

1 **Title**

2 A Qualitative Exploration of Two Risk Calculators Using Video-Recorded NHS Health Check
3 Consultations

4

5 **Authors**

6 Victoria Riley*, Staffordshire University, Brindley Building, Leek Road, Stoke-on-Trent, ST4 2DF,
7 victoria.riley@staffs.ac.uk

8 Naomi J. Ellis, Staffordshire University, Brindley Building, Leek Road, Stoke-on-Trent, ST4 2DF,
9 n.j.ellis@staffs.ac.uk

10 Lisa Cowap, Staffordshire University, Brindley Building, Leek Road, Stoke-on-Trent, ST4 2DF,
11 l.cowap@staffs.ac.uk

12 Sarah Grogan, Manchester Metropolitan University, Manchester Campus, Bonsall Street,
13 Manchester, M15 6GX, s.grogan@mmu.ac.uk

14 Elizabeth Cottrell, Keele University, Keele, Newcastle-under-Lyme, ST5 5BG, e.cottrell@keele.ac.uk

15 Diane Crone, Cardiff Metropolitan University, Cyncoed Campus, Cyncoed Road, Cardiff, CF23 6XD,
16 dmcrone@cardiffmet.ac.uk

17 Ruth Chambers, Stoke-on-Trent Clinical Commissioning Group, Smithfield One Building, Stoke-on-
18 Trent ST1 4FA, Ruth.Chambers@stoke.nhs.uk

19 David Clark-Carter, Staffordshire University, The Science Centre, Leek Road, Stoke-on-Trent, ST4 2DF,
20 d.clark-carter@staffs.ac.uk

21 [Sophia Federowicz, Staffordshire University, Brindley Building, Leek Road, Stoke-on-Trent, ST4 2DF,](mailto:Sophia.Federowicz@staffs.ac.uk)
22 f010904a@student.staffs.ac.uk

23 Christopher J. Gidlow, Staffordshire University, Brindley Building, Leek Road, Stoke-on-Trent, ST4
24 2DF, c.gidlow@staffs.ac.uk

25

26

27 *Corresponding author

28

29 **Abstract**

30 *Background:* The aim of the study was to explore practitioner-patient interactions and patient
31 responses when using QRISK®2 or JBS3 cardiovascular disease (CVD) risk calculators. Data were from
32 video-recorded NHS Health Check (NHSHC) consultations captured as part of the UK Risk
33 COmmunication (RICO) study; a qualitative study of video-recorded NHSHC consultations from 12
34 general practices in the West Midlands, UK. Participants were those eligible for NHSHC based on
35 national criteria (40-74 years old, no existing diagnoses for cardiovascular-related conditions, not on
36 statins), and practitioners, who delivered the NHSHC.

37 *Method:* NHSHCs were video-recorded. 128 consultations were transcribed and analysed using
38 deductive thematic analysis and coded using a template based around Protection Motivation
39 Theory.

40 *Results:* Key themes used to frame the analysis were Cognitive Appraisal (Threat Appraisal, and
41 Coping Appraisal), and Coping Modes (Adaptive, and Maladaptive). Analysis showed little evidence
42 of CVD risk communication, particularly in consultations using QRISK®2. Practitioners often missed
43 opportunities to check patient understanding and encourage risk- reducing behaviour, regardless of
44 the risk calculator used resulting in practitioner verbal dominance. JBS3 appeared to better promote
45 opportunities to initiate risk-factor discussion, and Heart Age and visual representation of risk were
46 more easily understood and impactful than 10-year percentage risk. However, a lack of effective
47 CVD risk discussion in both risk calculator groups increased the likelihood of a maladaptive coping
48 response.

49 *Conclusions:* The analysis demonstrates the importance of effective, shared practitioner-patient
50 discussion to enable adaptive coping responses to CVD risk information, and highlights a need for
51 effective and evidence-based practitioner training.

52 *Trial registration:* ISRCTN ISRCTN10443908. Registered 7th February 2017

53 **Keywords:** Cardiovascular disease; risk communication; NHS Health Check; chronic disease
54 prevention.

55

56

57

58

59

60

61

62

63

64

65

66

67 **Background**

68 Cardiovascular disease (CVD) is the leading cause of death worldwide, accounting for one in four
 69 deaths in England (1). NHS Health Check (NHSHC) is a national programme designed to screen CVD
 70 risk, facilitate early diagnosis and reduce health inequalities (2). All eligible adults, aged 40-74 years,
 71 should be invited for NHSHC where CVD risk is assessed based on several risk factors (e.g., blood
 72 pressure and cholesterol). Best practice guidance suggests a patient should be given appropriate CVD
 73 risk management advice following effective risk communication (3). However, information on the
 74 nature and quality of the consultation is scarce. Insight is limited to patient and practitioner
 75 experiences (4), which do not provide a complete understanding of patient-practitioner interactions
 76 within the NHSHC.

77 Communicating risk is challenging (6) and differs according to patient understanding, numerical
 78 literacy, and personality traits (7). Further, emotional responses to risk and the resulting influence on
 79 health behaviour varies between patients (8–11). If delivered sub optimally, risk communication can
 80 increase anxiety and reduce confidence in health professionals (12). Effective risk communication can
 81 improve knowledge, empower and create autonomy (13–15). Within NHSHC, 10-year percentage is
 82 calculated and communicated to patients using a prediction algorithm, QRISK®2 [with current
 83 transference to QRISK®3 (16)], which is populated from new and pre-existing data within the patient’s
 84 record. However, most younger eligible adults are predisposed to a lower CVD risk which can lead to
 85 false reassurances (17,18), misinterpretation (5,19–22), and poor patient recall and confusion (23).
 86 The 2014 JBS risk calculator (JBS Board, 2014) includes Heart Age (25–28) and 10-year percentage
 87 risk, but primarily focuses on lifetime risk of CVD events through CVD event-free survival (Table 1). It
 88 also presents information using multiple visual displays (Table 1) (6) and a function to manipulate the
 89 scores to show how risk-factor modification affects overall risk (e.g., smoking cessation). Whilst there
 90 is some evidence to suggest that lifetime risk, Heart Age and visual displays may be more effective
 91 during the communication of risk (27–36), until recently, no research has compared the efficacy of
 92 JBS3 and QRISK®2 for communicating risk in NHSHC.

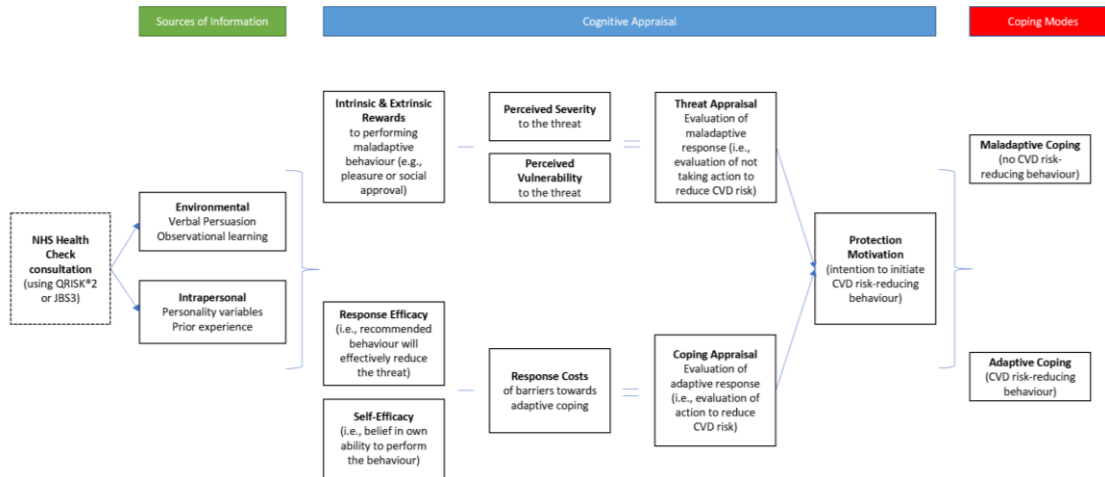
93

94 Table 1. Features available in each of the risk calculators included in the study

Risk Calculator	Absolute risk (10-year percentage risk)	Relative risk	Heart Age	CVD Event-Free Survival Age	Icon Arrays	Thermometer scale	Visual Analogue Scale	Bar Chart	Line Graph	Risk Modification Function
QRISK®2	✓	✓	✓		✓					
QRISK®2 +Informatica	✓	✓	✓		✓	✓		✓		✓
JBS3	✓		✓	✓	✓		✓	✓	✓	✓

95

96 Patient-practitioner interactions are complex (37,38), yet application of theories such as Protection
 97 Motivation Theory (PMT; 37) have shown how fear of threat can translate in to health-protective
 98 behaviour (39). Within PMT, the intention to engage in health-protective behaviour is influenced by
 99 an individual’s cognitive appraisals (Fig 1). CVD risk information presented in an NHSHC can feed into
 100 such appraisals, either threat appraisal (risk of CVD), or coping appraisal (consequences of undertaking
 101 positive behaviour change).



