

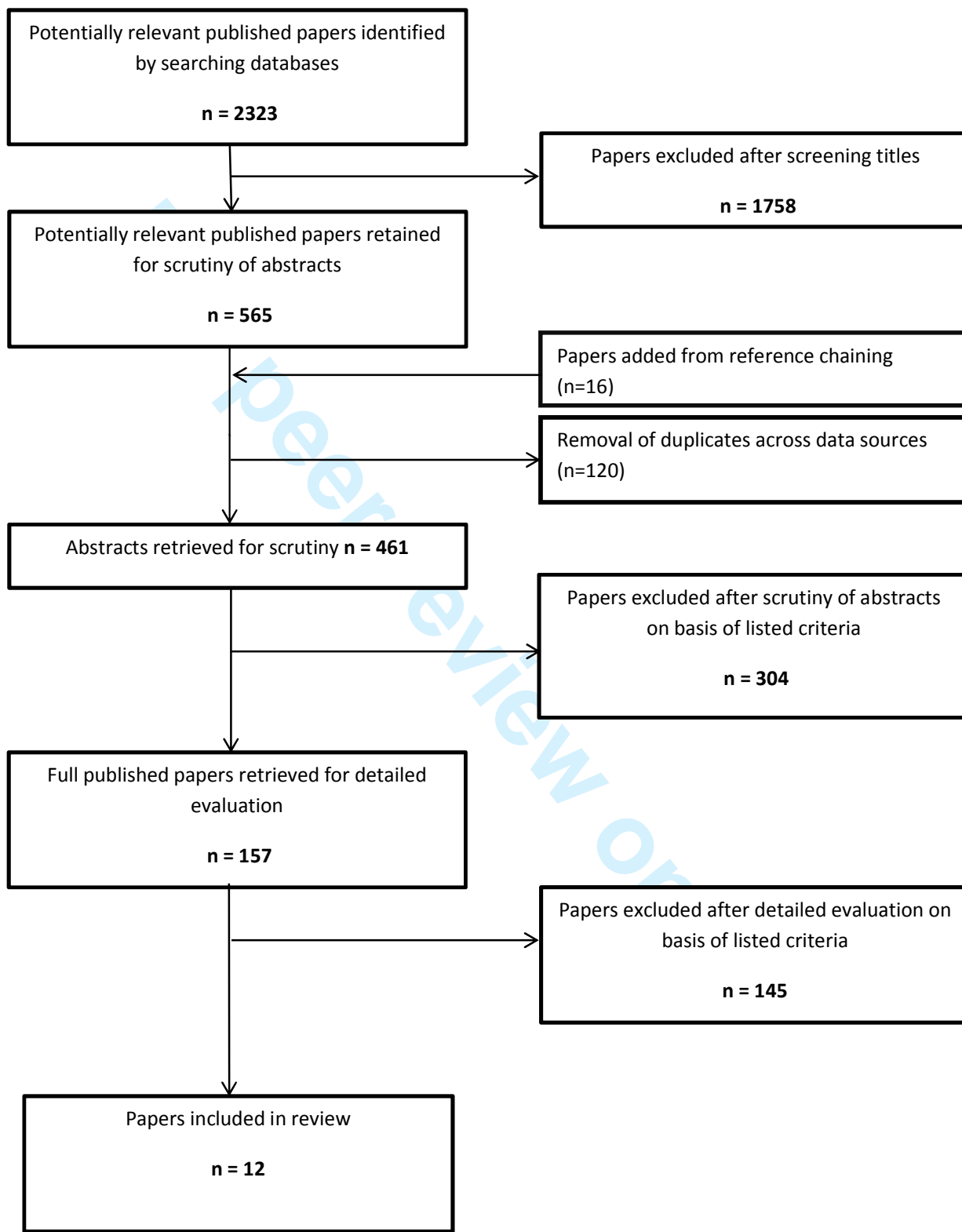


**Behavioural components associated with increased uptake and effectiveness of screening programmes for coronary heart disease and diabetes: A systematic review.**

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2013-003428
Article Type:	Research
Date Submitted by the Author:	17-Jun-2013
Complete List of Authors:	Holland, Carol; Aston University, Psychology Cooper, Yvonne; Aston University, Psychology Shaw, Rachel; Aston University, Pattison, Helen; Aston University, Psychology; Aston University, Health Sciences Cooke, Richard; Aston University, Psychology
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	Cardiovascular medicine, Diabetes and endocrinology
Keywords:	PRIMARY CARE, PREVENTIVE MEDICINE, General diabetes < DIABETES & ENDOCRINOLOGY, Coronary heart disease < CARDIOLOGY

SCHOLARONE™  
Manuscripts

Figure 1 Flow chart of intervention studies included and excluded from this review



## PRISMA checklist

**Table 1**

Checklist of items to include when reporting a systematic review or meta-analysis

Section/topic	Item No	Checklist item	Reported on page No
<b>Title</b> Behavioural components associated with increased uptake and effectiveness of screening programmes for coronary heart disease and diabetes: A systematic review.			
Title	1	Identify the report as a systematic review, meta-analysis, or both	2
<b>Abstract</b>			
Structured summary	2	Provide a structured summary including, as applicable, background, objectives, data sources, study eligibility criteria, participants, interventions, study appraisal and synthesis methods, results, limitations, conclusions and implications of key findings, systematic review registration number	2-3
<b>Introduction</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	5
<b>Methods</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (such as web address), and, if available, provide registration information including registration number	N/A

Section/topic	Item No	Checklist item	Reported on page No
Eligibility criteria	6	Specify study characteristics (such as PICOS, length of follow-up) and report characteristics (such as years considered, language, publication status) used as criteria for eligibility, giving rationale	5
Information sources	7	Describe all information sources (such as databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	Appendix 1, p36
Study selection	9	State the process for selecting studies (that is, screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	6
Data collection process	10	Describe method of data extraction from reports (such as piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	6
Data items	11	List and define all variables for which data were sought (such as PICOS, funding sources) and any assumptions and simplifications made	6-7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis	7
Summary measures	13	State the principal summary measures (such as risk ratio, difference in means).	Table 32-34
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (such as I <sup>2</sup> statistic) for each meta-analysis	N/A
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (such as publication bias, selective reporting within studies)	7

Section/topic	Item No	Checklist item	Reported on page No
Additional analyses	16	Describe methods of additional analyses (such as sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified	N/A
<b>Results</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	6, flow diagram in this supplementary file
Study characteristics	18	For each study, present characteristics for which data were extracted (such as study size, PICOS, follow-up period) and provide the citations	Table 1, pages 32-34
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see item 12).	Included in SIGN 50, see Table 1.
Results of individual studies	20	For all outcomes considered (benefits or harms), present for each study (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot	Table 1, 32-34, main findings presented, but standard summary data not possible
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15)	22
Additional analysis	23	Give results of additional analyses, if done (such as sensitivity or subgroup analyses, meta-regression) (see item 16)	N/A
<b>Discussion</b>			
Summary of	24	Summarise the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (such as health care	Summary boxes PP15, 20,

Section/topic	Item No	Checklist item	Reported on page No
evidence		providers, users, and policy makers)	24, policy implications, p23
Limitations	25	Discuss limitations at study and outcome level (such as risk of bias), and at review level (such as incomplete retrieval of identified research, reporting bias)	22
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	23
<b>Funding</b>			
Funding	27	Describe sources of funding for the systematic review and other support (such as supply of data) and role of funders for the systematic review	25

1  
2  
3 **Effectiveness and uptake of screening programmes for coronary heart disease**  
4 **and diabetes: A realist review of design components used in interventions.**  
5  
6  
7

8  
9 Short title: Effectiveness and uptake of screening programmes  
10

11  
12 Carol Holland (Senior Lecturer), Yvonne Cooper (Research Associate), Rachel Shaw  
13  
14 (Senior lecturer), Helen Pattison (Professor), Richard Cooke (Senior lecturer).  
15  
16

17  
18 Health and Lifespan Psychology Group  
19

20  
21 School of Life & Health Sciences  
22

23  
24 Aston University  
25

26  
27 Birmingham  
28

29  
30 B4 7ET  
31

32  
33 UK  
34  
35

36  
37 **Corresponding author: C. Holland (email [c.holland1@aston.ac.uk](mailto:c.holland1@aston.ac.uk))**  
38

39  
40 The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all  
41 authors, an exclusive licence on a worldwide basis to the BMJ Publishing Group Ltd to permit this article (if  
42 accepted) to be published in BMJ editions and any other BMJPG products and sublicences such use and  
43 exploit all subsidiary rights, as set out in our licence.  
44  
45  
46  
47

48 **Word count (excl. abstract, summary, refs, table, boxes) (5938)**  
49

50  
51 **1 Table**  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Abstract

### Objective

To evaluate behavioural components and strategies associated with increased uptake and effectiveness of screening for coronary heart disease (CHD) and diabetes, with an implementation science focus.

### Design

Realist review.

### Data sources

PubMed, Web of Knowledge, Cochrane Database of Systematic Reviews, Cochrane Controlled Trials Register and reference chaining. Searches limited to English language studies published since 1990.

### Eligibility criteria

Eligible studies evaluated interventions designed to increase uptake of CVD and diabetes screening and examined behavioural and/or strategic designs. Studies were excluded if they evaluated changes in risk factors or cost-effectiveness only.

### Results

In 12 eligible studies, several different intervention designs and evidence based strategies were evaluated. Salient themes were effects of feedback on behaviour change, or benefits of health dialogues over simple feedback. Studies provide mixed evidence about benefits of these intervention constituents which are suggested to be



1  
2  
3 situation and design specific, broadly supporting their use, but highlighting concerns  
4 about fidelity of intervention delivery, raising implementation science issues.<sup>1,2</sup> Three  
5  
6  
7  
8 studies examined effects of informed choice, or loss versus gain frame invitations,  
9  
10 finding no effect on screening uptake, but highlighting opportunistic screening as more  
11  
12 successful for recruiting higher CVD and diabetes risk patients than invitation letter, with  
13  
14 no differences in outcomes once recruited. Two studies examined differences between  
15  
16 attenders and non-attenders, finding higher risk factors amongst non-attenders, and  
17  
18 higher diagnosed CVD and diabetes amongst those who later dropped out of  
19  
20 longitudinal studies.  
21  
22  
23  
24

## 25 **Conclusions**

26  
27  
28 If risk and prevalence of these diseases are to be reduced, interventions must take into  
29  
30 account what we know about effective health behaviour change mechanisms, monitor  
31  
32 delivery by trained professionals, and examine the possibility of tailoring programmes  
33  
34 according to contexts such as risk level to reach those most in need. Further research is  
35  
36 needed to determine the best strategies for lifelong approaches to screening.  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Article Summary

- 1) Article Focus: The primary objective of this realist review was to evaluate the impact on health and attendance outcomes of theoretically supported behaviour change features embedded within intervention designs of screening programmes targeting CHD and diabetes.
- A secondary objective was to evaluate factors predicting attendance and attrition from these programmes and appraise their impact, with implications for design in specific contexts.

## 2) Key Messages

- The benefits of a structured, motivational health dialogue, with feedback, are supported over simple screening and advice, where outcomes are measured long term. Structure of motivational health dialogues and the terms over which they are most successful needs further research
- However, the issue of intervention fidelity (adherence to intervention protocol by those delivering) has potential to differentiate between programmes that are or are not successful in getting patients to change health behaviour and as such represents a key implementation science component of the review.
- This review highlights the need for a more systematic approach to using the evidence base for strategic design, conduct and analysis of health interventions

1  
2  
3 by taking into account the complex interactions between design, delivery,  
4  
5 attrition, context and health outcomes.  
6  
7  
8  
9

### 10 3) Strengths and Limitations.

#### 11 Strengths:

- 12 • The study's strength is its focus on what contributes to success and reach of  
13 screening plus intervention studies, based on health psychology evidence.  
14  
15 • Its evaluation of the degree and fidelity with which evidenced health behaviour  
16 strategies are used has important implications for practitioners managing  
17 screening and intervention programmes.  
18  
19 • Evaluation of opportunistic screening confirms previous work showing that it  
20 reaches people with higher CVD risk factors than reached using standard  
21 invitations, but additionally demonstrates that people screened opportunistically  
22 show very similar improvements in assessed risk factors and behaviours to  
23 people invited in other ways.  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40

#### 41 Limitations:

- 42 • This review raised two key challenges. First, many studies do not analyse  
43 behavioural components of the intervention design discretely, making it  
44 impossible to discern which factors are at work in producing the observed effects.  
45  
46 Second, the heterogeneity of outcome measures precludes statistical evaluations  
47 using meta-analysis.  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- Publication or outcome bias may have affected our results, though not all included studies found significant reductions in assessed risk or differences in outcomes between intervention and control groups.
- Several potentially relevant studies focusing on design of screening interventions were excluded because they were not delivered in healthcare settings.
- Well-known selective drop out (“selective attrition”) biases are confirmed in these studies, whereby people with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments. Careful methodological and statistical controls are needed to reduce resultant effects on findings, but few studies employ these.
- As a realist review, this document examines outcomes which may be situation specific. The acknowledgement that some findings that may be situation specific is important in generalisation of results.

## Introduction

Previous reviews of multiple risk factor interventions for primary prevention of coronary heart disease (CHD) and diabetes often conclude that interventions have no overall effect on mortality.<sup>3</sup> Nevertheless, CHD deaths have halved in the UK and other developed countries in the last 30 years.<sup>4</sup> Unal et al<sup>5</sup> compared targeted interventions and general population screening. They estimated the proportion of reduced deaths from CHD in England and Wales between 1981 and 2000 that were attributable to changes in risk factors in patients with CHD or changes in cardiovascular risk factors in the general population, and found both approaches beneficial. These authors calculated that reductions in risk factors (such as smoking, high blood pressure) in the general population account for 50-75% of the fall in cardiac deaths, and pharmacological and surgical treatments for diagnosed CHD patients account for 25-50%.<sup>5</sup> However, that benefit was greater when individuals without CHD were screened: results indicated an additional 21 years of life for each death prevented in those with no CHD diagnosis compared to 7.5 years for those with CHD.

Public health campaigns to reduce these conditions usually involve: government-sponsored programmes at the population level or changes in policy (such as food labelling legislation); targeted interventions for those at heightened risk (for example, moderate-intensity, low-impact exercise for those very overweight or with chronic conditions); or general population screening and intervention to reduce risk development in the healthy population and identify high risk people leading to specific referral for detected or previously untreated symptoms (for example, current NHS Health Check<sup>6</sup> programme).

1  
2  
3 This review focuses on quantitative evaluations of screening plus intervention  
4 programmes that target the general population to reduce incidence of CHD and  
5 diabetes. These conditions were selected because they are the focus of screening  
6 programmes in many countries and the negative outcomes of these conditions can be  
7 ameliorated by lifestyle behaviour change. Previous reviews have focussed on  
8 reductions in risk measurements, cost effectiveness, or years of life added.<sup>3</sup> In contrast,  
9 the primary objective of this review was to examine use of behaviour change features  
10 embedded within intervention designs of screening programmes targeting CHD and  
11 diabetes, and their impact on health outcomes. A secondary objective was to evaluate  
12 the factors predicting attendance and attrition from these programmes.  
13  
14

15 These objectives are not well-suited to systematic review and meta-analysis  
16 approaches, where the aim is to synthesise results across contexts to gain a sense of  
17 the pattern of results for studies conducted using similar methodologies. In contrast, the  
18 present paper is focused on questions around “how” and “why” behavioural features are  
19 incorporated into interventions, and how these features can contribute to the success of  
20 interventions. Therefore, we adopted a realist review, also called a meta-narrative  
21 approach. This approach was adopted to gain insights into the direction the evidence is  
22 pointing and the underlying theoretically driven concepts, behaviour change  
23 mechanisms, and barriers, that may combine to contribute to outcomes in population  
24 screening for CHD and diabetes.<sup>7</sup> Focus on the mechanisms and use of evidence  
25 based behaviour change strategies locate the review within an implementation science  
26 approach, given that “one of the most consistent findings from clinical and health  
27 services research is the failure to translate research into practice and policy” p1.<sup>2</sup>  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 A realist methodology<sup>8</sup> is suited to areas where there is a diverse literature, which may  
7  
8 have a variety of methods, components and outcomes. This methodology is concerned  
9  
10 with explaining more fully the processes of interventions within the complexity of their  
11  
12 contexts, rather than focussing on simple cause and effect deterministic theories.

13  
14  
15 Realist reviews can “contribute to programme understandings even when the outcomes  
16  
17 are not rigidly defined at the outset of the review and have been characterised as a  
18  
19 theory-driven and interpretive approach to systematic reviews to answer questions  
20  
21 about what works, for whom and in what circumstances” p4.<sup>9</sup>  
22  
23

24  
25  
26 Inclusion of studies in a realist review is intended to be less proscribed than in a  
27  
28 systematic review to allow for a mix of methods and outcomes to be included, ensuring  
29  
30 that underlying theories and approaches can be evaluated rather than a focus on  
31  
32 specific measured outcomes.<sup>8</sup> Inclusion criteria in this review of screening plus  
33  
34 intervention studies were generated using guidance from systematic reviews on  
35  
36 screening (PRISMA),<sup>10</sup> but were further generated iteratively using the themes that  
37  
38 emerged. The flowchart and checklist are available as supplementary material.  
39  
40  
41

#### 42 43 **Data sources**

44  
45  
46 Web of Knowledge, PubMed, Cochrane Database of Systematic Reviews, Cochrane  
47  
48 Controlled Trials Register restricted to English language and published post 1990.

49  
50 Reference chaining of identified studies was then conducted.

#### 51 52 53 **Search strategy**

1  
2  
3 Search terms were adapted from previous Cochrane reviews of screening plus uptake  
4 studies.<sup>11,12</sup> The full strategy is available in Appendix 1. The search was first carried out  
5  
6 in July 2010 and updated in March 2013.  
7  
8  
9

## 10 11 **Study selection**

12  
13  
14 The initial inclusion criteria were: studies that tested interventions designed to increase  
15 uptake of CHD and diabetes screening programmes, or to increase early detection and  
16 prevention of these conditions *and* examined the behavioural and/or strategic design of  
17 the intervention tested. Studies which only reported on changes in risk factors or cost-  
18 effectiveness were excluded.  
19  
20  
21  
22  
23  
24  
25  
26

27 The initial search elicited 2323 relevant published papers. Retrieved papers were  
28 screened according to the inclusion criteria. Details of screening and exclusion stages  
29 are detailed in Figure 1 in the supplementary material.  
30  
31  
32  
33  
34

35 Following screening of titles, 565 relevant papers remained. Reference lists and  
36 citations of these papers were searched (using Pubmed and Web of Knowledge)  
37 specifically to identify studies that evaluated behavioural aspects of interventions tested;  
38 a pragmatic approach was taken to ensure that articles which may not have been found  
39 using such traditional chaining were not missed, in that new keywords elicited from  
40 themes of identified articles were added to the search, notably on specific behavioural  
41 approaches. An example was “informed choice invitation”. This process identified a  
42 further 16 articles. Following removal of duplicates across sources (120), and removal  
43 after abstract screening (304), two authors (CH, YC) independently reviewed 157 full  
44 text papers, and further excluded studies which only evaluated changes in risk factors  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 or cost-effectiveness. Further exclusions at abstract and full text stages were guided by  
4 framing of the interventions into their constituent components using PICO(T) categories  
5 (Population, Intervention, Comparison, Outcome and Type of study design). The review  
6 was concerned with general population (adult) screening, and so interventions that  
7 considered only those already identified as at high risk of CVD/Diabetes or already  
8 receiving treatment, younger or specific age or disease limited groups, were excluded.  
9

10 Although initial reading included interventions in a variety of settings, the selection of the  
11 final set of papers restricted inclusion to studies set in primary health care in line with  
12 the aim of this review being to inform primary health care based interventions.  
13

14 Comparison with a control group of some nature was necessary for inclusion, and  
15 although most of the identified studies did consist of Randomised or Cluster  
16 Randomised Control Trials, other designs were not excluded, and the relevant quality  
17 appraisal criteria for the different designs were used as appropriate (See Table 1).  
18

19 Although most of the studies examined outcomes in terms of successful or unsuccessful  
20 lowering of CVD or diabetic risk, the intention of this review was to determine “how, why  
21 and what works” or what may prevent it working<sup>8</sup>, so outcome type was not restricted.  
22

23 Preliminary examination of studies sought to extract dominant themes reflecting the  
24 behavioural features of the “how and why” such interventions succeed or fail in reducing  
25 CVD or Diabetic risk. Most studies examined the effect of a multi-component  
26 intervention, in which key features were engaging populations in screening, providing  
27 screened populations with feedback about risk status, a health dialogue (defined as  
28 counselling that includes aspects of shared decision making such as goal setting or  
29 intention formation, and is not just information giving or psychological support),  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 information about the impact of risk factors on illness development, counselling,  
4  
5 motivational interviewing, referral, and pharmacological treatment. The impact of  
6  
7 feedback and health dialogue on health outcomes was reported but due to the multiple  
8  
9 constituents of interventions, isolating the effects of any one feature is often difficult.  
10  
11 Search for studies that focused on explicitly examining such features therefore  
12  
13 developed. Twelve studies were left that fulfilled this requirement and met inclusion  
14  
15 criteria. Details of the components covered by these papers, year of publication, details  
16  
17 of the samples recruited, populations studied and main findings are presented in Table  
18  
19 1. The selection process is summarized in a PRISMA flow diagram (supplementary  
20  
21 materials).

## 22 23 24 25 26 27 28 **Data extraction**

29  
30  
31 Two reviewers (CH and YC) independently extracted information from each article, and  
32  
33 one author (CH) reviewed all studies. Data were extracted on study authors,  
34  
35 geographical location, year of publication, study cohort characteristics, behavioural  
36  
37 design features of the intervention, and outcome measures (see Table 1).  
38  
39

## 40 41 42 **Results**

### 43 44 45 **Study characteristics and quality**

46  
47 The SIGN 50 assessment of quality of studies included is summarised in Table 1. Two  
48  
49 authors (CH and RC) independently rated each included study for quality using the  
50  
51 SIGN 50 guidelines,<sup>13</sup> with each study rated as either ++ = high quality, + = acceptable  
52  
53 quality or 0 = low quality. After independent ratings the authors met to discuss their  
54  
55 ratings. All disagreements were resolved via discussion. Seven studies were of  
56  
57  
58  
59  
60

1  
2  
3 acceptable quality and five were high quality studies. The key elements of the studies  
4  
5 were summarised into Table 1, so that key themes and evidence from the papers could  
6  
7 be identified and extracted for examination.  
8  
9

10  
11  
12 The review of included papers begins by describing studies that addressed the question  
13  
14 of what impact behaviour change features embedded within intervention designs of  
15  
16 CVD and diabetes screening programmes have on health outcomes. The review then  
17  
18 proceeds to cover literature that evaluates the factors predicting attendance and attrition  
19  
20 from screening and intervention programmes.  
21  
22  
23

### 24 25 26 27 **Impact of feedback on behaviour change**

28  
29 Providing people with feedback on their behaviour can prompt behaviour change,<sup>14,15</sup>  
30  
31 and has been recognised as an effective behaviour change technique in Abraham and  
32  
33 Michie's behaviour change taxonomy.<sup>16,17</sup> In general, there are two types of feedback:  
34  
35 informing patients about their risk status, e.g. of CVD; and giving patients behaviour-  
36  
37 specific feedback, e.g. discussion related to detailed dietary analysis<sup>18</sup>, with a key point  
38  
39 of contention being the effectiveness and practicalities of these two approaches Two  
40  
41 studies examined the impact of feedback on behaviour change.  
42  
43  
44  
45

46  
47  
48 Aubin et al<sup>19</sup> investigated whether knowledge of blood cholesterol level affected  
49  
50 intention to adopt a low fat diet. The study was conducted in hospital-based family  
51  
52 medical centres in Quebec, Canada. Participants were randomly assigned to complete  
53  
54 a questionnaire about CVD risk profile, intention to adopt a low fat diet, and dietary fat  
55  
56  
57  
58  
59  
60

1  
2  
3 intake either before or after receiving their screening results, i.e. one group knew their  
4 results, and one did not at the time of completing the questionnaire. Patients who were  
5 aware of their blood screening results before they completed the questionnaire showed  
6 a significantly higher intention to adopt a lower fat diet than patients who were not ( $F_{1,417}$   
7 = 5.4,  $p < 0.02$ ). In addition, in those who had received their results, intention tended to  
8 rise with blood cholesterol level (non-significant,  $F_{5,413} = 2.0$ ,  $p < 0.08$ ).  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19

20 Three months after screening, participants' dietary fat intake and changes in eating  
21 habits were assessed by comparing diet with that reported at baseline. Data for 391  
22 participants (mean age = 35 years) were analysed. Mean dietary fat intake significantly  
23 reduced from 48.5g per day at baseline, to 37.7g per day at three month follow-up for  
24 the participant group as a whole. After three months, patients who had abnormal  
25 cholesterol levels had a significantly greater reduction in dietary fat intake than patients  
26 with normal cholesterol results ( $F_{(2,388)} = 3.6$ ,  $p = 0.03$ ); correlational analysis showed a  
27 highly significant link between reduction in fat intake and reduction in blood cholesterol  
28 (the researchers report an  $R^2$  of 0.5,  $p = 0.001$ , but confirmed by email that a Pearson's  
29 correlation was intended). This shows that patients who had higher blood cholesterol  
30 were more likely to make dietary changes. Although the method and analysis did not  
31 separate out people who were aware of their cholesterol levels in the longitudinal  
32 comparisons, the authors concluded that informing patients of their blood cholesterol  
33 levels effects an immediate change in dietary habits, and that over all, the change in  
34 dietary habits effects a reduction in fat intake and lower CVD risk.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Elton et al<sup>20</sup> used a workplace screening and intervention trial in Manchester, UK to  
4  
5 examine if knowledge of cholesterol level led to a reduction in cholesterol over a thirteen  
6  
7 week period. Participants were randomly allocated to either an intervention group that  
8  
9 received information on their current cholesterol level, or to a control group where this  
10  
11 information was not provided. Then all participants attended a health education session  
12  
13 about diet. The results demonstrated that the reduction in cholesterol measurements  
14  
15 thirteen weeks after baseline was greater in intervention participants with initially high  
16  
17 (>6.5mmol/l) serum cholesterol than in matched control participants (change of -0.29 for  
18  
19 intervention participants, 95% CI -0.48 to -0.11, but only a change of -0.01, 95% CI -  
20  
21 0.16 to +0.15 for controls, difference between groups reached significance at  $p < 0.024$ ).  
22  
23  
24  
25  
26  
27 A key difference between this and an earlier study<sup>18</sup> which had not shown an effect of  
28  
29 informing participants of their cholesterol level was that the interventions specifically  
30  
31 focussed on diet here, whereas the earlier study delivered a general health education  
32  
33 package.  
34  
35  
36

### 37 **Impact of health dialogue on behaviour change**

38  
39  
40 Five studies examined the role of health dialogue in influencing health outcomes of  
41  
42 screening interventions.<sup>21-25</sup> Färnkvist et al<sup>21</sup> investigated the extent to which health  
43  
44 screening with or without health dialogue influenced self-reported CVD and diabetes  
45  
46 morbidity 11 years post-screening. Participants were men aged 35-55 years in  
47  
48 Härnösand, Sweden. Screening included objective measurements (e.g. blood  
49  
50 pressure), a self-report questionnaire, and health counselling provided by nurses.  
51  
52  
53  
54 Although described alternately as health dialogue and counselling in this study, it did  
55  
56 actually consist of a structured motivational dialogue that included discussion of the  
57  
58  
59  
60

1  
2  
3 individual's CVD risk, and possible lifestyle changes, and hence fulfils our definition of a  
4  
5 health dialogue. Other healthcare providers in the same community (mainly  
6  
7 occupational health services; OHS) carried out the same screening but without the  
8  
9 health dialogue.  
10  
11

12  
13  
14  
15 Eleven years later participants were asked to complete a questionnaire including  
16  
17 questions about smoking, alcohol, physical activity, height, weight, fat intake and the  
18  
19 presence of CVD and/or diabetes. There was no significant decline in health during the  
20  
21 11 years for those participants who received the screening plus health dialogue (8.2%  
22  
23 incidence of CVD and/or diabetes), in stark contrast to those who received screening  
24  
25 only (22.6% incidence) or no screening (19.2%). The odds ratios (OR) of developing  
26  
27 CVD or diabetes over the 11 years was 2.5 for those who had screening with no health  
28  
29 dialogue, and 3.0 for those who had not participated in either the original screening or  
30  
31 the dialogue, as compared with the dialogue group. That is, the risk was more than  
32  
33 doubled for any group who had not received the dialogue. The authors concluded that  
34  
35 screening that includes a structured, motivational health dialogue is more effective than  
36  
37 screening without this dialogue.  
38  
39  
40  
41  
42  
43  
44  
45

46 Engberg et al<sup>22</sup> conducted a RCT in Denmark investigating the impact of general health  
47  
48 screening versus screening plus GP-patient discussions about CVD risk profile.

