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1 Title: Genetic cancer risk assessment in general practice: systematic review of tools
2 available, clinician attitudes and outcomes for patients.

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46

47

48 **Abstract**

49

50 **Background** The growing demand for cancer genetic services has led to
51 suggestions for the involvement of general practitioners. How and in which
52 conditions they can be involved need to be defined and there may be important
53 barriers to implementation.

54

55 **Aim** To review the tools available, clinicians' attitudes and experiences, and the
56 effects on patients of genetic cancer risk assessment in general practice.

57

58 **Design and setting** Systematic review

59

60 **Method:** Searching MEDLINE/Ovid, EMBASE, Cochrane Library, CINAHL and
61 PsycInfo databases and grey literature from 1996 to December 2017. Study quality
62 was assessed with relevant Critical Appraisal Skills Programme (CASP) tool
63 checklists and a narrative synthesis of findings was conducted.

64

65 **Results:** 40 studies were included. There was a variety of tools available for genetic
66 cancer risk assessment in general practice, both testing and screening, principally
67 for breast, breast-ovarian and colorectal cancer risk. Practitioners often reported low
68 knowledge and confidence to engage with genetic cancer risk assessment, and
69 despite barriers of time pressure, and worries about confidentiality especially
70 concerning impact of results for family members, some recognised potential
71 importance relating to such a development of the GP's role. Studies found few
72 reported benefits for patients. Concerns about negative impacts on patient anxiety
73 and cancer worries were largely not borne out.

74

75 **Conclusion** General practitioners may have a potential role in identifying patients at
76 risk of hereditary cancer that can be facilitated by family history tools. There is
77 currently insufficient evidence to support implementation of population-wide
78 screening for genetic cancer risk within the competing demands of general practice.

79

80 **How this fits in**

81

82 Cancer incidence is rising across the world and genetic risk is a significant
83 contributor. Cancer risk screening and testing is a potential role for General
84 practitioners (GPs). Several tools are available but none is superior. GPs identify
85 needs for more education to improve their knowledge and confidence regarding
86 cancer genetic risks before wider implementation.

87

88

89 INTRODUCTION

90

91 According to the World Health Organization, one in six deaths is due to cancer and
92 number of new cases is expected to rise by 70% over the next two decades. In UK,
93 5% of patients with bowel cancer have a family history of bowel cancer, 3% of breast
94 cancers are associated with inherited faulty genes and 10% of melanoma cases are
95 also associated with a family history of the disease¹. In those cases and other
96 cancers in which genetic risks are involved, earlier detection and treatment could
97 reduce cancer mortality.

98

99 There is an increasing demand for cancer genetic services and the potential
100 importance of involving general practitioners is recognized². Patients commonly seek
101 out information regarding their risks and clinicians need to be able to respond to this
102 demand. Direct-to-consumer testing is also increasingly available³. In addition to
103 such 'testing', when presented or accessed by patients, there are also potential
104 opportunities for systematically or opportunistically screening attendees in general
105 practice, perhaps based on increased familial risk (see Box 1). However, the ways in
106 which general practitioners might respond to such trends, particularly within the
107 context of increasingly time- and resource-constrained everyday practice have not
108 been effectively established⁴.

109

110 Family medical history is commonly used in general practice and could be regarded
111 as a genetic screening strategy^{5,6}. This tool needs to be developed and standardized
112 to optimize health outcomes in those at risk of inherited cancer. General practitioners
113 are potentially well placed with access to longitudinal comprehensive health records
114 and their focus on family to recognise individuals at risk^{7,8}. In the UK (National Health
115 Service), a patient is eligible for a genetic test if: an inherited faulty gene has already
116 been identified in one of the patient's relatives or, there is a strong family history of
117 cancer in his/her family. In these scenarios, patients are referred to specialist
118 genetics services (33 across UK) for consideration of further genetics tests.

119

120

121 Carroll et al suggest GPs have a potential role as gatekeepers in genetic cancer risk
122 assessment (testing and screening)⁹. However, general practitioners may face
123 challenges regarding this expanding role due to a lack of clinical genetics knowledge,
124 perceived lack of confidence in the domain, and time constraints^{3,10-15}. There may be
125 difficulties in considering genetic cancer risk in routine primary care visits, especially
126 as acute illness is often the priority, and other (e.g. cardiovascular) preventive
127 measures have greater prominence than genetic risk of cancer. Testing or
128 screening, leading to preventive measures, will be more successful if cancer genetic

129 risk is assessed in large segments of society, not only those who are better informed
130 and actively consult their general practitioner.