102

103 Fig 1. Protection Motivation Theory model adapted to proposed study context (39)

104

105 Threat appraisal focuses on the source of the threat (CVD risk) and evaluates the probability of a
 106 maladaptive response (i.e., behaviours that inhibit patients’ ability to adjust to the threat). It considers
 107 patients’ perceived severity of CVD risk, the consequences of CVD, perceived vulnerability to future
 108 CVD and intrinsic and extrinsic rewards for not addressing CVD risk [i.e., perceived benefits of not
 109 acting to manage or reduce risk (maladaptive response)]. Coping appraisal evaluates the adaptive
 110 coping responses available to the patient to deal with the threat (i.e., evaluation of ways to reduce
 111 CVD risk). This includes patients’ perceptions of self-efficacy to engage in adaptive coping,
 112 practitioners’ promotion of self-efficacy through individualisation, perceived response efficacy of
 113 adaptive coping, and response cost of adaptive coping (Figure 1). Both are influenced by intrapersonal
 114 (e.g., prior experience of both positive (adaptive) and negative (maladaptive) behaviours) and
 115 environmental variables (e.g., persuasive communication) (41). For NHSHC, PMT highlights the
 116 practitioners’ key role in providing information on CVD risk whilst taking into account a patients’
 117 experience, priorities and beliefs to encourage engagement in risk-reducing behaviours (42).

118 The Risk COmmunication in NHSHC (RICO) study involved analysis of video-recorded NHSHC
 119 consultations (43). Analysis of quantitatively characterised content of consultations found that
 120 compared with JBS3 consultations, those using QRISK®2 were shorter, more verbally dominated by
 121 practitioners and involved less discussion of CVD risk (44). This provided the first insight from objective
 122 data on the nature and content of NHSHC consultations, with comparison between risk calculators.
 123 But the need for more in-depth qualitative analysis, to explore the quality of interactions around CVD
 124 risk and how this differs by CVD risk calculator, was clear. This paper uses deductive thematic analysis
 125 on a sample of video-recorded consultations, from the RICO study, which aimed to: explore how
 126 practitioners use QRISK®2 and JBS3 to communicate CVD risk in the consultation; explore how patients
 127 respond to risk information.

128

129 **Methods**

130

131 **Design**

132 The RICO study sought to explore the perception and understanding of CVD risk from both patients
133 and practitioners, when using the JBS3 or QRISK®2 calculator, the practitioners' associated advice or
134 offer of treatment and the patients' response. Information regarding the overall study, including
135 recruitment and data collection is available (43). In this report, we focus on qualitative deductive
136 analysis of video-recorded NHSHC consultations.

137

138 **Participants and Recruitment**

139 A detailed description of patient and public engagement along with participant and practice
140 recruitment is available elsewhere (44). To summarise; data were collected from general practices
141 (n=12) located in the West Midlands of England (Jan-17 to Feb-19), supported by the Clinical Research
142 Network West Midlands. Practices were matched in pairs, based on deprivation, and assigned to usual
143 practice (communicated CVD risk using QRISK®2) or intervention (communicated CVD risk using JBS3).
144 Two practices in the QRISK®2 group used Informatica (supplementary software within in the NHSHC
145 template that includes Heart Age and risk manipulation similar to JBS3; Table 1); data were included
146 in the analysis as this was felt representative of 'usual care'. Quotations from the transcripts from
147 these practices are referred to as 'QRISK®2+Informatica'. Only patients who were eligible for an
148 NHSHC, based on national criteria, were included in the study (45). Postal invitations included a
149 participant information sheet and were stratified based on gender, age and ethnicity for each practice.
150 Practitioners were already employed by the practice (8 Health Care Assistants (HCAs), 6 Practice
151 Nurses, 1 Sister) and all but one practitioner already had experience of delivering NHSHC as part of
152 their job role (a HCA who was new to NHSHC delivery; 1-2 weeks prior to study commencement).

153 In total, 175 video-recorded NHSHCs were conducted (range 6.8 to 38 minutes), reduced to 173
154 following screening of data (JBS3=100; QRISK®2=73; practitioner error resulted in 2 exclusions). To
155 define the sample for qualitative analysis, a further 21 Health Checks were excluded for reasons
156 including: projected (not actual) risk score communicated (n=7), no discussion of risk (n=2), no
157 communication of lifetime risk (n=4), incorrect use of JBS3 (n=6), insufficient use of English language
158 (n=2). Of the remaining sample (n=154), 64 Health Checks included communication of CVD risk using
159 QRISK®2. Therefore, 64 NHSHC using JBS3 were identified, matched on patients' gender, ethnicity and
160 CVD risk score (Table 2), giving a sample of 128 for analysis.

161

162 **Procedure**

163 Practices video-recorded NHSHCs, communicating CVD risk using QRISK®2 or JBS3 (following both
164 patient and practice consent). All consultation dialogue was transcribed verbatim.

165

166 **Analysis**

167 Data were analysed using deductive thematic analysis (46,47) using a coding template based around
168 Protection Motivation Theory (PMT; 37) (Supplementary Material 1). Each transcript was uploaded to
169 QSR International's NVivo 12 qualitative data analysis software (51). This allowed for interpretation of
170 how QRISK®2 and JBS3 were used to communicate risk in the context of PMT components (e.g., verbal
171 persuasion, influencing patient prior beliefs and priorities; and how patients respond, which will
172 reflect the nature of their appraisal within the consultation).

173 Initially, 14 transcripts were inductively coded independently by two Caucasian female researchers,
 174 experienced in qualitative research, a senior researcher (LC; DPsych) and research associate (VR;
 175 MSc). The senior researcher (LC) had previous research experience related to children’s healthy
 176 eating whilst the research associate (VR) had previous research experience in risk communication in
 177 NHSHC. This was to check the application of PMT to NHSHC consultations and agree coding between
 178 the researchers. Following inductive coding, 13 new codes were added to the framework (e.g.,
 179 medical history, clarification of results). The final version of the coding template shows how
 180 elements of the PMT were classified including code definitions and examples from the NHSHC
 181 consultations (Supplementary Material 2). The remaining 114 transcripts were individually coded by
 182 LC and VR; two in every 20 transcripts were independently dual-coded to check reliability using
 183 Kappa coefficients for each NVivo node within the PMT framework (i.e., 19th, 20th, 39th, 40th, 59th,
 184 60th etc). Reliability ranged from .48 to .71 over the five reliability checks conducted, indicating fair
 185 to good reliability (52). Data saturation was considered reached at the point of completion of coding.

186 Subsequent analysis of codes was led by SF (Researcher; MSc) (supported by SG, CG, NE and VR) to
 187 identify codes for key elements of the PMT model, splitting the consultations into two groups
 188 (QRISK[®]2 and JBS3). Specific parts of transcripts that illustrated the practitioner communicating CVD
 189 risk to the patient and patient responses were identified. These related to Cognitive Appraisal (Threat
 190 Appraisal, and Coping Appraisal), and Coping Modes (Adaptive, and Maladaptive). The focus of the
 191 present analysis was the consultation time spent communicating CVD risk (across sample
 192 approximately 1.7 (±0.83) minutes) (44), to explore similarities and differences between the two
 193 calculators under investigation. Most patients said little in response to CVD risk information.
 194 Therefore, where there was evidence of two-way dialogue, we present quotations that best illustrate
 195 risk communication and subsequent patient response.