49  
50 Randomly selected men aged 30-50 from several GP practices were sent an invitation  
51  
52 letter and postal questionnaire about lifestyle. Those who agreed to take part completed  
53  
54 a second questionnaire asking about their health, lifestyle, psychosocial status and life  
55  
56  
57  
58  
59  
60

1  
2  
3 events. Participants were randomised to a control group (questionnaire only, no  
4  
5 screening) or one of two intervention groups: screening only and screening plus health  
6  
7 discussions (time points not given). Participants in the health screening plus discussion  
8  
9 group were offered a 45-minute consultation with their GP to discuss their results and  
10  
11 how to adapt to a healthier lifestyle. They were encouraged to set their own topics for  
12  
13 discussion and to set health-related lifestyle goals to achieve within the next year.  
14  
15

16  
17 These participants were offered further discussions annually for five years.

18  
19 Randomisation to groups was stratified based on the GP to whom they were registered,  
20  
21 age, sex, BMI and "cohabitation status". All screened participants received personal  
22  
23 written feedback from their GPs, including advice on lifestyle change (where necessary)  
24  
25 and information leaflets about a healthy lifestyle. All participants were followed up at 1  
26  
27 and 5 years.  
28  
29

30  
31  
32 At the 5 year follow-up, there were no significant differences in measures of CVD risk  
33  
34 factors between the two intervention groups (screening only versus screening plus  
35  
36 discussion). Taken together, however, these two intervention groups had a much lower  
37  
38 proportion of patients with elevated CVD risk scores than the control group, whose  
39  
40 prevalence of elevated CVD risk was approximately twice that of the intervention groups  
41  
42 (RR = 0.54, 95% CI = 0.40-0.73). However, there were no significant differences  
43  
44 between the control and intervention groups for blood pressure, and no effects on  
45  
46 smoking. The authors concluded that though the intervention as a whole had a marked  
47  
48 effect on CVD risk, the discussions did not improve the cardiovascular health of  
49  
50 participants over and above the improvement shown from screening with feedback.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Rubak et al<sup>23</sup> examined the difference in patient outcomes (improved metabolic status in  
4 patients with diabetes) between those whose GPs had received training in motivational  
5 interviewing and those whose GPs had been allocated to a control group. Both groups  
6  
7  
8 of GPs received training in intensive treatment of Type 2 Diabetes. The study found that  
9  
10 patients with GPs in both groups showed significant improvements, with no difference  
11  
12 between the groups at one year follow-up. One explanation for the lack of difference  
13  
14 found is that GPs in the motivational interview group had used an average of less than 2  
15  
16 of the 3 motivational interview sessions allocated to them. The authors suggest that  
17  
18 some contamination of effect may have occurred, in that the control group GPs also  
19  
20 became aware of MI, and that the GPs in the motivational interview group did not use it  
21  
22 as much as had been recommended.  
23  
24  
25  
26  
27  
28  
29

30 Koelewijn-van Loon et al<sup>24</sup> investigated differences between participants who had a  
31  
32 structured dialogue with a trained nurse (including risk assessment, risk communication,  
33  
34 motivational interview and a patient “decision support tool”) and patients who received  
35  
36 usual care. Outcome measures were self-reported lifestyle behaviours, diet, exercise,  
37  
38 smoking and alcohol use, which were measured 12 weeks after baseline to assess  
39  
40 change. 522 patients completed the follow-up measures. The authors concluded that  
41  
42 the results showed an improvement in lifestyle in both groups; there were no differences  
43  
44 between groups in terms of effects.  
45  
46  
47  
48  
49

50 Craigie et al<sup>25</sup> examined the impact of a personalised lifestyle programme (HealthForce)  
51  
52 aimed at promoting lifestyle behaviour change and based specifically on health  
53  
54 behaviour change theory. HealthForce targeted motivational elements to create  
55  
56 intentions to change behaviour and volitional elements, focussing on translating  
57  
58  
59  
60



1  
2  
3 intentions into planned behaviours. It involved patients attending three face-to-face  
4 sessions with a trained lifestyle counsellor, plus other materials, with topics being  
5 activity, diet and weight management. The outcome assessments all showed significant  
6 positive changes for the intervention group (all  $p < 0.01$ ), with no positive, but some  
7 negative changes for the control group. Consumption of 5 portions of fruit and  
8 vegetables a day went from 56% to 85% for the intervention group; weight was down by  
9 an average of 1.1kg, BMI went from a mean of 26.7 to 26.2kg/m<sup>2</sup> (with increases, rather  
10 than decreases, for the control group,  $p < 0.01$ ) and waist circumference went from 87.3  
11 to 84.0cm (no significant change for control group).  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24

25 The contrast between these five similar studies is striking; Färnkvist et al and Craigie et  
26 al's analyses supported the impact of health dialogue, Engberg et al found that  
27 screening plus verbal health dialogue was not superior to screening that included a  
28 written dialogue, while Rubak et al and Koelewijn-van Loon et al found no effect.  
29 However, the outcome measures, and time between measurements, vary across  
30 studies; Färnkvist et al compared risk of CVD and diabetes diagnosis over 11 years,  
31 Engberg et al assessed differences between groups in risk factors five years after initial  
32 screening, Rubak et al tested metabolic status in patients with diabetes after one year,  
33 Koelewijn-van Loon et al compared self-reports of lifestyle behaviours 12 weeks after  
34 the intervention, and Craigie et al compared anthropometric and health behaviour  
35 changes 12 weeks later. This raises a number of issues. First, endpoint diagnosis is the  
36 most objective measure of the impact of intervention, and the strongest evidence of  
37 efficacy. Second, in general, longer-term follow-ups are preferable, however selective  
38 attrition could be a greater issue for longer-term follow-ups, biasing the sample.  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Conversely, shorter-term follow-ups may not allow enough time for change to happen.  
4  
5 Finally, these studies, though conducted with similar samples, were run in four different  
6  
7 countries with subsequent differences in healthcare services and risk levels at baseline,  
8  
9 and so conclusions need to take into account the healthcare context when assessing  
10  
11 the mechanisms and outcomes.<sup>8</sup>  
12  
13

14  
15  
16 Of particular interest were the two studies (Craigie et al and Koelewijn-van Loon et al)  
17  
18 which both used self-reported behavioural outcomes and a 12 week follow-up and yet  
19  
20 had contradictory results. Both included face to face counselling on more than one  
21  
22 occasion, telephone support sessions, and motivational interview plus decision support  
23  
24 or goal setting. The most obvious difference is that patients in Craigie et al's study were  
25  
26 all pre-selected as high risk (but not on statins), whereas only 28% of those in  
27  
28 Koelewijn-van Loon et al's study were designated as high CVD risk. Indeed the latter  
29  
30 study did find a difference between intervention and control groups in fruit and  
31  
32 vegetable consumption when only those with diagnosed diabetes were included. As in  
33  
34 previous analyses, the difference seems to be due to the finding that those with higher  
35  
36 perceived risk are more likely to make appropriate changes to their health behaviour.  
37  
38 Again context is highlighted, but here in terms of the individuals one is trying to  
39  
40 influence.  
41  
42  
43  
44  
45  
46  
47

48 **Key points:**

49 **Providing patients with feedback on screened measurements can promote changes in**  
50 **behavioural intentions and actual health behaviour change.**

51 **The benefits of a structured, motivational health dialogue are supported over simple**  
52 **screening where outcomes are measured long term, but the actual structure of such**  
53 **dialogues has not been directly analysed in the literature.**

54 **The comparison of similar studies highlights the need for a set of basic standardised**  
55 **measures.**

56 **Comparisons suggest that longer term influences on disease occurrence need assessing.**

57 *For peer review only - <http://bmjopen.bmj.com/site/about/guidelines.xhtml>*

58 **Patients informed they are at high risk tend to make the most lifestyle changes and achieve**  
59 **the most positive outcomes**  
60

## Factors predicting uptake, attendance and attrition from screening programmes

### Uptake and invitation

For screening programmes to be cost-effective it is essential to maintain high levels of uptake, attendance and avoid excessive attrition. Research<sup>21</sup> has demonstrated that some groups, for example, the less healthy, are less likely to participate in screening programmes, and more likely to drop out if they do commence participation. Attempts have been made to encourage uptake of screening by manipulating the method of invitation: three studies examined the effect of invitation style on uptake and health outcome.<sup>27-29</sup>

Marteau et al<sup>27</sup> hypothesised that providing an informed choice leaflet lower attendance relative to standard invitations, because individuals receiving the leaflet would see that screening is unlikely to provide individual benefits. The authors found no difference in attendance rates between individuals who received an informed choice letter versus a standard letter, but they did replicate previous studies in finding that attendance fell with increasing social deprivation. There was no interaction between social deprivation and invitation type, however, the authors concluded that the ethical advantage gained in informed choice invitations did not outweigh the attendance benefit of standard invitations.

1  
2  
3 Park et al<sup>28</sup> investigated the effects of loss- and gain-framed messages in an invitation  
4 to screen for Type 2 diabetes. The loss frame message (“If you have diabetes but are  
5 not detected early, your diabetes may lead to more complications”) highlights the  
6 possible losses due to not attending; the gain frame message (“If your diabetes is  
7 detected early, you can receive early and more effective treatment”) emphasises the  
8 possible gains of attending. Participants, aged 40-69 years, were randomly selected  
9 from two GP practices in Cambridgeshire, England. Fifty-nine patients were randomised  
10 to receive the loss-framed invitation and 57 the gain-frame. All invitations included a  
11 neutral framed message (“A simple blood test is the best way to detect diabetes”).  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

27 There were no significant differences in attendance rates between groups (loss-frame =  
28 81% vs gain-frame = 82%). Overall, results show that how information was framed  
29 made little difference to attendance rates. There was, however, a significant interaction  
30 effect between sex and invitation frame; attendance was higher in men invited using the  
31 loss-frame (89%) compared to the gain-frame (77%), and higher in women invited using  
32 the gain-frame (94%) compared to the loss-frame (68%). Although this result should be  
33 viewed with caution because of the small numbers, it does suggest potential for using  
34 different frames for different patient groups.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

47 In addition to investigating the content and format of invitation letters, researchers have  
48 also examined the potential of opportunistic screening that is asking patients to  
49 complete screening while they are attending a healthcare setting for another purpose,  
50 such as collecting medication. Hellénus et al<sup>29</sup> investigated opportunistic screening on  
51 visits to a healthcare centre for other purposes in a suburban area of Sweden  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 (Sollentuna). Male and female adults under the age of 60 who visited health centres  
4  
5 were opportunistically invited to screening. This group was compared with a group who  
6  
7 were invited by letter. 59% of those invited by letter participated (249 people) compared  
8  
9 to 15% of the men and 20% of the women who were invited when they visited their  
10  
11 health centres (4655 people, the opportunistic sample). Frequency of hypertension, high  
12  
13 cholesterol, high triglycerides were greater in the opportunistic sample than the letter-  
14  
15 invited sample, but there were no differences in smoking or likelihood of being  
16  
17 overweight. Outcomes of the intervention showed significant blood pressure,  
18  
19 cholesterol, and triglyceride reductions, but no differences in the level of reductions in  
20  
21 risk factors between opportunistic and letter-invited participants. The authors concluded  
22  
23 that the integration of a large scale CVD risk screening programme into a regular  
24  
25 primary healthcare system was successful, and that, taking into account low uptake,  
26  
27 opportunistically screening patients was successful in identifying those with high CVD  
28  
29 risk factors whose risk factor level could be reduced.  
30  
31  
32  
33  
34  
35  
36

### 37 **Difference between attenders and non-attenders**

38  
39  
40 It has been noted that differences exist between individuals who attend screening and  
41  
42 those who do not<sup>26</sup> and our search strategy identified two papers on this topic. Jones et  
43  
44 al<sup>30</sup> recruited 3800 patients (aged 25-55 years) across six GP practices in Wales who  
45  
46 were invited for a CHD risk factor screening programme. 2402 (63.2%) attended for  
47  
48 screening, 1389 (36.8%) did not attend. A 1 in 10 random sample of 140 non-attenders  
49  
50 was obtained, using a further letter offering them a medical "MOT" with specific  
51  
52 reference made to heart disease and asking them to make an appointment any morning  
53  
54 or afternoon. (MOT is an annual car maintenance test which is legally required by the  
55  
56  
57  
58  
59  
60

1  
2  
3 Ministry of Transport for cars on UK public roads, a term which is very familiar in the  
4 UK.) After three weeks any persisting non-respondents were sent another letter  
5 including a specific appointment time, asking them to contact the surgery if this was not  
6 convenient. A final contact was made by telephone after a further three weeks, and the  
7 nurse visited the home for the appointment if necessary. This approach resulted in 98  
8 (70.0%) of the original non-attenders being screened. They were asked to indicate  
9 reasons for their initial non-attendance. Reasons (in order of frequency) were: invitation  
10 letter not received (36.7%); 'practical reasons' (26.5%); felt screening was unnecessary  
11 because they were feeling well (18.4%); already under medical care for CHD related  
12 issues (12.2%); already aware of having risk factors and so felt screening was  
13 unnecessary (10.2%); felt apathetic about screening (10.2%); afraid of screening  
14 (7.1%); forgot to attend appointment (4.1%).

15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33 Non-attenders were significantly older than attenders (mean age 42.6 years and 39.4  
34 years respectively;  $p < 0.001$ , 95% CI of difference 1.50, 4.88). They were more likely to  
35 have lower SES than attenders and more likely to have a personal history of CHD (12%  
36 versus 5.7%,  $p < 0.05$ ). In addition, mean BMI ( $p < 0.01$ ; 95% CI 0.84, 2.58), cholesterol  
37 ( $p < 0.01$ , 95% CI 0.26, 0.74), and blood pressure (systolic  $p < 0.001$ ; 95% CI 9.57, 15.86;  
38 diastolic  $p < 0.01$ ; 95% CI 1.63, 5.82) were significantly higher for non-attenders than  
39 attenders. These results show that those people most in need of healthcare are less  
40 likely to access it. However, it is also clear that approximately 22% of non-attenders did  
41 not attend because they were already under medical care for CHD issues or were  
42 already aware of their risk factors (no data for attenders), possibly influencing the  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 outcome differences between attenders and non-attenders, and potentially reducing the  
4 likelihood of these individuals responding to an invitation to screening.  
5  
6  
7

8  
9 A further issue of non-attendance is that of differences between people who continue in  
10 a programme once started, and those who drop out. Thomas et al<sup>31</sup> examined the  
11 characteristics of attenders and non-attenders at the 20-year follow-up screening in the  
12 British Regional Heart Study. The non-attenders referred to here were all people who  
13 had attended originally, but failed to return for re-assessment, i.e. had dropped out. A  
14 total of 7735 men took part in the original screening, and 4252 (77%) attended the  
15 follow-up. There were no significant differences at baseline in age, BMI and cholesterol  
16 between those who attended those who did not attend at the follow-up, but non-  
17 attenders at follow-up had higher baseline blood pressure. Questionnaire data on the  
18 non-attenders was available from 2-4 years before the invitation to the follow-up health  
19 check. This showed that they were more likely to have suffered stroke, peripheral  
20 vascular disease and bronchitis and that they were twice as likely to smoke cigarettes.  
21 Attenders were significantly more likely to be married, to own their own home, to have  
22 access to a car, and to be educated past the age of 16.  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42

43 Mortality rates within one year of follow-up were significantly higher among non-  
44 attenders than attenders (6.2% vs. 1.7%), though the majority of deaths were non CVD-  
45 related. Non-attenders who self-reported having poor or fair health and a disability were  
46 significantly less likely to attend for follow-up, as were participants who reported using  
47 four or more medications regularly. Furthermore non-attenders were shown to be taking  
48 multiple prescribed medications, report more disabling conditions, and had a high early  
49 mortality rate.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Key points:**

**Informed choice invitations are preferable ethically and do not appear to reduce screening uptake**

**Framing of invitations to screen may affect attendance rates for men and women; where a screening invitation is gender specific, targeting may benefit from framing**

**Opportunistic screening at visits to GP surgeries for other purposes is shown to be effective**

- Evaluation of opportunistic screening confirms that it reaches people with higher CVD risk factors than reached using standard invitations.
- People screened opportunistically showed very similar improvements in assessed risk factors to people invited in other ways

**People who do not attend or who drop out at later stages may be different.**

- Differences between people who respond to invitations for screening and who do not are difficult to ascertain, but evidence suggests non-attenders have higher CVD risk factors.
- Selective drop out (“selective attrition”) biases longitudinal studies in that inevitably people who are less healthy, less well educated, of lower socio-economic status or with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments.
- Selective attrition may result in outcomes in longitudinal studies appearing more positive (overestimate of effect) because people who remain in the study are the healthier people
- Careful methodological and statistical controls are needed to reduce resultant effects on findings.

**Discussion**

This realist review focussed on use of evidence based design features of interventions which aimed to increase uptake of CVD and diabetes screening with a view to increasing early detection and reduction of risk factors for these diseases. Only 12 studies were identified that critically examined the intervention design and tested the efficacy of health behaviour change components, such as feedback, against health outcomes. Key findings include the following: health-related feedback or health dialogue can be effective, but in order to enable specific analyses, a working definition of what



1  
2  
3 this communication entails is required; whether individuals are invited for screening or  
4  
5 are screened opportunistically may influence the nature of participants recruited, with  
6  
7 those at higher risk less likely to respond to an invitation; and selective attrition of those  
8  
9 at higher risk may be skewing results of longitudinal studies because it is the healthier,  
10  
11 lower risk patients who are most likely to attend for follow-up.  
12  
13

### 14 15 16 **Impact of behavioural features on quality and outcome of interventions** 17

18  
19 It is clear from the studies reviewed that consideration of evidenced behavioural  
20  
21 features of interventions is limited; in particular, several large UK studies<sup>(26,32,33)</sup> were  
22  
23 excluded from the review at an early stage in the search process because they did not  
24  
25 examine any design, behavioural or psychological features of screening or intervention.  
26  
27 Nevertheless, the studies included in the review indicate several strategies that could be  
28  
29 usefully employed to reduce risk in high risk and general population targets, such as  
30  
31 providing opportunistic screening. There was a lack of evidence that intervention design  
32  
33 was based on health psychology theory (e.g., Ajzen's theory of planned behaviour,<sup>34</sup>  
34  
35 despite research showing that such theories can predict screening attendance,<sup>35</sup> and  
36  
37 lifestyle behaviours that are the target of screening interventions.<sup>36</sup> Even studies that  
38  
39 claimed to be based on theories and target motivation<sup>25</sup> failed to specify the theory base  
40  
41 for their intervention. This lack of emphasis on health psychology theories suggests a  
42  
43 greater focus on the outcome of the intervention (i.e., did people change their  
44  
45 behaviour?) rather than a focus on the motivations and perspectives of the individuals  
46  
47 invited to screen. This 'one-size fits all' approach to intervention design is unlikely to  
48  
49 yield success as research shows that even in a sample of 10 participants not all of them  
50  
51 respond positively to the same interventions.<sup>37</sup> Although there was limited use of  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 health psychology theories in the design of the interventions included in this review,  
4  
5 several interventions included elements such as the influence of health dialogue, goal  
6  
7 setting and feedback, which have been shown to promote health behaviour change,<sup>38,39</sup>  
8  
9 although much of this research has been conducted outside of primary care settings.  
10  
11 Therefore, it was encouraging to find that goal setting promoted changes in outcomes in  
12  
13 Craigie et al and that feedback was helpful in Aubin et al and Elton et al. These  
14  
15 elements require further examination with reference to a behaviour change taxonomy  
16  
17 e.g., Abraham and Michie's,<sup>16</sup> to determine whether they are effective within the context  
18  
19 of CVD and diabetes screening programmes. Relatedly, an issue highlighted by our  
20  
21 evaluation of a CVD screening intervention in the UK,<sup>40</sup> is the extent to which healthcare  
22  
23 practitioners use the strategies and tools with which they have been provided in the  
24  
25 health dialogues they have with their patients. This issue of intervention fidelity has the  
26  
27 potential to differentiate between programmes that are successful in getting patients to  
28  
29 change their behaviour and programmes that are not,<sup>41</sup> and is evident in Rubak et al<sup>23</sup>  
30  
31 who found that GPs failed to deliver, on average, more than one session of motivational  
32  
33 interview to patients, when they were facilitated to deliver three. CERAG's definition of  
34  
35 implementation research: "the scientific study of methods to promote the systematic  
36  
37 uptake of clinical research findings and other evidence-based practices in routine  
38  
39 practice, and hence to improve the quality (effectiveness, reliability, safety,  
40  
41 appropriateness, equity, efficiency) of healthcare" (cited in Eccles et al.<sup>1</sup>) sets this study  
42  
43 firmly in the context of implementation science.  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

## 56 **Study limitations**

57  
58  
59  
60

1  
2  
3 This review raised two key challenges. First, studies rarely analyse behavioural  
4 components of the intervention design discretely, making it impossible to discern which  
5  
6  
7 factors are at work in producing the observed effects. Second, the heterogeneity of  
8  
9  
10 outcome measures precludes statistical evaluations using meta-analysis. Publication or  
11  
12  
13 outcome bias may have affected our results, though not all included studies found  
14  
15  
16 significant reductions in assessed risk or differences in outcomes between intervention  
17  
18  
19 and control groups. Several potentially relevant studies that focus on the design of  
20  
21  
22 screening interventions were excluded because they were not delivered in healthcare  
23  
24  
25 settings. The reviewed studies also highlight the disadvantages of Intention-To-Treat  
26  
27  
28 analyses, which are better suited for assessing the efficacy of an intervention in practice  
29  
30  
31 as opposed to understanding “how” and “why” and intervention works, and the need to  
32  
33  
34 control for selective attrition either by use of features which reduce drop out or by  
35  
36  
37 statistical control for known differences between returners and non-returners, but few  
38  
39  
40 studies employ this. As a realist review, this document examines outcomes which may  
41  
42  
43 be situation specific. The acknowledgement that some findings that may be situation or  
44  
45  
46 population specific is important in generalisation of results.

