studies are required to explore if policy
39 612 changes and/or incentives might influence Willingness to uptake a decisions aid in the
40 613 Australian context.
41
42
43
44
45
46
47
48
49
50
51
52
53
54

55 614
56
57
58
59
60

1
2
3 615 To enhance Ability to uptake, it appears important to address the dearth of non-operative
4
5 616 alternatives to surgery for end-stage knee OA so that surgeons have the resources to carry
6
7
8 617 out decisions. Future research to design and implement effective, evidence-based, non-
9
10 618 operative interventions should be a priority. Targeting Orthopaedic Surgeons' beliefs
11
12 619 about the efficacy of such interventions through education strategies will also be
13
14 620 important. The study findings suggest that Ability to uptake may be enhanced if a
15
16 621 decision aid is packaged in an electronic or online format that is quick and easily
17
18 622 accessible. Focus groups involving surgeons and patients to gain feedback on prototypes
19
20 623 of a decision aid during the design phase is important to ensure that not only the format,
21
22 624 but also content, are accessible to a range of end users.
23
24
25
26
27
28

625

626 **Conclusions**

627

628 Using a theoretical framework to systematically explore barriers and facilitators to
629 uptake, this study will inform the design and implementation of future TKA decision
630 aids.¹² The findings suggest that a multifaceted approach will be required to ensure that
631 Orthopaedic Surgeons are ready, willing and able to use a decision aid that can reduce the
632 suffering and economic burden of 'failed' TKA. Research exploring patients' beliefs and
633 attitudes towards a TKR decision aid is required prior to implementation.

634

635 **Abbreviations**

636 TKA = Total Knee Arthroplasty

637 OA = Osteoarthritis

638

639

640

641

642

643

1
2
3 638 TDF = Theoretical Domains Framework
4
5
6 639
7

8 640 **Declarations**
9

10 641 **Ethics approval:** This study was carried out in compliance with the Helsinki
11
12 642 Declaration. Approval was given by St Vincent's Hospital Melbourne, Australia (QA 019
13
14 /_16).
15
16

17 644 **Availability of data and materials:** Requests regarding the datasets used in this study
18
19 645 can be directed to the first author. Full interview transcripts will not be shared to protect
20
21 646 the anonymity of the study participants.
22
23

24 647 **Competing interests:** The authors declare that they have no competing interests
25
26

27 648 **Funding:** This project was supported by a University of Melbourne FBE/MDHS
28
29 649 Collaborative Research Seed-Funding Grant (2015).
30
31

32 650 **Authors contributions:** SB: led the study design, data collection, data analysis and
33
34 651 manuscript preparation. EN contributed to the data analysis. AS, PC and MD contributed
35
36 652 to the study design, data analysis and manuscript preparation. SF contributed to the study
37
38 653 design and manuscript preparation.
39
40

41 654 **Acknowledgements:** We acknowledge Pascal Buenzli for assistance with the data
42
43 655 management software and inter-rater reliability calculation. We extend our thanks to all
44
45 656 the surgeons for kindly donating their time to participate in this study.
46
47

48 657

49 658

50 659 **References:**
51
52 660

53 661 1. Cobos R, Lattore A. Variability of indication criteria in knee and hip replacement:
54 662 An observational study. *BMC Musculoskeletal Disorders* 2010;11(249)
55
56
57
58
59
60

- 1
2
3 663 2. Dowsey M, Smith A, Choong P. Latent Class Growth Analysis predicts long term
4 664 pain and function trajectories in total knee arthroplasty: a study of 689
5 665 patients. *Osteoarthritis and Cartilage* 2015;23(12):2141-49.
- 6 666 3. Riddle DL, Jiranek WA, Hayes CW. Use of a validated algorithm to judge the
7 667 appropriateness of total knee arthroplasty in the United States: a multicenter
8 668 longitudinal cohort study. *Arthritis & rheumatology* 2014;66(8):2134-43. doi:
9 669 10.1002/art.38685
- 10 670 4. Curtis AJ, Wolfe R, Russell COH, et al. Determining priority for joint replacement:
11 671 comparing the views of orthopaedic surgeons and other professionals. *The*
12 672 *Medical Journal of Australia* 2011;195(11):699-702. doi:
13 673 10.5694/mja10.11052
- 14 674 5. Frankel L, Sanmartin C, Hawker G, et al. Perspectives of orthopaedic surgeons on
15 675 patients' appropriateness for total joint arthroplasty: a qualitative study.
16 676 *Journal of evaluation in clinical practice* 2016;22(2):164-70. doi:
17 677 10.1111/jep.12449
- 18 678 6. Gooberman-Hill R, Sansom A, Sanders C, et al. Unstated factors in orthopaedic
19 679 decision-making: A qualitative study. *BMC Musculoskeletal Disorders*
20 680 2010;11(213)
- 21 681 7. Kuehn B. States explore shared decision making. *JAMA* 2009;301(24):2539-41.
- 22 682 8. Jayadev C, Khan T, Coulter A, et al. Patient decision aids in knee replacement
23 683 surgery. *Knee* 2012;19(6):746.
- 24 684 9. Van den Bart B, Zwikker H, van den Ende C. Medication adherence in patients with
25 685 rheumatoid arthritis: a critical appraisal of the existing literature. *Expert*
26 686 *Reviews in Clinical Immunology* 2012;8:337-51.
- 27 687 10. Feldman-Stewart D, Brennenstuhl S, McIssac K, et al. A systematic review of
28 688 information in decision aids. *Health Expectations* 2007;10(1):46-61.
- 29 689 11. Sacks GD, Dawes AJ, Ettner SL, et al. Impact of a Risk Calculator on Risk
30 690 Perception and Surgical Decision Making: A Randomized Trial. *Annals of*
31 691 *surgery* 2016 doi: 10.1097/SLA.0000000000001750
- 32 692 12. Dowsey M, Spelman T, Choong P. Development of a prognostic nomogram for
33 693 predicting the probability of nonresponse to total knee arthroplasty 1 year
34 694 after surgery. *Journal of Arthroplasty* 2016;In press
- 35 695 13. Barsoum W, Murray T, Klika A, et al. Predicting patient discharge disposition
36 696 after total joint arthroplasty in the United States. *Journal of Arthroplasty*
37 697 2010;25(6):885-92.
- 38 698 14. Kattan M. Nomograms are difficult to beat. *European Urology* 2008;53(4):671.
- 39 699 15. Stacey D, Bennett C, Barry M, et al. Decision aids for people facing health
40 700 treatment or screening decisions. *Cochrane Database of Systematic Reviews*
41 701 2011(10):CD001431.
- 42 702 16. Knops AM, Legemate DA, Goossens A, et al. Decision aids for patients facing a
43 703 surgical treatment decision: a systematic review and meta-analysis. *Annals of*
44 704 *surgery* 2013;257(5):860-6. doi: 10.1097/SLA.0b013e3182864fd6
- 45 705 17. Adam J, Khaw F, Thomson R, et al. Patient decision aids in joint replacement
46 706 surgery: A literature review and an opinion survey of consultant orthopaedic
47 707 surgeons. *Annals of the Royal College of Surgeons of England* 2008;90(3):198-
48 708 207.

- 1
2
3 709 18. Phillips C, Marshall A, Chaves N, et al. Experiences of using the Theoretical
4 710 Domains Framework across diverse clinical environments: A qualitative
5 711 study. *Journal of Multidisciplinary Healthcare* 2015;8:139-46. doi:
6 712 10.2147/JMDH.S78458
7
8 713 19. Eccles M, Grimshaw J, Walker A, et al. Changing the behaviour of healthcare
9 714 professionals: the use of theory in promoting the uptake of research findings.
10 715 *Journal of Clinical Epidemiology* 2005;58:107-12.
11
12 716 20. Noar S, Zimmerman R. Health behaviour theory and cumulative knowledge
13 717 regarding health behaviours: Are we moving in the right direction? *Health*
14 718 *Education Research* 2005;20(3):275-90.
15
16 719 21. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework
17 720 for use in behaviour change and implementation research *Implementation*
18 721 *Science* 2012;7(37)
19
20 722 22. Sansom A, Donovan J, Sanders C, et al. Routes to total joint replacement surgery:
21 723 patients' and clinicians' perceptions of need. *Arthritis Care and Research*
22 724 2010;62(9):1252-57.
23
24 725 23. Michie S, Johnston M, Abraham C, et al. Making psychological theory useful for
25 726 implementing evidence based practice: A consensus approach. *Qualitative*
26 727 *and Safety in Health Care* 2005;14:26-33. doi: 10.1136/qshc.2004.011155
27
28 728 24. Dobson F, Bennell K, French S, et al. Barriers and facilitators to exercise
29 729 participation in people with hip and/or knee osteoarthritis. *American Journal*
30 730 *of Physical Medicine and Rehabilitation* 2016;95(5):372-89.
31
32 731 25. French S, Green S, O'Connor D, et al. Developing theory-informed behaviour
33 732 change interventions to implement evidence into practice: A systematic
34 733 approach using the Theoretical Domains Framework. *Implementation Science*
35 734 2012;7(38)
36
37 735 26. Patey A, Islam R, Francis J, et al. Anaesthesiologists' and surgeons' perceptions
38 736 about routine pre-operative testing in low risk patients: application of the
39 737 Theoretical Domains Framework to identify factors that influence physicians'
40 738 decisions to order pre-operative tests. *Implementation Science* 2012;7(52)
41
42 739 27. Sepucha KR, Mulley AG. Extending decision support: preparation and
43 740 implementation. *Patient Education and Counseling* 2003;50(3):269-71. doi:
44 741 10.1016/s0738-3991(03)00048-x
45
46 742 28. Buenzli P. Codesort software, 2012.
47 743 29. Sacks GD, Dawes AJ, Ettner SL, et al. Surgeon Perception of Risk and Benefit in
48 744 the Decision to Operate. *Annals of surgery* 2016 doi:
49 745 10.1097/SLA.0000000000001784
50
51 746 30. Hawker G, Bohm ER, Conner-Spady B, et al. Perspectives of Canadian
52 747 Stakeholders on Criteria for Appropriateness for Total Joint Arthroplasty in
53 748 Patients With Hip and Knee Osteoarthritis. *Arthritis & rheumatology*
54 749 2015;67(7):1806-15. doi: 10.1002/art.39124
55
56 750 31. Teunis T, Janssen S, Guitton TG, et al. Do Orthopaedic Surgeons Acknowledge
57 751 Uncertainty? *Clinical orthopaedics and related research* 2016;474(6):1360-9.
58 752 doi: 10.1007/s11999-015-4623-0
59
60 753 32. Kahneman D. Thinking, fast and slow. New York, USA: Macmillan 2011.

- 1
2
3 754 33. Hofestede S, Marang-van de Mheen P, Vliet Vlieland T, et al. Barriers and
4 755 facilitators associated with non-surgical treatment use for osteoarthritis
5 756 patients in orthopaedic practice. *PLoS One* 2016 doi:
6 757 DOI:10.1371/journal.pone.0147406
7
8 758 34. Elwyn G, Rix A, Holt T, et al. Why do clinicians not refer patients to online
9 759 decision support tools? Interviews with front line clinics in the NHS. *BMJ*
10 760 *open* 2012;2(6) doi: 10.1136/bmjopen-2012-001530
11
12 761 35. Tai-Seale M, Elwyn G, Wilson CJ, et al. Enhancing Shared Decision Making
13 762 Through Carefully Designed Interventions That Target Patient And Provider
14 763 Behavior. *Health affairs* 2016;35(4):605-12. doi: 10.1377/hlthaff.2015.1398
15 764 36. Weinstein JN, Clay C, Morgan T. Informed patient choice: patient centred valuing
16 765 of surgical risks and benefits. *Health affairs* 2007;26(3):726-30.
17 766 37. Lesthaeghe R, Vanderhoeft C. Ready, willing and able: A conceptualization of
18 767 transitions to new behavioral forms. In: Casterline J, ed. Diffusion processes
19 768 and fertility transition: selected perspectives. Washington DC: National
20 769 Academies Press 2001:240-64.
21 770 38. Shultz C, Jimbo M. Decision aid use in primary care: An overview and theory-
22 771 based framework. *Family Medicine* 2015;47(9):679-92.
23 772 39. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional
24 773 practice and healthcare outcomes (Review). *Cochrane Database of Systematic*
25 774 *Reviews* 2012(6):CD000259.
26 775 40. Davis D, Mazmanian P, Fordis M, et al. Accuracy of physician self-assessment
27 776 compared with observed measures of competence: a systematic review.
28 777 *JAMA* 2006;296(9):1094-102.
29 778 41. Emanuel E, Ubel P, Kessler H, et al. Using behavioural economics to design
30 779 physician incentives that deliver high-value care. *Annals of Internal Medicine*
31 780 2016;164:114-19.
32 781 42. Arterburn D, Wellman R, Westbrook E, et al. Introducing decision aids at Group
33 782 Health was linked to sharply lower hip and knee surgery rates and costs.
34 783 *Health affairs* 2012;31(9):2094-104. doi: 10.1377/hlthaff.2011.0686
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

Table 1. Interview Schedule

TDF domain	Questions
Knowledge	<p><i>Evidence from the literature suggests that up to 22% of patients presenting for total knee arthroplasty will not have a clinically meaningful improvement from surgery.</i></p> <ul style="list-style-type: none"> - What do you think about this figure? -How do you interpret the term ‘no clinically meaningful improvement’? <p><i>For the purposes of this interview, we are interpreting clinically meaningful improvement as no improvement in pain, function or QOL following surgery.</i></p> <ul style="list-style-type: none"> - Are you aware of what percentage of patients that you operate on do not benefit from surgery? How do you know this? Do you track it? Would you like to know? How could feed this information back to you? In what format?
Beliefs about capabilities	<ul style="list-style-type: none"> - How confident are you in identifying patients who are unlikely to experience an improvement in symptoms from TKR? - How good do you think you are at it compared to others? - Do you feel you are unsure about identifying these patients at times? If so, what would you do?
Behavioural regulation	<ul style="list-style-type: none"> - Of all the patients referred to you, what is the % of patients that proceed to surgery and how many do you turn away? - What do you do with the ones that don’t? Do you refer them somewhere?
Skills	<ul style="list-style-type: none"> - What skills help you decide if someone is likely to benefit from surgery or not? - Are you aware of any tools currently available to help you assess a patients’ risk of not responding? Do you use them? Why/ why not?
Beliefs about consequences	<p><i>Based on a set of evidence-based parameters, decision aids can predict the degree of risk that a patient will not achieve a clinically meaningful improvement from TKA</i></p> <ul style="list-style-type: none"> -What do you think the benefits of using a decision aid might be? -What might be the disadvantages of using an aid? - Do you see anything legal or ethical about using a decision aid? -Would the benefits outweigh the potential harms? Why?
Intentions, Goal	<ul style="list-style-type: none"> -Would using a decision aid influence your surgical decision making? Why/why not?