196

197 **Results**

198 Deductive thematic analysis was conducted on 128 video-recorded NHSHC consultations. Patients
 199 were approximately matched by gender, age and ethnicity. Those in the QRISK[®]2 group were
 200 marginally younger (Table 2).

201

202 Table 2. Characteristics of patients included in analysis

		QRISK [®] 2	JBS3
Gender			
	Female	32	32
	Male	32	32
	Total	64	64
Age			
	40-54	34	21
	55-64	17	20
	65-74	13	23
	Total	64	64

Ethnicity			
	White British (WBRI)	58	56
	Black Asian and Minority Ethnic (BAME)	6	8
	Total	64	64
CVD Risk			
	Low %	43	43
	Med-high %	21	21
	Total	64	64

203

204 Results of the deductive thematic analysis demonstrate how practitioners communicated risk using
 205 either QRISK®2 or JBS3. They also present patients' responses to the communication of risk, allowing
 206 for evaluation of the two calculators. Each quote is coded to denote which risk calculator was used,
 207 the consultation identifier, patient gender and age.

208

209 **Cognitive Appraisal**

210 *Threat appraisal*

211 Threat appraisal was the most commonly identified element of the PMT model. It was observed in all
 212 consultations, although less frequently in JBS3 consultations (coded 584 times; average
 213 9/consultation) compared to QRISK®2 consultations (coded 634 times; average 10/consultation).

214 Once presented with a QRISK®2 score, patients acknowledged their risk level, but their understanding
 215 of 10-year percentage risk was unclear. For example, one asked '*is that percentage of risk alright?*'.
 216 Generally, the risk score was acknowledged with a single word response, such as '*yeah*' or '*okay*',
 217 impeding practitioners' ability to gauge patient understanding and classification of response for this
 218 analysis. Heart Age aided patient understanding of CVD risk, resulting in questions such as: "*... so really*
 219 *what can I do about that? I mean I know it is all estimated.*" Such questions reflected a level of
 220 understanding of the score and intention to engage in risk-reducing behaviour. Several patients
 221 expressed surprise at their risk. Below, the patient appeared to question how the score was calculated
 222 as they perceived themselves to be healthier than the outcome suggested, leading to some mistrust.
 223 They also made two references to being 'fitter' than the risk score indicated, which was not addressed
 224 by the practitioner:

225 *P I thought I was fitter than that though.*

226 *HP (Laughter) You are doing good exercises,*

227 *P But I was fitter than that though...*

228 *HP OK, so the health years, so on average expect to survive is 80 for yourself without a heart*
 229 *attack or a stroke, yeah? And then your risk of a heart attack or stroke in the next ten years is*
 230 *15%, so you do need to look after yourself, because we would say that is a medium risk.*

231 *P Yes*

232 *HP So wouldn't say it is too high or low, but a medium to high.*

233 *P OK*

234 *HP OK, and then that's what it looks like so from now until there, that's the last one the chance of*
 235 *surviving without a heart attack.*

236 *P That's estimated?*

237 *HP This is estimated, we don't know what's going to happen you might be even longer.*

238 P So about 94 I might snuff it?
239 (JBS3, 11_028, Male, 58)
240
241 By overlooking the patient's surprise and perhaps focusing on the process of NHSHC, the patient
242 momentarily shut down until they were presented with their CVD event-free survival age. The
243 concept, included within JBS3, prompted some misunderstanding among patients and practitioners.
244 This was perceived by some patients as an estimate of life expectancy.

245 Practitioners provided little follow-up risk score explanation when using QRISK®2 or JBS3.

246 HP Right, this is the screening I was telling you about. I will just print that out for you. So your
247 risk of any heart disease is 15%.

248 P Yeah, which is not very high.

249 HP It does increase with age. If it is above 10% we then pass it on for them to have a look at it
250 and they will be able to decide when to have your next health check which should be three
251 years or one year. Obviously next time you come in any results you've got in the red tend to
252 up your risk and they tend to up your Heart Age as well. So when you come in next time if your
253 blood pressure is back down, and obviously it could be less so... Your Heart Age has come up
254 as 66.

255 P Well I am 66 this year.

256 HP Yes, yes, so it is quite near isn't it?
257 Yes. So, for example, if you were a smoker and that was in the red that would put your Heart
258 Age at 75. So the only one we have got in the red really is that one cholesterol...

259 P It's only marginal though isn't it
260 (QRISK®2+Informatica, 2_016, Male, 65)
261

262 Above, the patient was identified as medium-high risk, but the practitioner did not elaborate on the
263 severity or implications, leaving the patient's interpretation of their risk score as "not very high". This
264 was compounded when the patient received their Heart Age. The practitioner did not address the
265 patient's misinterpretation of the severity of their risk nor explain why their results are conflicting,
266 again perhaps focussing more so on the consultation process than the patient. This led the patient to
267 dismiss their elevated cholesterol as "only marginal". The absence of active listening skills was
268 recurrent across both groups making it difficult to gauge patient understanding.

269 Although limited, there was more evidence of active practitioner-patient engagement in conversation
270 regarding threat of CVD in the JBS3 group following risk score manipulation (e.g., practitioners visually
271 showed patients that a reduction in blood pressure, could lower their Heart Age):

272 HP ... so obviously your blood pressure is not too bad, that is fine where it is at 128, but your
273 cholesterol, so ideally we like that to be below 5. So if you could get it below 5, so lets put it
274 down to 4.8, you can see that automatically that it brings your risk down to 1.8%

275 P Oh I see yes

276 HP ... improves your life expectancy slightly, and probably brings your Heart Age down a year. So
277 it is just you know showing that it can and obviously, the lower you can keep these factors that
278 you influence, for longer, the better quality of life and life expectancy there is... your risk is
279 going to increase slightly with age. So it is about trying to moderate those other factors.

280 P So what impact does exercise have on that?

281 HP It has quite a significant impact on your cholesterol, it does help your cholesterol a lot. We
282 know that it helps because that increases your good cholesterol, which can help increase the
283 balance so, that can help with it as well.

284 P So what's the normal range that is seen for HDL cholesterol?

285 HP HDL can be anything from sort of 1.1 to about 2.5, you don't get much over, I can't say I have
286 seen many, I have seen a few. But your cholesterol could be anything down to you know 3.5.
287 P OK and really bad would be?
288 HP 6 or 7's, so would be sort of ...
289 P Oh OK – so 5.6 is yeah it is edging up isn't it?
290 (JBS3, 7_020, Male, 45)
291

292 The patient evaluated the threat and sought information to facilitate their appraisal. Whilst positive,
293 this exchange again demonstrated misunderstanding of CVD event-free survival age as life expectancy,
294 this time from the practitioner. The visual impact of demonstrating how CVD risk can be reduced
295 through risk factor modification (e.g., cholesterol, smoking status) aided patient understanding and
296 realistic threat appraisal. There were fewer examples of active engagement during discussion of the
297 CVD risk score within QRISK®2 consultations, which may be due to the inability to show risk factor
298 modification when using the calculator.

299

300 *Coping appraisal*

301 References to coping appraisal were more common among JBS3 (60, 94%) than QRISK®2 consultations
302 (55, 86%). Communication of risk in JBS3 consultations were not observed in the same way as QRISK2;
303 with most focussed on facilitators of adaptive coping (i.e., risk-reducing changes that patients could
304 make):

305 HP *Erm and then this gives you your healthy year's outlook, so based on your current lifestyle your*
306 *risk of a heart attack or a stroke in the next 10 years is coming out at 2.4 %. We aim for*
307 *peoples risk to be below 10% so that's...*
308 P *Yeah.*
309 HP *...absolutely fine and on average you expected to survive to an age of 84 without a heart attack*
310 *or stroke, so brilliant. So as I say your blood pressure pretty good as it is you not going get*
311 *that much lower.*
312 P *No.*
313 HP *Diet wise would you say you got a pretty good diet do you know the sorts of...*
314 P *We sort of grow our own vegetables and fruit and stuff like that...*
315 HP *Yeah.*
316 P *...so erm I mean we eat reasonably healthy.*
317 (JBS3, 7_044, Female, 54)
318

319 Following communication of the risk score, the practitioner moved on to ways the patient could
320 maintain a low risk through identification of eating behaviours, suggesting that whilst practitioners
321 (from both groups) spent little time talking about the CVD risk score, the additional risk information
322 available in JBS3 may have helped to facilitate more risk factor discussion between the patient and
323 practitioner than when using QRISK®2.