131

132

133 This study aims to examine and review the tools available, clinicians' attitudes and
134 effects on patients of genetic cancer risk assessment in general practice. From this
135 we aim also to discuss potential roles that general practitioners might play in genetic
136 cancer risk assessment and whether systematic screening may be feasible and
137 effective in general practice.

138

139

140 To meet these aims, the following research questions were addressed:

- 141 1) What tests (medical procedure to detect those at high risk) and tools (support or
142 format for those procedures) are available for identifying increased genetic risk
143 of cancer in general practice?
- 144 2) What are clinicians' attitudes towards screening or testing the population groups
145 for genetic cancer risk?
- 146 3) What are the levels of patient knowledge, satisfaction and anxiety in relation to
147 tests and communication by a general practitioner about cancer risk? What are
148 patients' risk perceptions following screening or testing for genetic cancer risk in
149 primary care?
- 150 4) What are the outcomes of referrals to secondary care following genetic cancer
151 risk identification in general practice?

152

153

154 **METHOD**

155

156 The following databases were electronically searched: MEDLINE/Ovid, EMBASE,
157 The Cochrane Library, CINAHL and PsycInfo from 1996 to December 2017. The
158 grey literature was also searched via OpenGrey and The Health Management
159 Information Consortium (HMIC) database (also to December 2017). The search
160 strategy was adapted to each database, with layers of terms around: general
161 practice, cancer, genetics, testing and tools, attitudes, outcomes and effectiveness.
162 Hand searching of key journals (Family Practice, Genetics in Medicine and British
163 Journal of General Practice) and reference lists of relevant papers was also
164 conducted. The search outputs were downloaded and merged into Zotero, where
165 duplicates were removed.

166

167 Inclusion criteria:

168 • Study population:

169 Studies involving adults (age 18 and above), of either gender, considered to be at
170 high risk of hereditary cancer were eligible for inclusion.

171 As advocated by Scheuner et al¹⁶ high-risk family history characteristics include the
172 presence of multiple affected first-degree relatives (FDR) or a FDR with age of onset
173 of 50 years or less.

174

175 And

176 • Intervention:

177 Strategies used for cancer genetic risk testing or screening within general practice.
178 As suggested by Olesen¹⁷, general practice (known as family practice in some
179 countries) was defined as: “the general practitioner is a specialist trained to work in
180 the front line of a healthcare system and to take the initial steps to provide care for
181 any health problem(s) that patients may have.”

182 Or

183 • Studies assessing outcome variables;

184 Clinician attitudes to tests for cancer genetic risk assessment, patient outcomes
185 following such tests or the outcomes of referrals to secondary care after the
186 intervention in primary care.

187

188 • Study design

189 A range of study designs was included to address the different questions within the
190 review: qualitative, focus groups, semi structured interviews, observational / cross-
191 sectional, cluster randomised controlled trial, implementation studies.

192

193 Exclusion criteria:

- 194 • Study not based primarily in general practice or separate data relating to GPs not
195 presented
- 196 • Non-cancerous conditions only
- 197 • Cancers without a known familial component
- 198 • Test activity described only i.e. number of tests undertaken
- 199 • Population based screening application only (not involving primary care)
- 200 • Non-English language studies

201

202 We wanted to investigate scenarios involving either the identification of patients at
203 high risk of hereditary cancer in opportunistic health visits with their general
204 practitioner, or potential broad systematic or opportunistic screening of patient
205 populations in general practice to identify those at a high genetic cancer risk.

206

207 Assessment of study inclusion

208 The selection criteria were initially applied independently to all titles and/or abstracts
209 by BM or FL. Once narrowed down to references that were potentially relevant, full-
210 copy papers were also assessed by a third reviewer (AE) to determine inclusion and
211 exclusion. Disagreements were resolved through discussion.

212

213 Data extraction

214 BM or FL extracted all data onto an excel spreadsheet, recording the study title,
215 aims, design, setting, participants, inclusion and exclusion criteria, nature of
216 intervention (where applicable), methods, outcome measures, analysis, key findings
217 and limitations.

218

219 Assessment of methodological quality

220 The quality of all eligible studies was assessed using the relevant Critical Appraisal
221 Skills Programme (CASP) tool checklists¹⁸, dependent on study design for qualitative
222 studies or trials. As there is no CASP tool for observational cross-sectional studies,
223 common points included within the checklists for observational cohort and case-
224 control study designs were selected and combined.