## 47 **Conclusions and policy implications**

48 This review highlights the need for a more systematic approach to the strategic design,  
49  
50  
51 conduct and analysis of health interventions by taking into account the complex  
52  
53  
54 interactions between design, delivery, attrition and health outcomes. It is recommended  
55  
56  
57 that insights from health psychology should be incorporated in the design of  
58  
59  
60 interventions aimed at increasing screening uptake, as well as involving cross-  
disciplinary specialist areas such as physical activity and nutrition to promote lifestyle

1  
2  
3 behaviour change alongside pharmacological treatment. Furthermore, to control the  
4 effects of selective attrition, there is a need to perform sensitivity analyses in order to  
5 monitor the make-up of the sample and perhaps some purposive sampling to protect  
6 against biasing the sample toward a healthier baseline and therefore reduced effect at  
7 follow-up, particularly in longitudinal studies. It is anticipated that such carefully  
8 designed interventions would result in health behaviour change that provide as much  
9 benefit to the wider population as they do for those with heightened risk, resulting in  
10 better overall population outcomes.  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**What is already known on this topic**

**Previous reviews have raised concerns about the cost effectiveness of CVD and diabetes screening interventions.**

- Some researchers have instead recommended replacement of screening programmes with pharmacological interventions alone, (e.g. prescription of statins to everyone aged 55 or older<sup>42</sup>).
- Other work has illustrated that health behaviour change and intervention effectiveness can significantly reduce CVD risk, controlling for effects of pharmacological intervention.
- Some features of intervention style, and of populations, often result in less than optimum risk reduction.

**What this study adds**

- **The study confirms the need for and success of strategies that encourage higher risk patients to become and stay involved in screening and intervention programmes, such as opportunistic screening.**
- Careful training and monitoring of the use of evidenced behaviour change strategies in improving the reach and success of interventions is needed.
- Ethically supported invitation styles such as fully informed choice do not reduce participation or effect outcome.
- Clear feedback and targeted intervention on specific risk factors or behaviours is supported, whereas general lifestyle advice is less effective.
- Structure of motivational health dialogues and the terms over which they are most successful needs further research.

**Contributorship statement:**

CH, RS, HP, and RC were responsible for the conception and design of the study. YC had principal responsibility for search and sourcing of articles and initial data extraction, and RC contributed to reference chaining. Two authors (CH, YC) independently reviewed the 157 full text papers retrieved, and further excluded studies which only evaluated changes in risk factors or cost-effectiveness. CH and RC assigned quality scores to each included full-text article based on the Scottish Intercollegiate Guidelines Network (SIGN 50) quality assessment instruments. CH had principal responsibility for data extraction, analysis and interpretation of the data and for drafting the article,

1  
2  
3 revisions, and final approval. RS, HP, and RC contributed to interpretation of the data,  
4  
5 revisions and final article approval. CH and RC are the guarantors.  
6  
7  
8  
9  
10

11  
12 Funding: This study is a sub-section of a larger review which was commissioned by  
13 Heart of Birmingham teaching and Primary Care Trust, which funded YC as a Research  
14 Associate as part of a larger research project. CH, HP, RC and RS are all members of  
15 the Health and Lifespan Psychology Research group working at Aston University. The  
16 funders had no role in design of this review, the data collection, analysis, and  
17 interpretation, writing the manuscript, or the decision to submit the research for  
18 publication.  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29

### 30 **Competing interest statement**

31  
32 All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf)  
33 (available on request from the corresponding author) and declare: no support from any organisation for  
34 the submitted work other than that outlined under "Funding" above; no other financial relationships  
35 with any organisations that might have an interest in the submitted work in the previous 3 years ; no  
36 other relationships or activities that could appear to have influenced the submitted work .  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 **Ethical approval:** Not required.  
47  
48

49 **Data sharing:** No additional data available.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

1. Eccles, M P, Armstrong, A, Baker R, Cleary, K, et al. An implementation research agenda *Implementation Science* 2009, 4:18 doi:10.1186/1748-5908-4-18
2. Grimshaw, J.M., Eccles, M.P., Lavis, J.N., Hill, S J, Squires, J.E. Knowledge translation of research findings, *Implementation Science*, 2012, 7:50.
3. Ebrahim S, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. *Cochrane Database of Systematic Reviews* 2006; (4): CD001561.
4. Allender S, Peto V, Scarborough P, Kaur A, Rayner, M. *Coronary heart disease statistics*. British Heart Foundation: London, 2008.
5. Unal B, Critchley J A, Capewell, S. Modelling the decline in coronary heart disease deaths in England and Wales, 1981 – 2000: comparing contributions from primary prevention and secondary prevention. *BMJ* 2005; 331: 614-9.
6. NHS Health Check programme. 2012. <http://www.healthcheck.nhs.uk/> .
7. Petticrew M. “More research needed”. Plugging gaps in the evidence base on health inequalities. *Eur J Public Health* 2007, 17:5; 411-413.
8. Pawson R, et al; Realist review – a new method of systematic review designed for complex policy interventions. *J Health Services Research and Policy* 2005, 10 (Suppl 1): 21-34.
9. McMahon T, Ward P R. HIV among immigrants living in high-income countries: a realist review of evidence to guide targeted approaches to

- 1  
2  
3 behavioural HIV prevention *Systematic reviews* 1: 56 DOI: 10.1186/2046-  
4 4053-1-: 2012 )  
5  
6  
7
- 8 10. Moher D, Liberati A, Tetzlaff J, Altman DG. for the PRISMA group. Preferred  
9 reporting items for systematic reviews and meta-analyses: the PRISMA  
10 statement. *BMJ* 2009;339: 332-6.  
11  
12
- 13 11. Flight IHK, Wilson CL, Griffiths L, Myers, RE. Interventions for improving  
14 uptake of population-based screening for colorectal cancer using fecal occult  
15 blood testing. *Cochrane Database of Systematic Reviews* 2004; (4):  
16 CD005035.  
17  
18
- 19 12. Forbes C A, Jepson RG, Martin-Hirsch PPL. Interventions targeted at women  
20 to encourage the uptake of cervical screening. *Cochrane Database of*  
21 *Systematic Reviews*, 2002; (3): CD002834  
22  
23
- 24 13. Scottish Intercollegiate Guidelines Network (SIGN 50) methodology  
25 checklists. Circa 2001-2013, updated 15/04/13,  
26 <http://www.sign.ac.uk/guidelines/fulltext/50/checklist3.html>  
27  
28
- 29 14. Shahab L, Hall S, Marteau T. Showing smokers with vascular disease images  
30 of their arteries to motivate cessation: A pilot study. *Br J Health Psychol*  
31 2007;12: 275-83.  
32  
33
- 34 15. Shahab L, West R, McNeill A. A randomized, controlled trial of adding expired  
35 carbon monoxide feedback to brief stop smoking advice: Evaluation of  
36 cognitive and behavioral effects. *Health Psychol* 2011; 30: 49-57.  
37  
38
- 39 16. Abraham C, Michie S. A taxonomy of behaviour change techniques used in  
40 interventions. *Health Psychol* 2008; 27: 379-87.  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
17. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and health eating behaviours: The CALO-RE taxonomy. *Psychol Health*, 2011; 26: 1479-98.
18. Robertson I, Phillips A, Mant D. Motivational effect of cholesterol measurement in general practice health checks. *Br J Gen Pract* 1992; 42: 469-472.
19. Aubin M, Godin G, Vézina L, Maziade J, Desharnais R. Hypercholesterolemia screening. Does knowledge of blood cholesterol level affect dietary fat intake? *Canadian Family Physician* 1998; 44: 1289-97.
20. Elton PJ, Hammer M, Page F. Randomised controlled trial in northern England of the effect of a person knowing their own serum cholesterol concentration. *J Epidemiol Community Health* 1994; 48: 22-5.
21. Färnkvist L, Olofsson N, Weinehall L. Did a health dialogue matter? Self-reported cardiovascular disease and diabetes 11 years after health screening. *Scand J Prim Health Care* 2008; 26: 135-9.
22. Engberg M, Christensen B, Karlslose B, Lous J, Lauritzen T. General health screenings to improve cardiovascular risk profiles: a randomised controlled trial in general practice with 5-year follow-up. *J Fam Pract* 2002; 51; 546-52.
23. Rubak S, Sandbaek A, Lauritzen T, Borch-Johnsen K, Christensen B. Effect of "motivational interviewing" on quality of care measures in screen detected

- 1  
2  
3 type 2 diabetes patients: A one year follow-up of and RCT, ADDITION  
4  
5 Denmark. *Scand J Prim Health Care* 2011; 29: 92-8.  
6  
7  
8 24. Koelewijn-van Loo, MS, van der Weijden T, Ronda G, van Steenkiste B,  
9  
10 Winkens B, Elwyn G, et al. Improving lifestyle and risk perception through  
11  
12 patient involvement in nurse-led cardiovascular risk management: a cluster-  
13  
14 randomised controlled trial in primary care. *Prev Med* 2010; 50: 35-44.  
15  
16  
17 25. Craigie AM, Barton KL, Macleod M, Williams B, van Teijlingen E. A feasibility  
18  
19 study of a personalised lifestyle programme (Healthforce) for individuals who  
20  
21 have participated in cardiovascular screening. *Prev Med* 2011, 52: 387-9.  
22  
23  
24 26. Wood DA, Kinmonth AL, Davies GA, Yarwood J, Thompson SD, Pyke SDM,  
25  
26 et al. Randomised controlled trial evaluating cardiovascular screening and  
27  
28 intervention in general practice: principal results of British family heart study.  
29  
30 *BMJ* 1994; 308:313-20.  
31  
32  
33 27. Marteau TM, Mann E, Prevost AT, Vasconcelos JC, Kellar I, Sanderson S,  
34  
35 Parker M, et al. Impact of an informed choice invitation on uptake of  
36  
37 screening for diabetes in primary care (DICISION): randomised trial. *BMJ*  
38  
39 2010; 340: c2138.  
40  
41  
42 28. Park P, Simmons RK, Prevost AT, Griffin SJ. A randomized evaluation of  
43  
44 loss and gain frames in an invitation to screening for Type 2 diabetes: Effects  
45  
46 on attendance, anxiety and self-rated health. *J Health Psychol* 2010; 15: 196-  
47  
48 204.  
49  
50  
51 29. Hellénus M L, Johansson J, de Faire U, Elofsson S, Krakau I. Four years'  
52  
53 experience of cardiovascular opportunistic screening and prevention  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 programme in the primary health care in Sollentuna, Sweden. *Scand J Prim*  
4  
5 *Health Care* 1999; 17: 111-5.  
6  
7  
8 30. Jones A, Cronin P A, Bowen M. Comparison of risk factors for coronary  
9  
10 heart disease among attenders and non-attenders at a screening programme.  
11  
12 *Br J Gen Pract* 1993; 43:375-7.  
13  
14  
15 31. Thomas MC, Walker M, Lennon L T, Thomson A G, Lampe FC, Shaper AG,  
16  
17 et al. Non-attendance at re-examination 20 years after screening in the  
18  
19 British Regional Heart Study. *J Public Health Med* 2002; 24:285-91.  
20  
21  
22 32. Muir J, Lancaster T, Jones L. The Imperial Cancer Research Fund  
23  
24 OXCHECK Study Group . Effectiveness of health checks conducted by  
25  
26 nurses in primary care: final results from the OXCHECK study. *BMJ* 1995;  
27  
28 310: 1099-104.  
29  
30  
31 33. Muir J, Mant D, Jones L, Yudkin P. Effectiveness of health checks conducted  
32  
33 by nurses in primary care: results of the OXCHECK study. *BMJ* 1994; 308:  
34  
35 308-12.  
36  
37  
38 34. Ajzen I. The theory of planned behavior. *Organisational Behaviour and*  
39  
40 *Human Decision Processes* 1991; 5: 179-211.  
41  
42  
43 35. Cooke R, French P. How well do the theory of reasoned action and theory of  
44  
45 planned behaviour predict screening attendance? A meta-analysis.  
46  
47 *Psychology & Health*, 2008; 23: 745-765.  
48  
49  
50 36. McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of  
51  
52 health-related behaviours within the theory of planned behaviour: A meta-  
53  
54 analysis. *Health Psychology Review* 2011; 5: 97-144.  
55  
56  
57  
58  
59  
60

- 1  
2  
3 37. Sniehotta FF, Pesseau J, Hobbs N, Araújo-Soares V. Testing self-regulation  
4 interventions to increase walking using factorial randomised N-of-1 trials.  
5  
6 *Health Psychology* 2012; 31: 733  
7  
8  
9
- 10 38. Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement:  
11 a meta-analysis of effects and processes. In Zanna, M.P. (Ed.) *Advances in*  
12 *Experimental Social Psychology*; 2006: 39, Academic Press, New York, 69-  
13 119.  
14  
15  
16  
17  
18  
19
- 20 39. Gill J, & O'May F. Practical demonstration of personal daily consumption  
21 limits: A useful intervention tool to promote responsible drinking among UK  
22 adults? *Alcohol and Alcoholism*; 2007: 42, 436-441.  
23  
24  
25  
26
- 27 40. Shaw R, Cooke R, Holland C, Cooper Y, Dahdah M, Pattison H. (under  
28 review). Be SMART and follow the protocol: lessons learned from an  
29 evaluation of the NHS Health Check, *Soc Sci Med*.  
30  
31  
32  
33
- 34 41. Borrelli B, Sepinwall D, Ernst D, Bellg AJ, Czajkowski S, Breger R, et al. A  
35 new tool to assess treatment fidelity and evaluation of treatment fidelity  
36 across 10 years of health behaviour research. *J Consult Clin Psychol* 2005;  
37 73: 852-8.  
38  
39  
40  
41  
42  
43
- 44 42. Wald NJ, Simmonds M, Morris JK. Screening for Future Cardiovascular  
45 Disease Using Age Alone Compared with Multiple Risk Factors and Age.  
46 *PLoS ONE* 2011;6(5): e18742. doi:10.1371/journal.pone.0018742.  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Table 1. Included Studies

Study	Country	Sample	N	Design	Intervention Component	Main findings	Quality
Aubin 1998 <sup>14</sup>	Canada	58% female, mean age 35 years	391	RCT, controls completed questionnaire on intention to eat a low fat diet before they received results of cholesterol screening, intervention participants completed it after	Impact of feedback on behaviour change	Intervention participants were more likely to intend to adopt a low fat diet than controls. Patients with abnormally high cholesterol ( $\geq 6.3\text{mmol/L}$ ) showed a greater reduction in dietary fat intake than those who had a normal cholesterol ( $<5.2\text{mmol/L}$ )	+
Elton 1994 <sup>15</sup>	England	44% female, mean age 37.9 years	469	Prospective, blinded RCT, Intervention participants knew their cholesterol level before the health education	Impact of feedback on behaviour change	Participants whose initial serum cholesterol was $\geq 6.5\text{mmol/L}$ and who had been informed of this, showed a significantly greater	++

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

				and diet session, control participants did not.		reduction in serum cholesterol than control participants in the same high cholesterol group who had not been informed. All participants received the same dietary advice.	
Färnkvist 2008 <sup>16</sup>	Sweden	100% male, age stratified, aged 66, 56 and 46 years.	817	Cross-sectional study. Screening only, Screening plus health dialogue by trained professionals, and non-participants compared.	Benefits of health dialogue over simple feedback	Odds ratios of developing diabetes or CVD over 11 years were 2.5 for those had received screening with no health dialogue and 3.0 for those who had not participated in the original screening, as compared with those who had received screening plus a structured, motivational health dialogue.	+

1 2 3 4 5 6 7 8 9 10 11 12 13 14	Engberg 2002 <sup>17</sup>	Denmark	52% female, Mean age 40.4 years	150 7	RCT, Screening, screening plus health dialogue compared with normal care control group.	Benefits of health dialogue over simple feedback	After 5 years there were no differences between the two intervention groups Total intervention/control Risk Ratio was 0.54. Absolute risk reduction 8.6%.	++
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41	Rubak 2011 <sup>18</sup>	Denmark	42% female, Mean age 61 years. Patients with screen detected type 2 diabetes	628	Cluster RCT, Intervention and control groups received training in intensive treatment of Diabetes, intervention group GPs additionally received training in Motivational Interviewing (MI) and instructed to use it.	Benefits of health dialogue over simple feedback	No effect of motivational interview on medication adherence or metabolic status in relative to control group. Medication adherence across both groups almost 100%, both groups showed significant improvements in all risk measures. Key issues were lower than planned use of motivational interview by intervention group GPs, and contamination of	++

						methods and training into control group GPs.	
Koelewijn -van Loon 2010 <sup>19</sup>	Netherlan ds	55% female, Mean age 57 years	615	Cluster RCT, Intervention nurses received training to use risk assessment, communication, a decision support tool and MI. Control group nurses received training on risk assessment and applied usual care.	Benefits of health dialogue over simple feedback	Outcome measures were self- reported lifestyle measures. No differences between control and intervention groups noted at 12 week follow up, but overall both groups showed improvements.	+
Craigie 2011 <sup>20</sup>	Scotland	72% female, Mean age 54.5 years, high risk but not on statins.	75	RCT, Intervention – motivational interview and volitional aspects to change planned behaviour, Control group usual care.	Benefits of health dialogue over simple feedback	Percentage achieving 5 portions of fruit and vegetables a day, and weight maintenance or loss indicators were significantly better in the intervention group over the 12 week follow up. Control group	+



						made no positive change.	
Marteau 2010 <sup>22</sup>	England	47.6 % female, mean age 57.4 years	127 2	RCT, informed choice invitation compared with standard invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups Secondary outcome of intention to change health behaviour was unaffected by invitation type.	++
Park 2010 <sup>23</sup>	England	66.6% male, Mean age 58 years	116	RCT, loss frame compared with gain frame invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups (invitation types). Secondary outcome measures of anxiety, self- perceived health and illness representation also did not differ between groups.	++
Hellénus 1998 <sup>24</sup>	Sweden	65% female, age range 20-60 years	490 4	Observational Cross sectional study, those screened as a result of	Impact of type of invitation on	Opportunistically screened participants showed higher CVD risk factors than letter invited	+

				opportunistic invitations compared with those responding to a letter invitation.	uptake and outcome	participants at baseline. Effectiveness of screening in lowering risk factors did not differ between the two groups.	
Jones 1993 <sup>25</sup>	Wales	53.4% female, mean age 42.5 years	254 2	Observational cross-sectional study, those not responding to initial invitations to screenings compared with those who did.	Differences between attenders and non-attenders	Non-attenders showed more risk factors than attenders.	+
Thomas 2002 <sup>26</sup>	England	100% male, Mean age 69.1 years,	565 5	Observational cross sectional study, Health characteristics of those who attended and did not attend a 20 year follow-up were compared.	Differences between attenders and non-attenders	Despite no differences at baseline in BMI and cholesterol, those who later dropped out of a longitudinal study had higher blood pressure at baseline and greater number of CVD and bronchial diagnoses, and	+

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

						adverse lifestyle factors (e.g. OR of smoking in non-attenders 2.33).	
--	--	--	--	--	--	---	--

Note. SIGN 50 cohort checklist used to assess study quality. ++ = High quality study, + = Acceptable, 0 = Unacceptable.

For peer review only

Appendix 1. Search terms used in search strategy

The following terms were used in all data sources: (cardiovascular OR vascular OR CVD OR “chronic heart disease” OR “coronary heart disease” OR CHD OR diabetes) AND (“mass screening” OR surveillance\*) AND (letter OR mail\* OR phone OR telephone OR “reminder system\*” OR “videotape recording\*” OR “audiotape recording\*” OR questionnaire\* OR strateg\* OR alert\* OR hotline OR community OR media) AND (intervention\* OR goal OR “behav\* change” OR “implementation intention\*” OR plans OR planned OR planning OR plan OR educat\* OR campaign\* OR barriers OR intention\* OR “behav\* outcome” OR outcome OR “lifestyle change” OR longitudinal OR “follow up” OR motivation\*) AND (satisf\* OR dropout\* OR “drop out” OR attrition OR uptak\* OR adher\* OR compliance OR complie\* OR comply\* OR “patient acceptance of health care” OR encourag\* OR improve\* OR improving OR increas\* OR promot\* OR particip\* OR nonattend\* OR “non attend” OR accept\* OR attend\* OR attitud\* OR utilisation OR utilization OR refus\* OR respond\* OR respons\* OR reluctan\* OR nonrespon\* OR “non respon\*” OR incidence OR prevalence OR prevelence OR satisfaction OR cooperat\* OR “co operat\*”) AND (findings OR interview\* OR qualitative OR experienc\* OR RCT OR “randomised controlled trial” OR trial).



**Effectiveness and uptake of screening programmes for coronary heart disease and diabetes: A realist review of design components used in interventions.**

Journal:	<i>BMJ Open</i>
Manuscript ID:	bmjopen-2013-003428.R1
Article Type:	Research
Date Submitted by the Author:	27-Sep-2013
Complete List of Authors:	Holland, Carol; Aston University, Psychology Cooper, Yvonne; Aston University, Psychology Shaw, Rachel; Aston University, Pattison, Helen; Aston University, Psychology; Aston University, Health Sciences Cooke, Richard; Aston University, Psychology
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	Cardiovascular medicine, Diabetes and endocrinology, Evidence based practice
Keywords:	PRIMARY CARE, PREVENTIVE MEDICINE, General diabetes < DIABETES & ENDOCRINOLOGY, Coronary heart disease < CARDIOLOGY

SCHOLARONE™  
Manuscripts

Only

1  
2  
3 **Effectiveness and uptake of screening programmes for coronary heart disease**  
4 **and diabetes: A realist review of design components used in interventions.**  
5  
6  
7

8  
9 Short title: Effectiveness and uptake of screening programmes  
10

11  
12 Carol Holland (Senior Lecturer), Yvonne Cooper (Research Associate), Rachel Shaw  
13  
14 (Senior lecturer), Helen Pattison (Professor), Richard Cooke (Senior lecturer).  
15  
16

17  
18 Health and Lifespan Psychology Group  
19

20  
21 School of Life & Health Sciences  
22

23  
24 Aston University  
25

26  
27 Birmingham  
28

29  
30 B4 7ET  
31

32  
33 UK  
34  
35  
36

37 **Corresponding author: C. Holland (email [c.holland1@aston.ac.uk](mailto:c.holland1@aston.ac.uk))**  
38

39  
40 The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all  
41 authors, an exclusive licence on a worldwide basis to the BMJ Publishing Group Ltd to permit this article (if  
42 accepted) to be published in BMJ editions and any other BMJPG products and sublicences such use and  
43 exploit all subsidiary rights, as set out in our licence.  
44  
45  
46  
47

48 **Word count (excl. abstract, summary, refs, table, boxes) (5938)**  
49

50  
51 **1 Table**  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Abstract

### Objective

To evaluate behavioural components and strategies associated with increased uptake and effectiveness of screening for coronary heart disease (CHD) and diabetes, with an implementation science focus.

### Design

Realist review.

### Data sources

PubMed, Web of Knowledge, Cochrane Database of Systematic Reviews, Cochrane Controlled Trials Register and reference chaining. Searches limited to English language studies published since 1990.

### Eligibility criteria

Eligible studies evaluated interventions designed to increase uptake of CVD and diabetes screening and examined behavioural and/or strategic designs. Studies were excluded if they evaluated changes in risk factors or cost-effectiveness only.