Reinforcement	-What would motivate you to use a decision aid? -Would you need to be presented with evidence from the literature? How would this evidence be best delivered? Who would it need to be delivered by?
Environmental context and resources	-What would facilitate the use of a decision aid for you? -How would it best be packaged? -When do you think it would be best used? Do you think you are the best person to use it?
Decision process	-If a decision aid predicted that patient had a 50% risk of not benefiting from surgery would you still operate? What about a 70% risk? What would your level of acceptable risk be?
Social/Professional role and identity	-Do you think there would be agreement between surgeons on this cut point?
Social/Emotional influences	-What if something like this tool became compulsory – how would you feel? How do you think other surgeons would feel? -How do you think patients would respond? Would their response influence your use of an aid? -Would you worry about missing potential candidates who might have responded to surgery?
Optimism	-How optimistic are you that a decision aid will reduce the rate of surgery in patients who are at high risk of not benefiting from surgery?

Table 2. Findings summary

Relevant TDF Domains	Specific Belief	Facilitator or barrier	Example quote (participant code)	Frequency out of 20
Knowledge	I am aware of the literature that up to 20% of patients do not have a CMI from TKR	Facilitator	“I think 22% is the high end. But there is a lot of different papers that all suggest 10,15,20%” (012)	19
	I think that this % is lower in my patients	Barrier	“I don’t count it, but I think around 10% would be saying they aren’t entirely satisfied by surgery” (016)	17
	Any improvement in pain is still an improvement, it depends how you define ‘meaningful’	Barrier	“If the surgery is done for the right reason, the pain would decrease, the question is whether the decrease would be 10%, 50% or 100% depending on whether there are other reasons for the pain. But there would be an improvement” (025) “To me a good result is: they are going to have some intermittent ache in the knee, they’re not going to be able to kneel or squat. Others on some assessment scale might consider that a failure. So you have get those parameters right” (010)	7
Behavioural regulation	I am aware that the feedback I get from my patients may be biased	Facilitator	“To please you, patients often say it is doing better than it really is. So I would think my outcomes are better than 20%, but I am aware of the glasses that I see it through as well as what patients might tell me” (014)	6
	I would be interested in feedback on the	Facilitator	“There’s always a difference between how well you think you are doing and how you <i>are</i> doing. Having formal feedback on patient outcomes gives you the	20

	percentage of my patients who achieve a clinically meaningful improvement		<p>opportunity to change things if you are not doing as well as you want to” (023)</p> <p>“What I would like to know is the patient who overall is unhappy with their results and didn’t get the result they expected” (010)</p> <p>“I would like feedback on the number of patients who are in each category of satisfaction and I would like to see how my personal results are compared to the group” (016)</p>	
Memory, attention and decision processes	Patient expectations are an important consideration in surgical decision making	Facilitator	“If the patients’ expectations are not meeting mine, I won’t do the operation because then the patient isn’t happy and sometimes they have 2/10 pain and they are not happy. And that is silly. So it is about telling the patient what they can expect and after the operation it is about ”you remember what we said” (013)	20
	The lack of effective non-operative alternatives influences my surgical decision making	Barrier	<p>“You have to be able to say ‘although we don’t think you would benefit from surgery, we’re going to put you in this intense physiotherapy program with dieticians to improve your knee pain. They need to be offered something. The problem is these things are available at an individual component level ... but I don’t think there is anything formally put in place that patients can be referred from arthroplasty clinics into these programs” (029)</p> <p>“Well if you make an alternative plan and say we are not going to do surgery we are going to lose weight, do some physiotherapy, take pain killers, you send them off and they come back and say they have done all of that. It means you don’t have another option to offer</p>	12

			<p>them and those patients often just want an option and if there is an option you can give them it is easier to push them away from surgery” (016)</p> <p>“I think there are limitations on what you can improve with non-operative measures” (016)</p>	
	My threshold of acceptable risk for surgery is >80% likelihood of good outcome	Facilitator	“You have got to be 95% and above. I wouldn’t accept anything less than that. I wouldn’t offer the operation. It is too big an operation, to bigger deal, too bigger cost” (024)	8
	My level of acceptable risk is patient dependent	Facilitator (of shared decision making)	<p>“It is all about risk for reward. When you think about... the person is not unwell, they can safely have an anaesthetic, even risks as high as 50% one in two that the patient will have no benefit, are worth considering...A patient may be so severely impacted that a 1 in 2 shot is worth it...it is totally patient dependent” (023)</p> <p>“I would rather a 10% chance of getting better than sitting in a wheelchair in a lot of pain” (022)</p>	11
Beliefs about capabilities	I find it difficult to assess the patient-related factors that can influence TKR outcome	Facilitator	<p>“It is patient factors more than anything else. Because it is easy to look at xrays and say K-L, 1, 2, 3, 4 for disease severity. There’s not much argument over that. It’s about the patient factors, the psychology and behavioural aspects of it which you want reassurance for” (016)</p> <p>“Obviously I am not very good because 1 in 5 come back with a problem... so no I didn’t know how to identify them pre- operatively. Something is</p>	8

			happening from my assessment to the patients' outcome and I don't know what the link is" (024)	
	I am reasonably good at picking the patients who will do well	Barrier	"I think I am reasonably good... I do have a little bit of a gut feeling about patients" (013)	12
	It can be difficult to say no to patients	Facilitator	"Most of the time if we bring a patient to the case conference it is to get the support of everyone else to say no don't do it. Because if want to do the operation, you just go ahead and do it. If you don't want to do it and you want support that is when you take them along" (016) "It is always easier to consent than decline" (025)	5
Skills	I mostly rely on my experience when it comes to surgical decision making	Barrier	"You spend all your life looking at patients and assessing them and you start to develop a bit of a gut feeling as to what might be happening. Sometimes you sit in front a patient and think: I know you are telling me this, but I know something else is happening" (015) "I don't use any formal tools. I use I guess old fashioned clinical acumen is what I would call it...I have been doing this for a while and you develop a way of assessing people" (028)	10
Social/professional role and identity	Surgery is an art and a science – it is not just about the evidence"	Barrier	"The human body is not a scientific machine. Medicine is an art and science and the art isn't always represented in the research" (028) "I think that medicine is not about numbers, it is about patients. Each patient has their own different pathology and own different personality" (017)	10

Beliefs/attitudes towards a decision aid				
Intention	I would use a decision aid to support, not replace my decision-making	Facilitator	<p>“I don’t think it would really influence my surgical decision making, I think it would more affirm my decision to not offer a patient an operation” (029)</p> <p>“If I think they are ok and they score badly I will relook at it and say why is that? Am I missing something obvious? But at the end of the day if an aid says one thing and my sniff test says there is something not right, I’m still following my nose” (010)</p>	16
Beliefs about consequences	I think a decision aid would be a useful objective tool to help me say no to patients	Facilitator	<p>“It would be clinically helpful in the patient cohort who we don’t think will do well from surgery, giving us an evidenced based approach for saying this is the reasons why we don’t think you will benefit from surgery” (029)</p> <p>“I think that the main benefit of an aid would be making the patient understand if I am saying no to the surgery it’s not because I don’t like him or her, it is because there is data written black on white that they are not going to do well. ..It will not just be my gut feeling. I can give them data and say ”sorry it is written here. It’s not me it’s the computer. So it backs up what I am saying” (013)</p>	9
	I think an aid would be useful for gaining patient informed consent and shared decision	Facilitator	“I think that is one of the important things about a decision aid and part of the consent process is that they know what to expect and it is still the patients decision to decide if they want to have surgery or not, but they have to be appropriately informed and have the	10

	making		appropriate expectations to weigh up the risk and benefit" (019) "It comes back down to getting patient consent, as part of that I would incorporate it into my consent form and say preoperatively you have a 50:50 chance and that has been discussed with a validated tool" (021)	
	I think a decision aid has the potential to improve the use of resources and save costs	Facilitator	"If you could use a decision aid to triage patients and push them somewhere else, it would be more effective for the patient and there would be cost savings for the hospital and the community" (016)	7
	A disadvantage of a decision aid is that it may not capture the nuances of the individual patient and some patients may miss out on surgery	Barrier	"There are always reasons why people will fall on one side of the line or the other and the data will show that the tool might predict you will do really well but you happen to fall in that small group who are set to do really well but don't, similarly the tool might say you will do really badly we better not operate on you but someone took the punt and you turned out really well so there are always those smaller groups and at times it is possible for the tool to miss certain nuances" (015)	13
	I have concerns about the legal/ethical implications of a decision aid	Barrier	"You have to think of the medico-legal implications of a patient having a risk value documented in their notes. If they don't have a good result and then lawyers look through and say you had this validated tool and you still went ahead, where would we lie medico-legally?" (024) "I guess the ethicists would say you are denying patient-centred care, so that is where there is a potential for a can of worms" (021)	8
Environmental	I would not like to	-*	"I don't think there are things that can become	17

context and resources (how the tool might be implemented)	see a decision aid with mandatory cut-offs implemented		<p>compulsory in terms of a decision aid as I mentioned because it takes away patient-centred care” (025)</p> <p>“No you can’t make anything compulsory like that. Not in medicine. Medicine is not black and white, it is grey, you can never make anything compulsory because a surgeon will operate according to their experience” (024)</p> <p>“Surgeons wouldn’t care if it was compulsory to use an aid, as long as they didn’t have to do any work. Making it compulsory to follow it would be dangerous. Because we’re all individuals, what you are doing is taking the human experience aspect of the consultation out and then you turn us into proceduralists that just look at a tick box and operate on someone” (016)</p>	
	I don’t think surgeons could ever agree on a cut-off level on a decision aid	-*	<p>“A lot of surgeons would say in their hands they will get better results, that is just an inherent bias associated with surgical procedures and surgeons themselves so it would be hard to agree on a level” (019)</p> <p>“Unless you can clearly demonstrate a certain cut-off does better, so until there is almost black and white there will be some shades of grey and surgeons will differ in those shades of grey. And even if there is evidence you will still get surgeons that will reject it. That is just my feeling” (021)</p>	17
	I could see an electronic or online tool working well in	Facilitator	“I can imagine something working on the phone, just an app. Simple and intuitive so you put in a little info - BMI, age, degree of arthritis etc.. tick tick tick. And	6

	my practice		then it gives you the number, bang.” (013) “A lot of patients look on my website. You could have a thing on your website saying: ‘sometimes patients with certain problems may not be appropriate for a TKA, this test can give you a rough idea of your likely success rate’. You could put it out there before they even come to see you. ‘Is this operation for you?’ type of thing” (028)	
	Time would be a key concern to using a decision aid in my practice	Barrier	“I just couldn’t use a tool that is going to take up more time. There is already so much demands on our time and there is not enough time as it is. So the tool may only take 5 minutes but then you add 4, 5, 6 patients and that is half an hour extra of your time that you didn’t have” (022) “It is frantic getting patients through and there is always that rush to see all the patients in a really short time and to spend 5-10 minutes to do a questionnaire with a patient... it is hard to justify that. But if there was something validated and it was done as a routine process, the patient came in with a form filled out with a score that would be really nice” (016)	6
Reinforcement	Evidence that tool had been widely validated would not convince me to use it. I would need to correlate it with my own clinical decision making	-*	“I never trust evidence because you only have to go to Dr x ... even in research, there is a lot of doubtful stuff. You’ve got to be careful about basing something totally on results. I know we have got to be evidenced-based but the evidence may apply to a certain situation in a certain individual at a period in time and there is always variations or exceptions around that. So I would try and correlate them in my own mind and if after a while I am seeing well that person is a bit odd	9

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

			and they are scoring badly on the aid, well ok, this has legs.” (010) “I trust [the research] but I want my data no doubt about it because I think I am better... I know lots of faults in techniques or little things that really can comprise outcome. So everyone has a different hand and surgery is very touchy practice.... So I believe what happens around but at the same time I want mine as well because I know what I do differently or I am more careful about” (013)	
	I would be more likely to trust a tool developed and implemented by my peers	Facilitator	“If a decision aid is implemented and I see my colleagues implementing it and it is working in their hands then possibly that would convince me” (024) “I think people are mistrustful of things that come out of other institutions but I would trust that a study from [the Department] would be a rigorous design. Where people are invested in something, they’re much more likely to use it. If the results showed an aid was valid, I guess I would be prepared to try it and see whether I thought it was valid in my hands, in my practice” (026)	4
Goals	My goal is to optimise patient outcomes	Facilitator	“Certainly, surgeons want results. If you say you are going to reduce our risk, then why wouldn’t we be happy with that” (012)	20