225

226 Data Synthesis

227 Due to the heterogeneous nature of the studies included, a narrative synthesis was
228 undertaken to collate the evidence relating to each of the research questions¹⁹.
229 Specific sub-groups of studies were assessed and are presented regarding testing
230 and screening for genetic cancer risk.

231

232

233 RESULTS

234

235 Description of studies

236 Study selection is summarised in Figure 1. A total of 40 articles was included.

237 Sixteen of these were observational: cross-sectional studies^{2,20–32} and two
238 retrospective^{15,33}. There were six qualitative^{4,9,34–37}, including four semi structured

239 interviews^{4,34,35,37}. There were 13 intervention studies^{38–50}: three validation
240 studies^{38,47,50}, one before-after⁴⁹, three hybrid implementation^{42,45,48}, one comparison
241 against standard care⁴⁰, two comparative^{41,44} and three observational studies^{39,43,46}.

242 Three studies were cluster randomised controlled trials^{51–53} and two descriptive
243 feasibility studies^{54,55}.

244

245 Populations studied

246 All studies involved both male and female patients or their general practitioners,
247 except for one study with only female patients and female practitioners. Fourteen
248 studies were carried out in the UK^{2,4,20–22,25,34,41,44,49–51,54,55}, 17 in North

249 America^{9,15,23,27–31,35,37,39,42,43,45,48,52,53}, two in South America^{38,47}, two in Australia^{33,36}.

250 The remaining four were conducted in EU^{40,26,46,32} (Netherlands, Belgium, Spain) and
251 one study reported data from four countries across Europe²⁴, namely UK, France,
252 Germany and the Netherlands.

253

254 Methodological quality

255 The details of studies are contained in Table 1. The included studies were generally
256 well designed and reported. Recruitment of participants was suitable, and methods
257 and analyses were described clearly. Studies varied in the generalizability of their
258 findings to populations beyond those studied.

259

260

261 Screening

262

263 1) Method of screening

264

265 A variety of tools, which could be used in general practice for screening genetic
266 cancer risk was described^{15,29,30,38,39,42–45,47–50,52–55}. Examples of family history
267 collection tools include Family Healthware^{52,53}, a self-administered web-based tool,
268 and FHS-7³⁸ which comprises seven questions, both cover family history of breast,
269 ovarian and colorectal cancer, MeTree^{42,45,48} is a computerized tool stratifying risk of
270 hereditary cancer syndromes, i.e. breast, ovarian and colorectal cancer, to be
271 completed at routine visits and to support clinical decisions. Two studies examined
272 an office screening form for familial breast cancer alone^{29,30}, whilst Walter et al⁵⁰

273 developed a family history questionnaire assessing breast and colorectal cancer, to
274 be completed at a planned data collection session in the general practice surgery.
275 In 2013, The US Preventive Services Task Force updated their recommendations
276 and recognised The Ontario Family History Assessment Tool, Manchester Scoring
277 System, Referral Screening Tool, Pedigree Assessment Tool and FHS-7 as suitable
278 for primary care providers to screen women and suggest testing for BRCA1 or 2
279 genes⁵⁶.

280

281 The Gail risk model provides the basis for a questionnaire implemented by Owens et
282 al, and which identifies patients deemed high risk for breast cancer. Four studies
283 described simple postal questionnaires^{44,49,54,55}, with Leggatt et al^{49,54} screening for
284 genetic risk assessment of breast and colorectal cancer, House et al⁵⁵ identifying
285 those at risk of colorectal cancer alone and Qureshi⁴⁴ collecting non-specific cancer
286 family history information. Biswas et al developed and tested a two-stage approach
287 with three simplified versions of BRCAPRO to reduce the genetic counselling burden
288 in general practice¹⁵. Flória-Santos⁴⁷ described a self-reported cancer family history
289 as a tool to detect breast, prostate, and colon cancer, potentially also useful to
290 screen other hereditary cancer syndromes.