### Results

In 12 eligible studies, several different intervention designs and evidence based strategies were evaluated. Salient themes were effects of feedback on behaviour change, or benefits of health dialogues over simple feedback. Studies provide mixed evidence about benefits of these intervention constituents which are suggested to be

1  
2  
3 situation and design specific, broadly supporting their use, but highlighting concerns  
4  
5 about fidelity of intervention delivery, raising implementation science issues.<sup>1,2</sup> Three  
6  
7  
8 studies examined effects of informed choice, or loss versus gain frame invitations,  
9  
10 finding no effect on screening uptake, but highlighting opportunistic screening as more  
11  
12 successful for recruiting higher CVD and diabetes risk patients than invitation letter, with  
13  
14 no differences in outcomes once recruited. Two studies examined differences between  
15  
16 attenders and non-attenders, finding higher risk factors amongst non-attenders, and  
17  
18 higher diagnosed CVD and diabetes amongst those who later dropped out of  
19  
20 longitudinal studies.  
21  
22  
23  
24

## 25 **Conclusions**

26  
27  
28 If risk and prevalence of these diseases are to be reduced, interventions must take into  
29  
30 account what we know about effective health behaviour change mechanisms, monitor  
31  
32 delivery by trained professionals, and examine the possibility of tailoring programmes  
33  
34 according to contexts such as risk level to reach those most in need. Further research is  
35  
36 needed to determine the best strategies for lifelong approaches to screening.  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



## Article Summary

- 1) Article Focus: The primary objective of this **realist review** was to evaluate the impact on health and attendance outcomes of **theoretically supported** behaviour change features embedded within intervention designs of screening programmes targeting CHD and diabetes.
- A secondary objective was to evaluate factors predicting attendance and attrition from these programmes **and appraise their impact, with implications for design in specific contexts.**

## 2) Key Messages

- The benefits of a structured, motivational health dialogue, with feedback, are supported over simple screening and advice, where outcomes are measured long term. Structure of motivational health dialogues and the terms over which they are most successful needs further research
- However, the issue of intervention fidelity (adherence to intervention protocol by those delivering) has potential to differentiate between programmes that are **or are not successful in getting patients to change health behaviour and as such represents a key implementation science component of the review.**
- This review highlights the need for a more systematic approach to **using the evidence base for** strategic design, conduct and analysis of health interventions

1  
2  
3 by taking into account the complex interactions between design, delivery,  
4  
5 attrition, **context** and health outcomes.  
6  
7  
8  
9

### 10 3) Strengths and Limitations.

#### 11 Strengths:

- 12 • The study's strength is its focus on what contributes to success and reach of  
13 screening plus intervention studies, based on health psychology evidence.  
14  
15 • Its evaluation of the degree and fidelity with which evidenced health behaviour  
16 strategies are used has important implications for practitioners managing  
17 screening and intervention programmes.  
18  
19 • Evaluation of opportunistic screening confirms previous work showing that it  
20 reaches people with higher CVD risk factors than reached using standard  
21 invitations, but additionally demonstrates that people screened opportunistically  
22 show very similar improvements in assessed risk factors and behaviours to  
23 people invited in other ways.  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40

#### 41 Limitations:

- 42 • This review raised two key challenges. First, many studies do not analyse  
43 behavioural components of the intervention design discretely, making it  
44 impossible to discern which factors are at work in producing the observed effects.  
45  
46 Second, the heterogeneity of outcome measures precludes statistical evaluations  
47 using meta-analysis.  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
- Publication or outcome bias may have affected our results, though not all included studies found significant reductions in assessed risk or differences in outcomes between intervention and control groups.
  - Several potentially relevant studies focusing on design of screening interventions were excluded because they were not delivered in healthcare settings.
  - Well-known selective drop out (“selective attrition”) biases are confirmed in these studies, whereby people with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments. Careful methodological and statistical controls are needed to reduce resultant effects on findings, but few studies employ these.
  - As a realist review, this document examines outcomes which may be situation specific. The acknowledgement that some findings that may be situation specific is important in generalisation of results.

## Introduction

Previous reviews of multiple risk factor interventions for primary prevention of coronary heart disease (CHD) and diabetes often conclude that interventions have no overall effect on mortality.<sup>3</sup> Nevertheless, CHD deaths have halved in the UK and other developed countries in the last 30 years.<sup>4</sup> Unal et al<sup>5</sup> compared targeted interventions and general population screening. They estimated the proportion of reduced deaths from CHD in England and Wales between 1981 and 2000 that were attributable to changes in risk factors in patients with CHD or changes in cardiovascular risk factors in the general population, and found both approaches beneficial. These authors calculated that reductions in risk factors (such as smoking, high blood pressure) in the general population account for 50-75% of the fall in cardiac deaths, and pharmacological and surgical treatments for diagnosed CHD patients account for 25-50%.<sup>5</sup> However, that benefit was greater when individuals without CHD were screened: results indicated an additional 21 years of life for each death prevented in those with no CHD diagnosis compared to 7.5 years for those with CHD.

Public health campaigns to reduce these conditions usually involve: government-sponsored programmes at the population level or changes in policy (such as food labelling legislation); targeted interventions for those at heightened risk (for example, moderate-intensity, low-impact exercise for those very overweight or with chronic conditions); or general population screening and intervention to reduce risk development in the healthy population and identify high risk people leading to specific referral for detected or previously untreated symptoms (for example, current NHS Health Check<sup>6</sup> programme).

1  
2  
3 This review focuses on quantitative evaluations of screening plus intervention  
4 programmes that target the general population to reduce incidence of CHD and  
5 diabetes. These conditions were selected because they are the focus of screening  
6 programmes in many countries and the negative outcomes of these conditions can be  
7 ameliorated by lifestyle behaviour change. Previous reviews have focussed on  
8 reductions in risk measurements, cost effectiveness, or years of life added.<sup>3</sup> In contrast,  
9 the primary objective of this review was to examine use of behaviour change features  
10 embedded within intervention designs of screening programmes targeting CHD and  
11 diabetes, and their impact on health outcomes. A secondary objective was to evaluate  
12 the factors predicting attendance and attrition from these programmes.  
13  
14

15 These objectives are not well-suited to systematic review and meta-analysis  
16 approaches, where the aim is to synthesise results across contexts to gain a sense of  
17 the pattern of results for studies conducted using similar methodologies. In contrast, the  
18 present paper is focused on questions around “how” and “why” behavioural features are  
19 incorporated into interventions, and how these features can contribute to the success of  
20 interventions. Therefore, we adopted a realist review, also called a meta-narrative  
21 approach. This approach was adopted to gain insights into the direction the evidence is  
22 pointing and the underlying theoretically driven concepts, behaviour change  
23 mechanisms, and barriers, that may combine to contribute to outcomes in population  
24 screening for CHD and diabetes.<sup>7</sup> Focus on the mechanisms and use of evidence  
25 based behaviour change strategies locate the review within an implementation science  
26 approach, given that “one of the most consistent findings from clinical and health  
27 services research is the failure to translate research into practice and policy” p1.<sup>2</sup>  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 A realist methodology<sup>8</sup> is suited to areas where there is a diverse literature, which may  
7  
8 have a variety of methods, components and outcomes. This methodology is concerned  
9  
10 with explaining more fully the processes of interventions within the complexity of their  
11  
12 contexts, rather than focussing on simple cause and effect deterministic theories.  
13  
14 Realist reviews can “contribute to programme understandings even when the outcomes  
15  
16 are not rigidly defined at the outset of the review and have been characterised as a  
17  
18 theory-driven and interpretive approach to systematic reviews to answer questions  
19  
20 about what works, for whom and in what circumstances” p4.<sup>9</sup>  
21  
22  
23  
24  
25

26  
27 Inclusion of studies in a realist review is intended to be less proscribed than in a  
28  
29 systematic review to allow for a mix of methods and outcomes to be included, ensuring  
30  
31 that underlying theories and approaches can be evaluated rather than a focus on  
32  
33 specific measured outcomes.<sup>8</sup> Inclusion criteria in this review of screening plus  
34  
35 intervention studies were generated using guidance from systematic reviews on  
36  
37 screening (PRISMA),<sup>10</sup> but were further generated iteratively using the themes that  
38  
39 emerged. The flowchart and checklist are available as supplementary material.  
40  
41  
42

### 43 **Data sources**

44  
45  
46 Web of Knowledge, PubMed, Cochrane Database of Systematic Reviews, Cochrane  
47  
48 Controlled Trials Register restricted to English language and published post 1990.  
49  
50 Reference chaining of identified studies was then conducted.  
51  
52

### 53 **Search strategy**

54  
55  
56  
57  
58  
59  
60

1  
2  
3 Search terms were adapted from previous Cochrane reviews of screening plus uptake  
4 studies.<sup>11,12</sup> The full strategy is available in Appendix 1. The search was first carried out  
5  
6 in July 2010 and updated in March 2013.  
7  
8  
9

## 10 11 **Study selection**

12  
13  
14 The initial inclusion criteria were: studies that tested interventions designed to increase  
15 uptake of CHD and diabetes screening programmes, or to increase early detection and  
16 prevention of these conditions *and* examined the behavioural and/or strategic design of  
17 the intervention tested. Studies which only reported on changes in risk factors or cost-  
18 effectiveness were excluded.  
19  
20  
21  
22  
23  
24  
25  
26

27 The initial search elicited 2323 relevant published papers. Retrieved papers were  
28 screened according to the inclusion criteria. Details of screening and exclusion stages  
29 are detailed in Figure 1 **in the supplementary material.**  
30  
31  
32  
33  
34

35 Following screening of titles, 565 relevant papers remained. Reference lists and  
36 citations of these papers were searched (using Pubmed and Web of Knowledge)  
37 specifically to identify studies that evaluated behavioural aspects of interventions tested;  
38  
39 **a pragmatic approach was taken to ensure that articles which may not have been found**  
40 **using such traditional chaining were not missed, in that new keywords elicited from**  
41 **themes of identified articles were added to the search, notably on specific behavioural**  
42 **approaches. An example was “informed choice invitation”.** This process identified a  
43 further 16 articles. Following removal of duplicates across sources (120), and removal  
44 after abstract screening (304), two authors (CH, YC) independently reviewed 157 full  
45 text papers, and further excluded studies which only evaluated changes in risk factors  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 or cost-effectiveness. Further exclusions at abstract and full text stages were guided by  
4  
5 framing of the interventions into their constituent components using PICO(T) categories  
6  
7 (Population, Intervention, Comparison, Outcome and Type of study design). The review  
8  
9 was concerned with general population (adult) screening, and so interventions that  
10  
11 considered only those already identified as at high risk of CVD/Diabetes or already  
12  
13 receiving treatment, younger or specific age or disease limited groups, were excluded.  
14  
15 Although initial reading included interventions in a variety of settings, the selection of the  
16  
17 final set of papers restricted inclusion to studies set in primary health care in line with  
18  
19 the aim of this review being to inform primary health care based interventions.  
20  
21 Comparison with a control group of some nature was necessary for inclusion, and  
22  
23 although most of the identified studies did consist of Randomised or Cluster  
24  
25 Randomised Control Trials, other designs were not excluded, and the relevant quality  
26  
27 appraisal criteria for the different designs were used as appropriate (See Table 1).  
28  
29 Although most of the studies examined outcomes in terms of successful or unsuccessful  
30  
31 lowering of CVD or diabetic risk, the intention of this review was to determine “how, why  
32  
33 and what works” or what may prevent it working<sup>8</sup>, so outcome type was not restricted.  
34  
35 Preliminary examination of studies sought to extract dominant themes reflecting the  
36  
37 behavioural features of the “how and why” such interventions succeed or fail in reducing  
38  
39 CVD or Diabetic risk. Most studies examined the effect of a multi-component  
40  
41 intervention, in which key features were engaging populations in screening, providing  
42  
43 screened populations with feedback about risk status, a health dialogue (defined as  
44  
45 counselling that includes aspects of shared decision making such as goal setting or  
46  
47 intention formation, and is not just information giving or psychological support),  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 information about the impact of risk factors on illness development, counselling,  
4  
5 motivational interviewing, referral, and pharmacological treatment. The impact of  
6  
7 feedback and health dialogue on health outcomes was reported but due to the multiple  
8  
9 constituents of interventions, isolating the effects of any one feature is often difficult.  
10  
11 Search for studies that focused on explicitly examining such features therefore  
12  
13 developed. Twelve studies were left that fulfilled this requirement and met inclusion  
14  
15 criteria. Details of the components covered by these papers, year of publication, details  
16  
17 of the samples recruited, populations studied and main findings are presented in Table  
18  
19 1. The selection process is summarized in a PRISMA flow diagram (supplementary  
20  
21 materials).

## 22 23 24 25 26 27 28 **Data extraction**

29  
30  
31 Two reviewers (CH and YC) independently extracted information from each article, and  
32  
33 one author (CH) reviewed all studies. Data were extracted on study authors,  
34  
35 geographical location, year of publication, study cohort characteristics, behavioural  
36  
37 design features of the intervention, and outcome measures (see Table 1).  
38  
39  
40

## 41 42 **Results**

### 43 44 45 **Study characteristics and quality**

46  
47 Most of the studies examined the effect of a multi-component intervention, in which key features were  
48  
49 engaging populations in screening, providing screened populations with feedback about risk status, a  
50  
51 health dialogue (defined as counselling that includes aspects of shared decision making such as goal  
52  
53 setting or intention formation, and is not just information giving or psychological support), information  
54  
55 about the impact of risk factors on illness development, counselling, motivational interviewing, referral,  
56  
57  
58  
59  
60

1  
2  
3 and pharmacological treatment. The impact of feedback and health dialogue on health outcomes was  
4 reported but due to the multiple constituents of interventions, isolating the effects of any one feature is  
5 often difficult.  
6  
7  
8  
9

10 The SIGN 50 assessment of quality of studies included is summarised in Table 1. Two  
11 authors (CH and RC) independently rated each included study for quality using the  
12 SIGN 50 guidelines,<sup>13</sup> with each study rated as either ++ = high quality, + = acceptable  
13 quality or 0 = low quality. After independent ratings the authors met to discuss their  
14 ratings. All disagreements were resolved via discussion. Seven studies were of  
15 acceptable quality and five were high quality studies. The key elements of the studies  
16 were summarised into Table 1, so that key themes and evidence from the papers could  
17 be identified and extracted for examination.  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30

31 The review of included papers begins by describing studies that addressed the question  
32 of what impact behaviour change features embedded within intervention designs of  
33 CVD and diabetes screening programmes have on health outcomes. The review then  
34 proceeds to cover literature that evaluates the factors predicting attendance and attrition  
35 from screening and intervention programmes.  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45

### 46 **Impact of feedback on behaviour change**

47 Providing people with feedback on their behaviour can prompt behaviour change,<sup>14,15</sup>  
48 and has been recognised as an effective behaviour change technique in Abraham and  
49 Michie's behaviour change taxonomy.<sup>16,17</sup> In general, there are two types of feedback:  
50 informing patients about their risk status, e.g. of CVD; and giving patients behaviour-  
51 specific feedback, e.g. discussion related to detailed dietary analysis<sup>18</sup>, with a key point  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 of contention being the effectiveness and practicalities of these two approaches Two  
4  
5 studies examined the impact of feedback on behaviour change.  
6  
7  
8  
9

10 Aubin et al<sup>19</sup> investigated whether knowledge of blood cholesterol level affected  
11  
12 intention to adopt a low fat diet. The study was conducted in hospital-based family  
13  
14 medical centres in Quebec, Canada. Participants were randomly assigned to complete  
15  
16 a questionnaire about CVD risk profile, intention to adopt a low fat diet, and dietary fat  
17  
18 intake either before or after receiving their screening results, i.e. one group knew their  
19  
20 results, and one did not at the time of completing the questionnaire. Patients who were  
21  
22 aware of their blood screening results before they completed the questionnaire showed  
23  
24 a significantly higher intention to adopt a lower fat diet than patients who were not ( $F_{1,417}$   
25  
26 = 5.4,  $p < 0.02$ ). In addition, in those who had received their results, intention tended to  
27  
28 rise with blood cholesterol level (non-significant,  $F_{5,413} = 2.0$ ,  $p < 0.08$ ).  
29  
30  
31  
32  
33  
34  
35

36 Three months after screening, participants' dietary fat intake and changes in eating  
37  
38 habits were assessed by comparing diet with that reported at baseline. Data for 391  
39  
40 participants (mean age = 35 years) were analysed. Mean dietary fat intake significantly  
41  
42 reduced from 48.5g per day at baseline, to 37.7g per day at three month follow-up for  
43  
44 the participant group as a whole. After three months, patients who had abnormal  
45  
46 cholesterol levels had a significantly greater reduction in dietary fat intake than patients  
47  
48 with normal cholesterol results ( $F_{(2,388)} = 3.6$ ,  $p = 0.03$ ); correlational analysis showed a  
49  
50 highly significant link between reduction in fat intake and reduction in blood cholesterol  
51  
52 (the researchers report an  $R^2$  of 0.5,  $p = 0.001$ , but confirmed by email that a Pearson's  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 correlation was intended). This shows that patients who had higher blood cholesterol  
4  
5 were more likely to make dietary changes. Although the method and analysis did not  
6  
7 separate out people who were aware of their cholesterol levels in the longitudinal  
8  
9 comparisons, the authors concluded that informing patients of their blood cholesterol  
10  
11 levels effects an immediate change in dietary habits, and that over all, the change in  
12  
13 dietary habits effects a reduction in fat intake and lower CVD risk.  
14  
15

16  
17  
18 Elton et al<sup>20</sup> used a workplace screening and intervention trial in Manchester, UK to  
19  
20 examine if knowledge of cholesterol level led to a reduction in cholesterol over a thirteen  
21  
22 week period. Participants were randomly allocated to either an intervention group that  
23  
24 received information on their current cholesterol level, or to a control group where this  
25  
26 information was not provided. Then all participants attended a health education session  
27  
28 about diet. The results demonstrated that the reduction in cholesterol measurements  
29  
30 thirteen weeks after baseline was greater in intervention participants with initially high  
31  
32 (>6.5mmol/l) serum cholesterol than in matched control participants (change of -0.29 for  
33  
34 intervention participants, 95% CI -0.48 to -0.11, but only a change of -0.01, 95% CI -  
35  
36 0.16 to +0.15 for controls, difference between groups reached significance at  $p < 0.024$ ).  
37  
38  
39 A key difference between this and an earlier study<sup>18</sup> which had not shown an effect of  
40  
41 informing participants of their cholesterol level was that the interventions specifically  
42  
43 focussed on diet here, whereas the earlier study delivered a general health education  
44  
45 package.  
46  
47  
48  
49  
50

## 51 52 **Impact of health dialogue on behaviour change** 53 54 55 56 57 58 59 60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Five studies examined the role of health dialogue in influencing health outcomes of screening interventions.<sup>21-25</sup> Färnkvist et al<sup>21</sup> investigated the extent to which health screening with or without health dialogue influenced self-reported CVD and diabetes morbidity 11 years post-screening. Participants were men aged 35-55 years in Härnösand, Sweden. Screening included objective measurements (e.g. blood pressure), a self-report questionnaire, and health counselling provided by nurses. Although described alternately as health dialogue and counselling in this study, it did actually consist of a structured motivational dialogue that included discussion of the individual's CVD risk, and possible lifestyle changes, and hence fulfils our definition of a health dialogue. Other healthcare providers in the same community (mainly occupational health services; OHS) carried out the same screening but without the health dialogue.

Eleven years later participants were asked to complete a questionnaire including questions about smoking, alcohol, physical activity, height, weight, fat intake and the presence of CVD and/or diabetes. There was no significant decline in health during the 11 years for those participants who received the screening plus health dialogue (8.2% incidence of CVD and/or diabetes), in stark contrast to those who received screening only (22.6% incidence) or no screening (19.2%). The odds ratios (OR) of developing CVD or diabetes over the 11 years was 2.5 for those who had screening with no health dialogue, and 3.0 for those who had not participated in either the original screening or the dialogue, as compared with the dialogue group. That is, the risk was more than doubled for any group who had not received the dialogue. The authors concluded that

1  
2  
3 screening that includes a structured, motivational health dialogue is more effective than  
4  
5 screening without this dialogue.  
6  
7

8  
9  
10  
11 Engberg et al<sup>22</sup> conducted a RCT in Denmark investigating the impact of general health  
12 screening versus screening plus GP-patient discussions about CVD risk profile.  
13  
14 Randomly selected men aged 30-50 from several GP practices were sent an invitation  
15 letter and postal questionnaire about lifestyle. Those who agreed to take part completed  
16 a second questionnaire asking about their health, lifestyle, psychosocial status and life  
17 events. Participants were randomised to a control group (questionnaire only, no  
18 screening) or one of two intervention groups: screening only and screening plus health  
19 discussions (time points not given). Participants in the health screening plus discussion  
20 group were offered a 45-minute consultation with their GP to discuss their results and  
21 how to adapt to a healthier lifestyle. They were encouraged to set their own topics for  
22 discussion and to set health-related lifestyle goals to achieve within the next year.  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36

37 These participants were offered further discussions annually for five years.

38  
39 Randomisation to groups was stratified based on the GP to whom they were registered,  
40 age, sex, BMI and "cohabitation status". All screened participants received personal  
41 written feedback from their GPs, including advice on lifestyle change (where necessary)  
42 and information leaflets about a healthy lifestyle. All participants were followed up at 1  
43  
44  
45  
46  
47  
48  
49 and 5 years.  
50

51  
52 At the 5 year follow-up, there were no significant differences in measures of CVD risk  
53 factors between the two intervention groups (screening only versus screening plus  
54 discussion). Taken together, however, these two intervention groups had a much lower  
55  
56  
57  
58  
59  
60

1  
2  
3 proportion of patients with elevated CVD risk scores than the control group, whose  
4 prevalence of elevated CVD risk was approximately twice that of the intervention groups  
5 (RR = 0.54, 95% CI = 0.40-0.73). However, there were no significant differences  
6  
7 between the control and intervention groups for blood pressure, and no effects on  
8 smoking. The authors concluded that though the intervention as a whole had a marked  
9 effect on CVD risk, the discussions did not improve the cardiovascular health of  
10 participants over and above the improvement shown from screening with feedback.  
11  
12  
13  
14  
15  
16  
17  
18  
19

20 Rubak et al<sup>23</sup> examined the difference in patient outcomes (improved metabolic status in  
21 patients with diabetes) between those whose GPs had received training in motivational  
22 interviewing and those whose GPs had been allocated to a control group. Both groups  
23 of GPs received training in intensive treatment of Type 2 Diabetes. The study found that  
24 patients with GPs in both groups showed significant improvements, with no difference  
25 between the groups at one year follow-up. One explanation for the lack of difference  
26 found is that GPs in the motivational interview group had used an average of less than 2  
27 of the 3 motivational interview sessions allocated to them. The authors suggest that  
28 some contamination of effect may have occurred, in that the control group GPs also  
29 became aware of MI, and that the GPs in the motivational interview group did not use it  
30 as much as had been recommended.  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

47 Koelewijn-van Loon et al<sup>24</sup> investigated differences between participants who had a  
48 structured dialogue with a trained nurse (including risk assessment, risk communication,  
49 motivational interview and a patient “decision support tool”) and patients who received  
50 usual care. Outcome measures were self-reported lifestyle behaviours, diet, exercise,  
51 smoking and alcohol use, which were measured 12 weeks after baseline to assess  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 change. 522 patients completed the follow-up measures. The authors concluded that  
4  
5 the results showed an improvement in lifestyle in both groups; there were no differences  
6  
7 between groups in terms of effects.  
8  
9

10  
11 Craigie et al<sup>25</sup> examined the impact of a personalised lifestyle programme (HealthForce)  
12  
13 aimed at promoting lifestyle behaviour change and based specifically on health  
14  
15 behaviour change theory. HealthForce targeted motivational elements to create  
16  
17 intentions to change behaviour and volitional elements, focussing on translating  
18  
19 intentions into planned behaviours. It involved patients attending three face-to-face  
20  
21 sessions with a trained lifestyle counsellor, plus other materials, with topics being  
22  
23 activity, diet and weight management. The outcome assessments all showed significant  
24  
25 positive changes for the intervention group (all  $p < 0.01$ ), with no positive, but some  
26  
27 negative changes for the control group. Consumption of 5 portions of fruit and  
28  
29 vegetables a day went from 56% to 85% for the intervention group; weight was down by  
30  
31 an average of 1.1kg, BMI went from a mean of 26.7 to 26.2kg/m<sup>2</sup> (with increases, rather  
32  
33 than decreases, for the control group,  $p < 0.01$ ) and waist circumference went from 87.3  
34  
35 to 84.0cm (no significant change for control group).  
36  
37  
38  
39  
40  
41  
42

43 The contrast between these five similar studies is striking; Färnkvist et al and Craigie et  
44  
45 al's analyses supported the impact of health dialogue, Engberg et al found that  
46  
47 screening plus verbal health dialogue was not superior to screening that included a  
48  
49 written dialogue, while Rubak et al and Koelewijn-van Loon et al found no effect.  
50  
51 However, the outcome measures, and time between measurements, vary across  
52  
53 studies; Färnkvist et al compared risk of CVD and diabetes diagnosis over 11 years,  
54  
55 Engberg et al assessed differences between groups in risk factors five years after initial  
56  
57  
58  
59  
60



1  
2  
3 screening, Rubak et al tested metabolic status in patients with diabetes after one year,  
4  
5 Koelewijn-van Loon et al compared self-reports of lifestyle behaviours 12 weeks after  
6  
7 the intervention, and Craigie et al compared anthropometric and health behaviour  
8  
9 changes 12 weeks later. This raises a number of issues. First, endpoint diagnosis is the  
10  
11 most objective measure of the impact of intervention, and the strongest evidence of  
12  
13 efficacy. Second, in general, longer-term follow-ups are preferable, however selective  
14  
15 attrition could be a greater issue for longer-term follow-ups, biasing the sample.  
16  
17  
18 Conversely, shorter-term follow-ups may not allow enough time for change to happen.  
19  
20  
21 Finally, these studies, though conducted with similar samples, were run in four different  
22  
23 countries with subsequent differences in healthcare services and risk levels at baseline,  
24  
25 and so conclusions need to take into account the healthcare context when assessing  
26  
27 the mechanisms and outcomes.<sup>8</sup>  
28  
29  
30

31  
32 Of particular interest were the two studies (Craigie et al and Koelewijn-van Loon et al)  
33  
34 which both used self-reported behavioural outcomes and a 12 week follow-up and yet  
35  
36 had contradictory results. Both included face to face counselling on more than one  
37  
38 occasion, telephone support sessions, and motivational interview plus decision support  
39  
40 or goal setting. The most obvious difference is that patients in Craigie et al's study were  
41  
42 all pre-selected as high risk (but not on statins), whereas only 28% of those in  
43  
44 Koelewijn-van Loon et al's study were designated as high CVD risk. Indeed the latter  
45  
46 study did find a difference between intervention and control groups in fruit and  
47  
48 vegetable consumption when only those with diagnosed diabetes were included. As in  
49  
50 previous analyses, the difference seems to be due to the finding that those with higher  
51  
52 perceived risk are more likely to make appropriate changes to their health behaviour.  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Again context is highlighted, but here in terms of the individuals one is trying to  
4  
5 influence.  
6  
7  
8  
9