* (-) donates that the belief may be either a facilitator or barrier depending on how an aid is implemented

Additional file 1. Theoretical Domains Framework definitions for coding (adapted from Cane et al. 2012)

TDF Domain	Description
Knowledge	<p><i>An awareness of the existence of something</i></p> <ul style="list-style-type: none"> - Awareness of scientific rationale regarding patients at risk of no clinically meaningful improvement from surgery - Awareness of own percentage of patients who don't respond - Awareness of decision aids to assist in identifying surgical candidates
Skills	<p><i>An ability or proficiency acquired through practice</i></p> <ul style="list-style-type: none"> - Ability required/acquired through practice/experience to help decide if a patient is likely to benefit from surgery or not - Use of tool to assist in identifying suitable candidates for surgery
Social/ Professional role/identity	<p><i>A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting</i></p> <ul style="list-style-type: none"> - Surgeons' expressions about their own professional identity/job/role/professional boundaries when managing a person at high risk of no clinically meaningful improvement
Beliefs about capabilities	<p><i>Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use</i></p> <ul style="list-style-type: none"> - The surgeon's confidence that they can identify patients at risk of no clinically meaningful improvement and can employ the skills needed to refuse to operate on the patients
Optimism	<p><i>The confidence that things will happen for the best, of that desired goals will be attained</i></p> <ul style="list-style-type: none"> - The confidence expressed that a decision aid will reduce the rate of surgery in patients at high risk of no clinically meaningful improvement
Beliefs about consequences	<p><i>Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation</i></p> <ul style="list-style-type: none"> - Perceptions about outcomes, advantages and disadvantages of using a decision aid - Any legal or ethical concerns about using a decision aid
Reinforcement	<p><i>Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus</i></p> <ul style="list-style-type: none"> - What incentives would influence the surgeon using a decision aid
Intentions	<p><i>A conscious decision to perform a behaviour or a resolve to act in a certain way</i></p> <ul style="list-style-type: none"> - Intentions to use a decision aid
Goals	<p><i>Mental representation of outcomes or end states that an individual wants to achieve</i></p>
Memory, attention and decision	<p><i>The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives</i></p> <ul style="list-style-type: none"> - The processes involved and factors taken into account when the

1 2 3 4 5 6 7	processes	<p>surgeon makes decisions about whether to operate or not</p> <ul style="list-style-type: none"> - If the surgeon surgical decision making will be influenced by the decision aid - Surgeon's perceptions of acceptable levels of risk
8 9 10 11 12 13 14 15 16 17	Environmental context and resources	<p><i>Any circumstance of a person's situation or environment that discourage or encourage the development of skills and abilities, independence, social competence and adaptive behaviour</i></p> <ul style="list-style-type: none"> - Availability of, and confidence in, non-operative alternatives - Public versus private differences - How a decision aid might best be packaged/implemented - Attitudes towards mandating use of a decision aid - How surgeons can agree on level of acceptable risk with decision aid
18 19 20 21 22 23 24 25 26 27	Social influences	<p><i>Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours</i></p> <ul style="list-style-type: none"> - The influences that other surgeons have on surgeon decision to operate or not - The influences patients have on surgeon decision to operate or not - How the surgeon believes patients might respond to the use of a decision aid
28 29 30 31 32 33	Emotion	<p><i>A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event</i></p> <ul style="list-style-type: none"> - The emotional responses of the surgeon to using a decision aid
34 35 36 37 38 39 40	Behavioural regulation	<p><i>Anything aimed at managing or changing objectively observed or measured actions</i></p> <ul style="list-style-type: none"> - Consistency of decisions to operate or not in patients at high risk of not responding - Processes that help regulate behaviour

SUPPLEMENT 1: COREQ 32-ITEM CHECKLIST

Tong A, Sainsbury P, Craig J. (2007) Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Healthcare*: 19:349 – 357

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
1. Inter viewer/facilitator	Which author/s conducted the interview?	7
2. Credentials	What were the researcher's credentials?	7
3. Occupation	What was their occupation at the time of the study?	7
4. Gender	Was the researcher male or female?	7
5. Experience and training	What experience or training did the researcher have?	7
6. Relationship with participants established	Was a relationship established prior to study commencement?	7
7. Participant knowledge of the interviewer	What did the participants know about the researcher?	7
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator?	7
Domain 2: study design		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study?	8
10. Sampling	How were participants selected?	6
11. Method of approach	How were participants approached?	6
12. Sample size	How many participants were in the study?	10
13. Non-participation	How many people refused to participate or dropped out? Reasons?	10
14. Setting of data collection	Where was the data collected?	7
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	7
16. Description of sample	What are the important characteristics of the sample?	10
17. Interview guide	Were questions, prompts, guides provided by the authors?	Table 1
18. Repeat interviews	Were repeat interviews carried out?	7
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	7
20. Field notes	Were field notes made during and/or after the inter view?	7
21. Duration	What was the duration of the interviews	7
22. Data saturation	Was data saturation discussed?	7
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	8
Domain 3: analysis and findings		
24. Number of data coders	How many data coders coded the data?	8, 9
25. Description of the coding tree	Did authors provide a description of the coding tree?	Additional file 1
26. Derivation of themes	Were themes identified in advance or derived from the data?	8, 9
27. Software	What software, if applicable, was used to	9

	manage the data?	
28. Participant checking	Did participants provide feedback on the findings?	8
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified?	11-22
30. Data and findings consistent	Was there consistency between the data presented and the findings?	11-22
31. Clarity of major themes	Were major themes clearly presented in the findings?	11-22
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	19, 22, 23

BMJ Open

Barriers and facilitators to Orthopaedic Surgeons' uptake of decision aids for Total Knee Arthroplasty: A qualitative study

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-018614.R1
Article Type:	Research
Date Submitted by the Author:	09-Oct-2017
Complete List of Authors:	Bunzli, Samantha; The University of Melbourne, Department of Surgery, St Vincent's Hospital Melbourne Nelson, Elizabeth ; St Vincent's Hospital, Melbourne, Department of Orthopaedics Scott, Anthony; The University of Melbourne, Melbourne Institute of Applied Economic and Social Research French, Simon; Queen's University, School of Rehabilitation Therapy; Monash University, School of Public Health and Preventive Medicine Choong, Peter; University of Melbourne, Surgery; St Vincent's Hospital, Orthopaedics Dowsey, Michelle; University of Melbourne, Department of Surgery, St Vincent's Hospital, Melbourne
Primary Subject Heading:	Evidence based practice
Secondary Subject Heading:	Qualitative research
Keywords:	Knee < ORTHOPAEDIC & TRAUMA SURGERY, QUALITATIVE RESEARCH, Total Knee Arthroplasty, Decision aids, Implementation

SCHOLARONE™
Manuscripts

1
2
3 **1 Barriers and facilitators to Orthopaedic Surgeons' uptake of decision aids for Total**
4 **2 Knee Arthroplasty: A qualitative study**
5
6 **3**

7 4 * Samantha Bunzli. The University of Melbourne, Department of Surgery, St. Vincent's
8 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
9 Victoria, Australia. Email: sbunzli@unimelb.edu.au
10 6

11 7
12 8 Elizabeth Nelson. Department of Orthopaedics, St Vincent's Hospital. 41 Victoria
13 Parade, Fitzroy, Melbourne 3065 Australia. Email: elizabeth.nelson@svha.org.au
14 9

15 10
16 11 Anthony Scott. Melbourne Institute of Applied Economic and Social Research, The
17 University of Melbourne. Level 5, Faculty of Business and Economics Building, 111
18 Barry Street, Melbourne 3010 Victoria, Australia. Email: a.scott@unimelb.edu.au
19 14

20 15 Simon French. School of Rehabilitation Therapy, Faculty of Health Sciences, Louise D.
21 Acton Building, Room 222. Queen's University, 99 University Ave, Kingston, ON K7L
22 3N6. Canada. Email: simon.french@queensu.ca
23 17

24 18
25 19 Peter Choong. The University of Melbourne, Department of Surgery, St. Vincent's
26 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
27 Victoria, Australia. Email: pchoong@unimelb.edu.au
28 21

29 22
30 23 Michelle Dowsey. The University of Melbourne, Department of Surgery, St. Vincent's
31 Hospital, Melbourne. Level 2, Clinical Sciences Building, 29 Regent street, Fitzroy 3065,
32 Victoria, Australia. Email: mmdowsey@unimelb.edu.au
33 25

34 26
35 27
36 28 * Corresponding author
37

38 29
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 **Abstract**
4

5 *Objectives:* The demand for Total Knee Arthroplasty (TKA) is increasing. Differentiating
6
7
8 who will derive a clinically meaningful improvement from TKA from others is a key
9
10
11 challenge for Orthopaedic Surgeons. Decision aids can help surgeons select appropriate
12
13
14 candidates for surgery, but their uptake has been low. The aim of this study was to
15
16 explore the barriers and facilitators to decision aid uptake among Orthopaedic Surgeons.

17
18 *Design:* A qualitative study involving face-to-face interviews. Questions were
19
20
21 constructed on the Theoretical Domains Framework to systematically explore barriers
22
23
24 and facilitators. *Setting:* One tertiary hospital in Australia. *Participants:* Twenty
25
26
27 Orthopaedic Surgeons performing TKA. *Outcome measures:* Beliefs underlying similar
28
29
30 interview responses were identified and grouped together as themes describing relevant
31
32
33 barriers and facilitators to uptake of decision aids. *Results:* While prioritising their
34
35
36 clinical acumen, surgeons believed a decision aid could enhance communication and
37
38
39 patient informed consent. Barriers identified included the perception that one's patient
40
41
42 outcomes were already optimal; a perceived lack of non-operative alternatives for the
43
44
45 management of end-stage osteoarthritis; concerns about mandatory cut-offs for patient-
46
47
48 centred care, and concerns about the medico-legal implications of using a decision aid.

49
50
51 *Conclusions:* Multifaceted implementation interventions are required to ensure that
52
53
54 Orthopaedic Surgeons are ready, willing and able to use a TKA decision aid.
55
56
57 Audit/feedback to address current decision-making biases such as overconfidence may
58
59
60 enhance readiness to uptake. Policy changes and/or incentives may enhance willingness
to uptake. Finally, the design/implementation of effective non-operative treatments may

1
2
3 52 enhance ability to uptake by ensuring that surgeons have the resources they need to carry
4
5 53 out decisions.
6
7

8 54
9

10 55 **Strengths and limitations of the study**

11
12
13 56 • Very few qualitative studies involving Orthopaedic Surgeons have been published
14
15 57 in the literature.

16
17
18 58 • This study took place in one of the largest arthroplasty clinics in Australia. All
19
20 59 twenty surgeons performing TKA in this hospital participated in a one-to-one
21
22 60 interview.

23
24
25 61 • A theoretical framework was used to systematically explore the barriers and
26
27 62 facilitators to uptake of a decision aid by Orthopaedic Surgeons.

28
29
30 63 • Consistent findings are documented between this single site study and international
31
32 64 surveys of surgeon' attitudes.

33
34
35 65 • Beliefs and attitudes are distinct from actual behaviour, and therefore the themes
36
37 66 elicited in this study do not provide evidence of the actual influences on uptake of a
38
39 67 decision aid.