324 Discussions around response costs for adaptive coping (i.e. perceived costs associated with a
325 recommended behaviour) related to use of statins or blood pressure medication were only observed
326 in seven JBS consultations (11%) and, not any QRISK®2 consultations.

327 HP *Obviously we've tried them, and they haven't agreed with you.*
328 P *I tried the ***17,34 statin*
329 HP *Yeah, and there are other statins we can discuss and obviously benefits of those they can*
330 *reduce your cholesterol obviously and we can reduce your risk of cardiovascular disease so it*

331 *might be worth having a think about and if you want to just discuss that further or a different*
 332 *type of statin...*
 333 P *All they did was it affected my reflux and it made the reflux worse*
 334 HP *Yeah*
 335 P *So*
 336 HP *Yeah*
 337 P *I was on that and an Aspirin – I did the aspirin first and then ...*
 338 HP *Yeah, but it was affecting you. I mean it might be worth a having another... err you know a*
 339 *think about whether you wanted to erm take that, because obviously it would lower your*
 340 *cholesterol, obviously add to a healthier heart erm and reduce that risk of cardiovascular*
 341 *disease, but then obviously we'll not gonna push that onto you, err it is something you can*
 342 *talk to myself, one of the doctor's once you have had time to think erm and they can advise*
 343 *or XXX the prescribing nurse, because they can prescribe, you know talk about you know*
 344 *what's best, which statin would be best, and not all statins agree with everybody but there*
 345 *might be one out there that actually has a better erm compatibility with yourself OK?*
 346 P *Yeah*
 347 HP *How do you feel about what I have told you today?*
 348 P *I would consider it.*

(JBS3, 8_177, Male, 71)

350
 351 Here, the patient's prior engagement with statins as a response cost was discussed between the
 352 patient and the practitioner, leading to a re-evaluation of the medical intervention by the patient.
 353 However, the patient's concern regarding their previous experience of taking statins was not well
 354 addressed. The practitioner appeared to interrupt the patient to repeat the benefits of statins. The
 355 perceived cost of taking statins also provided motivation to adopt risk-promoting behaviours:

356 HP *But well done!*
 357 P *I am pleased about that yes.*
 358 HP *That's really good, no I am very pleased with you because that's really good. And where you*
 359 *were at 10% just before, it is now 5%, so you have halved the risk in that time. So that's really*
 360 *good. So it shows it can be done.*
 361 P *Yeah, yeah and that's what I would rather do than taking tablets,*
 362 HP *Of course*
 363 P *I would rather think, no I know what's wrong, I will deal with it in time.*
 364 (QRISK®2+Informatica, 12_055, Female, 64)
 365

366 In a previous NHC (conducted 5 years prior), the patient identified what was wrong and showed
 367 accountability for making health-related behavioural changes, "I will deal with it". However,
 368 opportunities to discuss facilitators of adaptive coping were sometimes missed by practitioners:

369 HP *I look at your [total: HDL cholesterol] ratio and your ratio is good. But just to keep a little eye*
 370 *on it, maybe they will test it again in a year's time. You probably won't be due this Health*
 371 *Check, because your risk is only 3%, which is low. It will increase as you age, so your Health*
 372 *Check wouldn't be due again for five years, but you could probably have your cholesterol done*
 373 *in about a year, with you know normal bloods taken out of your arm. Erm your Heart Age,*
 374 *because you got such results in the green, your Heart Age has come up less than your actual*
 375 *age, but that's with the two years added on from being an ex-smoker.*
 376 P *So is it possible that I could get that even lower, if my cholesterol came down a lot.*
 377 HP *Well we will have a look now, I will play about with it. So if you had never smoked at all, your*
 378 *Heart Age would be 45. If you were still smoking, it could be 51. So being an ex-smoker tends*
 379 *to add two years, so with your cholesterol, it could be brought down to 46.*

380 P *Massively yeah.*
381 *(QRISK®2+Informatica, 2_077, Male, 48)*
382

383 The patient above attempted to understand how their risk could be reduced. The practitioner did not
384 engage with this to encourage the risk-reducing behaviour or discuss ways to reduce cholesterol.
385 Rather, they proceeded to talk about the impact of previous smoking status (which is unmodifiable)
386 on CVD risk. Whilst references to coping appraisal were more common among JBS3 consultations,
387 again practitioners in both groups appeared to focus more on the consultation process than the
388 patient.

389

390 **Coping Modes**

391 *Maladaptive Coping*

392 Maladaptive coping was classified when the patient appeared to negatively engage in risk
393 management discussion with the practitioner and was dismissive of suggestions (e.g., patient believes
394 they have a sufficiently healthy lifestyle and dismisses discussion about change). As noted, patient
395 responses to risk information were often limited to single words. Where context allowed, apparent
396 non-engagement and minimal verbal responses from patients were also interpreted as maladaptive
397 coping responses when the risk information communicated by the practitioner did not provoke a
398 response from the patient (i.e., a monosyllabic response). Maladaptive coping was identified in 49
399 (77%) QRISK®2 consultations (coded 139 times; average 3/consultation), compared to 40 (62.5%) JBS3
400 consultations (coded 110 times; average 3/per consultation). Below, the practitioner briefly
401 communicates QRISK®2 before moving on to Heart Age (using Informatica):

402 HP *Yeah this is the screening I was telling you about. So, your risk is 9%*
403 P *Right*
404 HP *Which is your key risk for you over the heart disease and diabetes and stroke risk*
405 P *And heart disease*
406 HP *As you, as you age your risk does seem to increase, erm any results that you've got in the red*
407 *tend to push up your Heart Age slightly*
408 P *Aha*
409 HP *So if we can get the results out of the red and back into the green, that can reduce that one*
410 *down*
411 P *Right OK*
412 HP *So for example, being an ex-smoker actually puts 2 years onto your Heart Age there.*
413 P *Yeah*
414 HP *So would be its 66 and it would be 66 if you never smoked at all.*
415 P *Right*
416 HP *Erm if you were still smoking it would be 73.*
417 P *Oh my gosh*
418 HP *Your Heart Age has come up as 71 – you are 69. Any results you have got in the red do tend to*
419 *increase your Heart Age. It is just that one cholesterol one that was in the red.*
420 *(QRISK®2+Informatica, 2_001, Female, 66)*
421

422 Sometimes maladaptive responses to the 10-year percentage risk score could be prompted into a
423 more positive response through communication of Heart Age. The brief exchange prior to the
424 communication of Heart Age may have also suggested that the practitioner was less confident in

425 discussing absolute risk, a recurrent observation. If practitioners cannot clearly explain the meaning
426 of a patient's percentage risk score to confer understanding, subsequent discussion/actions regarding
427 risk management may be undermined.

428 Minimal engagement following communication of the risk score was also identified in JBS3
429 consultations:

430 *HP OK. And your blood pressure being under 82 but that's fine everything is OK with that. Now,*
431 *on average what they're saying is that your risk of a heart attack or stroke in the next 10 years*
432 *is 15%, again, that is down to the fact that you smoke.*

433 *P Hm*

434 *HP OK.*

435 *P Sigh*

436 *HP And to expect to survive till the age of 78 without a heart attack or a stroke OK. And if we have*
437 *a look at the next, this one, just reiterates its this, but if I changed it to... say if you didn't smoke*
438 *OK and we went to the next your Heart Age would then become equal with your age.*

439 *P Hm hm*

440 *HP And your risks in... of a heart attack or stroke in the next 10 years comes down to 9.6% and*
441 *your actual survival to the age of 83 without a heart attack or a stroke OK and that reiterates*
442 *it in that as well.*

443 *P Hm hm*

444 *HP OK so that's the difference.*

445 *P Hm hm*

446 *P Hm hm*

447 *HP OK. Erm*

448 *P Cough*

449 *HP So it gives you food for thought.*

450 *P Hmm hmm. You haven't told me anything I didn't already know.*

451 *(JBS3, 1_181, Male, 65)*

452

453 The practitioner did not encourage the patient to quit smoking nor did they explore any experience
454 with previous attempts and therefore were unlikely to promote intention to change behaviour. With
455 an added pressure of time within NHSHC consultations, adherence to the process of completing the
456 NHSHC may result in patients being passive recipients of information. As shown above (and
457 throughout), the practitioner delivered the information presented on the screen without asking
458 questions to check understanding or provide context. This resulted in little response from the patient
459 which may be indicative of deference to the practitioner's health knowledge and is, again, evidence
460 of power imbalance.