10 **Key points:**

11  
12 **Providing patients with feedback on screened measurements can promote changes in**  
13 **behavioural intentions and actual health behaviour change.**

14  
15 **The benefits of a structured, motivational health dialogue are supported over simple**  
16 **screening where outcomes are measured long term, but the actual structure of such**  
17 **dialogues has not been directly analysed in the literature.**

18  
19 **The comparison of similar studies highlights the need for a set of basic standardised**  
20 **measures.**

21  
22 **Comparisons suggest that longer term influences on disease occurrence need assessing.**

23  
24 **Patients informed they are at high risk tend to make the most lifestyle changes and achieve**  
25 **the most positive outcomes**

26  
27  
28 **Factors predicting uptake, attendance and attrition from screening programmes**  
29  
30

31 **Uptake and invitation**

32  
33  
34 For screening programmes to be cost-effective it is essential to maintain high levels of  
35 uptake, attendance and avoid excessive attrition. Research<sup>21</sup> has demonstrated that  
36 some groups, for example, the less healthy, are less likely to participate in screening  
37 programmes, and more likely to drop out if they do commence participation. Attempts  
38 have been made to encourage uptake of screening by manipulating the method of  
39 invitation: three studies examined the effect of invitation style on uptake and health  
40 outcome.<sup>27-29</sup>

41  
42  
43 Marteau et al<sup>27</sup> hypothesised that providing an informed choice leaflet lower attendance  
44 relative to standard invitations, because individuals receiving the leaflet would see that  
45 screening is unlikely to provide individual benefits. The authors found no difference in  
46 attendance rates between individuals who received an informed choice letter versus a  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 standard letter, but they did replicate previous studies in finding that attendance fell with  
4  
5 increasing social deprivation. There was no interaction between social deprivation and  
6  
7 invitation type, however, the authors concluded that the ethical advantage gained in  
8  
9 informed choice invitations did not outweigh the attendance benefit of standard  
10  
11 invitations.  
12  
13

14  
15  
16  
17 Park et al<sup>28</sup> investigated the effects of loss- and gain-framed messages in an invitation  
18  
19 to screen for Type 2 diabetes. The loss frame message (“If you have diabetes but are  
20  
21 not detected early, your diabetes may lead to more complications”) highlights the  
22  
23 possible losses due to not attending; the gain frame message (“If your diabetes is  
24  
25 detected early, you can receive early and more effective treatment”) emphasises the  
26  
27 possible gains of attending. Participants, aged 40-69 years, were randomly selected  
28  
29 from two GP practices in Cambridgeshire, England. Fifty-nine patients were randomised  
30  
31 to receive the loss-framed invitation and 57 the gain-frame. All invitations included a  
32  
33 neutral framed message (“A simple blood test is the best way to detect diabetes”).  
34  
35  
36  
37  
38  
39

40  
41 There were no significant differences in attendance rates between groups (loss-frame =  
42  
43 81% vs gain-frame = 82%). Overall, results show that how information was framed  
44  
45 made little difference to attendance rates. There was, however, a significant interaction  
46  
47 effect between sex and invitation frame; attendance was higher in men invited using the  
48  
49 loss-frame (89%) compared to the gain-frame (77%), and higher in women invited using  
50  
51 the gain-frame (94%) compared to the loss-frame (68%). Although this result should be  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 viewed with caution because of the small numbers, it does suggest potential for using  
4  
5 different frames for different patient groups.  
6  
7

8  
9 In addition to investigating the content and format of invitation letters, researchers have  
10  
11 also examined the potential of opportunistic screening that is asking patients to  
12  
13 complete screening while they are attending a healthcare setting for another purpose,  
14  
15 such as collecting medication. Hellénus et al<sup>29</sup> investigated opportunistic screening on  
16  
17 visits to a healthcare centre for other purposes in a suburban area of Sweden  
18  
19 (Sollentuna). Male and female adults under the age of 60 who visited health centres  
20  
21 were opportunistically invited to screening. This group was compared with a group who  
22  
23 were invited by letter. 59% of those invited by letter participated (249 people) compared  
24  
25 to 15% of the men and 20% of the women who were invited when they visited their  
26  
27 health centres (4655 people, the opportunistic sample). Frequency of hypertension, high  
28  
29 cholesterol, high triglycerides were greater in the opportunistic sample than the letter-  
30  
31 invited sample, but there were no differences in smoking or likelihood of being  
32  
33 overweight. Outcomes of the intervention showed significant blood pressure,  
34  
35 cholesterol, and triglyceride reductions, but no differences in the level of reductions in  
36  
37 risk factors between opportunistic and letter-invited participants. The authors concluded  
38  
39 that the integration of a large scale CVD risk screening programme into a regular  
40  
41 primary healthcare system was successful, and that, taking into account low uptake,  
42  
43 opportunistically screening patients was successful in identifying those with high CVD  
44  
45 risk factors whose risk factor level could be reduced.  
46  
47  
48  
49  
50  
51  
52

### 53 54 55 **Difference between attenders and non-attenders** 56 57 58 59 60

1  
2  
3 It has been noted that differences exist between individuals who attend screening and  
4 those who do not<sup>26</sup> and our search strategy identified two papers on this topic. Jones et  
5 al<sup>30</sup> recruited 3800 patients (aged 25-55 years) across six GP practices in Wales who  
6 were invited for a CHD risk factor screening programme. 2402 (63.2%) attended for  
7 screening, 1389 (36.8%) did not attend. A 1 in 10 random sample of 140 non-attenders  
8 was obtained, using a further letter offering them a medical “MOT” with specific  
9 reference made to heart disease and asking them to make an appointment any morning  
10 or afternoon. (MOT is an annual car maintenance test which is legally required by the  
11 Ministry of Transport for cars on UK public roads, a term which is very familiar in the  
12 UK.) After three weeks any persisting non-respondents were sent another letter  
13 including a specific appointment time, asking them to contact the surgery if this was not  
14 convenient. A final contact was made by telephone after a further three weeks, and the  
15 nurse visited the home for the appointment if necessary. This approach resulted in 98  
16 (70.0%) of the original non-attenders being screened. They were asked to indicate  
17 reasons for their initial non-attendance. Reasons (in order of frequency) were: invitation  
18 letter not received (36.7%); ‘practical reasons’ (26.5%); felt screening was unnecessary  
19 because they were feeling well (18.4%); already under medical care for CHD related  
20 issues (12.2%); already aware of having risk factors and so felt screening was  
21 unnecessary (10.2%); felt apathetic about screening (10.2%); afraid of screening  
22 (7.1%); forgot to attend appointment (4.1%).

23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52 Non-attenders were significantly older than attenders (mean age 42.6 years and 39.4  
53 years respectively;  $p < 0.001$ , 95% CI of difference 1.50, 4.88). They were more likely to  
54 have lower SES than attenders and more likely to have a personal history of CHD (12%  
55  
56  
57  
58  
59  
60

1  
2  
3 versus 5.7%,  $p < 0.05$ ). In addition, mean BMI ( $p < 0.01$ ; 95% CI 0.84, 2.58), cholesterol  
4  
5 ( $p < 0.01$ , 95% CI 0.26, 0.74), and blood pressure (systolic  $p < 0.001$ ; 95% CI 9.57, 15.86;  
6  
7 diastolic  $p < 0.01$ ; 95% CI 1.63, 5.82) were significantly higher for non-attenders than  
8  
9 attenders. These results show that those people most in need of healthcare are less  
10  
11 likely to access it. However, it is also clear that approximately 22% of non-attenders did  
12  
13 not attend because they were already under medical care for CHD issues or were  
14  
15 already aware of their risk factors (no data for attenders), possibly influencing the  
16  
17 outcome differences between attenders and non-attenders, and potentially reducing the  
18  
19 likelihood of these individuals responding to an invitation to screening.  
20  
21  
22  
23  
24

25  
26 A further issue of non-attendance is that of differences between people who continue in  
27  
28 a programme once started, and those who drop out. Thomas et al<sup>31</sup> examined the  
29  
30 characteristics of attenders and non-attenders at the 20-year follow-up screening in the  
31  
32 British Regional Heart Study. The non-attenders referred to here were all people who  
33  
34 had attended originally, but failed to return for re-assessment, i.e. had dropped out. A  
35  
36 total of 7735 men took part in the original screening, and 4252 (77%) attended the  
37  
38 follow-up. There were no significant differences at baseline in age, BMI and cholesterol  
39  
40 between those who attended those who did not attend at the follow-up, but non-  
41  
42 attenders at follow-up had higher baseline blood pressure. Questionnaire data on the  
43  
44 non-attenders was available from 2-4 years before the invitation to the follow-up health  
45  
46 check. This showed that they were more likely to have suffered stroke, peripheral  
47  
48 vascular disease and bronchitis and that they were twice as likely to smoke cigarettes.  
49  
50 Attenders were significantly more likely to be married, to own their own home, to have  
51  
52 access to a car, and to be educated past the age of 16.  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Mortality rates within one year of follow-up were significantly higher among non-  
4  
5 attenders than attenders (6.2% vs. 1.7%), though the majority of deaths were non CVD-  
6  
7 related. Non-attenders who self-reported having poor or fair health and a disability were  
8  
9 significantly less likely to attend for follow-up, as were participants who reported using  
10  
11 four or more medications regularly. Furthermore non-attenders were shown to be taking  
12  
13 multiple prescribed medications, report more disabling conditions, and had a high early  
14  
15 mortality rate.  
16  
17  
18  
19  
20  
21

#### 22 **Key points:**

23  
24 **Informed choice invitations are preferable ethically and do not appear to reduce screening**  
25 **uptake**

26  
27 **Framing of invitations to screen may affect attendance rates for men and women; where a**  
28 **screening invitation is gender specific, targeting may benefit from framing**

29  
30 **Opportunistic screening at visits to GP surgeries for other purposes is shown to be effective**

- 31  
32
- 33 • Evaluation of opportunistic screening confirms that it reaches people with higher CVD risk factors than reached using standard invitations.
  - 34 • People screened opportunistically showed very similar improvements in assessed risk factors to people invited in other ways
- 35  
36

37 **People who do not attend or who drop out at later stages may be different.**

- 38
- 39 • Differences between people who respond to invitations for screening and who do not are difficult to ascertain, but evidence suggests non-attenders have higher CVD risk factors.
  - 40
  - 41 • Selective drop out (“selective attrition”) biases longitudinal studies in that inevitably people who are less healthy, less well educated, of lower socio-economic status or with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments.
  - 42
  - 43 • Selective attrition may result in outcomes in longitudinal studies appearing more positive (overestimate of effect) because people who remain in the study are the healthier people
  - 44
  - 45 • Careful methodological and statistical controls are needed to reduce resultant effects on findings.
  - 46
  - 47
  - 48
  - 49
  - 50
  - 51
- 52  
53  
54

## 55 **Discussion**

56  
57  
58  
59  
60

1  
2  
3 This realist review focussed on use of evidence based design features of interventions  
4  
5 which aimed to increase uptake of CVD and diabetes screening with a view to  
6  
7 increasing early detection and reduction of risk factors for these diseases. Only 12  
8  
9 studies were identified that critically examined the intervention design and tested the  
10  
11 efficacy of health behaviour change components, such as feedback, against health  
12  
13 outcomes. Key findings include the following: health-related feedback or health dialogue  
14  
15 can be effective, but in order to enable specific analyses, a working definition of what  
16  
17 this communication entails is required; whether individuals are invited for screening or  
18  
19 are screened opportunistically may influence the nature of participants recruited, with  
20  
21 those at higher risk less likely to respond to an invitation; and selective attrition of those  
22  
23 at higher risk may be skewing results of longitudinal studies because it is the healthier,  
24  
25 lower risk patients who are most likely to attend for follow-up.  
26  
27  
28  
29  
30  
31

### 32 **Impact of behavioural features on quality and outcome of interventions**

33  
34  
35

36 It is clear from the studies reviewed that consideration of evidenced behavioural  
37  
38 features of interventions is limited; in particular, several large UK studies<sup>(26,32,33)</sup> were  
39  
40 excluded from the review at an early stage in the search process because they did not  
41  
42 examine any design, behavioural or psychological features of screening or intervention.  
43  
44 Nevertheless, the studies included in the review indicate several strategies that could be  
45  
46 usefully employed to reduce risk in high risk and general population targets, such as  
47  
48 providing opportunistic screening. There was a lack of evidence that intervention design  
49  
50 was based on health psychology theory (e.g., Ajzen's theory of planned behaviour,<sup>34</sup>  
51  
52 despite research showing that such theories can predict screening attendance,<sup>35</sup> and  
53  
54 lifestyle behaviours that are the target of screening interventions.<sup>36</sup> Even studies that  
55  
56  
57  
58  
59  
60



1  
2  
3 claimed to be based on theories and target motivation<sup>25</sup> failed to specify the theory base  
4  
5 for their intervention. This lack of emphasis on health psychology theories suggests a  
6  
7 greater focus on the outcome of the intervention (i.e., did people change their  
8  
9 behaviour?) rather than a focus on the motivations and perspectives of the individuals  
10  
11 invited to screen. This 'one-size fits all' approach to intervention design is unlikely to  
12  
13 yield success as research shows that even in a sample of 10 participants not all of them  
14  
15 respond positively to the same interventions.<sup>37</sup> Although there was limited use of  
16  
17 health psychology theories in the design of the interventions included in this review,  
18  
19 several interventions included elements such as the influence of health dialogue, goal  
20  
21 setting and feedback, which have been shown to promote health behaviour change,<sup>38,39</sup>  
22  
23 although much of this research has been conducted outside of primary care settings.  
24  
25 Therefore, it was encouraging to find that goal setting promoted changes in outcomes in  
26  
27 Craigie et al and that feedback was helpful in Aubin et al and Elton et al. These  
28  
29 elements require further examination with reference to a behaviour change taxonomy  
30  
31 e.g., Abraham and Michie's,<sup>16</sup> to determine whether they are effective within the context  
32  
33 of CVD and diabetes screening programmes. Relatedly, an issue highlighted by our  
34  
35 evaluation of a CVD screening intervention in the UK,<sup>40</sup> is the extent to which healthcare  
36  
37 practitioners use the strategies and tools with which they have been provided in the  
38  
39 health dialogues they have with their patients. This issue of intervention fidelity has the  
40  
41 potential to differentiate between programmes that are successful in getting patients to  
42  
43 change their behaviour and programmes that are not,<sup>41</sup> and is evident in Rubak et al<sup>23</sup>  
44  
45 who found that GPs failed to deliver, on average, more than one session of motivational  
46  
47 interview to patients, when they were facilitated to deliver three. CERAG's definition of  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 implementation research: “the scientific study of methods to promote the systematic  
4  
5 uptake of clinical research findings and other evidence-based practices in routine  
6  
7 practice, and hence to improve the quality (effectiveness, reliability, safety,  
8  
9 appropriateness, equity, efficiency) of healthcare” (cited in Eccles et al.<sup>1</sup>) sets this study  
10  
11 firmly in the context of implementation science.  
12  
13  
14

### 18 Study limitations

21 This review raised two key challenges. First, studies rarely analyse behavioural  
22  
23 components of the intervention design discretely, making it impossible to discern which  
24  
25 factors are at work in producing the observed effects. Second, the heterogeneity of  
26  
27 outcome measures precludes statistical evaluations using meta-analysis. Publication or  
28  
29 outcome bias may have affected our results, though not all included studies found  
30  
31 significant reductions in assessed risk or differences in outcomes between intervention  
32  
33 and control groups. Several potentially relevant studies that focus on the design of  
34  
35 screening interventions were excluded because they were not delivered in healthcare  
36  
37 settings. The reviewed studies also highlight the disadvantages of Intention-To-Treat  
38  
39 analyses, which are better suited for assessing the efficacy of an intervention in practice  
40  
41 as opposed to understanding “how” and “why” and intervention works, and the need to  
42  
43 control for selective attrition either by use of features which reduce drop out or by  
44  
45 statistical control for known differences between returners and non-returners, but few  
46  
47 studies employ this. As a realist review, this document examines outcomes which may  
48  
49 be situation specific. The acknowledgement that some findings that may be situation or  
50  
51 population specific is important in generalisation of results.  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Conclusions and policy implications

This review highlights the need for a more systematic approach to the strategic design, conduct and analysis of health interventions by taking into account the complex interactions between design, delivery, attrition and health outcomes. It is recommended that insights from health psychology should be incorporated in the design of interventions aimed at increasing screening uptake, as well as involving cross-disciplinary specialist areas such as physical activity and nutrition to promote lifestyle behaviour change alongside pharmacological treatment. Furthermore, to control the effects of selective attrition, there is a need to perform sensitivity analyses in order to monitor the make-up of the sample and perhaps some purposive sampling to protect against biasing the sample toward a healthier baseline and therefore reduced effect at follow-up, particularly in longitudinal studies. It is anticipated that such carefully designed interventions would result in health behaviour change that provide as much benefit to the wider population as they do for those with heightened risk, resulting in better overall population outcomes.

**What is already known on this topic**

**Previous reviews have raised concerns about the cost effectiveness of CVD and diabetes screening interventions.**

- Some researchers have instead recommended replacement of screening programmes with pharmacological interventions alone, (e.g. prescription of statins to everyone aged 55 or older<sup>42</sup>).
- Other work has illustrated that health behaviour change and intervention effectiveness can significantly reduce CVD risk, controlling for effects of pharmacological intervention.
- Some features of intervention style, and of populations, often result in less than optimum risk reduction.

**What this study adds**

- **The study confirms the need for and success of strategies that encourage higher risk patients to become and stay involved in screening and intervention programmes, such as opportunistic screening.**
- Careful training and monitoring of the use of evidenced behaviour change strategies in improving the reach and success of interventions is needed.
- Ethically supported invitation styles such as fully informed choice do not reduce participation or effect outcome.
- Clear feedback and targeted intervention on specific risk factors or behaviours is supported, whereas general lifestyle advice is less effective.
- Structure of motivational health dialogues and the terms over which they are most successful needs further research.

**Contributorship statement:**

CH, RS, HP, and RC were responsible for the conception and design of the study. YC had principal responsibility for search and sourcing of articles and initial data extraction, and RC contributed to reference chaining. Two authors (CH, YC) independently reviewed the 157 full text papers retrieved, and further excluded studies which only evaluated changes in risk factors or cost-effectiveness. CH and RC assigned quality scores to each included full-text article based on the Scottish Intercollegiate Guidelines Network (SIGN 50) quality assessment instruments. CH had principal responsibility for data extraction, analysis and interpretation of the data and for drafting the article,

1  
2  
3 revisions, and final approval. RS, HP, and RC contributed to interpretation of the data,  
4  
5 revisions and final article approval. CH and RC are the guarantors.  
6  
7  
8  
9  
10

11  
12 Funding: This study is a sub-section of a larger review which was commissioned by  
13 Heart of Birmingham teaching and Primary Care Trust, which funded YC as a Research  
14 Associate as part of a larger research project. CH, HP, RC and RS are all members of  
15 the Health and Lifespan Psychology Research group working at Aston University. The  
16 funders had no role in design of this review, the data collection, analysis, and  
17 interpretation, writing the manuscript, or the decision to submit the research for  
18 publication.  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29

### 30 **Competing interest statement**

31  
32 All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf)  
33 (available on request from the corresponding author) and declare: no support from any organisation for  
34 the submitted work other than that outlined under "Funding" above; no other financial relationships  
35 with any organisations that might have an interest in the submitted work in the previous 3 years ; no  
36 other relationships or activities that could appear to have influenced the submitted work .  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 **Ethical approval:** Not required.  
47  
48

49 **Data sharing:** No additional data available.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

1. Eccles, M P, Armstrong, A, Baker R, Cleary, K, et al. An implementation research agenda *Implementation Science* 2009, 4:18 doi:10.1186/1748-5908-4-18
2. Grimshaw, J.M., Eccles, M.P., Lavis, J.N., Hill, S J, Squires, J.E. Knowledge translation of research findings, *Implementation Science*, 2012, 7:50.
3. Ebrahim S, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. *Cochrane Database of Systematic Reviews* 2006; (4): CD001561.
4. Allender S, Peto V, Scarborough P, Kaur A, Rayner, M. *Coronary heart disease statistics*. British Heart Foundation: London, 2008.
5. Unal B, Critchley J A, Capewell, S. Modelling the decline in coronary heart disease deaths in England and Wales, 1981 – 2000: comparing contributions from primary prevention and secondary prevention. *BMJ* 2005; 331: 614-9.
6. NHS Health Check programme. 2012. <http://www.healthcheck.nhs.uk/> .
7. Petticrew M. “More research needed”. Plugging gaps in the evidence base on health inequalities. *Eur J Public Health* 2007, 17:5; 411-413.
8. Pawson R, et al; Realist review – a new method of systematic review designed for complex policy interventions. *J Health Services Research and Policy* 2005, 10 (Suppl 1): 21-34.
9. McMahon T, Ward P R. HIV among immigrants living in high-income countries: a realist review of evidence to guide targeted approaches to

- 1  
2  
3 behavioural HIV prevention *Systematic reviews* 1: 56 DOI: 10.1186/2046-  
4 4053-1-: 2012 )  
5  
6  
7
- 8 10. Moher D, Liberati A, Tetzlaff J, Altman DG. for the PRISMA group. Preferred  
9 reporting items for systematic reviews and meta-analyses: the PRISMA  
10 statement. *BMJ* 2009;339: 332-6.  
11  
12  
13
- 14 11. Flight IHK, Wilson CL, Griffiths L, Myers, RE. Interventions for improving  
15 uptake of population-based screening for colorectal cancer using fecal occult  
16 blood testing. *Cochrane Database of Systematic Reviews* 2004; (4):  
17 CD005035.  
18  
19  
20  
21  
22  
23
- 24 12. Forbes C A, Jepson RG, Martin-Hirsch PPL. Interventions targeted at women  
25 to encourage the uptake of cervical screening. *Cochrane Database of*  
26 *Systematic Reviews*, 2002; (3): CD002834  
27  
28  
29  
30  
31
- 32 13. Scottish Intercollegiate Guidelines Network (SIGN 50) methodology  
33 checklists. Circa 2001-2013, updated 15/04/13,  
34 <http://www.sign.ac.uk/guidelines/fulltext/50/checklist3.html>  
35  
36  
37  
38
- 39 14. Shahab L, Hall S, Marteau T. Showing smokers with vascular disease images  
40 of their arteries to motivate cessation: A pilot study. *Br J Health Psychol*  
41 2007;12: 275-83.  
42  
43  
44  
45
- 46 15. Shahab L, West R, McNeill A. A randomized, controlled trial of adding expired  
47 carbon monoxide feedback to brief stop smoking advice: Evaluation of  
48 cognitive and behavioral effects. *Health Psychol* 2011; 30: 49-57.  
49  
50  
51  
52
- 53 16. Abraham C, Michie S. A taxonomy of behaviour change techniques used in  
54 interventions. *Health Psychol* 2008; 27: 379-87.  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
17. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and health eating behaviours: The CALO-RE taxonomy. *Psychol Health*, 2011; 26: 1479-98.
18. Robertson I, Phillips A, Mant D. Motivational effect of cholesterol measurement in general practice health checks. *Br J Gen Pract* 1992; 42: 469-472.
19. Aubin M, Godin G, Vézina L, Maziade J, Desharnais R. Hypercholesterolemia screening. Does knowledge of blood cholesterol level affect dietary fat intake? *Canadian Family Physician* 1998; 44: 1289-97.
20. Elton PJ, Hammer M, Page F. Randomised controlled trial in northern England of the effect of a person knowing their own serum cholesterol concentration. *J Epidemiol Community Health* 1994; 48: 22-5.
21. Färnkvist L, Olofsson N, Weinehall L. Did a health dialogue matter? Self-reported cardiovascular disease and diabetes 11 years after health screening. *Scand J Prim Health Care* 2008; 26: 135-9.
22. Engberg M, Christensen B, Karlsmose B, Lous J, Lauritzen T. General health screenings to improve cardiovascular risk profiles: a randomised controlled trial in general practice with 5-year follow-up. *J Fam Pract* 2002; 51; 546-52.
23. Rubak S, Sandbaek A, Lauritzen T, Borch-Johnsen K, Christensen B. Effect of "motivational interviewing" on quality of care measures in screen detected