40
41 68
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

69 Background

70 Up to one quarter of Total Knee Arthroplasties (TKA) are performed on inappropriate
71 candidates according to evidence-based criteria¹ and a similar proportion experience
72 minimal clinical benefit from surgery.² The rates of TKA are increasing³; differentiating
73 who will derive a clinically meaningful improvement from TKA from others is a key
74 challenge for Orthopaedic Surgeons. While the degree osteoarthritis (OA) severity, pain
75 severity and the impact of pain, are key indicators for TKA, surgeons' consideration of
76 other evidence-based indicators such as psychosocial factors remains varied⁴⁻⁶
77 Observations of orthopaedic consultations suggest that other 'unstated factors' may also
78 influence clinical judgments such as the surgeons' beliefs in their own ability to conduct
79 surgery and their 'instincts' about the patients ability to cope with pain.⁷

80
81 In recent years there has been a move towards a model of shared decision-making in
82 Orthopaedics as part of informed consent.^{8,9} This model implies that surgeons have a duty
83 to inform patients about the benefits and harms of TKA and the likelihood of their
84 occurrence, supporting them to arrive at an informed, shared decision. Evidence suggests
85 that there is often a lack of time during the clinical encounter for patients to consider or
86 discuss all available treatment options and arrive at a decision congruent with their own
87 preferences.¹⁰

88
89 To help address variations in clinical judgments and promote shared decision-making,
90 decision aids may be useful.^{11,12} Decision aids can be designed to estimate important,
91 patient-specific risks of responding to surgery, based on independent prognostic

1
2
3 92 correlates of post-TKA response such as body mass index, degree of OA severity, pre-
4
5 93 operative pain, function and mental health.¹³ Similar aids have been found to predict
6
7
8 94 outcomes in other areas of medicine with superior accuracy to clinical judgments alone.¹⁴
9
10 95 ¹⁵ Decision aids have improved patient knowledge and confidence in decisions,¹⁶ and
11
12 96 have even been found to reduce the rate of surgical procedures.¹⁷
13
14
15 97
16
17 98 Orthopaedic Surgeons recognize the need for an aid to support their decision making for
18
19 99 TKA and optimize communication with patients.^{6 18} However, the uptake of decision aids
20
21 100 amongst surgeons has been low.⁹ A number of factors can influence uptake of a decision
22
23 101 aid, and the success of implementation efforts depends on the careful assessment of the
24
25 102 barriers to, and facilitators of, uptake.¹⁹ The implementation literature advocates the use
26
27 103 of theory to ensure the systematic identification of such factors and inform the design of
28
29 104 interventions to address them.²⁰ Using theory not only assists in designing studies that
30
31 105 are better able to facilitate behavior change,²¹ but also provides a basis for better
32
33 106 understanding the processes underpinning behavior change.²² To date, studies of
34
35 107 decision-making amongst Orthopaedic Surgeons have been few and atheoretical^{6 7 23} and
36
37 108 the barriers and facilitators of uptake of decision aids for TKA have not been rigorously
38
39 109 explored.^{9 18}
40
41
42
43
44
45
46
47

111 **Methods**

113 **Aim and Design:**

114

1
2
3 115 This theoretically-informed qualitative study is the first phase of a wider project seeking
4
5 116 to design and implement a decision aid into an Australian Orthopaedic clinic setting. The
6
7
8 117 aim of this study was to explore the barriers and facilitators to uptake of a TKA decision
9
10 118 aid through structured one-to-one interviews with Orthopaedic Surgeons.
11
12

13 119

14
15 120 **Participants:**

16
17 121

18
19
20 122 All Orthopaedic Surgeons and Registrars performing TKA at one tertiary teaching
21
22 123 hospital in Australia were eligible. Eligible candidates received the study details via
23
24 124 email from an institutional administration officer, and were invited to contact the
25
26
27 125 researchers to arrange an interview at a time and place suitable to them.
28

29 126

30
31 127 **Data collection:**

32 128

33
34
35
36 129 The Theoretical Domains Framework (TDF)²⁴ was selected as a comprehensive and
37
38 130 validated framework for determining barriers and facilitators related to the
39
40 131 implementation of best practice and clinicians' behavior change. The TDF was developed
41
42 132 by implementation scientists to synthesise existing behavior change theories into a single
43
44 133 framework. A six-stage consensus approach resulted in the identification of 12 theoretical
45
46 134 'domains' describing possible mediators of behavior change.²⁴ A subsequent validation
47
48 135 study²² revised the original TDF to 14 domains: Knowledge; Skills; Social/professional
49
50 136 role and identity; Beliefs about capabilities; Optimism; Beliefs about consequences;
51
52
53 137 Reinforcement; Intentions; Goals; Memory, attention and decision processes;
54
55
56
57
58
59
60

1
2
3 138 Environmental context and resources, Social influences; Emotions; and Behavioural
4
5 139 regulation. The revised TDF, used in this study, has explained implementation problems
6
7
8 140 and informed the development of theory-informed behavior change interventions.²⁵⁻²⁷
9

10 141

11
12 142 Interview questions were developed for each domain of the TDF with the advice of
13
14
15 143 content experts in the TDF (SF), orthopaedic surgery (MD) and decision-making
16
17 144 processes (AS), and in consultation with the literature.²⁸ Interviews were prefaced by
18
19
20 145 stating that the researchers planned to develop a decision aid, thus the discussion was
21
22 146 centered around a hypothetical decision aid rather than a defined one. In the first part of
23
24
25 147 the interview, questions aimed to elicit current decision-making processes and biases. In
26
27 148 the second part, questions aimed to identify beliefs and attitudes towards decision aids
28
29 149 and factors that may influence decisions to use one. Table 1 presents the interview
30
31 150 schedule.

32
33
34 151

35
36 152 [Insert Table 1]

37
38
39 153

40
41 154 The interviewer (SB), a female post-doctoral researcher with methodological expertise in
42
43 155 qualitative research, had no previous relationship with the participants and no affiliation
44
45
46 156 with the hospital. Data saturation was considered complete when the beliefs and attitudes
47
48 157 of all 20 surgeons working in this setting had been elicited. Face-to-face interviews were
49
50 158 conducted with 18 participants in a private office; phone interviews were conducted with
51
52
53 159 two participants. Interviews lasted 20-30 minutes. Nineteen interviews were audio
54
55 160 recorded and transcribed verbatim. One participant did not wish the interview to be
56
57
58
59
60

1
2
3 161 recorded, therefore hand-written notes were made during the interview. Participant
4
5 162 anonymity was ensured at all times. All transcripts were de-identified prior to data
6
7
8 163 analysis. All participants had the opportunity to review the study findings during a
9
10 164 presentation at a scheduled surgical meeting. There was consensus agreement with the
11
12 165 researchers' interpretations and no adjustments were made to the study themes.
13
14
15 166

167 **Analysis:**

168
169 Adopting an implementation approach,²⁶ three stages of data analysis were conducted. In
170 the first stage, two researchers (SB, EN) independently coded interview transcripts by
171 classifying each interview response or utterance into one of the 14 TDF domains. For
172 example, the response "I think 22 per cent is the high end. But there are a lot of different
173 papers that all suggest 10, 15, 20 per cent", was classified into the 'Knowledge' domain
174 of the TDF. Definitions for each domain were derived from the literature¹⁹ and adapted to
175 the study context. Pilot coding was performed in which the two researchers
176 independently coded two transcripts. Inter-coder comparisons resulted in refinement of
177 domain definitions (see Additional file 1). This process was conducted three times, until
178 the two researchers were confident that all relevant interview responses could be clearly
179 coded into one domain. The two researchers then independently coded all 20 transcripts.
180 Disagreements were discussed and consensus reached in each instance. Coded responses
181 were uploaded into a qualitative data sorting software (Codesort²⁹) to facilitate further
182 analysis.

183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200

1
2
3 184 In the second stage of analysis, one researcher (SB) generated 'belief statements' based
4
5 185 on the coded interview responses. For example, from the response: "I think 22 per cent is
6
7 186 the high end. But there are a lot of different papers that all suggest 10, 15, 20 per cent"
8
9 187 classified in the 'Knowledge' domain, we generated the belief statement: 'I am aware of
10
11 188 the literature that up to 20 per cent of patients do not have a clinically meaningful
12
13 189 improvement from TKA'. Belief statements were worded such that they could describe
14
15 190 similar responses from different participants. Belief statements were reviewed by two
16
17 191 further researchers (EN, MD), before being interpreted as a likely 'facilitator' or 'barrier'
18
19 192 to surgeon's uptake of a decision aid. Continuing the example above, the belief
20
21 193 statement: 'I am aware of the literature that up to 20 per cent of patients do not have a
22
23 194 clinically meaningful improvement from TKA' was interpreted as a facilitator to uptake,
24
25 195 in that we considered surgeons would be more likely to use a decision aid if they were
26
27 196 aware that a substantial proportion of TKA's resulted in suboptimal outcomes.
28
29
30
31
32
33

34 197

35
36 198 In the third stage of analysis, we identified the domains most likely to influence
37
38 199 surgeon's behaviour (i.e. using a decision aid or not). This was determined by: 1.
39
40 200 Frequency of beliefs across transcripts and 2. The perceived strength of beliefs in
41
42 201 influencing behaviour. To illustrate, the belief statement: 'I think that the percentage of
43
44 202 my patients who achieve clinically meaningful improvement is higher than that reported
45
46 203 in the literature' appeared in 17/20 transcripts and was considered to have a strong
47
48 204 influence on whether a surgeon would use a decision aid or not, implying that behaviour
49
50 205 change (i.e. using a decision aid) was unlikely if surgeons considered that their patients'
51
52 206 outcomes were already optimised. 'Knowledge' was therefore identified as a relevant
53
54
55
56
57
58
59
60

1
2
3 207 domain. Where the researchers considered that beliefs within and between domains
4
5 208 represented similar barriers/facilitators, these were grouped into themes. We present
6
7
8 209 frequencies of beliefs (see Table 2) to provide the reader with a better understanding of
9
10 210 the range of interview responses and to assist us in identifying 'relevant' domains of the
11
12 211 TDF. However, readers should be cognisant that the absence of a belief in a transcript is
13
14
15 212 not the same as a lack of endorsement.
16
17
18 213

20 214 **Results**

21 215 22 216 **Participants:**

23
24
25 217
26
27 218 Aggregate data describing the demographics of the sample is provided to protect
28
29 219 individual anonymity. The sample comprised of 15 Consultant surgeons and five
30
31 220 Registrars. The surgeons' total experience performing TKA ranged from six months to 30
32
33 221 years (mean \pm SD, 12.9 \pm 9.3) and the number of TKAs performed each month ranged
34
35 222 from less than one to 12 (mean \pm SD, 5.9 \pm 3.0).
36
37
38
39
40
41
42
43

44 224 ***Relevant domains***

45
46 225 Across the 20 interview transcripts, 628 utterances were coded into the 14 domains.
47
48 226 Eleven domains of the TDF were identified as relevant: Knowledge; Behavioural
49
50 227 regulation; Memory attention and decision processes; Beliefs about capabilities; Skills;
51
52 228 Goals; Social/Professional role and identity; Intention; Beliefs about consequences;
53
54
55
56
57
58
59
60

1
2
3 229 Environmental context; and Reinforcement. Table 2 presents the relevant domains, with
4
5 230 specific belief statements supported by example quotes.
6
7

8 231

9
10 232 [Insert Table 2]
11

12 233

13
14
15 234 The seven themes are described below, illustrated by interview extracts found in Table 3
16
17 235 and denoted in the text as 'Quote' numbers e.g. Q1
18

19 236

20
21
22 237 [Insert Table 3]
23

24 238

25
26
27 239 ***Themes identified:***

28
29 240 1. Knowledge of one's own patient outcomes
30

31
32 241 (Relevant TDF domains: Goals; Knowledge; Behavioural regulation; and Beliefs about
33
34 242 capabilities)
35

36 243

37
38
39 244 The goal of all participations was to optimise outcomes for their patients (Q1). While
40
41 245 almost all participants (n=19) were aware of the literature that up to 20 per cent of
42
43 246 patients undergoing TKA have no clinically meaningful improvement from surgery, most
44
45 247 believed that this percentage was significantly lower in the patients they operated on
46
47 248 (Q2). All participants based this estimation on patient presentations at post-surgical
48
49 249 follow-up appointments. However participants acknowledged the 'rose-coloured glasses'
50
51 250 they saw their patients through, citing the subtleties of rapport that made patients less
52
53 251 likely to report dissatisfaction with surgery (Q3).
54
55
56
57
58
59
60

1
2
3 252
4
5

6 253 It was also recognised that patients with poor post-surgical outcomes may be less likely
7
8 254 to attend follow-up appointments, choosing to seek care elsewhere. Participants believed
9
10 255 that tracking long-term patient outcomes through an existing joint registry could counter-
11
12 256 act this (Q4, Q5).
13

14
15 257
16

17 258 However, a key problem identified by many participants was how to define clinically
18
19 259 meaningful improvement. Seven surgeons emphasised the importance of ‘asking the right
20
21 260 question in the right way’ (Q6, Q7). The discrepancy between surgeons’ perception of
22
23 261 clinically meaningful improvement and that of their patients was commonly attributed to
24
25 262 mis-matched surgeon-patient pre-surgical expectations of TKA. Surgeons reported their
26
27 263 expectations of TKA to be a resolution of joint pathology with some corresponding
28
29 264 improvement in pain. While disease and pain severity were key considerations in surgical
30
31 265 decision-making, all participants acknowledged that patient expectations were important
32
33 266 (Q8, Q9).
34
35
36
37
38

39 267
40

41 268 2. Reliance on ‘clinical intuition’

42
43 269 (Relevant TDF domains: Memory, attention and decision processes; and Skills)
44
45
46 270
47

48 271 The accurate assessment of patient expectations presented a challenge for many surgeons.
49

50 272 While the physical aspects of the clinical assessment were routine skills that all
51
52 273 participants believed they had mastered well, many junior and senior surgeons reported
53
54 274 difficulties assessing the psychological aspects of the patients’ presentation (Q10).
55
56
57
58
59
60

1
2
3 275
4

5 276 Only a few participants were aware of any validated tools to assess pre-surgical patient
6
7
8 277 predictive factors. One participant had prior knowledge of a decision aid but had not
9
10 278 used it. None of the other participants were aware of any decision aid for TKA.
11
12 279 Participants relied on their ‘clinical intuition’ for patients who were less likely to do well.
13
14
15 280 A ‘gut-feeling’ for patients was developed with experience, over time (Q11).
16
17

18 281

19
20 282 3. The role of aids in supporting clinical decision-making

21
22 283 (Relevant TDF domains: Intention; Reinforcement)
23
24

25 284

26
27 285 Fifteen of the participants believed an aid would support decision-making, like a
28
29 286 ‘barometer’ or weather app to forecast outcomes, particularly in patients they were
30
31 287 unsure about (Q12, Q13). However, most participants (n=13) believed an aid would be
32
33 288 insensitive to nuances at an individual level and could therefore not replace their clinical
34
35 289 acumen (Q14).
36
37

38
39 290

40
41 291 All participants expected to be provided with evidence that a decision aid had been
42
43 292 rigorously validated and shown to have high specificity and sensitivity before considering
44
45 293 using it. Participants were more likely to trust this evidence if it came from their own
46
47 294 institution (Q15). However, half of the participants reported that evidence supporting the
48
49 295 validity of a decision aid would not be sufficient to convince them to use it. Instead they
50
51 296 would need to see how the tool correlated with their own clinical decision-making (Q16).
52
53

54
55 297
56
57
58
59
60

1
2
3 298 4. Implications of a decision aid for patient-surgeon communication and shared decision-
4
5 299 making

6
7
8 300 (Relevant TDF domains: Beliefs about consequences; Memory, attention and decision
9
10 301 processes)

11
12 302

13
14
15 303 Nine participants perceived that a decision aid would give them an evidence-based
16
17 304 approach for saying 'no' to patient, particularly for those participants who reported
18
19 305 difficulty declining for surgery (Q17). Many participants (n=10) believed an aid could be
20
21 306 an important component of patient informed consent, providing patients with objective
22
23 307 data on their likely risk outcomes, enabling them to have the appropriate expectations to
24
25 308 weigh up the risk and benefits of surgery for themselves. In this way, a decision aid was
26
27 309 seen as a valuable support to shared decision-making (Q18).
28
29
30
31

32 310

33
34 311 When asked how they would feel about operating if a decision aid predicted a patient had
35
36 312 a 50 per cent chance of not responding to TKA, surgeons were divided in their responses.