461 Negative engagement in discussion of risk factor management was also evident following the
462 suggestion of statin use:

463 *HP What we do tend to say if you risk is above 10%, obviously I don't know whether the doctors*
464 *have ever discussed a statin with you?*

465 *P I don't see the point, I mean if I am going to live to 83, I am quite happy to live to 83.*

466 *HP So it's just about being aware that we know that taking a statin can help reduce your overall*
467 *risk, so it's one that sort of we usually advise that ...*

468 *P If we do this next time and I don't know, it was 04 [last cholesterol check], and we are now in*
469 *2018, so what does that mean, it could be another 12 to 14 years [for the next Health Check]?*

470 *HP Well I do normally try and do these every five years, so yeah.*

471 *P So yes, if it is hugely worse*

472 HP Yeah
473 P ... in five years, I will consider it.

474 (JBS3, 7_012, Male, 70)
475

476 Again, the patient misinterpreted CVD event-free survival age and suggested that their risk was not
477 severe enough to consider medical intervention in the short-term; only if it was “*hugely worse*” in the
478 next NHSHC. This was another example of a missed opportunity for the practitioner to question the
479 patient’s understanding of their risk and potential false reassurance provided by the 10-year
480 percentage risk score.

481

482 *Adaptive Coping*

483 Adaptive coping was classified when the patient appeared to positively engage with discussion of
484 interventions to manage CVD risk; apparently listened to and engaged in the consultation and
485 accepted what was being said/suggested. Adaptive coping was identified in 58 QRISK[®]2 (91%)
486 consultations with (310 codes; average 5/consultation) and 55 JBS3 (86%) consultations (328 codes;
487 average 6/consultation). The frequency of occurrences overall and per consultation were similar
488 between the two groups for adaptive coping in medical interventions [39 QRISK[®]2 (61%) consultations
489 and 116 codes (average 3/consultation); 42 JBS3 (66%) consultations and 142 codes (average
490 3/consultation)] and lifestyle changes [11 QRISK[®]2 (17%) consultations and 15 codes (average
491 1/consultation); 20 JBS3 (31%) consultations and 32 codes (average 2/consultation)]. A number of
492 patients showed intentions to change behaviour as a result of their CVD risk.

493 HP So your ratio is 3.5. So this is the screening I was telling you about. So your risk is 3%. That
494 will increase as you age.

495 P Yeah

496 HP And obviously if we can, perhaps with your smoking, it has pushed your Heart Age up to 48,
497 and your age is 41. Because that is the only result you have got in the red. Because all your
498 other results are really good, they are in the green.

499 P They are really good, so I need to ...

500 HP Yeah, so if you had never smoked at all, your Heart Age would be aged 40.

501 P I think I need to do something about that don't I?

502 (QRISK[®]2+Informatica, 2_122, Male, 41)
503

504 Here is another example of how Heart Age changed the way the patient responded to the information
505 presented. Whilst a positive response was received, little time was allowed to respond before the
506 practitioner moved on. Giving time for the patient to check their understanding with the practitioner
507 may have provided opportunity for the patient to increase their confidence in actively engaging with
508 coping behaviours. Another example of positive engagement during the discussion of risk was also
509 identified in another practice:

510 HP OK that's good. Err let's see your key risk.

511 P If I know what weight so I can just try to change my life.

512 HP Yeah, yeah it would be good if you can cut down and, and lose a bit of the weight err what was
513 it 13.8. So it's only a little higher it should ideally be below 10% is what we want so 13.8 is a
514 bit high but it is because of, because of your weight. OK you don't smoke you don't drink
515 alcohol so that's all good, but your waist is a bit big as well.

516 P Yeah

517 HP Your waist is erm it's 112 let's have a look.

518 P *Around my tummy around here.*
519 HP *Yeah let's have a look. So your waist is 44 inches.*
520 P *And that's this bit here.*

(QRISK®2, 3_259, Male, 57)

521
522
523 The patient above engaged in the information presented about their risk and suggested a need for
524 weight management, somewhat reinforced by the practitioner. However, the interaction was
525 disjointed, which may be a result of the practitioner's need to complete all elements of the NSHC
526 and attending to what the patient is saying, creating a barrier for adaptive coping. Whilst scarce, a
527 successful strategy for supporting adaptive coping used by one practitioner was to ask the patient to
528 reflect on the risk information they had received, prompting consideration of action needed:

529 HP *So average survival free of heart attack or stroke is 84.1 years OK? So how do you feel about*
530 *that?*

531 P *Oh I will make more of an effort to lose some weight.*

(JBS3, 1_154, Female, 70)

532
533
534 The approach adopted by the practitioner encouraged the patient to express their immediate reaction
535 to their CVD risk, which gave the patient time to evaluate their action and show intention to change
536 their behaviour. This was a rare example of the PMT in action; showing connection between risk
537 information and the patient's intention to change her behaviour, helping to redress the power
538 imbalance evident in most consultations across both groups. It also demonstrated the significant role
539 the practitioner plays in ensuring risk communication is delivered effectively regardless of the risk
540 calculator.

541

542

543 Discussion

544 We report the first qualitative data from 128 video-recorded NSHCs to explore how practitioners use
545 QRISK®2 and JBS3 to communicate CVD risk in the consultation, and how patients respond to risk
546 information. An ecologically valid approach was used to compare usual practice (QRISK2) with use of
547 JBS3 following basic introductory training to familiarise practitioners with the tool and features to use.
548 This allowed a realistic study of how practitioners would use JBS3 if it was made available, without
549 additional risk communication training, which is generally not provided for NSHC practitioners (4,53).

550 Main findings in relation to our aims were, first, that components of the PMT including threat
551 appraisal, facilitators of and response costs to adaptive coping were coded more frequently in
552 consultations using JBS3 (compared with QRISK2). This suggests that JBS3 may provide more
553 opportunities to initiate risk factor discussion than QRISK2, possibly due to the risk factor modification
554 function. Second, CVD event-free survival age communicated in JBS3, was misunderstood by both
555 patients and practitioners. Third, patients presented with a QRISK®2 score acknowledged their risk
556 level, but it was unclear whether they understood 10-year percentage risk (or trusted the basis and
557 relevance to them). Visual presentations of risk and Heart age, found in JBS3 (not typically
558 communicated within standard practice systems - although can be generated in QRISK®2), appeared
559 more impactful and aided patient understanding, compared with QRISK®2. This is in line with evidence
560 that Heart Age is easier to understand than 10-year percentage risk (30,54) and visual displays are
561 preferable for promoting risk-reducing behaviour (31).

562 Regardless of the risk calculator used and despite the recognised importance of risk communication
563 in both the NHSHC best practice guidance (3) and competence framework (55), there was little
564 discussion of CVD risk. This was particularly marked in QRISK®2 consultations. Practitioners often
565 simply relayed the risk score, without discussing the implications of the risk for the patient or what
566 they could do about it. Equally, most patients offered minimal responses to the risk information, often
567 acknowledging with a single word. Practitioners may have avoided confirming patient understanding
568 if they felt unable to explain the risk scores in more detail or the pressure of time may have prevented
569 further exploration at the expense of the quality of risk communication. This supports evidence that
570 patients and practitioners struggle to understand CVD risk and some practitioners lack confidence in
571 communicating the risk score (4,18–21) leading to poor patient recall of CVD risk, confusion (22) and
572 misunderstanding.

573 There was an apparent absence of active listening by practitioners who frequently missed cues from
574 patients who were unclear about their risk score. Active listening involves making a conscious effort
575 to focus on what is being said rather than passively ‘hearing’ the message, and leads to improved
576 levels of patient satisfaction and greater adherence to treatment options (56). By not providing
577 additional information to patients that would allow them to appraise their risk, practitioners are
578 limiting the opportunity for patients to show intent to engage in risk reducing behaviours, thus
579 encouraging a maladaptive coping response. Best practice guidance (3) recommends that
580 practitioners use motivational interviewing (MI) to encourage adherence to recommended treatment
581 (57). Motivational interviewing is a person-centred approach to promote discussion with patients to
582 resolve ambivalence (58). There was little to no evidence of MI techniques in our 128 NHSHC.