- 1  
2  
3 type 2 diabetes patients: A one year follow-up of and RCT, ADDITION  
4  
5 Denmark. *Scand J Prim Health Care* 2011; 29: 92-8.  
6  
7  
8 24. Koelewijn-van Loo, MS, van der Weijden T, Ronda G, van Steenkiste B,  
9  
10 Winkens B, Elwyn G, et al. Improving lifestyle and risk perception through  
11  
12 patient involvement in nurse-led cardiovascular risk management: a cluster-  
13  
14 randomised controlled trial in primary care. *Prev Med* 2010; 50: 35-44.  
15  
16  
17 25. Craigie AM, Barton KL, Macleod M, Williams B, van Teijlingen E. A feasibility  
18  
19 study of a personalised lifestyle programme (Healthforce) for individuals who  
20  
21 have participated in cardiovascular screening. *Prev Med* 2011, 52: 387-9.  
22  
23  
24 26. Wood DA, Kinmonth AL, Davies GA, Yarwood J, Thompson SD, Pyke SDM,  
25  
26 et al. Randomised controlled trial evaluating cardiovascular screening and  
27  
28 intervention in general practice: principal results of British family heart study.  
29  
30 *BMJ* 1994; 308:313-20.  
31  
32  
33 27. Marteau TM, Mann E, Prevost AT, Vasconcelos JC, Kellar I, Sanderson S,  
34  
35 Parker M, et al. Impact of an informed choice invitation on uptake of  
36  
37 screening for diabetes in primary care (DICISION): randomised trial. *BMJ*  
38  
39 2010; 340: c2138.  
40  
41  
42 28. Park P, Simmons RK, Prevost AT, Griffin SJ. A randomized evaluation of  
43  
44 loss and gain frames in an invitation to screening for Type 2 diabetes: Effects  
45  
46 on attendance, anxiety and self-rated health. *J Health Psychol* 2010; 15: 196-  
47  
48 204.  
49  
50  
51 29. Hellénus M L, Johansson J, de Faire U, Elofsson S, Krakau I. Four years'  
52  
53 experience of cardiovascular opportunistic screening and prevention  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 programme in the primary health care in Sollentuna, Sweden. *Scand J Prim*  
4  
5 *Health Care* 1999; 17: 111-5.  
6  
7
- 8 30. Jones A, Cronin P A, Bowen M. Comparison of risk factors for coronary  
9  
10 heart disease among attenders and non-attenders at a screening programme.  
11  
12 *Br J Gen Pract* 1993; 43:375-7.  
13  
14
- 15 31. Thomas MC, Walker M, Lennon L T, Thomson A G, Lampe FC, Shaper AG,  
16  
17 et al. Non-attendance at re-examination 20 years after screening in the  
18  
19 British Regional Heart Study. *J Public Health Med* 2002; 24:285-91.  
20  
21
- 22 32. Muir J, Lancaster T, Jones L. The Imperial Cancer Research Fund  
23  
24 OXCHECK Study Group . Effectiveness of health checks conducted by  
25  
26 nurses in primary care: final results from the OXCHECK study. *BMJ* 1995;  
27  
28 310: 1099-104.  
29  
30
- 31 33. Muir J, Mant D, Jones L, Yudkin P. Effectiveness of health checks conducted  
32  
33 by nurses in primary care: results of the OXCHECK study. *BMJ* 1994; 308:  
34  
35 308-12.  
36  
37
- 38 34. Ajzen I. The theory of planned behavior. *Organisational Behaviour and*  
39  
40 *Human Decision Processes* 1991; 5: 179-211.  
41  
42
- 43 35. Cooke R, French P. How well do the theory of reasoned action and theory of  
44  
45 planned behaviour predict screening attendance? A meta-analysis.  
46  
47 *Psychology & Health*, 2008; 23: 745-765.  
48  
49
- 50 36. McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of  
51  
52 health-related behaviours within the theory of planned behaviour: A meta-  
53  
54 analysis. *Health Psychology Review* 2011; 5: 97-144.  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
37. Sniehotta FF, Penseau J, Hobbs N, Araújo-Soares V. Testing self-regulation interventions to increase walking using factorial randomised N-of-1 trials. *Health Psychology* 2012; 31: 733
38. Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement: a meta-analysis of effects and processes. In Zanna, M.P. (Ed.) *Advances in Experimental Social Psychology*; 2006: 39, Academic Press, New York, 69-119.
39. Gill J, & O'May F. Practical demonstration of personal daily consumption limits: A useful intervention tool to promote responsible drinking among UK adults? *Alcohol and Alcoholism*; 2007: 42, 436-441.
40. Shaw R, Cooke R, Holland C, Cooper Y, Dahdah M, Pattison H. (under review). Be SMART and follow the protocol: lessons learned from an evaluation of the NHS Health Check, *Soc Sci Med*.
41. Borrelli B, Sepinwall D, Ernst D, Bellg AJ, Czajkowski S, Breger R, et al. A new tool to assess treatment fidelity and evaluation of treatment fidelity across 10 years of health behaviour research. *J Consult Clin Psychol* 2005; 73: 852-8.
42. Wald NJ, Simmonds M, Morris JK. Screening for Future Cardiovascular Disease Using Age Alone Compared with Multiple Risk Factors and Age. *PLoS ONE* 2011;6(5): e18742. doi:10.1371/journal.pone.0018742.

Table 1. Included Studies

Study	Country	Sample	N	Design	Intervention Component	Main findings	Quality
Aubin 1998 <sup>14</sup>	Canada	58% female, mean age 35 years	391	RCT, controls completed questionnaire on intention to eat a low fat diet before they received results of cholesterol screening, intervention participants completed it after	Impact of feedback on behaviour change	Intervention participants were more likely to intend to adopt a low fat diet than controls. Patients with abnormally high cholesterol ( $\geq 6.3\text{mmol/L}$ ) showed a greater reduction in dietary fat intake than those who had a normal cholesterol ( $<5.2\text{mmol/L}$ )	+
Elton 1994 <sup>15</sup>	England	44% female, mean age 37.9 years	469	Prospective, blinded RCT, Intervention participants knew their cholesterol level before the health education	Impact of feedback on behaviour change	Participants whose initial serum cholesterol was $\geq 6.5\text{mmol/L}$ and who had been informed of this, showed a significantly greater	++

				and diet session, control participants did not.		reduction in serum cholesterol than control participants in the same high cholesterol group who had not been informed. All participants received the same dietary advice.	
Färnkvist 2008 <sup>16</sup>	Sweden	100% male, age stratified, aged 66, 56 and 46 years.	817	Cross-sectional study. Screening only, Screening plus health dialogue by trained professionals, and non-participants compared.	Benefits of health dialogue over simple feedback	Odds ratios of developing diabetes or CVD over 11 years were 2.5 for those had received screening with no health dialogue and 3.0 for those who had not participated in the original screening, as compared with those who had received screening plus a structured, motivational health dialogue.	+

1 2 3 4 5 6 7 8 9 10 11 12 13 14	Engberg 2002 <sup>17</sup>	Denmark	52% female, Mean age 40.4 years	150 7	RCT, Screening, screening plus health dialogue compared with normal care control group.	Benefits of health dialogue over simple feedback	After 5 years there were no differences between the two intervention groups Total intervention/control Risk Ratio was 0.54. Absolute risk reduction 8.6%.	++
15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49	Rubak 2011 <sup>18</sup>	Denmark	42% female, Mean age 61 years. Patients with screen detected type 2 diabetes	628	Cluster RCT, Intervention and control groups received training in intensive treatment of Diabetes, intervention group GPs additionally received training in Motivational Interviewing (MI) and instructed to use it.	Benefits of health dialogue over simple feedback	No effect of motivational interview on medication adherence or metabolic status in relative to control group. Medication adherence across both groups almost 100%, both groups showed significant improvements in all risk measures. Key issues were lower than planned use of motivational interview by intervention group GPs, and contamination of	++

						methods and training into control group GPs.	
Koelewijn -van Loon 2010 <sup>19</sup>	Netherlan ds	55% female, Mean age 57 years	615	Cluster RCT, Intervention nurses received training to use risk assessment, communication, a decision support tool and MI. Control group nurses received training on risk assessment and applied usual care.	Benefits of health dialogue over simple feedback	Outcome measures were self- reported lifestyle measures. No differences between control and intervention groups noted at 12 week follow up, but overall both groups showed improvements.	+
Craigie 2011 <sup>20</sup>	Scotland	72% female, Mean age 54.5 years, high risk but not on statins.	75	RCT, Intervention – motivational interview and volitional aspects to change planned behaviour, Control group usual care.	Benefits of health dialogue over simple feedback	Percentage achieving 5 portions of fruit and vegetables a day, and weight maintenance or loss indicators were significantly better in the intervention group over the 12 week follow up. Control group	+

						made no positive change.	
Marteau 2010 <sup>22</sup>	England	47.6 % female, mean age 57.4 years	127 2	RCT, informed choice invitation compared with standard invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups Secondary outcome of intention to change health behaviour was unaffected by invitation type.	++
Park 2010 <sup>23</sup>	England	66.6% male, Mean age 58 years	116	RCT, loss frame compared with gain frame invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups (invitation types). Secondary outcome measures of anxiety, self- perceived health and illness representation also did not differ between groups.	++
Hellénius 1998 <sup>24</sup>	Sweden	65% female, age range 20-60 years	490 4	Observational Cross sectional study, those screened as a result of	Impact of type of invitation on	Opportunistically screened participants showed higher CVD risk factors than letter invited	+



				opportunistic invitations compared with those responding to a letter invitation.	uptake and outcome	participants at baseline. Effectiveness of screening in lowering risk factors did not differ between the two groups.	
Jones 1993 <sup>25</sup>	Wales	53.4% female, mean age 42.5 years	254 2	Observational cross-sectional study, those not responding to initial invitations to screenings compared with those who did.	Differences between attenders and non-attenders	Non-attenders showed more risk factors than attenders.	+
Thomas 2002 <sup>26</sup>	England	100% male, Mean age 69.1 years,	565 5	Observational cross sectional study, Health characteristics of those who attended and did not attend a 20 year follow-up were compared.	Differences between attenders and non-attenders	Despite no differences at baseline in BMI and cholesterol, those who later dropped out of a longitudinal study had higher blood pressure at baseline and greater number of CVD and bronchial diagnoses, and	+

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

						adverse lifestyle factors (e.g. OR of smoking in non-attenders 2.33).	
--	--	--	--	--	--	---	--

Note. SIGN 50 cohort checklist used to assess study quality. ++ = High quality study, + = Acceptable, 0 = Unacceptable.

For peer review only

1  
2  
3  
4  
5  
6 Appendix 1. Search terms used in search strategy  
7  
8  
9  
10

11 The following terms were used in all data sources: (cardiovascular OR vascular OR  
12 CVD OR “chronic heart disease” OR “coronary heart disease” OR CHD OR diabetes)  
13 AND (“mass screening” OR surveillance\*) AND (letter OR mail\* OR phone OR  
14 telephone OR “reminder system\*” OR “videotape recording\*” OR “audiotape recording\*”  
15 OR questionnaire\* OR strateg\* OR alert\* OR hotline OR community OR media) AND  
16 (intervention\* OR goal OR “behav\* change” OR “implementation intention\*” OR plans  
17 OR planned OR planning OR plan OR educat\* OR campaign\* OR barriers OR  
18 intention\* OR “behav\* outcome” OR outcome OR “lifestyle change” OR longitudinal OR  
19 “follow up” OR motivation\*) AND (satisf\* OR dropout\* OR “drop out” OR attrition OR  
20 uptak\* OR adher\* OR compliance OR complie\* OR comply\* OR “patient acceptance of  
21 health care” OR encourag\* OR improve\* OR improving OR increas\* OR promot\* OR  
22 particip\* OR nonattend\* OR “non attend” OR accept\* OR attend\* OR attitud\* OR  
23 utilisation OR utilization OR refus\* OR respond\* OR respons\* OR reluctan\* OR  
24 nonrespon\* OR “non respon\*” OR incidence OR prevalence OR prevelence OR  
25 satisfaction OR cooperat\* OR “co operat\*”) AND (findings OR interview\* OR qualitative  
26 OR experienc\* OR RCT OR “randomised controlled trial” OR trial).  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

PRISMA checklist

**Table 1**

Checklist of items to include when reporting a systematic review or meta-analysis

Section/topic	Item No	Checklist item	Reported on page No
<b>Title Effectiveness and uptake of screening programmes for coronary heart disease and diabetes: A realist review of design components used in interventions</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both	Realist review, P2
<b>Abstract</b>			
Structured summary	2	Provide a structured summary including, as applicable, background, objectives, data sources, study eligibility criteria, participants, interventions, study appraisal and synthesis methods, results, limitations, conclusions and implications of key findings, systematic review registration number	2-3
<b>Introduction</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known	7-8
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)	8
<b>Methods</b>			
Protocol and	5	Indicate if a review protocol exists, if and where it can be accessed (such as web address), and, if available, provide registration information including	N/A

Section/topic	Item No	Checklist item	Reported on page No
registration		registration number	
Eligibility criteria	6	Specify study characteristics (such as PICOS, length of follow-up) and report characteristics (such as years considered, language, publication status) used as criteria for eligibility, giving rationale	10-11
Information sources	7	Describe all information sources (such as databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched	9-10
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated	Appendix 1, p46
Study selection	9	State the process for selecting studies (that is, screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)	10-11
Data collection process	10	Describe method of data extraction from reports (such as piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators	11-13
Data items	11	List and define all variables for which data were sought (such as PICOS, funding sources) and any assumptions and simplifications made	11-13
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis	13
Summary measures	13	State the principal summary measures (such as risk ratio, difference in means).	Table 39-43
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (such as $I^2$ statistic) for each meta-analysis	N/A

Section/topic	Item No	Checklist item	Reported on page No
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (such as publication bias, selective reporting within studies)	13
Additional analyses	16	Describe methods of additional analyses (such as sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified	N/A
<b>Results</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram	10, flow diagram in this supplementary file
Study characteristics	18	For each study, present characteristics for which data were extracted (such as study size, PICOS, follow-up period) and provide the citations	Table 1, pages 39-43
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see item 12).	Included in SIGN 50, see Table 1.
Results of individual studies	20	For all outcomes considered (benefits or harms), present for each study (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot	Table 1, 39-43, main findings presented, but standard summary data not possible
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see item 15)	29
Additional analysis	23	Give results of additional analyses, if done (such as sensitivity or subgroup analyses, meta-regression) (see item 16)	N/A

Section/topic	Item No	Checklist item	Reported on page No
<b>Discussion</b>			
Summary of evidence	24	Summarise the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (such as health care providers, users, and policy makers)	Summary boxes pp21,26,31 policy implications, p23
Limitations	25	Discuss limitations at study and outcome level (such as risk of bias), and at review level (such as incomplete retrieval of identified research, reporting bias)	5-6, 29
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research	30
<b>Funding</b>			
Funding	27	Describe sources of funding for the systematic review and other support (such as supply of data) and role of funders for the systematic review	32

1  
2  
3 **Effectiveness and uptake of screening programmes for coronary heart disease**  
4 **and diabetes: A realist review of design components used in interventions.**  
5  
6  
7

8  
9 Short title: Effectiveness and uptake of screening programmes  
10

11  
12 Carol Holland (Senior Lecturer), Yvonne Cooper (Research Associate), Rachel Shaw  
13  
14 (Senior lecturer), Helen Pattison (Professor), Richard Cooke (Senior lecturer).  
15  
16

17  
18 Health and Lifespan Psychology Group  
19

20  
21 School of Life & Health Sciences  
22

23  
24 Aston University  
25

26  
27 Birmingham  
28

29  
30 B4 7ET  
31

32  
33 UK  
34  
35  
36

37 **Corresponding author: C. Holland (email [c.holland1@aston.ac.uk](mailto:c.holland1@aston.ac.uk))**  
38

39  
40 The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all  
41 authors, an exclusive licence on a worldwide basis to the BMJ Publishing Group Ltd to permit this article (if  
42 accepted) to be published in BMJ editions and any other BMJ PGL products and sublicences such use and  
43 exploit all subsidiary rights, as set out in our licence.  
44  
45  
46  
47

48 **Word count (excl. abstract, summary, refs, table, boxes) (5938)**  
49

50  
51 **1 Table**  
52  
53  
54  
55  
56  
57  
58  
59  
60



## Abstract

### Objective

To evaluate behavioural components and strategies associated with increased uptake and effectiveness of screening for coronary heart disease (CHD) and diabetes, with an implementation science focus.

### Design

Realist review.

### Data sources

PubMed, Web of Knowledge, Cochrane Database of Systematic Reviews, Cochrane Controlled Trials Register and reference chaining. Searches limited to English language studies published since 1990.

### Eligibility criteria

Eligible studies evaluated interventions designed to increase uptake of CVD and diabetes screening and examined behavioural and/or strategic designs. Studies were excluded if they evaluated changes in risk factors or cost-effectiveness only.

### Results

In 12 eligible studies, several different intervention designs and evidence based strategies were evaluated. Salient themes were effects of feedback on behaviour change, or benefits of health dialogues over simple feedback. Studies provide mixed evidence about benefits of these intervention constituents which are suggested to be

1  
2  
3 situation and design specific, broadly supporting their use, but highlighting concerns  
4  
5 about fidelity of intervention delivery, raising implementation science issues.<sup>1,2</sup> Three  
6  
7  
8 studies examined effects of informed choice, or loss versus gain frame invitations,  
9  
10 finding no effect on screening uptake, but highlighting opportunistic screening as more  
11  
12 successful for recruiting higher CVD and diabetes risk patients than invitation letter, with  
13  
14 no differences in outcomes once recruited. Two studies examined differences between  
15  
16 attenders and non-attenders, finding higher risk factors amongst non-attenders, and  
17  
18 higher diagnosed CVD and diabetes amongst those who later dropped out of  
19  
20 longitudinal studies.  
21  
22  
23  
24

## 25 **Conclusions**

26  
27  
28 If risk and prevalence of these diseases are to be reduced, interventions must take into  
29  
30 account what we know about effective health behaviour change mechanisms, monitor  
31  
32 delivery by trained professionals, and examine the possibility of tailoring programmes  
33  
34 according to contexts such as risk level to reach those most in need. Further research is  
35  
36 needed to determine the best strategies for lifelong approaches to screening.  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## Article Summary

- 1) Article Focus: The primary objective of this realist review was to evaluate the impact on health and attendance outcomes of theoretically supported behaviour change features embedded within intervention designs of screening programmes targeting CHD and diabetes.
- A secondary objective was to evaluate factors predicting attendance and attrition from these programmes and appraise their impact, with implications for design in specific contexts.

## 2) Key Messages

- The benefits of a structured, motivational health dialogue, with feedback, are supported over simple screening and advice, where outcomes are measured long term. Structure of motivational health dialogues and the terms over which they are most successful needs further research
- However, the issue of intervention fidelity (adherence to intervention protocol by those delivering) has potential to differentiate between programmes that are or are not successful in getting patients to change health behaviour and as such represents a key implementation science component of the review.
- This review highlights the need for a more systematic approach to using the evidence base for strategic design, conduct and analysis of health interventions

1  
2  
3 by taking into account the complex interactions between design, delivery,  
4  
5 attrition, context and health outcomes.  
6  
7  
8  
9

### 10 3) Strengths and Limitations.

#### 11 Strengths:

- 12
- 13
- 14
- 15 • The study's strength is its focus on what contributes to success and reach of
- 16 screening plus intervention studies, based on health psychology evidence.
- 17
- 18
- 19
- 20 • Its evaluation of the degree and fidelity with which evidenced health behaviour
- 21 strategies are used has important implications for practitioners managing
- 22 screening and intervention programmes.
- 23
- 24
- 25
- 26
- 27 • Evaluation of opportunistic screening confirms previous work showing that it
- 28 reaches people with higher CVD risk factors than reached using standard
- 29 invitations, but additionally demonstrates that people screened opportunistically
- 30 show very similar improvements in assessed risk factors and behaviours to
- 31 people invited in other ways.
- 32
- 33
- 34
- 35
- 36
- 37
- 38
- 39
- 40

#### 41 Limitations:

- 42
- 43
- 44 • This review raised two key challenges. First, many studies do not analyse
- 45 behavioural components of the intervention design discretely, making it
- 46 impossible to discern which factors are at work in producing the observed effects.
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
- Publication or outcome bias may have affected our results, though not all included studies found significant reductions in assessed risk or differences in outcomes between intervention and control groups.
  - Several potentially relevant studies focusing on design of screening interventions were excluded because they were not delivered in healthcare settings.
  - Well-known selective drop out (“selective attrition”) biases are confirmed in these studies, whereby people with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments. Careful methodological and statistical controls are needed to reduce resultant effects on findings, but few studies employ these.
  - As a realist review, this document examines outcomes which may be situation specific. The acknowledgement that some findings that may be situation specific is important in generalisation of results.

## Introduction

Previous reviews of multiple risk factor interventions for primary prevention of coronary heart disease (CHD) and diabetes often conclude that interventions have no overall effect on mortality.<sup>3</sup> Nevertheless, CHD deaths have halved in the UK and other developed countries in the last 30 years.<sup>4</sup> Unal et al<sup>5</sup> compared targeted interventions and general population screening. They estimated the proportion of reduced deaths from CHD in England and Wales between 1981 and 2000 that were attributable to changes in risk factors in patients with CHD or changes in cardiovascular risk factors in the general population, and found both approaches beneficial. These authors calculated that reductions in risk factors (such as smoking, high blood pressure) in the general population account for 50-75% of the fall in cardiac deaths, and pharmacological and surgical treatments for diagnosed CHD patients account for 25-50%.<sup>5</sup> However, that benefit was greater when individuals without CHD were screened: results indicated an additional 21 years of life for each death prevented in those with no CHD diagnosis compared to 7.5 years for those with CHD.

Public health campaigns to reduce these conditions usually involve: government-sponsored programmes at the population level or changes in policy (such as food labelling legislation); targeted interventions for those at heightened risk (for example, moderate-intensity, low-impact exercise for those very overweight or with chronic conditions); or general population screening and intervention to reduce risk development in the healthy population and identify high risk people leading to specific referral for detected or previously untreated symptoms (for example, current NHS Health Check<sup>6</sup> programme).

1  
2  
3 This review focuses on quantitative evaluations of screening plus intervention  
4 programmes that target the general population to reduce incidence of CHD and  
5 diabetes. These conditions were selected because they are the focus of screening  
6 programmes in many countries and the negative outcomes of these conditions can be  
7 ameliorated by lifestyle behaviour change. Previous reviews have focussed on  
8 reductions in risk measurements, cost effectiveness, or years of life added.<sup>3</sup> In contrast,  
9 the primary objective of this review was to examine use of behaviour change features  
10 embedded within intervention designs of screening programmes targeting CHD and  
11 diabetes, and their impact on health outcomes. A secondary objective was to evaluate  
12 the factors predicting attendance and attrition from these programmes.  
13  
14

15 These objectives are not well-suited to systematic review and meta-analysis  
16 approaches, where the aim is to synthesise results across contexts to gain a sense of  
17 the pattern of results for studies conducted using similar methodologies. In contrast, the  
18 present paper is focused on questions around “how” and “why” behavioural features are  
19 incorporated into interventions, and how these features can contribute to the success of  
20 interventions. Therefore, we adopted a realist review, also called a meta-narrative  
21 approach. This approach was adopted to gain insights into the direction the evidence is  
22 pointing and the underlying theoretically driven concepts, behaviour change  
23 mechanisms, and barriers, that may combine to contribute to outcomes in population  
24 screening for CHD and diabetes.<sup>7</sup> Focus on the mechanisms and use of evidence  
25 based behaviour change strategies locate the review within an implementation science  
26 approach, given that “one of the most consistent findings from clinical and health  
27 services research is the failure to translate research into practice and policy” p1.<sup>2</sup>  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6 A realist methodology<sup>8</sup> is suited to areas where there is a diverse literature, which may  
7  
8 have a variety of methods, components and outcomes. This methodology is concerned  
9  
10 with explaining more fully the processes of interventions within the complexity of their  
11  
12 contexts, rather than focussing on simple cause and effect deterministic theories.

13  
14  
15 Realist reviews can “contribute to programme understandings even when the outcomes  
16  
17 are not rigidly defined at the outset of the review and have been characterised as a  
18  
19 theory-driven and interpretive approach to systematic reviews to answer questions  
20  
21 about what works, for whom and in what circumstances” p4.<sup>9</sup>  
22  
23

24  
25  
26 Inclusion of studies in a realist review is intended to be less proscribed than in a  
27  
28 systematic review to allow for a mix of methods and outcomes to be included, ensuring  
29  
30 that underlying theories and approaches can be evaluated rather than a focus on  
31  
32 specific measured outcomes.<sup>8</sup> Inclusion criteria in this review of screening plus  
33  
34 intervention studies were generated using guidance from systematic reviews on  
35  
36 screening (PRISMA),<sup>10</sup> but were further generated iteratively using the themes that  
37  
38 emerged. The flowchart and checklist are available as supplementary material.  
39  
40  
41

#### 42 43 **Data sources**

44  
45  
46 Web of Knowledge, PubMed, Cochrane Database of Systematic Reviews, Cochrane  
47  
48 Controlled Trials Register restricted to English language and published post 1990.

49  
50 Reference chaining of identified studies was then conducted.