291

292 2) Attitudes

293

294 Of the five studies examining GP attitudes, three addressed attitudes towards the
295 process of screening patients for inherited cancer risk in general^{27,28,37} and two
296 studies reported attitudes towards specific screening tools^{43,45}. Gramling et al²⁸
297 reported that 87% of 300 GPs surveyed agreed that screening patients for inherited
298 cancer risk was important to their practice but only 62% were confident in their own
299 screening effectiveness. Carroll et al³⁷ showed that primary care providers are
300 prepared to discuss personalised medicine. Another study by Gramling et al²⁷, with a
301 small sample of US family physicians, showed that the importance physicians placed
302 on screening was positively related to their beliefs that a high-risk genetic test result
303 would motivate behaviour change in patients. The methods for screening in question
304 were not described^{27,28}.

305

306 In contrast, Owens et al⁴³ discussed that some providers were concerned with the
307 accuracy of the Gail model formula in identifying high risk patients. Furthermore,
308 there were worries over the time needed to counsel patients newly determined to be
309 at high risk and about liability for not successfully providing risk counselling.

310

311 Wu et al⁴⁵ showed that physicians within two primary care clinics initially felt that they
312 were already collecting high quality family histories and that MeTree would

313 negatively impact their workflow. They believed that patients would redirect
314 discussions away from physician priorities to instead focus on MeTree
315 recommendations. However post-MeTree integration, 86 % of physicians believed
316 the tool improved the way they practiced medicine, making practice easier and none
317 reported that it adversely affected their workflow⁴⁵.

318

319 3) Patient outcomes

320

321 Six studies assessed patient outcomes following the various methods of screening
322 for genetic cancer risk^{29,30,39,45,49,53}. There was some evidence that screening can
323 lead to more accurate risk perceptions with risk feedback following an office
324 screening form, with greater odds of a patient correctly rating their breast cancer risk
325 as “high” in those who had a first degree relative with breast cancer³⁰. Wang et al
326 found that in comparison to control patients, those who underestimated their risk and
327 who were screened using the Family Healthware tool, increased their perceptions of
328 colon cancer risk, but not regarding breast or ovarian cancer⁵³. However, Baer et al³⁹
329 found that a higher percentage of patients who had been screened via YHS (Your
330 Health Snapshot) reported their perceived risk of colon cancer to be above average
331 (possibly incorrectly) compared to the control group. Wu et al⁴⁵ found 85% of 1,184
332 patients believed MeTree generally raised their awareness of both their personal and
333 family health risk, changing the way they think about health.

334

335 One study also showed that risk feedback following screening was associated with
336 lower perceived severity of breast cancer but not with the perceived likelihood of
337 developing breast cancer in the future²⁹. Gramling et al²⁹ also found that patients
338 who had had family medical history screened recently were less likely to be worried
339 about developing breast cancer. This association was present even in those at high
340 risk, although it was stronger for women with a lower risk family history. In contrast,
341 Laggatt et al found that completing a screening questionnaire and receiving an
342 assessment of high genetic risk had no significant impact on general anxiety and
343 cancer worries⁴⁹.

344

345 4) Outcomes of referrals

346

347 Only one study⁵² assessed the effectiveness of referrals following screening for
348 genetic cancer risk. Rubinstein et al⁵² found that in those at high risk, consultation
349 rates with genetic specialists did not differ between the group that completed Family
350 Healthware and the control group. Furthermore, both groups equally increased their
351 adherence to risk-based colon cancer screening and mammography schedules.

352

353 Testing

354

355 1) Available tests and tools

356

357 Eight tools were described that could be used in general practice for assessing a
358 genetic risk of cancer. These tools all incorporated family history into their
359 assessment and some included further decision support and recommendations.
360 The Gail model⁴³, MeTree^{42,42,45,48} and FHS-7³⁸ were also used for testing.
361 The GRAIDS^{20,51} (Genetic Risk Assessment in Genetics) software provides risk
362 estimates of breast, ovarian and colorectal cancer. RAGS^{34,41} (Risk Assessment in
363 Genetics) also addresses familial breast and ovarian cancer and YHS³⁹ (Your Health
364 Snapshot) calculates inherited susceptibility to colon, lung, breast and prostate
365 cancer. The set of GP guidelines by de Bock and al⁴⁰ assesses breast cancer risk
366 and Qureshi et al's FHQ⁴⁴ (family history questionnaire), identifies the presence of
367 relatives with cancer in general.

368

369 In relation to genomic tests, four studies reported testing for inherited susceptibility to
370 breast cancer^{23,24,26,31}, and one study included ovarian cancer³¹. Another study
371 related to predictive testing more broadly⁹. The remaining studies referred to the use
372 of a standard family history for identifying individuals at risk of hereditary breast
373 cancer^{21,22,25,29,43} and non-specific cancer^{2,4,23}.