583 Limited patient responses and poor listening skills, leading to practitioner dominance, were inferred
584 from quantitative analysis of the complete RICO study cohort [n=173 (44)]. These were confirmed
585 here, with evidence of missed opportunities to discuss patients’ intentions to behaviour change.
586 Missing these opportunities risks undermining the purpose of the NHSHC; without discussion of
587 intervention practitioners are unlikely to encourage patients to commit to engaging in risk-reducing
588 behaviours. The demands on practitioners to complete all aspects of an NHSHC within a limited time
589 could lead to prioritisation of process over patient engagement. The resulting practitioner-dominated
590 consultations are less patient-centred, and would be expected to lead to low patient and practitioner
591 satisfaction (59–62), and poor patient outcomes, such as adherence to clinical recommendations and
592 health-promoting behaviour (63). Where there was talk of risk-reducing behaviour, JBS3 appeared
593 more effective than QRISK®2 in promoting discussion of facilitators for adaptive coping, perhaps due
594 to additional functionality (i.e., manipulation of risk). This suggests that other methods of
595 communicating risk may be more suitable to promote discussion around risk-reducing behaviour.

596

597 **Implications for Practice**

598 The NHSHC programme is an ambitious non-communicable disease prevention programme, the
599 largest of its kind (4). An evidence-based review of NHSHC is underway to maximise the programme’s
600 benefit in the next decade, with likely changes to the universal offer of in-person consultations in
601 primary care (64). Whilst changes to delivery are inevitable, elements of the programme will still
602 require practitioner-patient consultation. Our findings show that certain functions of JBS3 are useful
603 for communicating CVD risk to patients, and also highlighted important implications for NHSHC
604 practice in general:

- 605 • There is a clear training need among NHSHC practitioners. There is an expectation that
606 practitioners ‘should be trained in communicating the risk score and results to the client’ and

607 that 'methods, such as motivational interviewing techniques, should engage clients in person-
608 centred conversations about their own reasons for change' (55) (p21). Yet it is difficult for
609 practitioners to meet these requirements without necessary training and ongoing support.
610 Here, these skills were generally not evident and we know from previous work that
611 practitioners responsible for delivering NHSHC generally receive little (or no) training in CVD
612 risk communication and motivational interviewing (22,65,66).

613 • Alongside training, there is also a need to prioritise the quality of interaction over the process
614 of the consultation. Increasing the overall appointment length or, perhaps more feasible,
615 streamlining the components of NHSHC would give practitioners more time to engage
616 patients in dialogue regarding their CVD risk and its management. The minimal response from
617 patients during NHSHC consultations made it difficult for us (and practitioners) to gauge
618 patient understanding and intentions for health-promoting behaviour.

619 Positive outcomes were identified when practitioners checked patient understanding, relayed
620 information in a way that was meaningful to the patient (e.g. Heart age) and asked for patient
621 feedback around the CVD risk score. Practices included in the sample allocated 15-30 minutes per
622 Health Check, but our quantitative evidence showed consultations lasted as little as 6.8 minutes (44).
623 There is clearly a need to provide additional support for practitioners. Measures to make consultations
624 more patient-focused and give practitioners the flexibility to allow engagement in dialogue should be
625 explored.

626

627 **Strengths and Limitations**

628 This is the first qualitative analysis to explore how risk is communicated and how patients respond
629 during video-recorded NHSHC consultations, including comparison of QRISK®2 and JBS3 CVD risk
630 calculators. Strengths include video-recording of NHSHCs across a diverse range of practices stratified
631 by deprivation, with stratified sampling of patients, a comprehensive coding approach and a large
632 sample (for qualitative analysis). Limitations are recognised:

- 633 • The use of QRISK®2+*Informatica* may have enhanced these consultations. To maintain
634 ecological validity of 'usual practice', patients from these practices were included in the main
635 analysis and has not altered our conclusions.
- 636 • Incorrect use of JBS3 (e.g., including communication of CVD event-free survival) resulted in
637 the exclusion of several consultations which may have biased our comparisons in favour of
638 JBS3.
- 639 • Sparse discussion specifically around the risk score and subsequent patient responses made
640 it difficult to apply the PMT framework effectively (the theoretical framework required
641 researchers to classify patient responses as either positive or negative). Thus, a third 'neutral'
642 classification was added to the framework to account for monosyllabic responses (see
643 Supplementary Material 2 for examples). Yet following the PMT, the new category still needed
644 to be classified as one of the two coping modes (i.e., adaptive or maladaptive). Moreover,
645 follow-up interviews with patients and practitioners as part of the RICO study, will be analysed
646 to further explore their experiences, perceptions and understanding of CVD risk and related
647 intentions.

648

649 **Conclusions**

650 Analysis of video-recorded NHSHC consultations showed sparse communication of CVD risk,
651 particularly in consultations supported by QRISK[®]2. Where risk was communicated, patient responses
652 were minimal and practitioners missed opportunities to check patient understanding and encourage
653 risk-reducing behaviour. JBS3 appeared to better promote opportunities to initiate risk-factor
654 discussion and Heart Age and visual representation of risk were more easily understood and impactful
655 than QRISK[®]2. The apparent lack of effective CVD risk discussion in both groups resulted in
656 misunderstandings, practitioner-dominated discussion and increased likelihood of a maladaptive
657 coping response. The NHSHC programme is currently the largest CVD prevention initiative in England.
658 Whilst an evidence-based review of NHSHC is underway (58), with likely changes to programme
659 delivery, face to face consultations are necessary to deliver key elements of NHSHC. The analysis
660 presented demonstrates the importance of effective, shared practitioner-patient discussion for
661 enabling adaptive coping responses, only achievable through solid practitioner understanding of the
662 nature of the information being shared and through effective training to deliver this information to
663 patients (66).

664

665 **Abbreviations**

666 CVD – Cardiovascular Diseases

667 NHS – National Health Service

668 NHSHC – National Health Service Health Check

669 RICO – Risk COmmunication Study

670 PMT – Protection Motivation Theory

671 JBS – Joint British Societies

672 HCA – Health Care Assistant

673

674 ***Declarations:***

675 ***Ethics approval and consent to participate***

676 The study was approved by the UK Health Research Authority Approval (HRA; 11/11/2017) and the
677 London - Dulwich Research Ethics Committee (11/09/2017) (reference: 17/LO/1463). Written
678 informed consent was obtained for all participants prior to taking part.

679 ***Consent for publication***

680 Not applicable, as no identifiable material is included.

681 ***Availability of data and materials***

682 All data generated and analysed during the current study are not publicly available due to the
683 confidential nature of participant transcript data, but are available from the corresponding author on
684 reasonable request.

685 ***Competing interests***

686 The authors declare that they have no competing interests.

687 **Funding**

688 This project is funded by the National Institute for Health Research HTA Programme (project number
689 15/170/02). The funders had no role in study design, data collection and analysis, decision to publish,
690 or preparation of the manuscript.

691 **Authors' contributions**

692 CG, DC, NE, EC, SG, RC and DCC contributed to the conceptualisation and design. LC and VR completed
693 coding, DCC supported reliability checks and SF completed analysis (supported by SG, CG, NE and VR)
694 of video-recorded NHSHC. NE, LC and VR contributed to the Patient Public Involvement. VR and CG
695 completed manuscript preparation. All authors contributed to the writing of the manuscript. All
696 authors read and approved the final manuscript.

697 **Acknowledgements**

698 The authors would like to acknowledge Clinical Research Network West Midlands colleagues for advice
699 in developing protocols, and members of the PPG and the virtual PPI participants who have informed
700 study development.