37
38 313 While eleven believed that decisions to proceed would need to be shared with the patient
39
40 314 (Q19), eight reported they would not consider surgery unless there was a greater than 80

41
42 315 per cent chance the patient would respond (Q20).
43
44
45

46 316

47
48 317 5. Ethical and legal concerns about decision aids

49
50 318 (Relevant TDF domain: Beliefs about consequences)

51
52 319
53
54
55
56
57
58
59
60

1
2
3 320 Eight participants had medico-legal concerns about documenting a specific risk value in
4
5 321 patient records, with a few believing that such information would have to be deliberately
6
7 322 withheld from patients in the case it fell into the 'wrong' hands (Q21). While some
8
9 323 participants believed it would be unethical *not* to use a decision aid if it had been shown
10
11 324 to improve patient outcomes, others were concerned about the ethical implications of a
12
13 325 tool if imposed cut-offs were used to deny patients surgery (Q22, Q23).
14
15
16
17
18
19

20 327 6. Available resources and organisational culture as barriers to uptake
21

22 328
23
24 329 (Relevant TDF domains: Environmental context and resources; Beliefs about
25
26 330 consequences and Social/Professional role and identity)
27
28

29 331
30
31 332 Almost all participants expressed concerns about making an aid compulsory and
32
33 333 imposing mandatory cut-off levels. While many recognised that implementing the tool in
34
35 334 this way would have the potential to improve the use of valuable health resources and
36
37 335 save costs (Q24), several participants commented that mandatory cut-offs would only be
38
39 336 possible if an effective, non-operative alternative was made available for patients that
40
41 337 were denied surgery. The existing lack of effective alternative to surgery was seen as a
42
43 338 key barrier (Q25).
44
45
46
47

48 339
49
50 340 There was widespread agreement amongst surgeons (n=17) that the logistics of agreeing
51
52 341 on a cut-off value for acceptable risk, and the threat to surgeons' professional identity as
53
54
55
56
57
58
59
60

1
2
3 342 a patient-centred practitioner, were insurmountable barriers to imposing mandatory cut-
4
5 343 offs (Q26, Q27).
6
7

8 344

9
10 345 7. Format and content of a decision aid
11

12 346 (Relevant TDF domain: Environmental context and resources)
13

14 347

15
16
17 348 Finally, physically integrating an aid into clinical practice was not seen as a key barrier to
18
19 349 implementation. An electronic or online format was seen as the most likely way an aid
20
21 350 could be implemented, particularly given the strict time constraints placed on outpatient
22
23 351 clinics (Q28).
24
25
26

27 352

28
29 353 Most believed that an aid would be best used within the patient-surgeon consultation
30
31 354 (Q29, Q30), while a couple suggested that an aid could be designed for patients to
32
33 355 use on their own or with a support network to save time in the clinical consultation
34
35 356 (Q31, Q32).
36
37

38 357

39
40
41 358 ***Irrelevant domains:***
42

43 359 Three domains did not appear to have a salient influence on the target behaviour. These
44
45 360 were: Optimism, Emotion and Social Influences. Optimism was closely connected to the
46
47 361 domain Reinforcement i.e. surgeons reported being neither optimistic nor pessimistic
48
49 362 about the utility of an aid until they had seen evidence of its effectiveness. The Emotion
50
51 363 domain did not appear relevant as described by one surgeon: “I am not worried about the
52
53 364 implications of a tool. TKA is wellness surgery, in the worst case scenario they don't get
54
55
56
57
58
59
60

1
2
3 365 a new knee". The Social Influence of patients did not appear relevant as surgeons
4
5 366 believed patients were accustomed to filling out questionnaires. While surgeons were
6
7
8 367 more likely to trust an aid if it had been developed by their peers, they preferred to test
9
10 368 the tool 'in their own hands' and therefore the Social Influences of other surgeons using
11
12
13 369 an aid appeared limited.

14
15 370

17 371 **Discussion**

18
19
20 372

21
22 373 These findings have implications for the future design and implementation of decision
23
24 374 aids into surgical clinical practice. It is possible that current decision-making biases may
25
26
27 375 be key barriers to uptake. Surgical decision-making involves the consideration of the
28
29 376 risks versus benefits of surgery.³⁰ In this study, participants expressed confidence in their
30
31 377 ability to successfully remove diseased tissue and correct joint deformity, and the
32
33
34 378 likelihood of some corresponding improvement in pain severity was perceived to be high.
35
36 379 At the same time, participants perceived that the risk their patients would not respond to
37
38
39 380 TKA was low. One potential explanation for this is an apparent lack of clarity around the
40
41 381 definition of 'clinically meaningful improvement' and 'non-response'. The literature
42
43 382 suggests that patients' perceptions of 'clinically meaningful improvement' depend on
44
45
46 383 their satisfaction with improvements in pain and function, closely linked to their
47
48 384 expectations of surgery.³¹ In contrast, the surgeons in this study believed that a resolution
49
50 385 in joint pathology and some corresponding improvement pain could be considered
51
52
53 386 'meaningful improvement'. This lack of clarity is important, as surgeons who believe that
54
55
56 387 their patient outcomes are already optimised may be less motivated to use a decision aid.
57
58
59
60

1
2
3 388
4
5
6

7 389 Another explanation may be that surgeons in this sample exhibited an over-confidence
8 390 bias. Indeed, most participants believed their own patient outcomes were better than that
9
10 391 reported in the literature. While it is possible that this belief is accurate and outcomes
11
12 392 amongst this sample of surgeons are indeed above average, similar observations were
13
14 393 made in a survey study involving 700 Orthopaedic Surgeons in Europe and North
15
16 394 America.³² In that study, 83 per cent of surgeons surveyed considered themselves to be
17
18 395 above average diagnosticians; 74 per cent believed they were above average surgeons and
19
20 396 25 per cent believed they were in the top five per cent of surgeons.³² This over-
21
22 397 confidence bias may lead to a confirmation bias in which surgeons only notice things that
23
24 398 agree with their point of view and are less attentive to alternative viewpoints due to
25
26 399 cognitive dissonance.³³ A confirmation bias can have consequences for the uptake of a
27
28 400 decision aid as surgeons may be less likely to consider evidence that contradicts their
29
30 401 clinical experience.
31
32
33
34
35

36 402
37
38

39 403 Surgical decision-making also involves weighing up of the risks versus benefits of non-
40
41 404 operative interventions.³⁰ The participants highlighted a lack of effective non-operative
42
43 405 interventions for end-stage knee OA. A study among Dutch Orthopaedic Surgeons
44
45 406 similarly documented a lack of confidence in the efficacy of non-surgical treatments
46
47 407 associated with a decreased referral rate.³⁴ Indeed, there is currently a dearth of evidence-
48
49 408 based, non-operative interventions for patients with end-stage knee OA either as an
50
51 409 alternative to surgery or as a definitive management when the patient is deemed
52
53 410 unsuitable for TKA. In the absence of a treatment alternative, surgery with all its risks
54
55
56
57
58
59
60

1
2
3 411 and costs is often the default intervention. This is an important barrier to uptake as
4
5 412 evidence suggests surgeons will not use an aid if they do not have the resources to carry
6
7
8 413 out the decisions,²⁸ or if the aid does not support their own view about effective
9
10 414 treatments.³⁵

11
12 415

13
14
15 416 The participants in this study believed a decision aid could promote shared decision-
16
17 417 making and enhance informed consent for TKA. Similar attitudes towards decision aids
18
19
20 418 were identified in a previous review⁹ and a survey of the wider population of Orthopaedic
21
22 419 Surgeons.¹⁸ It may be that surgeons can be motivated to uptake a decision aid because it
23
24 420 is the ethical thing to do.³⁶ However, our study identified concerns about the ethical
25
26 421 implications of imposing mandatory cut-offs that would determine eligibility for TKA.
27
28 422 These concerns may reflect the participants' desire to defend professional discretion and
29
30 423 autonomy. We take the opportunity to emphasise the function of a decision aid is to
31
32 424 support, not replace, clinical decision making. However, concerns were also expressed
33
34 425 about the legal implications of using a decision aid. This finding contrasts with a study
35
36 426 involving US Orthopaedic Surgeons who believed decision aids may reduce litigation
37
38 427 and malpractice insurance premiums by enhancing shared decision-making.³⁷ It may be
39
40 428 that these concerns are unique to the medico-legal context of Australia. Certainly,
41
42 429 surgeons will be less likely to be uptake a tool if they perceive it makes them vulnerable
43
44
45
46
47 430 to medico-legal action.

48
49
50 431

51
52
53 432 **Implications:**

54
55 433
56
57
58
59
60

1
2
3 434 The Ready, Willing and Able model posits that these three preconditions must be
4
5 435 satisfied before a decision aid will be adopted.³⁸ ‘Ready’ refers to the perceived benefit of
6
7
8 436 changing the status quo and adopting an aid to support decision-making. ‘Willing’ refers
9
10 437 to the perceived legitimacy of a decision aid and a willingness to overcome objections
11
12 438 and concerns. ‘Able’ refers to the ability to adopt the decision aid given available
13
14 439 resources.³⁹ Implications for enhancing the readiness, willingness and ability of
15
16
17 440 Australian Orthopaedic Surgeons to uptake a TKA decision aid are described below.
18
19

20 441

21
22 442 To enhance Readiness to uptake, current decision-making biases may need to be
23
24 443 addressed. Information to counter these biases could be provided through audit and
25
26 444 feedback. Audit and feedback is defined as a ‘summary of the clinical performance of
27
28 445 healthcare provider(s) over a specified period of time’ (p. 5).⁴⁰ It may be particularly
29
30 446 effective when clinicians’ ability to accurately self-assess is limited.⁴¹ This assumes that
31
32 447 clinicians are motivated to improve care but lack intention to change current behaviour
33
34 448 because they are unaware of their suboptimal performance. While effect sizes may
35
36 449 depend on the format and context in which feedback is provided, findings from a
37
38 450 Cochrane review suggest that audit and feedback can yield important improvements in
39
40 451 professional practice.⁴⁰ Clarity and consensus on the definition of ‘clinically meaningful
41
42 452 improvement’ and ‘non-response’ to TKA is likely to influence the success of an audit
43
44 453 and feedback intervention in this context. Future research is needed to explore how audit
45
46 454 and feedback is best delivered in this context including the immediacy and frequency of
47
48 455 feedback, and the potential to incorporate other approaches such as the use of surgeon
49
50 456 incentives.⁴²
51
52
53
54
55
56
57
58
59
60

1
2
3 457

4
5 458 To enhance Willingness to uptake, an audit and feedback intervention before and after
6
7
8 459 using a decision aid may be necessary for Orthopaedic Surgeons to gain confidence in its
9
10 460 legitimacy. The findings suggest that validating a decision aid in large multi-centre trials
11
12 461 may not be sufficient to encourage uptake, as surgeons believed such trials do not
13
14 462 account for variations in case load and years of experience. Surgeons perceived
15
16 463 themselves as not only scientists, but also ‘artists’; believing that surgical success
17
18 464 depended, in part, on the ‘hands’ that performed it. This suggests that Orthopaedic
19
20 465 Surgeons may need to be given the opportunity to validate a decision aid ‘in their own
21
22 466 hands’.

23
24
25
26
27 467

28
29 468 Addressing concerns about the medico-legal implications of a decision aid may also be
30
31 469 necessary to enhance Willingness to uptake. This may require the consultation of
32
33 470 multiple stakeholders including policy makers, lawyers and institutional administration
34
35 471 before the implementation of a decision aid. Legislative changes in the United States
36
37 472 have recognised decision aids as a higher standard of informed consent⁸ and in the United
38
39 473 Kingdom, incentives to use decision aids are being developed.⁹ There is evidence that
40
41 474 mandating the use of a decision aid as a requirement for gaining informed consent results
42
43 475 in significantly improved patient-outcomes including a reduction in the rate of TKA by
44
45 476 38 per cent in a six-month period.⁴³ Future studies are required to explore if policy
46
47 477 changes and/or incentives might influence Willingness to uptake a decisions aid in the
48
49 478 Australian context.