374

375 2) Clinician attitudes

376

377 A range of views of general practitioners to the genetic cancer risk assessment and
378 testing was evident. Overall, GPs considered genetic risk assessment to be a
379 potentially important role for them^{2,9,24-26,37}, but the extent to which they believed they
380 should be involved with genetics varied. Genetic counselling of patients in regard to
381 their risk and making management decisions was thought to be less appropriate for
382 GPs, whilst providing emotional support following testing was acknowledged to be
383 part of their job^{2,21,23,25,26}.

384

385 General practitioners admitted that they found assessing genetic risk difficult^{34,37} and
386 felt uncomfortable when doing so because of their lack of knowledge^{2,4,22}. For
387 instance, Hapgood et al²² showed 89.5% of GPs included in their study incorrectly
388 categorized a low-risk breast cancer family history as either moderate (52.9%) or
389 high (36.6%) risk. General practitioners also lacked confidence in their ability to
390 interpret genetic test results and explain them to patients^{2,4,21,22,34}. Furthermore,
391 inadequate skills in taking an appropriate family history were highlighted, with GPs
392 often failing to get sufficient information from patients to appropriately assess their

393 risk^{4,23,24}. Significant proportions of GPs were unfamiliar with their local cancer
394 genetics guidelines and knew little of the services that were available to them^{25,34}.

395

396 From the studies included, it appeared that clinicians were commonly also not
397 confident in discussing the benefits, risks and limitation of genetic testing with
398 patients^{2,21,37}. They were concerned by the unnecessary anxiety caused by the
399 process of genetic testing itself, in addition to an increased risk result being received
400 by patients^{4,9,20,25,32}. The belief that decreased-risk results would create a false
401 sense of security was also expressed by some GPs. Another further theme that
402 arose was about ethical implications and fears of legal repercussions after genetic
403 tests^{9,44}. This particularly derived from concerns that when a positive result from
404 testing had implications for patients' families, this generates concerns over patient
405 confidentiality and how best to inform other family members of their risk⁹.

406

407 Overall, GPs expressed concern regarding the validity of genomic testing and its
408 clinical utility. Time constraints were a further reason that practitioners gave for not
409 being able to sufficiently counsel patients regarding the benefits and risks of genomic
410 testing or being able to interpret test results sufficiently^{2,20,34,43,45}. Some GPs believed
411 that they needed education³⁷ before exploring an expanded role, but studies
412 conflicted for the intentions of GPs in seeking further education^{4,21,31}. For example,
413 Walter et al²⁵ reported that only a third of practitioners had attended education about
414 risk management for breast cancer in the last three years.

415

416 Table 2 summarises main findings regarding clinicians' attitudes towards screening
417 and testing.

418

419 3) Patient outcomes

420

421 Data about patient knowledge, satisfaction and anxiety in relation to tests and risk
422 communication were limited. For the GRAIDS software, there were no significant
423 differences in knowledge scores, but patients referred from intervention practices
424 had significantly lower cancer worry scores⁵¹. There was also no difference in mean
425 risk perception, although there was a non-significant trend towards more accurate
426 risk perception, with fewer intervention patients overestimating their risk at the point
427 of referral⁵¹.

428

429 4) Outcomes of referrals

430

431 There were few data evaluating the effectiveness of referrals to secondary care,
432 following the identification of high genetic risk of cancer in general practice. One

433 study⁴³ reported that of the patients referred to the breast centre after a high-risk
434 consultation, only half actually attended for their visits. A retrospective audit in
435 Australia found that GPs referred the majority of patients to the genetics service and
436 were also the most likely to refer inappropriately³³.

437

438 **DISCUSSION**

439

440 **Summary**

441 There are several tools available to GPs that can enable them to identify genetic risk
442 of cancer. Most of these involve a family history component, as an effective way of
443 determining a patient's risk of hereditary cancer. Regarding our review questions,
444 there was most evidence about clinician attitudes to cancer genetics, whereby GPs
445 consider the assessment of genetic risk to be a potentially important job for them.
446 Lack of confidence and knowledge may be reasons for their reluctance to undertake
447 an expanded role beyond that of a 'gatekeeper'. General practitioners were worried
448 about the impact of genetic risk assessment on patient anxiety³², particularly if
449 discussions with whole families would then be required. Furthermore, their ability to
450 adequately explain risk and its implications within short routine appointments was
451 raised as a concern. The results regarding patient outcomes show that there may be
452 a link between genetic risk assessment in primary care and lower cancer worry in
453 patients, but there were not enough data to accurately describe the relationship in
454 the general practice setting.