701 **Author's information**

702 Victoria Riley, Research Associate, Staffordshire University, Victoria.Riley@staffs.ac.uk

703

704 **References**

- 705 1. Public Health England. Health matters: preventing cardiovascular disease [Internet]. Gov.uk.
706 2019 [cited 2020 Mar 29]. Available from:
707 [https://www.gov.uk/government/publications/health-matters-preventing-cardiovascular-](https://www.gov.uk/government/publications/health-matters-preventing-cardiovascular-disease)
708 [disease](https://www.gov.uk/government/publications/health-matters-preventing-cardiovascular-disease)
- 709 2. Department of Health. Putting prevention first. NHS Health Check: vascular risk assessment
710 and management best practice guidance. London: Department of Health; 2009.
- 711 3. Public Health England. NHS Health Check: Best practice guidance. PHE Publ [Internet].
712 2017;(December):1–76. Available from:
713 <https://www.healthcheck.nhs.uk/document.php?o=1472>
- 714 4. Usher-Smith J, Martin A, Harte E, MacLure C, Meads C, Saunders C, et al. NHS Health Check
715 programme rapid evidence synthesis. 2017;(January). Available from:
716 www.healthcheck.nhs.uk/document.php?o=1251
- 717 5. Spiegelhalter D, Pearson M, Short I. Visualizing uncertainty about the future. *Science* (80-).
718 2011;333(6048):1393–400.
- 719 6. Beswick A, Brindle P, Fahey T, Ebrahim S. A systematic review of risk scoring methods and
720 clinical decision aids used in the primary prevention of coronary heart disease. *R Coll Gen*
721 *Pract [GRA]*. 2008;4–105.
- 722 7. Edwards a, Elwyn G, Covey J, Matthews E, Pill R. Presenting risk information - A review of the
723 effects of “framing” and other manipulations on patient outcomes.” *J Health Commun*.
724 2001;6(1):61–82.
- 725 8. Gigerenzer G, Edwards A. Simple tools for understanding risks: from innumeracy to insight.
726 *BMJ Br Med J*. 2003;327(7417):741–4.

- 727 9. Gigerenzer G, Gaissmaier W, Kurz-Milcke E, Schwartz LM, Woloshin S. Helping doctors and
728 patients make sense of health statistics. *Psychol Sci Public Interes Suppl.* 2007;8(2):53–96.
- 729 10. Goodyear-Smith F, Arroll B, Chan L, Jackson R, Wells S, Kenealy T. Patients prefer pictures to
730 numbers to express cardiovascular benefit from treatment. *Ann Fam Med.* 2008;6(3):213–7.
- 731 11. Thomson R, Edwards A, Grey J. Risk communication in the clinical consultation. Vol. 5, *Clinical
732 Medicine, Journal of the Royal College of Physicians of London.* 2005. p. 465–9.
- 733 12. Ahmed H, Naik G, Willoughby H, Edwards AGK. Communicating risk. *BMJ [Internet].*
734 2012;344(jun18 1):e3996–e3996. Available from:
735 <http://www.bmj.com/cgi/doi/10.1136/bmj.e3996>
- 736 13. Barratt A, Edwards A, Trevena L, McCaffery K, Woloshin S, Bekker H, et al. Presenting
737 probabilities. *IPDAS Collab Backgr Doc.* 2005;(c):1–54.
- 738 14. Usher-Smith JA, Silarova B, Schuit E, Moons KGM, Griffin SJ. Impact of provision of
739 cardiovascular disease risk estimates to healthcare professionals and patients: a systematic
740 review. Vol. 5, *BMJ open.* 2015. p. e008717.
- 741 15. Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, Minhas R, Sheikh A, et al. Predicting
742 cardiovascular risk in England and Wales: prospective derivation and validation of QRISK2.
743 *BMJ. England;* 2008 Jun;336(7659):1475–82.
- 744 16. JBS3 Board. Joint British Societies’ consensus recommendations for the prevention of
745 cardiovascular disease (JBS3). *Heart.* 2014 Apr;100(Suppl 2):ii1-ii67.
- 746 17. Karmali KN, Lloyd-Jones DM. Adding a life-course perspective to cardiovascular-risk
747 communication. *Nat Rev Cardiol.* 2013;10(2):111–5.
- 748 18. Edwards AGK, Evans R, Dundon J, Haigh S, Hood K, Elwyn GJ. Personalised risk communication
749 for informed decision making about taking screening tests. *Cochrane database Syst Rev.*
750 *England;* 2006 Oct;(4):CD001865.
- 751 19. Gigerenzer G, Hoffrage U. How to improve Bayesian reasoning without instruction: Frequency
752 formats. *Psychol Rev.* 1995;102(4):684–704.
- 753 20. Hoffrage U, Gigerenzer G. Using natural frequencies to improve diagnostic inferences. *Acad
754 Med.* 1998;73(5):538–40.
- 755 21. Slovic P, Monahan J, MacGregor DG. Violence risk assessment and risk communication: The
756 effects of using actual cases, providing instruction, and employing probability versus
757 frequency formats. *Law Hum Behav.* 2000;24(3):271–96.
- 758 22. Usher-Smith JA, Harte E, Maclure C, Martin A, Saunders CL, Meads C, et al. Patient experience
759 of NHS health checks: A systematic review and qualitative synthesis. *BMJ Open.* 2017;7(8).
- 760 23. Board JBS. Joint British Societies’ consensus recommendations for the prevention of
761 cardiovascular disease (JBS3). *Heart [Internet].* 2014;100(Suppl 2):ii1-ii67. Available from:
762 <http://heart.bmj.com/lookup/doi/10.1136/heartjnl-2014-305693>
- 763 24. Wells S, Kerr A, Broadbent E, MacKenzie C, Cole K, McLachlan A. Does Your Heart Forecast
764 help practitioner understanding and confidence with cardiovascular disease risk
765 communication? *J Prim Heal Care.* 2011;3(1):4–9.
- 766 25. Bonner C, Jansen J, Newell BR, Irwig L, Glasziou P, Doust J, et al. I Don’t Believe It, But I’d
767 Better Do Something About It: Patient Experiences of Online Heart Age Risk Calculators. *J
768 Med Internet Res. JMIR Publications Inc.;* 2014;16(5).

- 769 26. Reed JL, Prince SA, Cole CA, Fodor JG, Hiremath S, Mullen KA, et al. Workplace physical
770 activity interventions and moderate-to-vigorous intensity physical activity levels among
771 working-age women: a systematic review protocol. *Syst Rev*. Division of Prevention and
772 Rehabilitation, University of Ottawa Heart Institute, 40 Ruskin Street, Ottawa, ON K1Y 4W7,
773 Canada. jreed@ottawaheart.ca; 2014 Dec;3:147.
- 774 27. Soureti A, Hurling R, Murray P, van Mechelen W, Cobain M. Evaluation of a cardiovascular
775 disease risk assessment tool for the promotion of healthier lifestyles. *Eur J Cardiovasc Prev
776 Rehabil*. SAGE Publications; 2010;17(5):519–23.
- 777 28. Johns I, Moschonas KE, Medina J, Ossei-Gerning N, Kassianos G, Halcox JP. Risk classification
778 in primary prevention of CVD according to QRISK2 and JBS3 $\{\text{\textquoteleft}heart$
779 $\text{\textquoteright}\}$ age $\{\text{\textquoteright}\}$, and prevalence of elevated high-sensitivity C reactive protein in the UK
780 cohort of the EURIKA study. *Open Hear. Archives of Disease in childhood*; 2018;5(2).
- 781 29. Bonner C, Bell K, Jansen J, Glasziou P, Irwig L, Doust J, et al. Should heart age calculators be
782 used alongside absolute cardiovascular disease risk assessment? *BMC Cardiovasc Disord*.
783 *BMC Cardiovascular Disorders*; 2018;18(1):1–8.
- 784 30. Hawking MKD, Timmis A, Wilkins F, Potter JL, Robson J. Improving cardiovascular disease risk
785 communication in NHS Health Checks: a qualitative study. *BMJ Open*. 2019;9(8):e026058.
- 786 31. Waldron C-A, van der Weijden T, Ludt S, Gallacher J, Elwyn G. What are effective strategies to
787 communicate cardiovascular risk information to patients? A systematic review. *Patient Educ
788 Couns* [Internet]. Elsevier Ireland Ltd; 2011;82(2):169–81. Available from:
789 <http://linkinghub.elsevier.com/retrieve/pii/S0738399110001849>
- 790 32. Bonner C, Jansen J, McKinn S, Irwig L, Doust J, Glasziou P, et al. Communicating cardiovascular
791 disease risk: an interview study of General Practitioners' use of absolute risk within tailored
792 communication strategies. *BMC Fam Pract* [Internet]. 2014;15(1):106. Available from:
793 <http://bmcfampract.biomedcentral.com/articles/10.1186/1471-2296-15-106>
- 794 33. Kulendrarajah B, Grey A, Nunan D. How effective are age' tools at changing patient
795 behaviour? A rapid review. *BMJ Evidence-Based Med*. 2020;25(2):68–72.
- 796 34. Lopez-Gonzalez AA, Aguilo A, Frontera M, Bennasar-Veny M, Campos I, Vicente-Herrero T, et
797 al. Effectiveness of the Heart Age tool for improving modifiable cardiovascular risk factors in a
798 Southern European population: a randomized trial. *Eur J Prev Cardiol* [Internet].
799 2015;22(3):389–96. Available from:
800 <http://journals.sagepub.com/doi/10.1177/2047487313518479>
- 801 35. Manuel DG, Abdulaziz KE, Perez R, Beach S, Bennett C. Personalized risk communication for
802 personalized risk assessment: Real world assessment of knowledge and motivation for six
803 mortality risk measures from an online life expectancy calculator. *Informatics Heal Soc Care*
804 [Internet]. Taylor & Francis; 2018;43(1):42–55. Available from:
805 <https://doi.org/10.1080/17538157.2016.1255632>
- 806 36. Cobain, Mark, Fiumicelli G. Can heart age increase NHS Health Check uptake? Delivering an
807 RCT in the London Borough of Bromley [Internet]. 2015 [cited 2015 Oct 27]. Available from:
808 [http://www.healthcheck.nhs.uk/commissioners_and_healthcare_professionals/national_res
809 ource_and_training_development_tools/webinars/past_webinars/](http://www.healthcheck.nhs.uk/commissioners_and_healthcare_professionals/national_resources_and_training_development_tools/webinars/past_webinars/)
- 810 37. Paskins Z, McHugh G, Hassell AB. Getting under the skin of the primary care consultation
811 using video stimulated recall: a systematic review. *BMC Med Res Methodol*. BioMed Central
812 Ltd; 2014 Jan;14(1):101.