#### 51 52 53 54 **Search strategy**



1  
2  
3 Search terms were adapted from previous Cochrane reviews of screening plus uptake  
4 studies.<sup>11,12</sup> The full strategy is available in Appendix 1. The search was first carried out  
5  
6  
7  
8 in July 2010 and updated in March 2013.  
9

## 10 11 **Study selection**

12  
13  
14 The initial inclusion criteria were: studies that tested interventions designed to increase  
15 uptake of CHD and diabetes screening programmes, or to increase early detection and  
16 prevention of these conditions *and* examined the behavioural and/or strategic design of  
17 the intervention tested. Studies which only reported on changes in risk factors or cost-  
18 effectiveness were excluded.  
19  
20  
21  
22  
23  
24  
25

26  
27 The initial search elicited 2323 relevant published papers. Retrieved papers were  
28 screened according to the inclusion criteria. Details of screening and exclusion stages  
29 are detailed in Figure 1 in the supplementary material.  
30  
31  
32

33  
34  
35 Following screening of titles, 565 relevant papers remained. Reference lists and  
36 citations of these papers were searched (using Pubmed and Web of Knowledge)  
37 specifically to identify studies that evaluated behavioural aspects of interventions tested;  
38 a pragmatic approach was taken to ensure that articles which may not have been found  
39 using such traditional chaining were not missed, in that new keywords elicited from  
40 themes of identified articles were added to the search, notably on specific behavioural  
41 approaches. An example was “informed choice invitation”. This process identified a  
42 further 16 articles. Following removal of duplicates across sources (120), and removal  
43 after abstract screening (304), two authors (CH, YC) independently reviewed 157 full  
44 text papers, and further excluded studies which only evaluated changes in risk factors  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 or cost-effectiveness. Further exclusions at abstract and full text stages were guided by  
4 framing of the interventions into their constituent components using PICO(T) categories  
5 (Population, Intervention, Comparison, Outcome and Type of study design). The review  
6 was concerned with general population (adult) screening, and so interventions that  
7 considered only those already identified as at high risk of CVD/Diabetes or already  
8 receiving treatment, younger or specific age or disease limited groups, were excluded.  
9  
10 Although initial reading included interventions in a variety of settings, the selection of the  
11 final set of papers restricted inclusion to studies set in primary health care in line with  
12 the aim of this review being to inform primary health care based interventions.  
13  
14 Comparison with a control group of some nature was necessary for inclusion, and  
15 although most of the identified studies did consist of Randomised or Cluster  
16 Randomised Control Trials, other designs were not excluded, and the relevant quality  
17 appraisal criteria for the different designs were used as appropriate (See Table 1).  
18  
19 Although most of the studies examined outcomes in terms of successful or unsuccessful  
20 lowering of CVD or diabetic risk, the intention of this review was to determine “how, why  
21 and what works” or what may prevent it working<sup>8</sup>, so outcome type was not restricted.  
22  
23 Preliminary examination of studies sought to extract dominant themes reflecting the  
24 behavioural features of the “how and why” such interventions succeed or fail in reducing  
25 CVD or Diabetic risk. Most studies examined the effect of a multi-component  
26 intervention, in which key features were engaging populations in screening, providing  
27 screened populations with feedback about risk status, a health dialogue (defined as  
28 counselling that includes aspects of shared decision making such as goal setting or  
29 intention formation, and is not just information giving or psychological support),  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 information about the impact of risk factors on illness development, counselling,  
4 motivational interviewing, referral, and pharmacological treatment. The impact of  
5 feedback and health dialogue on health outcomes was reported but due to the multiple  
6 constituents of interventions, isolating the effects of any one feature is often difficult.  
7  
8 Search for studies that focused on explicitly examining such features therefore  
9 developed. Twelve studies were left that fulfilled this requirement and met inclusion  
10 criteria. Details of the components covered by these papers, year of publication, details  
11 of the samples recruited, populations studied and main findings are presented in Table  
12 1. The selection process is summarized in a PRISMA flow diagram (supplementary  
13 materials).

## 24 25 26 27 28 **Data extraction**

29  
30  
31 Two reviewers (CH and YC) independently extracted information from each article, and  
32 one author (CH) reviewed all studies. Data were extracted on study authors,  
33 geographical location, year of publication, study cohort characteristics, behavioural  
34 design features of the intervention, and outcome measures (see Table 1).  
35  
36  
37  
38  
39

## 40 41 **Results**

### 42 43 44 **Study characteristics and quality**

45  
46  
47 The SIGN 50 assessment of quality of studies included is summarised in Table 1. Two  
48 authors (CH and RC) independently rated each included study for quality using the  
49 SIGN 50 guidelines,<sup>13</sup> with each study rated as either ++ = high quality, + = acceptable  
50 quality or 0 = low quality. After independent ratings the authors met to discuss their  
51 ratings. All disagreements were resolved via discussion. Seven studies were of  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 acceptable quality and five were high quality studies. The key elements of the studies  
4  
5 were summarised into Table 1, so that key themes and evidence from the papers could  
6  
7 be identified and extracted for examination.  
8  
9

10  
11  
12 The review of included papers begins by describing studies that addressed the question  
13  
14 of what impact behaviour change features embedded within intervention designs of  
15  
16 CVD and diabetes screening programmes have on health outcomes. The review then  
17  
18 proceeds to cover literature that evaluates the factors predicting attendance and attrition  
19  
20 from screening and intervention programmes.  
21  
22  
23

### 24 25 26 27 **Impact of feedback on behaviour change**

28  
29 Providing people with feedback on their behaviour can prompt behaviour change,<sup>14,15</sup>  
30  
31 and has been recognised as an effective behaviour change technique in Abraham and  
32  
33 Michie's behaviour change taxonomy.<sup>16,17</sup> In general, there are two types of feedback:  
34  
35 informing patients about their risk status, e.g. of CVD; and giving patients behaviour-  
36  
37 specific feedback, e.g. discussion related to detailed dietary analysis<sup>18</sup>, with a key point  
38  
39 of contention being the effectiveness and practicalities of these two approaches Two  
40  
41 studies examined the impact of feedback on behaviour change.  
42  
43  
44  
45

46  
47  
48 Aubin et al<sup>19</sup> investigated whether knowledge of blood cholesterol level affected  
49  
50 intention to adopt a low fat diet. The study was conducted in hospital-based family  
51  
52 medical centres in Quebec, Canada. Participants were randomly assigned to complete  
53  
54 a questionnaire about CVD risk profile, intention to adopt a low fat diet, and dietary fat  
55  
56  
57  
58  
59  
60

1  
2  
3 intake either before or after receiving their screening results, i.e. one group knew their  
4 results, and one did not at the time of completing the questionnaire. Patients who were  
5 aware of their blood screening results before they completed the questionnaire showed  
6 a significantly higher intention to adopt a lower fat diet than patients who were not ( $F_{1,417}$   
7 = 5.4,  $p < 0.02$ ). In addition, in those who had received their results, intention tended to  
8 rise with blood cholesterol level (non-significant,  $F_{5,413} = 2.0$ ,  $p < 0.08$ ).  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19

20 Three months after screening, participants' dietary fat intake and changes in eating  
21 habits were assessed by comparing diet with that reported at baseline. Data for 391  
22 participants (mean age = 35 years) were analysed. Mean dietary fat intake significantly  
23 reduced from 48.5g per day at baseline, to 37.7g per day at three month follow-up for  
24 the participant group as a whole. After three months, patients who had abnormal  
25 cholesterol levels had a significantly greater reduction in dietary fat intake than patients  
26 with normal cholesterol results ( $F_{(2,388)} = 3.6$ ,  $p = 0.03$ ); correlational analysis showed a  
27 highly significant link between reduction in fat intake and reduction in blood cholesterol  
28 (the researchers report an  $R^2$  of 0.5,  $p = 0.001$ , but confirmed by email that a Pearson's  
29 correlation was intended). This shows that patients who had higher blood cholesterol  
30 were more likely to make dietary changes. Although the method and analysis did not  
31 separate out people who were aware of their cholesterol levels in the longitudinal  
32 comparisons, the authors concluded that informing patients of their blood cholesterol  
33 levels effects an immediate change in dietary habits, and that over all, the change in  
34 dietary habits effects a reduction in fat intake and lower CVD risk.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Elton et al<sup>20</sup> used a workplace screening and intervention trial in Manchester, UK to  
4  
5 examine if knowledge of cholesterol level led to a reduction in cholesterol over a thirteen  
6  
7 week period. Participants were randomly allocated to either an intervention group that  
8  
9 received information on their current cholesterol level, or to a control group where this  
10  
11 information was not provided. Then all participants attended a health education session  
12  
13 about diet. The results demonstrated that the reduction in cholesterol measurements  
14  
15 thirteen weeks after baseline was greater in intervention participants with initially high  
16  
17 (>6.5mmol/l) serum cholesterol than in matched control participants (change of -0.29 for  
18  
19 intervention participants, 95% CI -0.48 to -0.11, but only a change of -0.01, 95% CI -  
20  
21 0.16 to +0.15 for controls, difference between groups reached significance at  $p < 0.024$ ).  
22  
23  
24  
25  
26  
27 A key difference between this and an earlier study<sup>18</sup> which had not shown an effect of  
28  
29 informing participants of their cholesterol level was that the interventions specifically  
30  
31 focussed on diet here, whereas the earlier study delivered a general health education  
32  
33 package.  
34  
35  
36

### 37 **Impact of health dialogue on behaviour change**

38  
39  
40 Five studies examined the role of health dialogue in influencing health outcomes of  
41  
42 screening interventions.<sup>21-25</sup> Färnkvist et al<sup>21</sup> investigated the extent to which health  
43  
44 screening with or without health dialogue influenced self-reported CVD and diabetes  
45  
46 morbidity 11 years post-screening. Participants were men aged 35-55 years in  
47  
48 Härnösand, Sweden. Screening included objective measurements (e.g. blood  
49  
50 pressure), a self-report questionnaire, and health counselling provided by nurses.  
51  
52  
53  
54 Although described alternately as health dialogue and counselling in this study, it did  
55  
56 actually consist of a structured motivational dialogue that included discussion of the  
57  
58  
59  
60

1  
2  
3 individual's CVD risk, and possible lifestyle changes, and hence fulfils our definition of a  
4 health dialogue. Other healthcare providers in the same community (mainly  
5 occupational health services; OHS) carried out the same screening but without the  
6 health dialogue.  
7  
8  
9  
10  
11  
12  
13

14  
15 Eleven years later participants were asked to complete a questionnaire including  
16 questions about smoking, alcohol, physical activity, height, weight, fat intake and the  
17 presence of CVD and/or diabetes. There was no significant decline in health during the  
18 11 years for those participants who received the screening plus health dialogue (8.2%  
19 incidence of CVD and/or diabetes), in stark contrast to those who received screening  
20 only (22.6% incidence) or no screening (19.2%). The odds ratios (OR) of developing  
21 CVD or diabetes over the 11 years was 2.5 for those who had screening with no health  
22 dialogue, and 3.0 for those who had not participated in either the original screening or  
23 the dialogue, as compared with the dialogue group. That is, the risk was more than  
24 doubled for any group who had not received the dialogue. The authors concluded that  
25 screening that includes a structured, motivational health dialogue is more effective than  
26 screening without this dialogue.  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45

46 Engberg et al<sup>22</sup> conducted a RCT in Denmark investigating the impact of general health  
47 screening versus screening plus GP-patient discussions about CVD risk profile.  
48 Randomly selected men aged 30-50 from several GP practices were sent an invitation  
49 letter and postal questionnaire about lifestyle. Those who agreed to take part completed  
50 a second questionnaire asking about their health, lifestyle, psychosocial status and life  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 events. Participants were randomised to a control group (questionnaire only, no  
4  
5 screening) or one of two intervention groups: screening only and screening plus health  
6  
7 discussions (time points not given). Participants in the health screening plus discussion  
8  
9 group were offered a 45-minute consultation with their GP to discuss their results and  
10  
11 how to adapt to a healthier lifestyle. They were encouraged to set their own topics for  
12  
13 discussion and to set health-related lifestyle goals to achieve within the next year.  
14  
15

16  
17 These participants were offered further discussions annually for five years.

18  
19 Randomisation to groups was stratified based on the GP to whom they were registered,  
20  
21 age, sex, BMI and "cohabitation status". All screened participants received personal  
22  
23 written feedback from their GPs, including advice on lifestyle change (where necessary)  
24  
25 and information leaflets about a healthy lifestyle. All participants were followed up at 1  
26  
27 and 5 years.  
28  
29  
30

31  
32 At the 5 year follow-up, there were no significant differences in measures of CVD risk  
33  
34 factors between the two intervention groups (screening only versus screening plus  
35  
36 discussion). Taken together, however, these two intervention groups had a much lower  
37  
38 proportion of patients with elevated CVD risk scores than the control group, whose  
39  
40 prevalence of elevated CVD risk was approximately twice that of the intervention groups  
41  
42 (RR = 0.54, 95% CI = 0.40-0.73). However, there were no significant differences  
43  
44 between the control and intervention groups for blood pressure, and no effects on  
45  
46 smoking. The authors concluded that though the intervention as a whole had a marked  
47  
48 effect on CVD risk, the discussions did not improve the cardiovascular health of  
49  
50 participants over and above the improvement shown from screening with feedback.  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



1  
2  
3 Rubak et al<sup>23</sup> examined the difference in patient outcomes (improved metabolic status in  
4 patients with diabetes) between those whose GPs had received training in motivational  
5 interviewing and those whose GPs had been allocated to a control group. Both groups  
6 of GPs received training in intensive treatment of Type 2 Diabetes. The study found that  
7 patients with GPs in both groups showed significant improvements, with no difference  
8 between the groups at one year follow-up. One explanation for the lack of difference  
9 found is that GPs in the motivational interview group had used an average of less than 2  
10 of the 3 motivational interview sessions allocated to them. The authors suggest that  
11 some contamination of effect may have occurred, in that the control group GPs also  
12 became aware of MI, and that the GPs in the motivational interview group did not use it  
13 as much as had been recommended.  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29

30 Koelewijn-van Loon et al<sup>24</sup> investigated differences between participants who had a  
31 structured dialogue with a trained nurse (including risk assessment, risk communication,  
32 motivational interview and a patient “decision support tool”) and patients who received  
33 usual care. Outcome measures were self-reported lifestyle behaviours, diet, exercise,  
34 smoking and alcohol use, which were measured 12 weeks after baseline to assess  
35 change. 522 patients completed the follow-up measures. The authors concluded that  
36 the results showed an improvement in lifestyle in both groups; there were no differences  
37 between groups in terms of effects.  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48

49 Craigie et al<sup>25</sup> examined the impact of a personalised lifestyle programme (HealthForce)  
50 aimed at promoting lifestyle behaviour change and based specifically on health  
51 behaviour change theory. HealthForce targeted motivational elements to create  
52 intentions to change behaviour and volitional elements, focussing on translating  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 intentions into planned behaviours. It involved patients attending three face-to-face  
4  
5 sessions with a trained lifestyle counsellor, plus other materials, with topics being  
6  
7 activity, diet and weight management. The outcome assessments all showed significant  
8  
9 positive changes for the intervention group (all  $p < 0.01$ ), with no positive, but some  
10  
11 negative changes for the control group. Consumption of 5 portions of fruit and  
12  
13 vegetables a day went from 56% to 85% for the intervention group; weight was down by  
14  
15 an average of 1.1kg, BMI went from a mean of 26.7 to 26.2kg/m<sup>2</sup> (with increases, rather  
16  
17 than decreases, for the control group,  $p < 0.01$ ) and waist circumference went from 87.3  
18  
19 to 84.0cm (no significant change for control group).  
20  
21  
22  
23  
24

25 The contrast between these five similar studies is striking; Färnkvist et al and Craigie et  
26  
27 al's analyses supported the impact of health dialogue, Engberg et al found that  
28  
29 screening plus verbal health dialogue was not superior to screening that included a  
30  
31 written dialogue, while Rubak et al and Koelewijn-van Loon et al found no effect.  
32  
33 However, the outcome measures, and time between measurements, vary across  
34  
35 studies; Färnkvist et al compared risk of CVD and diabetes diagnosis over 11 years,  
36  
37 Engberg et al assessed differences between groups in risk factors five years after initial  
38  
39 screening, Rubak et al tested metabolic status in patients with diabetes after one year,  
40  
41 Koelewijn-van Loon et al compared self-reports of lifestyle behaviours 12 weeks after  
42  
43 the intervention, and Craigie et al compared anthropometric and health behaviour  
44  
45 changes 12 weeks later. This raises a number of issues. First, endpoint diagnosis is the  
46  
47 most objective measure of the impact of intervention, and the strongest evidence of  
48  
49 efficacy. Second, in general, longer-term follow-ups are preferable, however selective  
50  
51 attrition could be a greater issue for longer-term follow-ups, biasing the sample.  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 Conversely, shorter-term follow-ups may not allow enough time for change to happen.  
4  
5 Finally, these studies, though conducted with similar samples, were run in four different  
6  
7 countries with subsequent differences in healthcare services and risk levels at baseline,  
8  
9 and so conclusions need to take into account the healthcare context when assessing  
10  
11 the mechanisms and outcomes.<sup>8</sup>  
12  
13

14  
15  
16 Of particular interest were the two studies (Craigie et al and Koelewijn-van Loon et al)  
17  
18 which both used self-reported behavioural outcomes and a 12 week follow-up and yet  
19  
20 had contradictory results. Both included face to face counselling on more than one  
21  
22 occasion, telephone support sessions, and motivational interview plus decision support  
23  
24 or goal setting. The most obvious difference is that patients in Craigie et al's study were  
25  
26 all pre-selected as high risk (but not on statins), whereas only 28% of those in  
27  
28 Koelewijn-van Loon et al's study were designated as high CVD risk. Indeed the latter  
29  
30 study did find a difference between intervention and control groups in fruit and  
31  
32 vegetable consumption when only those with diagnosed diabetes were included. As in  
33  
34 previous analyses, the difference seems to be due to the finding that those with higher  
35  
36 perceived risk are more likely to make appropriate changes to their health behaviour.  
37  
38 Again context is highlighted, but here in terms of the individuals one is trying to  
39  
40 influence.  
41  
42  
43  
44  
45  
46  
47

48 **Key points:**

49 **Providing patients with feedback on screened measurements can promote changes in**  
50 **behavioural intentions and actual health behaviour change.**

51 **The benefits of a structured, motivational health dialogue are supported over simple**  
52 **screening where outcomes are measured long term, but the actual structure of such**  
53 **dialogues has not been directly analysed in the literature.**

54 **The comparison of similar studies highlights the need for a set of basic standardised**  
55 **measures.**

56 **Comparisons suggest that longer term influences on disease occurrence need assessing.**

57 *For peer review only - <http://bmjopen.bmj.com/site/about/guidelines.xhtml>*

58 **Patients informed they are at high risk tend to make the most lifestyle changes and achieve**  
59 **the most positive outcomes**  
60

## Factors predicting uptake, attendance and attrition from screening programmes

### Uptake and invitation

For screening programmes to be cost-effective it is essential to maintain high levels of uptake, attendance and avoid excessive attrition. Research<sup>21</sup> has demonstrated that some groups, for example, the less healthy, are less likely to participate in screening programmes, and more likely to drop out if they do commence participation. Attempts have been made to encourage uptake of screening by manipulating the method of invitation: three studies examined the effect of invitation style on uptake and health outcome.<sup>27-29</sup>

Marteau et al<sup>27</sup> hypothesised that providing an informed choice leaflet lower attendance relative to standard invitations, because individuals receiving the leaflet would see that screening is unlikely to provide individual benefits. The authors found no difference in attendance rates between individuals who received an informed choice letter versus a standard letter, but they did replicate previous studies in finding that attendance fell with increasing social deprivation. There was no interaction between social deprivation and invitation type, however, the authors concluded that the ethical advantage gained in informed choice invitations did not outweigh the attendance benefit of standard invitations.

1  
2  
3 Park et al<sup>28</sup> investigated the effects of loss- and gain-framed messages in an invitation  
4 to screen for Type 2 diabetes. The loss frame message (“If you have diabetes but are  
5 not detected early, your diabetes may lead to more complications”) highlights the  
6 possible losses due to not attending; the gain frame message (“If your diabetes is  
7 detected early, you can receive early and more effective treatment”) emphasises the  
8 possible gains of attending. Participants, aged 40-69 years, were randomly selected  
9 from two GP practices in Cambridgeshire, England. Fifty-nine patients were randomised  
10 to receive the loss-framed invitation and 57 the gain-frame. All invitations included a  
11 neutral framed message (“A simple blood test is the best way to detect diabetes”).  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

27 There were no significant differences in attendance rates between groups (loss-frame =  
28 81% vs gain-frame = 82%). Overall, results show that how information was framed  
29 made little difference to attendance rates. There was, however, a significant interaction  
30 effect between sex and invitation frame; attendance was higher in men invited using the  
31 loss-frame (89%) compared to the gain-frame (77%), and higher in women invited using  
32 the gain-frame (94%) compared to the loss-frame (68%). Although this result should be  
33 viewed with caution because of the small numbers, it does suggest potential for using  
34 different frames for different patient groups.  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46

47 In addition to investigating the content and format of invitation letters, researchers have  
48 also examined the potential of opportunistic screening that is asking patients to  
49 complete screening while they are attending a healthcare setting for another purpose,  
50 such as collecting medication. Hellénus et al<sup>29</sup> investigated opportunistic screening on  
51 visits to a healthcare centre for other purposes in a suburban area of Sweden  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 (Sollentuna). Male and female adults under the age of 60 who visited health centres  
4  
5 were opportunistically invited to screening. This group was compared with a group who  
6  
7 were invited by letter. 59% of those invited by letter participated (249 people) compared  
8  
9 to 15% of the men and 20% of the women who were invited when they visited their  
10  
11 health centres (4655 people, the opportunistic sample). Frequency of hypertension, high  
12  
13 cholesterol, high triglycerides were greater in the opportunistic sample than the letter-  
14  
15 invited sample, but there were no differences in smoking or likelihood of being  
16  
17 overweight. Outcomes of the intervention showed significant blood pressure,  
18  
19 cholesterol, and triglyceride reductions, but no differences in the level of reductions in  
20  
21 risk factors between opportunistic and letter-invited participants. The authors concluded  
22  
23 that the integration of a large scale CVD risk screening programme into a regular  
24  
25 primary healthcare system was successful, and that, taking into account low uptake,  
26  
27 opportunistically screening patients was successful in identifying those with high CVD  
28  
29 risk factors whose risk factor level could be reduced.  
30  
31  
32  
33  
34  
35  
36

### 37 **Difference between attenders and non-attenders**

38  
39  
40 It has been noted that differences exist between individuals who attend screening and  
41  
42 those who do not<sup>26</sup> and our search strategy identified two papers on this topic. Jones et  
43  
44 al<sup>30</sup> recruited 3800 patients (aged 25-55 years) across six GP practices in Wales who  
45  
46 were invited for a CHD risk factor screening programme. 2402 (63.2%) attended for  
47  
48 screening, 1389 (36.8%) did not attend. A 1 in 10 random sample of 140 non-attenders  
49  
50 was obtained, using a further letter offering them a medical "MOT" with specific  
51  
52 reference made to heart disease and asking them to make an appointment any morning  
53  
54 or afternoon. (MOT is an annual car maintenance test which is legally required by the  
55  
56  
57  
58  
59  
60

1  
2  
3 Ministry of Transport for cars on UK public roads, a term which is very familiar in the  
4 UK.) After three weeks any persisting non-respondents were sent another letter  
5 including a specific appointment time, asking them to contact the surgery if this was not  
6 convenient. A final contact was made by telephone after a further three weeks, and the  
7 nurse visited the home for the appointment if necessary. This approach resulted in 98  
8 (70.0%) of the original non-attenders being screened. They were asked to indicate  
9 reasons for their initial non-attendance. Reasons (in order of frequency) were: invitation  
10 letter not received (36.7%); 'practical reasons' (26.5%); felt screening was unnecessary  
11 because they were feeling well (18.4%); already under medical care for CHD related  
12 issues (12.2%); already aware of having risk factors and so felt screening was  
13 unnecessary (10.2%); felt apathetic about screening (10.2%); afraid of screening  
14 (7.1%); forgot to attend appointment (4.1%).

15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33 Non-attenders were significantly older than attenders (mean age 42.6 years and 39.4  
34 years respectively;  $p < 0.001$ , 95% CI of difference 1.50, 4.88). They were more likely to  
35 have lower SES than attenders and more likely to have a personal history of CHD (12%  
36 versus 5.7%,  $p < 0.05$ ). In addition, mean BMI ( $p < 0.01$ ; 95% CI 0.84, 2.58), cholesterol  
37 ( $p < 0.01$ , 95% CI 0.26, 0.74), and blood pressure (systolic  $p < 0.001$ ; 95% CI 9.57, 15.86;  
38 diastolic  $p < 0.01$ ; 95% CI 1.63, 5.82) were significantly higher for non-attenders than  
39 attenders. These results show that those people most in need of healthcare are less  
40 likely to access it. However, it is also clear that approximately 22% of non-attenders did  
41 not attend because they were already under medical care for CHD issues or were  
42 already aware of their risk factors (no data for attenders), possibly influencing the  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 outcome differences between attenders and non-attenders, and potentially reducing the  
4 likelihood of these individuals responding to an invitation to screening.  
5  
6  
7

8  
9 A further issue of non-attendance is that of differences between people who continue in  
10 a programme once started, and those who drop out. Thomas et al<sup>31</sup> examined the  
11 characteristics of attenders and non-attenders at the 20-year follow-up screening in the  
12 British Regional Heart Study. The non-attenders referred to here were all people who  
13 had attended originally, but failed to return for re-assessment, i.e. had dropped out. A  
14 total of 7735 men took part in the original screening, and 4252 (77%) attended the  
15 follow-up. There were no significant differences at baseline in age, BMI and cholesterol  
16 between those who attended those who did not attend at the follow-up, but non-  
17 attenders at follow-up had higher baseline blood pressure. Questionnaire data on the  
18 non-attenders was available from 2-4 years before the invitation to the follow-up health  
19 check. This showed that they were more likely to have suffered stroke, peripheral  
20 vascular disease and bronchitis and that they were twice as likely to smoke cigarettes.  
21 Attenders were significantly more likely to be married, to own their own home, to have  
22 access to a car, and to be educated past the age of 16.  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42

43 Mortality rates within one year of follow-up were significantly higher among non-  
44 attenders than attenders (6.2% vs. 1.7%), though the majority of deaths were non CVD-  
45 related. Non-attenders who self-reported having poor or fair health and a disability were  
46 significantly less likely to attend for follow-up, as were participants who reported using  
47 four or more medications regularly. Furthermore non-attenders were shown to be taking  
48 multiple prescribed medications, report more disabling conditions, and had a high early  
49 mortality rate.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60



**Key points:**

**Informed choice invitations are preferable ethically and do not appear to reduce screening uptake**

**Framing of invitations to screen may affect attendance rates for men and women; where a screening invitation is gender specific, targeting may benefit from framing**

**Opportunistic screening at visits to GP surgeries for other purposes is shown to be effective**

- Evaluation of opportunistic screening confirms that it reaches people with higher CVD risk factors than reached using standard invitations.
- People screened opportunistically showed very similar improvements in assessed risk factors to people invited in other ways

**People who do not attend or who drop out at later stages may be different.**

- Differences between people who respond to invitations for screening and who do not are difficult to ascertain, but evidence suggests non-attenders have higher CVD risk factors.
- Selective drop out (“selective attrition”) biases longitudinal studies in that inevitably people who are less healthy, less well educated, of lower socio-economic status or with more lifestyle risk factors (smoking, higher alcohol consumption, overweight) are more likely to fail to return for follow-up appointments.
- Selective attrition may result in outcomes in longitudinal studies appearing more positive (overestimate of effect) because people who remain in the study are the healthier people
- Careful methodological and statistical controls are needed to reduce resultant effects on findings.