50
51
52
53
54
55 479
56
57
58
59
60

1
2
3 480 To enhance Ability to uptake, it appears important to address the dearth of non-operative
4
5 481 alternatives to surgery for end-stage knee OA so that surgeons have the resources to carry
6
7 482 out decisions. Future research to design and implement effective, evidence-based, non-
8
9 483 operative interventions should be a priority. Targeting Orthopaedic Surgeons' beliefs
10
11 484 about the efficacy of such interventions through education strategies will also be
12
13 485 important. The study findings suggest that Ability to uptake may be enhanced if a
14
15 486 decision aid is packaged in an electronic or online format that is quick and easily
16
17 487 accessible. Focus groups involving surgeons and patients to gain feedback on prototypes
18
19 488 of a decision aid during the design phase is important to ensure that not only the format,
20
21 489 but also content, are accessible to a range of end users.
22
23
24
25
26

27 490

29 491 **Limitations**

30
31 492 Qualitative studies involving Orthopaedic Surgeons are rare. The strength of this study
32
33 493 is the 100% participation rate by Orthopaedic Surgeons in one tertiary hospital
34
35 494 setting. While the sampling strategy means the generalizability of these findings to
36
37 495 other contexts may be limited, we have documented significant similarities with
38
39 496 international studies. We acknowledge that while beliefs, attitudes and intentions
40
41 497 can predict behaviors with a degree of accuracy, they are distinct from actual
42
43 498 behavior⁴⁴. Thus the themes elicited in this study do not provide evidence of the
44
45 499 actual influences on uptake of a decision aid.
46
47
48
49

50 500

53 501 **Conclusions**

54 502

55

56

57

58

59

60

1
2
3 503 Using a theoretical framework to systematically explore barriers and facilitators to
4
5 504 uptake, this study will inform the design and implementation of future TKA decision
6
7
8 505 aids.¹³ The findings suggest that a multifaceted approach will be required to ensure that
9
10 506 Orthopaedic Surgeons are ready, willing and able to use a decision aid that can reduce the
11
12 507 suffering and economic burden of ‘failed’ TKA. Research exploring patients’ beliefs and
13
14 508 attitudes towards a TKA decision aid is required prior to implementation.
15
16
17
18 509

510 **Abbreviations**

511 TKA = Total Knee Arthroplasty

512 OA = Osteoarthritis

513 TDF = Theoretical Domains Framework

514

515 **Declarations**

516 **Ethics approval:** This study was carried out in compliance with the Helsinki
517 Declaration. Approval was given by St Vincent’s Hospital Melbourne, Australia (QA 019
518 /_16).

519 **Availability of data and materials:** Requests regarding the datasets used in this study
520 can be directed to the first author. Full interview transcripts will not be shared to protect
521 the anonymity of the study participants.

522 **Competing interests:** The authors declare that they have no competing interests

523 **Funding:** This project was supported by a University of Melbourne FBE/MDHS
524 Collaborative Research Seed-Funding Grant (2015).

1
2
3 525 **Authors contributions:** SB: led the study design, data collection, data analysis and
4
5 526 manuscript preparation. EN contributed to the data analysis. AS, PC and MD contributed
6
7 527 to the study design, data analysis and manuscript preparation. SF contributed to the study
8
9 528 design and manuscript preparation.

10
11 529 **Acknowledgements:** We acknowledge Pascal Buenzli for assistance with the data
12
13 530 management software and inter-rater reliability calculation. We extend our thanks to all
14
15 531 the surgeons for kindly donating their time to participate in this study.
16
17
18
19

20 532

21 533

22 534 **References:**

23 535

24 536 1. Cobos R, Lattore A. Variability of indication criteria in knee and hip replacement:

25 537 An observational study. *BMC Musculoskeletal Disorders* 2010;11(249)

26 538 2. Dowsey M, Smith A, Choong P. Latent Class Growth Analysis predicts long term

27 539 pain and function trajectories in total knee arthroplasty: a study of 689

28 540 patients. *Osteoarthritis and Cartilage* 2015;23(12):2141-49.

29 541 3. Australian Orthopaedic Association, . Annual Report. Adelaide: National Joint

30 542 Replacement Registry, 2014.

31 543 4. Riddle DL, Jiranek WA, Hayes CW. Use of a validated algorithm to judge the

32 544 appropriateness of total knee arthroplasty in the United States: a multicenter

33 545 longitudinal cohort study. *Arthritis & rheumatology* 2014;66(8):2134-43. doi:

34 546 10.1002/art.38685

35 547 5. Curtis AJ, Wolfe R, Russell COH, et al. Determining priority for joint replacement:

36 548 comparing the views of orthopaedic surgeons and other professionals. *The*

37 549 *Medical Journal of Australia* 2011;195(11):699-702. doi:

38 550 10.5694/mja10.11052

39 551 6. Frankel L, Sanmartin C, Hawker G, et al. Perspectives of orthopaedic surgeons on

40 552 patients' appropriateness for total joint arthroplasty: a qualitative study.

41 553 *Journal of evaluation in clinical practice* 2016;22(2):164-70. doi:

42 554 10.1111/jep.12449

43 555 7. Gooberman-Hill R, Sansom A, Sanders C, et al. Unstated factors in orthopaedic

44 556 decision-making: A qualitative study. *BMC Musculoskeletal Disorders*

45 557 2010;11(213)

46 558 8. Kuehn B. States explore shared decision making. *JAMA* 2009;301(24):2539-41.

47 559 9. Jayadev C, Khan T, Coulter A, et al. Patient decision aids in knee replacement

48 560 surgery. *Knee* 2012;19(6):746.

49 561 10. Van den Bart B, Zwikker H, van den Ende C. Medication adherence in patients

50 562 with rheumatoid arthritis: a critical appraisal of the existing literature. *Expert*

51 563 *Reviews in Clinical Immunology* 2012;8:337-51.

- 1
2
3 564 11. Feldman-Stewart D, Brennenstuhl S, McIssac K, et al. A systematic review of
4 565 information in decision aids. *Health Expectations* 2007;10(1):46-61.
- 5 566 12. Sacks GD, Dawes AJ, Ettner SL, et al. Impact of a Risk Calculator on Risk
6 567 Perception and Surgical Decision Making: A Randomized Trial. *Annals of*
7 568 *surgery* 2016 doi: 10.1097/SLA.0000000000001750
- 8 569 13. Dowsey M, Spelman T, Choong P. Development of a prognostic nomogram for
9 570 predicting the probability of nonresponse to total knee arthroplasty 1 year
10 571 after surgery. *Journal of Arthroplasty* 2016;In press
- 11 572 14. Barsoum W, Murray T, Klika A, et al. Predicting patient discharge disposition
12 573 after total joint arthroplasty in the United States. *Journal of Arthroplasty*
13 574 2010;25(6):885-92.
- 14 575 15. Kattan M. Nomograms are difficult to beat. *European Urology* 2008;53(4):671.
- 15 576 16. Stacey D, Bennett C, Barry M, et al. Decision aids for people facing health
16 577 treatment or screening decisions. *Cochrane Database of Systematic Reviews*
17 578 2011(10):CD001431.
- 18 579 17. Knops AM, Legemate DA, Goossens A, et al. Decision aids for patients facing a
19 580 surgical treatment decision: a systematic review and meta-analysis. *Annals of*
20 581 *surgery* 2013;257(5):860-6. doi: 10.1097/SLA.0b013e3182864fd6
- 21 582 18. Adam J, Khaw F, Thomson R, et al. Patient decision aids in joint replacement
22 583 surgery: A literature review and an opinion survey of consultant orthopaedic
23 584 surgeons. *Annals of the Royal College of Surgeons of England* 2008;90(3):198-
24 585 207.
- 25 586 19. Phillips C, Marshall A, Chaves N, et al. Experiences of using the Theoretical
26 587 Domains Framework across diverse clinical environments: A qualitative
27 588 study. *Journal of Multidisciplinary Healthcare* 2015;8:139-46. doi:
28 589 10.2147/JMDH.S78458
- 29 590 20. Eccles M, Grimshaw J, Walker A, et al. Changing the behaviour of healthcare
30 591 professionals: the use of theory in promoting the uptake of research findings.
31 592 *Journal of Clinical Epidemiology* 2005;58:107-12.
- 32 593 21. Noar S, Zimmerman R. Health behaviour theory and cumulative knowledge
33 594 regarding health behaviours: Are we moving in the right direction? *Health*
34 595 *Education Research* 2005;20(3):275-90.
- 35 596 22. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework
36 597 for use in behaviour change and implementation research *Implementation*
37 598 *Science* 2012;7(37)
- 38 599 23. Sansom A, Donovan J, Sanders C, et al. Routes to total joint replacement surgery:
39 600 patients' and clinicians' perceptions of need. *Arthritis Care and Research*
40 601 2010;62(9):1252-57.
- 41 602 24. Michie S, Johnston M, Abraham C, et al. Making psychological theory useful for
42 603 implementing evidence based practice: A consensus approach. *Qualitative*
43 604 *and Safety in Health Care* 2005;14:26-33. doi: 10.1136/qshc.2004.011155
- 44 605 25. Dobson F, Bennell K, French S, et al. Barriers and facilitators to exercise
45 606 participation in people with hip and/or knee osteoarthritis. *American Journal*
46 607 *of Physical Medicine and Rehabilitation* 2016;95(5):372-89.
- 47 608 26. French S, Green S, O'Connor D, et al. Developing theory-informed behaviour
48 609 change interventions to implement evidence into practice: A systematic

- 1
2
3 610 approach using the Theoretical Domains Framework. *Implementation Science*
4 611 2012;7(38)
- 5
6 612 27. Patey A, Islam R, Francis J, et al. Anaesthesiologists' and surgeons' perceptions
7 613 about routine pre-operative testing in low risk patients: application of the
8 614 Theoretical Domains Framework to identify factors that influence physicians'
9 615 decisions to order pre-operative tests. *Implementation Science* 2012;7(52)
- 10 616 28. Sepucha KR, Mulley AG. Extending decision support: preparation and
11 617 implementation. *Patient Education and Counseling* 2003;50(3):269-71. doi:
12 618 10.1016/s0738-3991(03)00048-x
- 13 619 29. Buenzli P. Codesort software, 2012.
- 14 620 30. Sacks GD, Dawes AJ, Ettner SL, et al. Surgeon Perception of Risk and Benefit in
15 621 the Decision to Operate. *Annals of surgery* 2016 doi:
16 622 10.1097/SLA.0000000000001784
- 17 623 31. Hawker G, Bohm ER, Conner-Spady B, et al. Perspectives of Canadian
18 624 Stakeholders on Criteria for Appropriateness for Total Joint Arthroplasty in
19 625 Patients With Hip and Knee Osteoarthritis. *Arthritis & rheumatology*
20 626 2015;67(7):1806-15. doi: 10.1002/art.39124
- 21 627 32. Teunis T, Janssen S, Guitton TG, et al. Do Orthopaedic Surgeons Acknowledge
22 628 Uncertainty? *Clinical orthopaedics and related research* 2016;474(6):1360-9.
23 629 doi: 10.1007/s11999-015-4623-0
- 24 630 33. Kahneman D. Thinking, fast and slow. New York, USA: Macmillan 2011.
- 25 631 34. Hofestede S, Marang-van de Mheen P, Vliet Vlieland T, et al. Barriers and
26 632 facilitators associated with non-surgical treatment use for osteoarthritis
27 633 patients in orthopaedic practice. *PLoS One* 2016 doi:
28 634 DOI:10.1371/journal.pone.0147406
- 29 635 35. Elwyn G, Rix A, Holt T, et al. Why do clinicians not refer patients to online
30 636 decision support tools? Interviews with front line clinics in the NHS. *BMJ*
31 637 *open* 2012;2(6) doi: 10.1136/bmjopen-2012-001530
- 32 638 36. Tai-Seale M, Elwyn G, Wilson CJ, et al. Enhancing Shared Decision Making
33 639 Through Carefully Designed Interventions That Target Patient And Provider
34 640 Behavior. *Health affairs* 2016;35(4):605-12. doi: 10.1377/hlthaff.2015.1398
- 35 641 37. Weinstein JN, Clay C, Morgan T. Informed patient choice: patient centred valuing
36 642 of surgical risks and benefits. *Health affairs* 2007;26(3):726-30.
- 37 643 38. Lesthaeghe R, Vanderhoeft C. Ready, willing and able: A conceptualization of
38 644 transitions to new behavioral forms. In: Casterline J, ed. Diffusion processes
39 645 and fertility transition: selected perspectives. Washington DC: National
40 646 Academies Press 2001:240-64.
- 41 647 39. Shultz C, Jimbo M. Decision aid use in primary care: An overview and theory-
42 648 based framework. *Family Medicine* 2015;47(9):679-92.
- 43 649 40. Ivers N, Jamtvedt G, Flottorp S, et al. Audit and feedback: effects on professional
44 650 practice and healthcare outcomes (Review). *Cochrane Database of Systematic*
45 651 *Reviews* 2012(6):CD000259.
- 46 652 41. Davis D, Mazmanian P, Fordis M, et al. Accuracy of physician self-assessment
47 653 compared with observed measures of competence: a systematic review.
48 654 *JAMA* 2006;296(9):1094-102.