- 813 38. Henry SG, Feters MD. Video Elicitation Interviews: A Qualitative Research Method for
814 Investigating Physician-Patient Interactions. *Ann Fam Med* . 2012 Mar;10(2):118–25.
- 815 39. Floyd DL, Prentice-Dunn S, Rogers RW. A Meta-Analysis of Research on Protection Motivation
816 Theory. Vol. 30, *Journal of Applied Social Psychology*. 2000. p. 407–29.
- 817 40. Maddux JE, Rogers RW. Protection motivation and self-efficacy: A revised theory of fear
818 appeals and attitude change. *J Exp Soc Psychol*. 1983;
- 819 41. Floyd DL, Prentice-Dunn S, Rogers RW. A meta-analysis of research on protection motivation
820 theory. *J Appl Soc Psychol*. 2000;
- 821 42. Plotnikoff RC, Rhodes RE, Trinh L. Protection motivation theory and physical activity: A
822 longitudinal test among a representative population sample of Canadian adults. *J Health*
823 *Psychol*. 2009;
- 824 43. Gidlow CJ, Ellis NJ, Cowap L, Riley V, Crone D, Cottrell E, et al. A qualitative study of
825 cardiovascular disease risk communication in NHS Health Check using different risk
826 calculators: protocol for the Risk COmmunication in NHS Health Check (RICO) study. *BMC*
827 *Fam Pract*. *BMC Family Practice*; 2019;20(1):1–10.
- 828 44. Gidlow CJ, Ellis NJ, Cowap L, Riley VA, Crone D, Cottrell E, et al. The nature and content of
829 NHS Health Checks: A quantitative comparison of video-recorded consultations using QRISK2
830 versus JBS3 CVD risk calculators. *Stoke-on-Trent*; 2020.
- 831 45. Public Health England. NHS Health Check Programme: Best practice guidance. London: PHE;
832 2013.
- 833 46. Braun V, Clarke V. Braun, V., Clarke, V. Using thematic analysis in psychology., 3:2 (2006), 77-
834 101. *Qual Res Psychol*. 2006;3:77–101.
- 835 47. Fereday J, Muir-Cochrane E. Demonstrating Rigor Using Thematic Analysis: A Hybrid
836 Approach of Inductive and Deductive Coding and Theme Development. *Int J Qual Methods*.
837 2006;
- 838 48. Aguiar E, Morgan P, Collins C, Plotnikoff R, Callister R. Efficacy of interventions that include
839 diet, aerobic and resistance training components for type 2 diabetes prevention: a systematic
840 review with meta-analysis. *Int J Behav Nutr Phys Act*. 2014;11(1):2.
- 841 49. Plotnikoff RC, Rhodes RE, Trinh L. Protection motivation theory and physical activity: a
842 longitudinal test among a representative population sample of Canadian adults. *J Health*
843 *Psychol*. 2009;14(8):1119–34.
- 844 50. Ritland R, Rodriguez L. The influence of antiobesity media content on intention to eat
845 healthily and exercise: A test of the ordered protection motivation theory. *J Obes*. 2014;2014.
- 846 51. Edwards-Jones A. Qualitative data analysis with NVIVO. *J Educ Teach*. 2014;
- 847 52. Everitt BS, Fleiss JL. Statistical Methods for Rates and Proportions. *Biometrics*. 1981;
- 848 53. Riley VA, Gidlow C, Ellis NJ, Povey RJ, Barnes O, Clark-Carter D. Improving cardiovascular
849 disease risk communication in the UK national health service health check programme.
850 *Patient Educ Couns*. 2019;
- 851 54. Bonner C, Bell K, Jansen J, Glasziou P, Irwig L, Doust J, et al. Should heart age calculators be
852 used alongside absolute cardiovascular disease risk assessment? *BMC Cardiovasc Disord*.
853 2018;18(1):19.

- 854 55. Public Health England. NHS Health Check competence framework. 2015;(March).
- 855 56. McCabe C, Timmins F. Communication Skills for Nursing Practice. Communication Skills for
856 Nursing Practice. 2013.
- 857 57. Levensky ER, Forcehimes A, O'Donohue WT, Beitz K. Motivational interviewing: An evidence-
858 based approach to counseling helps patients follow treatment recommendations. *Am J Nurs.*
859 2007;
- 860 58. Glover M, McRobbie H. Smoking Cessation. *Int Encycl Public Heal* [Internet]. Academic Press;
861 2008 Jan 1 [cited 2020 Apr 3];37–50. Available from:
862 <https://www.sciencedirect.com/science/article/pii/B9780123739605003518>
- 863 59. Howie JG, Heaney DJ, Maxwell M. Measuring quality in general practice. Pilot study of a
864 needs, process and outcome measure. *Occas Pap R Coll Gen Pract.* 1997;
- 865 60. Pawlikowska T, Zhang W, Griffiths F, van Dalen J, van der Vleuten C. Verbal and non-verbal
866 behavior of doctors and patients in primary care consultations - How this relates to patient
867 enablement. *Patient Educ Couns.* 2012;
- 868 61. Roter DL, Stewart M, Putnam SM, Lipkin M. J, Stiles W, Inui TS. Communication patterns of
869 primary care physicians. *J Am Med Assoc.* 1997;
- 870 62. Street RL, Makoul G, Arora NK, Epstein RM. How does communication heal? Pathways linking
871 clinician-patient communication to health outcomes. *Patient Educ Couns.* 2009;
- 872 63. Doyle C, Lennox L, Bell D. A systematic review of evidence on the links between patient
873 experience and clinical safety and effectiveness. *BMJ Open.* 2013.
- 874 64. Department of Health and Social Care. Advancing our health: prevention in the 2020s.
875 Cabinet Office. 2019.
- 876 65. Riley VA, Gidlow C, Ellis NJ. Understanding implementation and uptake in the National Health
877 Service Health Check Programme. *Public Health* [Internet]. The Royal Society for Public
878 Health; 2018;8–11. Available from: <https://doi.org/10.1016/j.puhe.2018.01.024>
- 879 66. Baessler F, Zafar A, Ciprianidis A, Wagner FL, Klein SB, Schweizer S, et al. Analysis of risk
880 communication teaching in psychosocial and other medical departments. *Med Educ Online*
881 [Internet]. Taylor & Francis; 2020;25(1):1746014. Available from:
882 <https://doi.org/10.1080/10872981.2020.1746014>

883