455

456 **Strengths and limitations**

457 A comprehensive search strategy was developed for high recall (sensitivity), with a
458 range of databases, grey literature and hand searches of reference lists conducted.
459 We included studies of various designs in order to gather evidence that addressed all
460 of our questions. There was considerable heterogeneity in the results, making
461 statistical analysis unfeasible and a narrative synthesis was conducted. Our inclusion
462 criteria were applied strictly, with a particular effort made only to include studies that
463 specified results from general practice. The main weakness of this literature review is
464 the limited number of studies that were identified for our review. The heterogeneity of
465 outcomes reported adds further to difficulties in drawing conclusions. We recognise
466 that the nature of primary care is likely to vary across the many countries in which
467 the included studies were conducted. This is particularly the case in North America
468 (concerning "family medicine", which is the equivalent of general practice in Europe),
469 from which almost half of the studies derived. Knowledge about genetic cancer risk
470 and referrals have dramatically changed over the 20 years period¹³ covered by those
471 studies reviewed. We also recognize that the studied population is a sub-population
472 in primary care. Nevertheless, this review still highlights where evidence is lacking.

473

474 **Comparison with existing literature**

475 Many studies have shown that GPs lack confidence in their skills involving cancer
476 genetics^{2,3,57}. Our results regarding clinician attitudes towards cancer genetics are
477 similar to those of Mathers et al¹², who reported GPs' resistance to clinical genetics
478 in general. They too showed that GPs believed genetic conditions required complex
479 knowledge that should be covered by specialist services, as they were worried about
480 the accuracy of their knowledge. A review by Emery and Hayflick⁷ in 2001 identified
481 family history as important and that GPs needed to gain generic knowledge and
482 skills in the ascertainment of genetic cancer risk. Our review confirms the current
483 evidence that clinicians' confidence in their knowledge is usually sub-optimal.

484

485 McClain et al⁵⁸ investigated six family history screening protocols for breast and/or
486 ovarian cancer by applying them to family histories taken from four cohorts of women
487 in a variety of settings. They showed that each of these protocols used alone gave
488 too many screen-positive results, but when all six protocols agreed, there was a
489 more acceptable screen-positive rate. Similarly, if some of the genetic cancer risk
490 screening tools identified in this review were compared directly, a singular composite
491 screening tool including key items, could potentially be identified.

492

493 **Implications for practice and research**

494 Advances in genetic medicine were expected to lead to a shift towards general
495 practice being more involved with provision of genetic services. General practitioners
496 are potentially important in identifying patients at increased risk of hereditary cancers
497 to ensure suitable subsequent management. The value of taking a comprehensive
498 family history should not be overlooked by clinicians, together with the many other
499 tools identified in this review that could potentially be used in practice. None of the
500 tools identified can be recommended for use over another at this stage, but
501 improving clinician awareness of their existence could support future implementation.
502 Being able to use one of these tools also implies being able to discuss advantages
503 and disadvantages of such screening and testing and results with patients. This is a
504 challenge also concerning test results that may be brought to GPs after direct-to-
505 consumer tests (e.g. 23andme.com). There is little evidence that GPs have the
506 combined knowledge, confidence, skills, experience or capacity to do this in usual
507 practice.

508

509 Further studies are needed to evaluate patient outcomes, particularly psychological
510 impact, of genetic cancer risk screening, particularly if it is to be offered routinely to
511 patients in general practice. Moreover, it is important to consider acceptability of
512 such screening to patients in primary care. Research with hard-to-reach groups who

513 may be less likely to take up screening when offered is also needed.

514

515 General practitioners have a potential role in identifying patients at risk of hereditary
516 cancer, however family history-taking practices are often inadequate to assess risk.

517 Consequently, several tools have been developed to help, facilitate and improve

518 genetic risk assessment in general practice. But, at this current point in time, it is

519 difficult to support the adoption of routinely available testing or population-wide

520 screening practices within primary care. Before the implementation of such genetic

521 risk assessment tools is recommended in practice, further well-conducted studies

522 are needed to provide evidence of their benefits, particularly on patient outcomes.

523 General practitioner knowledge and confidence regarding cancer genetics are

524 barriers that must also be improved if they are to consider an expanded role.

525

526

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