- 1
2
3 655 42. Emanuel E, Ubel P, Kessler H, et al. Using behavioural economics to design
4 656 physician incentives that deliver high-value care. *Annals of Internal Medicine*
5 657 2016;164:114-19.
6
7 658 43. Arterburn D, Wellman R, Westbrook E, et al. Introducing decision aids at Group
8 659 Health was linked to sharply lower hip and knee surgery rates and costs.
9 660 *Health affairs* 2012;31(9):2094-104. doi: 10.1377/hlthaff.2011.0686
10 661 44. Azjen I, Madden T. Prediction of goal-directed behaviour: Attitudes, intentions
11 662 and perceived behavioural control. *Journal of Experimental Social Psychology*
12 663 1986;22:453-74.
13
14
15 664
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1. Interview Schedule

TDF domain	Questions
Knowledge	<p><i>Evidence from the literature suggests that up to 22 per cent of patients presenting for total knee arthroplasty will not have a clinically meaningful improvement from surgery.</i></p> <ul style="list-style-type: none"> - What do you think about this figure? -How do you interpret the term ‘no clinically meaningful improvement’? <p><i>For the purposes of this interview, we are interpreting clinically meaningful improvement as no improvement in pain, function or QOL following surgery.</i></p> <ul style="list-style-type: none"> - Are you aware of what percentage of patients that you operate on do not benefit from surgery? How do you know this? Do you track it? Would you like to know? How could feed this information back to you? In what format?
Beliefs about capabilities	<ul style="list-style-type: none"> - How confident are you in identifying patients who are unlikely to experience an improvement in symptoms from TKA? - How good do you think you are at it compared to others? - Do you feel you are unsure about identifying these patients at times? If so, what would you do?
Behavioural regulation	<ul style="list-style-type: none"> - Of all the patients referred to you, what is the % of patients that proceed to surgery and how many do you turn away? - What do you do with the ones that don't? Do you refer them somewhere?
Skills	<ul style="list-style-type: none"> - What skills help you decide if someone is likely to benefit from surgery or not? - Are you aware of any tools currently available to help you assess a patients' risk of not responding? Do you use them? Why/ why not?
Beliefs about consequences	<p><i>Based on a set of evidence-based parameters, decision aids can predict the degree of risk that a patient will not achieve a clinically meaningful improvement from TKA</i></p> <ul style="list-style-type: none"> -What do you think the benefits of using a decision aid might be? -What might be the disadvantages of using an aid? - Do you see anything legal or ethical about using a decision aid? -Would the benefits outweigh the potential harms? Why?
Intentions, Goal	<ul style="list-style-type: none"> -Would using a decision aid influence your surgical decision making? Why/why not?

Reinforcement	-What would motivate you to use a decision aid? -Would you need to be presented with evidence from the literature? How would this evidence be best delivered? Who would it need to be delivered by?
Environmental context and resources	-What would facilitate the use of a decision aid for you? -How would it best be packaged? -When do you think it would be best used? Do you think you are the best person to use it?
Decision process	-If a decision aid predicted that patient had a 50 per cent risk of not benefiting from surgery would you still operate? What about a 70 per cent risk? What would your level of acceptable risk be?
Social/Professional role and identity	-Do you think there would be agreement between surgeons on this cut point?
Social/Emotional influences	-What if something like this tool became compulsory – how would you feel? How do you think other surgeons would feel? -How do you think patients would respond? Would their response influence your use of an aid? -Would you worry about missing potential candidates who might have responded to surgery?
Optimism	-How optimistic are you that a decision aid will reduce the rate of surgery in patients who are at high risk of not benefiting from surgery?

Table 2. Findings summary

Relevant TDF Domains	Specific Belief	Facilitator or barrier	Example quote (participant code)	Frequency out of 20
Knowledge	I am aware of the literature that up to 20 per cent of patients do not have a CMI from TKA	Facilitator	“I think 22 per cent is the high end. But there are a lot of different papers that all suggest 10,15,20 per cent” (012)	19
	I think that this % is lower in my patients	Barrier	“I don’t count it, but I think around 10 per cent would be saying they aren’t entirely satisfied by surgery” (016)	17
	Any improvement in pain is still an improvement, it depends how you define ‘meaningful’	Barrier	“If the surgery is done for the right reason, the pain would decrease, the question is whether the decrease would be 10, 50 or 100 per cent depending on whether there are other reasons for the pain. But there would be an improvement” (025) “To me a good result is: they are going to have some intermittent ache in the knee, they’re not going to be able to kneel or squat. Others on some assessment scale might consider that a failure. So you have get those parameters right” (010)	7
Behavioural regulation	I am aware that the feedback I get from my patients may be biased	Facilitator	“To please you, patients often say it is doing better than it really is. So I would think my outcomes are better than 20 per cent, but I am aware of the glasses that I see it through as well as what patients might tell me” (014)	6
	I would be interested in	Facilitator	“There’s always a difference between how well you think you are doing and how you <i>are</i> doing. Having	20

	feedback on the percentage of my patients who achieve a clinically meaningful improvement		<p>formal feedback on patient outcomes gives you the opportunity to change things if you are not doing as well as you want to” (023)</p> <p>“What I would like to know is the patient who overall is unhappy with their results and didn’t get the result they expected” (010)</p> <p>“I would like feedback on the number of patients who are in each category of satisfaction and I would like to see how my personal results are compared to the group” (016)</p>	
Memory, attention and decision processes	Patient expectations are an important consideration in surgical decision making	Facilitator	“If the patients’ expectations are not meeting mine, I won’t do the operation because then the patient isn’t happy and sometimes they have 2/10 pain and they are not happy. And that is silly. So it is about telling the patient what they can expect and after the operation it is about ”you remember what we said” (013)	20
	The lack of effective non-operative alternatives influences my surgical decision making	Barrier	<p>“You have to be able to say ‘although we don’t think you would benefit from surgery, we’re going to put you in this intense physiotherapy program with dieticians to improve your knee pain. They need to be offered something. The problem is these things are available at an individual component level ... but I don’t think there is anything formally put in place that patients can be referred from arthroplasty clinics into these programs” (029)</p> <p>“Well if you make an alternative plan and say we are not going to do surgery we are going to lose weight, do some physiotherapy, take pain killers, you send them off and they come back and say they have done all of</p>	12

			<p>that. It means you don't have another option to offer them and those patients often just want an option and if there is an option you can give them it is easier to push them away from surgery" (016)</p> <p>"I think there are limitations on what you can improve with non-operative measures" (016)</p>	
	My threshold of acceptable risk for surgery is >80% likelihood of good outcome	Facilitator	"You have got to be 95 per cent and above. I wouldn't accept anything less than that. I wouldn't offer the operation. It is too big an operation, to bigger deal, too bigger cost" (024)	8
	My level of acceptable risk is patient dependent	Facilitator (of shared decision making)	<p>"It is all about risk for reward. When you think about... the person is not unwell, they can safely have an anaesthetic, even risks as high as 50 per cent one in two that the patient will have no benefit, are worth considering...A patient may be so severely impacted that a 1 in 2 shot is worth it...it is totally patient dependent" (023)</p> <p>"I would rather a 10 per cent chance of getting better than sitting in a wheelchair in a lot of pain" (022)</p>	11
Beliefs about capabilities	I find it difficult to assess the patient-related factors that can influence TKA outcome	Facilitator	<p>"It is patient factors more than anything else. Because it is easy to look at xrays and say K-L, 1, 2, 3, 4 for disease severity. There's not much argument over that. It's about the patient factors, the psychology and behavioural aspects of it which you want reassurance for" (016)</p> <p>"Obviously I am not very good because 1 in 5 come back with a problem... so no I didn't know how to</p>	8

			identify them pre-operatively. Something is happening from my assessment to the patients' outcome and I don't know what the link is" (024)	
	I am reasonably good at picking the patients who will do well	Barrier	"I think I am reasonably good... I do have a little bit of a gut feeling about patients" (013)	12
	It can be difficult to say no to patients	Facilitator	"Most of the time if we bring a patient to the case conference it is to get the support of everyone else to say no don't do it. Because if want to do the operation, you just go ahead and do it. If you don't want to do it and you want support that is when you take them along" (016) "It is always easier to consent than decline" (025)	5
Skills	I mostly rely on my experience when it comes to surgical decision making	Barrier	"You spend all your life looking at patients and assessing them and you start to develop a bit of a gut feeling as to what might be happening. Sometimes you sit in front a patient and think: I know you are telling me this, but I know something else is happening" (015) "I don't use any formal tools. I use I guess old fashioned clinical acumen is what I would call it...I have been doing this for a while and you develop a way of assessing people" (028)	10
Social/professional role and identity	Surgery is an art and a science – it is not just about the evidence"	Barrier	"The human body is not a scientific machine. Medicine is an art and science and the art isn't always represented in the research" (028) "I think that medicine is not about numbers, it is about patients. Each patient has their own different	10

			pathology and own different personality" (017)	
Beliefs/attitudes towards a decision aid				
Intention	I would use a decision aid to support, not replace my decision-making	Facilitator	<p>"I don't think it would really influence my surgical decision making, I think it would more affirm my decision to not offer a patient an operation" (029)</p> <p>"If I think they are ok and they score badly I will relook at it and say why is that? Am I missing something obvious? But at the end of the day if an aid says one thing and my sniff test says there is something not right, I'm still following my nose" (010)</p>	16
Beliefs about consequences	I think a decision aid would be a useful objective tool to help me say no to patients	Facilitator	<p>"It would be clinically helpful in the patient cohort who we don't think will do well from surgery, giving us an evidenced based approach for saying this is the reasons why we don't think you will benefit from surgery" (029)</p> <p>"I think that the main benefit of an aid would be making the patient understand if I am saying no to the surgery it's not because I don't like him or her, it is because there is data written black on white that they are not going to do well. ..It will not just be my gut feeling. I can give them data and say "sorry it is written here. It's not me it's the computer. So it backs up what I am saying" (013)</p>	9
	I think an aid would be useful for gaining patient informed consent	Facilitator	"I think that is one of the important things about a decision aid and part of the consent process is that they know what to expect and it is still the patients decision to decide if they want to have surgery or not, but they	10

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

	and shared decision making		<p>have to be appropriately informed and have the appropriate expectations to weigh up the risk and benefit” (019)</p> <p>“It comes back down to getting patient consent, as part of that I would incorporate it into my consent form and say preoperatively you have a 50:50 chance and that has been discussed with a validated tool” (021)</p>	
	I think a decision aid has the potential to improve the use of resources and save costs	Facilitator	“If you could use a decision aid to triage patients and push them somewhere else, it would be more effective for the patient and there would be cost savings for the hospital and the community” (016)	7
	A disadvantage of a decision aid is that it may not capture the nuances of the individual patient and some patients may miss out on surgery	Barrier	“There are always reasons why people will fall on one side of the line or the other and the data will show that the tool might predict you will do really well but you happen to fall in that small group who are set to do really well but don’t, similarly the tool might say you will do really badly we better not operate on you but someone took the punt and you turned out really well so there are always those smaller groups and at times it is possible for the tool to miss certain nuances” (015)	13
	I have concerns about the legal/ethical implications of a decision aid	Barrier	<p>“You have to think of the medico-legal implications of a patient having a risk value documented in their notes. If they don’t have a good result and then lawyers look through and say you had this validated tool and you still went ahead, where would we lie medico-legally?” (024)</p> <p>“I guess the ethicists would say you are denying patient-centred care, so that is where there is a potential for a can of worms” (021)</p>	8

Environmental context and resources (how the tool might be implemented)	I would not like to see a decision aid with mandatory cut-offs implemented	-*	<p>“I don’t think there are things that can become compulsory in terms of a decision aid as I mentioned because it takes away patient-centred care” (025)</p> <p>“No you can’t make anything compulsory like that. Not in medicine. Medicine is not black and white, it is grey, you can never make anything compulsory because a surgeon will operate according to their experience” (024)</p> <p>“Surgeons wouldn’t care if it was compulsory to use an aid, as long as they didn’t have to do any work. Making it compulsory to follow it would be dangerous. Because we’re all individuals, what you are doing is taking the human experience aspect of the consultation out and then you turn us into proceduralists that just look at a tick box and operate on someone” (016)</p>	17
	I don’t think surgeons could ever agree on a cut-off level on a decision aid	-*	<p>“A lot of surgeons would say in their hands they will get better results, that is just an inherent bias associated with surgical procedures and surgeons themselves so it would be hard to agree on a level” (019)</p> <p>“Unless you can clearly demonstrate a certain cut-off does better, so until there is almost black and white there will be some shades of grey and surgeons will differ in those shades of grey. And even if there is evidence you will still get surgeons that will reject it. That is just my feeling” (021)</p>	17
	I could see an electronic or online	Facilitator	“I can imagine something working on the phone, just an app. Simple and intuitive so you put in a little info -	6

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49

	tool working well in my practice		BMI, age, degree of arthritis etc.. tick tick tick. And then it gives you the number, bang.” (013) “A lot of patients look on my website. You could have a thing on your website saying: ‘sometimes patients with certain problems may not be appropriate for a TKA, this test can give you a rough idea of your likely success rate’. You could put it out there before they even come to see you. ‘Is this operation for you?’ type of thing” (028)	
	Time would be a key concern to using a decision aid in my practice	Barrier	“I just couldn’t use a tool that is going to take up more time. There is already so much demands on our time and there is not enough time as it is. So the tool may only take 5 minutes but then you add 4, 5, 6 patients and that is half an hour extra of your time that you didn’t have” (022) “It is frantic getting patients through and there is always that rush to see all the patients in a really short time and to spend 5-10 minutes to do a questionnaire with a patient... it is hard to justify that. But if there was something validated and it was done as a routine process, the patient came in with a form filled out with a score that would be really nice” (016)	6
Reinforcement	Evidence that tool had been widely validated would not convince me to use it. I would need to correlate it with my own clinical decision making	-*	“I never trust evidence because you only have to go to Dr x ...even in research, there is a lot of doubtful stuff. You’ve got to be careful about basing something totally on results. I know we have got to be evidenced-based but the evidence may apply to a certain situation in a certain individual at a period in time and there is always variations or exceptions around that. So I would try and correlate them in my own mind and if	9

			<p>after a while I am seeing well that person is a bit odd and they are scoring badly on the aid, well ok, this has legs.” (010)</p> <p>“I trust [the research] but I want my data no doubt about it because I think I am better... I know lots of faults in techniques or little things that really can comprise outcome. So everyone has a different hand and surgery is very touchy practice.... So I believe what happens around but at the same time I want mine as well because I know what I do differently or I am more careful about” (013)</p>	
	I would be more likely to trust a tool developed and implemented by my peers	Facilitator	<p>“If a decision aid is implemented and I see my colleagues implementing it and it is working in their hands then possibly that would convince me” (024)</p> <p>“I think people are mistrustful of things that come out of other institutions but I would trust that a study from [the Department] would be a rigorous design. Where people are invested in something, they’re much more likely to use it. If the results showed an aid was valid, I guess I would be prepared to try it and see whether I thought it was valid in my hands, in my practice” (026)</p>	4
Goals	My goal is to optimise patient outcomes	Facilitator	“Certainly, surgeons want results. If you say you are going to reduce our risk, then why wouldn’t we be happy with that” (012)	20

* (-) denotes that the belief may be either a facilitator or barrier depending on how an aid is implemented

Table 3. Supporting extracts

Quote number	Quote (Participant code)
Q1	“Ultimately, we will always do our best for the patient” (024)
Q2	“I don’t count it, but you get an impression. Around 10 per cent of my patients would be saying they are not entirely satisfied by surgery” (016)
Q3	“Often, to please you, patients say that it is doing better than it really is. So I would think my outcomes are better than 20 per cent, but I am aware of the glasses that I see it through as well as what patients might tell me” (014)
Q4	“There’s always a difference between how well you are doing and how well you think you are doing. Having formal feedback on patient outcomes gives you the opportunity to change things if you are not doing as well as you want to” (023)
Q5	“If patients choose not to come back, the only way you have got to track them is looking at your results from the registry. But I want to know the answers to the clinical questions – are you happy? Is your pain better than it was pre-op? How you ask the question matters” (028)
Q6	“If you received feedback that the rate of clinically meaningful improvement reported by your patients is not as high as you think it should be, you have to look at whether you are not picking the right patients, or you are operating on patients that are not going to do well. I think it would be more likely to be the way the question is asked. I would want to check who is asking the questions, what they are asking and how they are asking it” (023)
Q7	“To me a good result is: they are going to have some intermittent ache in the knee, they are not going to be able to kneel or squat, they are going to be aware that it is there. That to me is a good result. Now others on some assessment scale they might say well that is in our system considered a failure thing, so you have get those parameters right” (010)
Q8	“At the end of the day if there is a pathology that can be deleted by surgery and the patient accepts some improvement then that means that the surgery will happen” (025)
Q9	“If the patients’ expectations are not meeting mine, I won’t do the operation because then the patient isn’t happy and sometimes they have 2/10 pain and they are not happy” (013)
Q10	“It is patient factors more than anything else. Because it is very easy for me to look at xrays and use the Kellgren-Lawrence scale: 1, 2, 3, 4 for disease severity. There is not much of an argument over that. It is about the patient factors, the psychology and behavioural aspects of it which is more what you want reassurance for” (016)
Q11	“You spend all your life looking at patients and assessing them and you start to develop a bit of a gut feeling as to what might be happening when you sit in front of a patient and you might be saying you know you are telling me this but actually I know something else is happening” (015)
Q12	“I don’t think it would really influence my surgical decision making, I think it would more affirm my decision to not offer

	a patient an operation” (029)
Q13	“If I think they are OK and they score badly I will relook at it and say why is that? Am I missing something obvious? But at the end of the day if the tool says one thing and my sniff test says there is something not right, I am still following my nose” (010)
Q14	“Not every tool is perfect and it may not capture every patient... the danger is we may end up refusing to do something because of this tool and therefore the patient may not receive the appropriate treatment based on a decision aid and nothing is 100% so you have to expect some patients would fall through the cracks” (019)
Q15	“I think people are mistrustful of things that come out of other institutions but I would trust that a study from [the Department] would be a rigorous design. Where people are invested in something, they are much more likely to use it. If the results showed the tool was valid, I guess I would be prepared to try it and see whether I thought it was valid in my hands, in my practice” (026)
Q16	“I never trust evidence because you only have to go to Dr x ...even in research, there is a lot of doubtful stuff and you have got to be careful about basing something totally on results. I know we have got to be evidenced based but the evidence may apply to a certain situation in a certain individual at a period in time and there is always variations or exceptions around that. So I would try and correlate them in my own mind and if after a while I am seeing well that person is a bit odd and they are scoring badly on that, well ok, this has legs.” (010)
Q17	“I think that the main benefit of a tool would be making the patient understand if I am saying no to the surgery it is not because I don’t like him or her, it is because there is data written black on white that they are not going to do well...It will not just be my gut feeling. I can give them data and say ”sorry it is written here. It is not me it is the computer. So it backs up what I am saying” (013)
Q18	“It comes back down to getting patient consent, as part of that I would incorporate it into my consent form and say preoperatively you have a 50:50 chance and that has been discussed with a validated tool. If the patient wishes to go ahead, they can make that informed decision” (021)
Q19	“A patient may be so severely impacted that a 1 in 2 shot is worth it...it is totally patient dependent” (023)
Q20	“You have got to be 95% and above. I wouldn’t accept anything less than that. I wouldn’t offer the operation. It is too big an operation, too big a deal, too big a cost” (024)
Q21	“You have to think the medico-legal implications of a patient having a risk value documented in their notes. If they don’t have a good result and then some have the lawyers look through and say you had this tool that was validated and you still went ahead where would we lie medico-legally?” (024)
Q22	“I guess the ethicists would say you are denying patient-centred care, so that is where there is a potential for a can of worms” (021)
Q23	“I don’t think it can become compulsory because it takes away patient-centred care” (025)

Q24	“If you could use the tool to triage patients and push them some where else, it would be more effective for the patient and there would be cost savings for the hospital and the community” (016)
Q25	“You have to be able to say: ‘although we don’t think you would benefit from surgery, we are going to put you in this intense physiotherapy program with dieticians and this is how we are going to improve your knee pain’. They need to be offered something. The problem is these things are available at an individual component level - we have got dieticians and physiotherapists and exercise groups, but I don’t think there is anything formally put in place that patients can be referred from arthroplasty clinics into these programs” (029)
Q26	“A lot of surgeons would say in their hands they will get better results, that is just an inherent bias associated with surgical procedures and surgeons themselves so it would be hard to agree on a level” (019)
Q27	“Well compulsory to have it? Ok. That would be easy to do and surgeons wouldn’t care as long as they didn’t have to do any work. Making it compulsory to follow it would be dangerous. Because we are all individuals, what you are doing is taking the human experience aspect of the consultation out and then you turn us into proceduralists that just look at a tick box and operate on someone” (016)
Q28	“I can imagine something working on the phone, an app. It needs to be simple and intuitive - so you put in a little info - BMI, age, degree of arthritis etc,.. tick tick tick. And then it gives you the number, bang” (013)
Q29	“I think it is something that should be done by the surgeon. It is also part of the process where the surgeon gets to know the patient as well - not just their xrays and physical examination but also their psychosocial situation” (019)
Q30	“I would want the tool to be applied within the consultation. Because I would never believe a value until I have seen the person. Because we might just have one of those weird situations that fall out of the ‘normal’ range.” (010)
Q31	“When you have got 10 minutes for a consultation you don’t have time to spend another 10 minutes going through the tool. So it would have to be either the patient themselves or secretarial person prior to the consultation” (012)
Q32	“I have a lot of patients look me up on my website. You could have a thing on your website saying: ‘sometimes patients with certain problems may not be appropriate for a TKA, this test can give you a rough idea of your success rate’. You could put it out there before they even come to see you. ‘Is this operation for you?’ type of thing” (028)

Appendix 1. Theoretical Domains Framework definitions for coding

TDF Domain	Description
Knowledge	<p><i>An awareness of the existence of something</i></p> <ul style="list-style-type: none"> - Awareness of scientific rationale regarding patients at risk of no clinically meaningful improvement from surgery - Awareness of own percentage of patients who don't respond - Awareness of decision aids to assist in identifying surgical candidates
Skills	<p><i>An ability or proficiency acquired through practice</i></p> <ul style="list-style-type: none"> - Ability required/acquired through practice/experience to help decide if a patient is likely to benefit from surgery or not - Use of tool to assist in identifying suitable candidates for surgery
Social/ Professional role/identity	<p><i>A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting</i></p> <ul style="list-style-type: none"> - Surgeons' expressions about their own professional identity/job/role/professional boundaries when managing a person at high risk of no clinically meaningful improvement
Beliefs about capabilities	<p><i>Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use</i></p> <ul style="list-style-type: none"> - The surgeon's confidence that they can identify patients at risk of no clinically meaningful improvement and can employ the skills needed to refuse to operate on the patients
Optimism	<p><i>The confidence that things will happen for the best, of that desired goals will be attained</i></p> <ul style="list-style-type: none"> - The confidence expressed that a decision aid will reduce the rate of surgery in patients at high risk of no clinically meaningful improvement
Beliefs about consequences	<p><i>Acceptance of the truth, reality or validity about outcomes of a behaviour in a given situation</i></p> <ul style="list-style-type: none"> - Perceptions about outcomes, advantages and disadvantages of using a decision aid - Any legal or ethical concerns about using a decision aid
Reinforcement	<p><i>Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus</i></p> <ul style="list-style-type: none"> - What incentives would influence the surgeon using a decision aid
Intentions	<p><i>A conscious decision to perform a behaviour or a resolve to act in a certain way</i></p> <ul style="list-style-type: none"> - Intentions to use a decision aid
Goals	<p><i>Mental representation of outcomes or end states that an individual wants to achieve</i></p>
Memory, attention and decision processes	<p><i>The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives</i></p> <ul style="list-style-type: none"> - The processes involved and factors taken into account when the surgeon makes decisions about whether to operate or not - If the surgeon surgical decision making will be influenced by the decision aid - Surgeon's perceptions of acceptable levels of risk
Environmental context and resources	<p><i>Any circumstance of a person's situation or environment that discourage or encourage the development of skills and abilities, independence, social competence and adaptive behaviour</i></p> <ul style="list-style-type: none"> - Availability of, and confidence in, non-operative alternatives

	<ul style="list-style-type: none"> - Public versus private differences - How a decision aid might best be packaged/implemented - Attitudes towards mandating use of a decision aid - How surgeons can agree on level of acceptable risk with decision aid
Social influences	<p><i>Those interpersonal processes that can cause an individual to change their thoughts, feelings or behaviours</i></p> <ul style="list-style-type: none"> - The influences that other surgeons have on surgeon decision to operate or not - The influences patients have on surgeon decision to operate or not - How the surgeon believes patients might respond to the use of a decision aid
Emotion	<p><i>A complex reaction pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event</i></p> <ul style="list-style-type: none"> - The emotional responses of the surgeon to using a decision aid
Behavioural regulation	<p><i>Anything aimed at managing or changing objectively observed or measured actions</i></p> <ul style="list-style-type: none"> - Consistency of decisions to operate or not in patients at high risk of not responding - Processes that help regulate behaviour

SUPPLEMENT 1: COREQ 32-ITEM CHECKLIST

Tong A, Sainsbury P, Craig J. (2007) Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Healthcare*: 19:349 – 357

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
1. Inter viewer/facilitator	Which author/s conducted the interview?	7
2. Credentials	What were the researcher's credentials?	7
3. Occupation	What was their occupation at the time of the study?	7
4. Gender	Was the researcher male or female?	7
5. Experience and training	What experience or training did the researcher have?	7
6. Relationship with participants established	Was a relationship established prior to study commencement?	7
7. Participant knowledge of the interviewer	What did the participants know about the researcher?	7
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator?	7
Domain 2: study design		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study?	8
10. Sampling	How were participants selected?	6
11. Method of approach	How were participants approached?	6
12. Sample size	How many participants were in the study?	10
13. Non-participation	How many people refused to participate or dropped out? Reasons?	10
14. Setting of data collection	Where was the data collected?	7
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	7
16. Description of sample	What are the important characteristics of the sample?	10
17. Interview guide	Were questions, prompts, guides provided by the authors?	Table 1
18. Repeat interviews	Were repeat interviews carried out?	7
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	7
20. Field notes	Were field notes made during and/or after the inter view?	7
21. Duration	What was the duration of the interviews	7
22. Data saturation	Was data saturation discussed?	7
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	8
Domain 3: analysis and findings		
24. Number of data coders	How many data coders coded the data?	8, 9
25. Description of the coding tree	Did authors provide a description of the coding tree?	Additional file 1
26. Derivation of themes	Were themes identified in advance or derived from the data?	8, 9
27. Software	What software, if applicable, was used to	8

	manage the data?	
28. Participant checking	Did participants provide feedback on the findings?	8
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified?	Table 3
30. Data and findings consistent	Was there consistency between the data presented and the findings?	11-22 and Table 3
31. Clarity of major themes	Were major themes clearly presented in the findings?	11-22 and Table 3
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	19, 22, 23 and Table 3