**Discussion**

This realist review focussed on use of evidence based design features of interventions which aimed to increase uptake of CVD and diabetes screening with a view to increasing early detection and reduction of risk factors for these diseases. Only 12 studies were identified that critically examined the intervention design and tested the efficacy of health behaviour change components, such as feedback, against health outcomes. Key findings include the following: health-related feedback or health dialogue can be effective, but in order to enable specific analyses, a working definition of what

1  
2  
3 this communication entails is required; whether individuals are invited for screening or  
4  
5 are screened opportunistically may influence the nature of participants recruited, with  
6  
7 those at higher risk less likely to respond to an invitation; and selective attrition of those  
8  
9 at higher risk may be skewing results of longitudinal studies because it is the healthier,  
10  
11 lower risk patients who are most likely to attend for follow-up.  
12  
13

### 14 15 16 **Impact of behavioural features on quality and outcome of interventions** 17

18  
19 It is clear from the studies reviewed that consideration of evidenced behavioural  
20  
21 features of interventions is limited; in particular, several large UK studies<sup>(26,32,33)</sup> were  
22  
23 excluded from the review at an early stage in the search process because they did not  
24  
25 examine any design, behavioural or psychological features of screening or intervention.  
26  
27 Nevertheless, the studies included in the review indicate several strategies that could be  
28  
29 usefully employed to reduce risk in high risk and general population targets, such as  
30  
31 providing opportunistic screening. There was a lack of evidence that intervention design  
32  
33 was based on health psychology theory (e.g., Ajzen's theory of planned behaviour,<sup>34</sup>  
34  
35 despite research showing that such theories can predict screening attendance,<sup>35</sup> and  
36  
37 lifestyle behaviours that are the target of screening interventions.<sup>36</sup> Even studies that  
38  
39 claimed to be based on theories and target motivation<sup>25</sup> failed to specify the theory base  
40  
41 for their intervention. This lack of emphasis on health psychology theories suggests a  
42  
43 greater focus on the outcome of the intervention (i.e., did people change their  
44  
45 behaviour?) rather than a focus on the motivations and perspectives of the individuals  
46  
47 invited to screen. This 'one-size fits all' approach to intervention design is unlikely to  
48  
49 yield success as research shows that even in a sample of 10 participants not all of them  
50  
51 respond positively to the same interventions.<sup>37</sup> Although there was limited use of  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 health psychology theories in the design of the interventions included in this review,  
4  
5 several interventions included elements such as the influence of health dialogue, goal  
6  
7 setting and feedback, which have been shown to promote health behaviour change,<sup>38,39</sup>  
8  
9 although much of this research has been conducted outside of primary care settings.  
10  
11 Therefore, it was encouraging to find that goal setting promoted changes in outcomes in  
12  
13 Craigie et al and that feedback was helpful in Aubin et al and Elton et al. These  
14  
15 elements require further examination with reference to a behaviour change taxonomy  
16  
17 e.g., Abraham and Michie's,<sup>16</sup> to determine whether they are effective within the context  
18  
19 of CVD and diabetes screening programmes. Relatedly, an issue highlighted by our  
20  
21 evaluation of a CVD screening intervention in the UK,<sup>40</sup> is the extent to which healthcare  
22  
23 practitioners use the strategies and tools with which they have been provided in the  
24  
25 health dialogues they have with their patients. This issue of intervention fidelity has the  
26  
27 potential to differentiate between programmes that are successful in getting patients to  
28  
29 change their behaviour and programmes that are not,<sup>41</sup> and is evident in Rubak et al<sup>23</sup>  
30  
31 who found that GPs failed to deliver, on average, more than one session of motivational  
32  
33 interview to patients, when they were facilitated to deliver three. CERAG's definition of  
34  
35 implementation research: "the scientific study of methods to promote the systematic  
36  
37 uptake of clinical research findings and other evidence-based practices in routine  
38  
39 practice, and hence to improve the quality (effectiveness, reliability, safety,  
40  
41 appropriateness, equity, efficiency) of healthcare" (cited in Eccles et al.<sup>1</sup>) sets this study  
42  
43 firmly in the context of implementation science.  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55

## 56 **Study limitations**

57  
58  
59  
60

1  
2  
3 This review raised two key challenges. First, studies rarely analyse behavioural  
4 components of the intervention design discretely, making it impossible to discern which  
5 factors are at work in producing the observed effects. Second, the heterogeneity of  
6 outcome measures precludes statistical evaluations using meta-analysis. Publication or  
7 outcome bias may have affected our results, though not all included studies found  
8 significant reductions in assessed risk or differences in outcomes between intervention  
9 and control groups. Several potentially relevant studies that focus on the design of  
10 screening interventions were excluded because they were not delivered in healthcare  
11 settings. The reviewed studies also highlight the disadvantages of Intention-To-Treat  
12 analyses, which are better suited for assessing the efficacy of an intervention in practice  
13 as opposed to understanding “how” and “why” and intervention works, and the need to  
14 control for selective attrition either by use of features which reduce drop out or by  
15 statistical control for known differences between returners and non-returners, but few  
16 studies employ this. As a realist review, this document examines outcomes which may  
17 be situation specific. The acknowledgement that some findings that may be situation or  
18 population specific is important in generalisation of results.  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40

## 41 **Conclusions and policy implications**

42  
43  
44  
45 This review highlights the need for a more systematic approach to the strategic design,  
46 conduct and analysis of health interventions by taking into account the complex  
47 interactions between design, delivery, attrition and health outcomes. It is recommended  
48 that insights from health psychology should be incorporated in the design of  
49 interventions aimed at increasing screening uptake, as well as involving cross-  
50 disciplinary specialist areas such as physical activity and nutrition to promote lifestyle  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 behaviour change alongside pharmacological treatment. Furthermore, to control the  
4 effects of selective attrition, there is a need to perform sensitivity analyses in order to  
5 monitor the make-up of the sample and perhaps some purposive sampling to protect  
6 against biasing the sample toward a healthier baseline and therefore reduced effect at  
7 follow-up, particularly in longitudinal studies. It is anticipated that such carefully  
8 designed interventions would result in health behaviour change that provide as much  
9 benefit to the wider population as they do for those with heightened risk, resulting in  
10 better overall population outcomes.  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**What is already known on this topic**

**Previous reviews have raised concerns about the cost effectiveness of CVD and diabetes screening interventions.**

- Some researchers have instead recommended replacement of screening programmes with pharmacological interventions alone, (e.g. prescription of statins to everyone aged 55 or older<sup>42</sup>).
- Other work has illustrated that health behaviour change and intervention effectiveness can significantly reduce CVD risk, controlling for effects of pharmacological intervention.
- Some features of intervention style, and of populations, often result in less than optimum risk reduction.

**What this study adds**

- **The study confirms the need for and success of strategies that encourage higher risk patients to become and stay involved in screening and intervention programmes, such as opportunistic screening.**
- Careful training and monitoring of the use of evidenced behaviour change strategies in improving the reach and success of interventions is needed.
- Ethically supported invitation styles such as fully informed choice do not reduce participation or effect outcome.
- Clear feedback and targeted intervention on specific risk factors or behaviours is supported, whereas general lifestyle advice is less effective.
- Structure of motivational health dialogues and the terms over which they are most successful needs further research.

**Contributorship statement:**

CH, RS, HP, and RC were responsible for the conception and design of the study. YC had principal responsibility for search and sourcing of articles and initial data extraction, and RC contributed to reference chaining. Two authors (CH, YC) independently reviewed the 157 full text papers retrieved, and further excluded studies which only evaluated changes in risk factors or cost-effectiveness. CH and RC assigned quality scores to each included full-text article based on the Scottish Intercollegiate Guidelines Network (SIGN 50) quality assessment instruments. CH had principal responsibility for data extraction, analysis and interpretation of the data and for drafting the article,

1  
2  
3 revisions, and final approval. RS, HP, and RC contributed to interpretation of the data,  
4  
5 revisions and final article approval. CH and RC are the guarantors.  
6  
7  
8  
9  
10

11  
12 Funding: This study is a sub-section of a larger review which was commissioned by  
13  
14 Heart of Birmingham teaching and Primary Care Trust, which funded YC as a Research  
15  
16 Associate as part of a larger research project. CH, HP, RC and RS are all members of  
17  
18 the Health and Lifespan Psychology Research group working at Aston University. The  
19  
20 funders had no role in design of this review, the data collection, analysis, and  
21  
22 interpretation, writing the manuscript, or the decision to submit the research for  
23  
24 publication.  
25  
26  
27  
28  
29

### 30 **Competing interest statement**

31  
32  
33 All authors have completed the Unified Competing Interest form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf)  
34  
35 (available on request from the corresponding author) and declare: no support from any organisation for  
36  
37 the submitted work other than that outlined under "Funding" above; no other financial relationships  
38  
39 with any organisations that might have an interest in the submitted work in the previous 3 years ; no  
40  
41 other relationships or activities that could appear to have influenced the submitted work .  
42  
43  
44  
45

46 **Ethical approval:** Not required.  
47  
48

49 **Data sharing:** No additional data available.  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

## References

1. Eccles, M P, Armstrong, A, Baker R, Cleary, K, et al. An implementation research agenda *Implementation Science* 2009, 4:18 doi:10.1186/1748-5908-4-18
2. Grimshaw, J.M., Eccles, M.P., Lavis, J.N., Hill, S J, Squires, J.E. Knowledge translation of research findings, *Implementation Science*, 2012, 7:50.
3. Ebrahim S, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. *Cochrane Database of Systematic Reviews* 2006; (4): CD001561.
4. Allender S, Peto V, Scarborough P, Kaur A, Rayner, M. *Coronary heart disease statistics*. British Heart Foundation: London, 2008.
5. Unal B, Critchley J A, Capewell, S. Modelling the decline in coronary heart disease deaths in England and Wales, 1981 – 2000: comparing contributions from primary prevention and secondary prevention. *BMJ* 2005; 331: 614-9.
6. NHS Health Check programme. 2012. <http://www.healthcheck.nhs.uk/> .
7. Petticrew M. “More research needed”. Plugging gaps in the evidence base on health inequalities. *Eur J Public Health* 2007, 17:5; 411-413.
8. Pawson R, et al; Realist review – a new method of systematic review designed for complex policy interventions. *J Health Services Research and Policy* 2005, 10 (Suppl 1): 21-34.
9. McMahon T, Ward P R. HIV among immigrants living in high-income countries: a realist review of evidence to guide targeted approaches to



- 1  
2  
3 behavioural HIV prevention *Systematic reviews* 1: 56 DOI: 10.1186/2046-  
4 4053-1-: 2012 )  
5  
6  
7
- 8 10. Moher D, Liberati A, Tetzlaff J, Altman DG. for the PRISMA group. Preferred  
9 reporting items for systematic reviews and meta-analyses: the PRISMA  
10 statement. *BMJ* 2009;339: 332-6.  
11  
12  
13
- 14 11. Flight IHK, Wilson CL, Griffiths L, Myers, RE. Interventions for improving  
15 uptake of population-based screening for colorectal cancer using fecal occult  
16 blood testing. *Cochrane Database of Systematic Reviews* 2004; (4):  
17 CD005035.  
18  
19  
20  
21  
22  
23
- 24 12. Forbes C A, Jepson RG, Martin-Hirsch PPL. Interventions targeted at women  
25 to encourage the uptake of cervical screening. *Cochrane Database of*  
26 *Systematic Reviews*, 2002; (3): CD002834  
27  
28  
29  
30  
31
- 32 13. Scottish Intercollegiate Guidelines Network (SIGN 50) methodology  
33 checklists. Circa 2001-2013, updated 15/04/13,  
34 <http://www.sign.ac.uk/guidelines/fulltext/50/checklist3.html>  
35  
36  
37  
38
- 39 14. Shahab L, Hall S, Marteau T. Showing smokers with vascular disease images  
40 of their arteries to motivate cessation: A pilot study. *Br J Health Psychol*  
41 2007;12: 275-83.  
42  
43  
44  
45
- 46 15. Shahab L, West R, McNeill A. A randomized, controlled trial of adding expired  
47 carbon monoxide feedback to brief stop smoking advice: Evaluation of  
48 cognitive and behavioral effects. *Health Psychol* 2011; 30: 49-57.  
49  
50  
51  
52
- 53 16. Abraham C, Michie S. A taxonomy of behaviour change techniques used in  
54 interventions. *Health Psychol* 2008; 27: 379-87.  
55  
56  
57  
58  
59  
60

- 1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60
17. Michie S, Ashford S, Sniehotta FF, Dombrowski SU, Bishop A, French DP. A refined taxonomy of behaviour change techniques to help people change their physical activity and health eating behaviours: The CALO-RE taxonomy. *Psychol Health*, 2011; 26: 1479-98.
18. Robertson I, Phillips A, Mant D. Motivational effect of cholesterol measurement in general practice health checks. *Br J Gen Pract* 1992; 42: 469-472.
19. Aubin M, Godin G, Vézina L, Maziade J, Desharnais R. Hypercholesterolemia screening. Does knowledge of blood cholesterol level affect dietary fat intake? *Canadian Family Physician* 1998; 44: 1289-97.
20. Elton PJ, Hammer M, Page F. Randomised controlled trial in northern England of the effect of a person knowing their own serum cholesterol concentration. *J Epidemiol Community Health* 1994; 48: 22-5.
21. Färnkvist L, Olofsson N, Weinehall L. Did a health dialogue matter? Self-reported cardiovascular disease and diabetes 11 years after health screening. *Scand J Prim Health Care* 2008; 26: 135-9.
22. Engberg M, Christensen B, Karlsmose B, Lous J, Lauritzen T. General health screenings to improve cardiovascular risk profiles: a randomised controlled trial in general practice with 5-year follow-up. *J Fam Pract* 2002; 51; 546-52.
23. Rubak S, Sandbaek A, Lauritzen T, Borch-Johnsen K, Christensen B. Effect of "motivational interviewing" on quality of care measures in screen detected

- 1  
2  
3 type 2 diabetes patients: A one year follow-up of and RCT, ADDITION  
4  
5 Denmark. *Scand J Prim Health Care* 2011; 29: 92-8.  
6  
7  
8 24. Koelewijn-van Loo, MS, van der Weijden T, Ronda G, van Steenkiste B,  
9  
10 Winkens B, Elwyn G, et al. Improving lifestyle and risk perception through  
11  
12 patient involvement in nurse-led cardiovascular risk management: a cluster-  
13  
14 randomised controlled trial in primary care. *Prev Med* 2010; 50: 35-44.  
15  
16  
17 25. Craigie AM, Barton KL, Macleod M, Williams B, van Teijlingen E. A feasibility  
18  
19 study of a personalised lifestyle programme (Healthforce) for individuals who  
20  
21 have participated in cardiovascular screening. *Prev Med* 2011, 52: 387-9.  
22  
23  
24 26. Wood DA, Kinmonth AL, Davies GA, Yarwood J, Thompson SD, Pyke SDM,  
25  
26 et al. Randomised controlled trial evaluating cardiovascular screening and  
27  
28 intervention in general practice: principal results of British family heart study.  
29  
30 *BMJ* 1994; 308:313-20.  
31  
32  
33 27. Marteau TM, Mann E, Prevost AT, Vasconcelos JC, Kellar I, Sanderson S,  
34  
35 Parker M, et al. Impact of an informed choice invitation on uptake of  
36  
37 screening for diabetes in primary care (DICISION): randomised trial. *BMJ*  
38  
39 2010; 340: c2138.  
40  
41  
42 28. Park P, Simmons RK, Prevost AT, Griffin SJ. A randomized evaluation of  
43  
44 loss and gain frames in an invitation to screening for Type 2 diabetes: Effects  
45  
46 on attendance, anxiety and self-rated health. *J Health Psychol* 2010; 15: 196-  
47  
48 204.  
49  
50  
51 29. Hellénus M L, Johansson J, de Faire U, Elofsson S, Krakau I. Four years'  
52  
53 experience of cardiovascular opportunistic screening and prevention  
54  
55  
56  
57  
58  
59  
60

- 1  
2  
3 programme in the primary health care in Sollentuna, Sweden. *Scand J Prim*  
4  
5 *Health Care* 1999; 17: 111-5.  
6  
7  
8 30. Jones A, Cronin P A, Bowen M. Comparison of risk factors for coronary  
9  
10 heart disease among attenders and non-attenders at a screening programme.  
11  
12 *Br J Gen Pract* 1993; 43:375-7.  
13  
14  
15 31. Thomas MC, Walker M, Lennon L T, Thomson A G, Lampe FC, Shaper AG,  
16  
17 et al. Non-attendance at re-examination 20 years after screening in the  
18  
19 British Regional Heart Study. *J Public Health Med* 2002; 24:285-91.  
20  
21  
22 32. Muir J, Lancaster T, Jones L. The Imperial Cancer Research Fund  
23  
24 OXCHECK Study Group . Effectiveness of health checks conducted by  
25  
26 nurses in primary care: final results from the OXCHECK study. *BMJ* 1995;  
27  
28 310: 1099-104.  
29  
30  
31 33. Muir J, Mant D, Jones L, Yudkin P. Effectiveness of health checks conducted  
32  
33 by nurses in primary care: results of the OXCHECK study. *BMJ* 1994; 308:  
34  
35 308-12.  
36  
37  
38 34. Ajzen I. The theory of planned behavior. *Organisational Behaviour and*  
39  
40 *Human Decision Processes* 1991; 5: 179-211.  
41  
42  
43 35. Cooke R, French P. How well do the theory of reasoned action and theory of  
44  
45 planned behaviour predict screening attendance? A meta-analysis.  
46  
47 *Psychology & Health*, 2008; 23: 745-765.  
48  
49  
50 36. McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of  
51  
52 health-related behaviours within the theory of planned behaviour: A meta-  
53  
54 analysis. *Health Psychology Review* 2011; 5: 97-144.  
55  
56  
57  
58  
59  
60

- 1  
2  
3 37. Sniehotta FF, Pesseau J, Hobbs N, Araújo-Soares V. Testing self-regulation  
4 interventions to increase walking using factorial randomised N-of-1 trials.  
5  
6 *Health Psychology* 2012; 31: 733  
7  
8  
9
- 10 38. Gollwitzer PM, Sheeran P. Implementation intentions and goal achievement:  
11 a meta-analysis of effects and processes. In Zanna, M.P. (Ed.) *Advances in*  
12 *Experimental Social Psychology*; 2006: 39, Academic Press, New York, 69-  
13 119.  
14  
15  
16  
17  
18  
19
- 20 39. Gill J, & O'May F. Practical demonstration of personal daily consumption  
21 limits: A useful intervention tool to promote responsible drinking among UK  
22 adults? *Alcohol and Alcoholism*; 2007: 42, 436-441.  
23  
24  
25  
26
- 27 40. Shaw R, Cooke R, Holland C, Cooper Y, Dahdah M, Pattison H. (under  
28 review). Be SMART and follow the protocol: lessons learned from an  
29 evaluation of the NHS Health Check, *Soc Sci Med*.  
30  
31  
32  
33
- 34 41. Borrelli B, Sepinwall D, Ernst D, Bellg AJ, Czajkowski S, Breger R, et al. A  
35 new tool to assess treatment fidelity and evaluation of treatment fidelity  
36 across 10 years of health behaviour research. *J Consult Clin Psychol* 2005;  
37 73: 852-8.  
38  
39  
40  
41  
42
- 43 42. Wald NJ, Simmonds M, Morris JK. Screening for Future Cardiovascular  
44 Disease Using Age Alone Compared with Multiple Risk Factors and Age.  
45  
46 *PLoS ONE* 2011;6(5): e18742. doi:10.1371/journal.pone.0018742.  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Table 1. Included Studies

Study	Country	Sample	N	Design	Intervention Component	Main findings	Quality
Aubin 1998 <sup>14</sup>	Canada	58% female, mean age 35 years	391	RCT, controls completed questionnaire on intention to eat a low fat diet before they received results of cholesterol screening, intervention participants completed it after	Impact of feedback on behaviour change	Intervention participants were more likely to intend to adopt a low fat diet than controls. Patients with abnormally high cholesterol ( $\geq 6.3\text{mmol/L}$ ) showed a greater reduction in dietary fat intake than those who had a normal cholesterol ( $<5.2\text{mmol/L}$ )	+
Elton 1994 <sup>15</sup>	England	44% female, mean age 37.9 years	469	Prospective, blinded RCT, Intervention participants knew their cholesterol level before the health education	Impact of feedback on behaviour change	Participants whose initial serum cholesterol was $\geq 6.5\text{mmol/L}$ and who had been informed of this, showed a significantly greater	++

				and diet session, control participants did not.		reduction in serum cholesterol than control participants in the same high cholesterol group who had not been informed. All participants received the same dietary advice.	
Färnkvist 2008 <sup>16</sup>	Sweden	100% male, age stratified, aged 66, 56 and 46 years.	817	Cross-sectional study. Screening only, Screening plus health dialogue by trained professionals, and non-participants compared.	Benefits of health dialogue over simple feedback	Odds ratios of developing diabetes or CVD over 11 years were 2.5 for those had received screening with no health dialogue and 3.0 for those who had not participated in the original screening, as compared with those who had received screening plus a structured, motivational health dialogue.	+

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

Engberg 2002 <sup>17</sup>	Denmark	52% female, Mean age 40.4 years	150 7	RCT, Screening, screening plus health dialogue compared with normal care control group.	Benefits of health dialogue over simple feedback	After 5 years there were no differences between the two intervention groups Total intervention/control Risk Ratio was 0.54. Absolute risk reduction 8.6%.	++
Rubak 2011 <sup>18</sup>	Denmark	42% female, Mean age 61 years. Patients with screen detected type 2 diabetes	628	Cluster RCT, Intervention and control groups received training in intensive treatment of Diabetes, intervention group GPs additionally received training in Motivational Interviewing (MI) and instructed to use it.	Benefits of health dialogue over simple feedback	No effect of motivational interview on medication adherence or metabolic status in relative to control group. Medication adherence across both groups almost 100%, both groups showed significant improvements in all risk measures. Key issues were lower than planned use of motivational interview by intervention group GPs, and contamination of	++



						methods and training into control group GPs.	
Koelewijn -van Loon 2010 <sup>19</sup>	Netherlan ds	55% female, Mean age 57 years	615	Cluster RCT, Intervention nurses received training to use risk assessment, communication, a decision support tool and MI. Control group nurses received training on risk assessment and applied usual care.	Benefits of health dialogue over simple feedback	Outcome measures were self- reported lifestyle measures. No differences between control and intervention groups noted at 12 week follow up, but overall both groups showed improvements.	+
Craigie 2011 <sup>20</sup>	Scotland	72% female, Mean age 54.5 years, high risk but not on statins.	75	RCT, Intervention – motivational interview and volitional aspects to change planned behaviour, Control group usual care.	Benefits of health dialogue over simple feedback	Percentage achieving 5 portions of fruit and vegetables a day, and weight maintenance or loss indicators were significantly better in the intervention group over the 12 week follow up. Control group	+

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

						made no positive change.	
Marteau 2010 <sup>22</sup>	England	47.6 % female, mean age 57.4 years	127 2	RCT, informed choice invitation compared with standard invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups Secondary outcome of intention to change health behaviour was unaffected by invitation type.	++
Park 2010 <sup>23</sup>	England	66.6% male, Mean age 58 years	116	RCT, loss frame compared with gain frame invitation.	Impact of type of invitation on uptake and outcome	Primary outcome of attendance did not differ between groups (invitation types). Secondary outcome measures of anxiety, self- perceived health and illness representation also did not differ between groups.	++
Hellénius 1998 <sup>24</sup>	Sweden	65% female, age range 20-60 years	490 4	Observational Cross sectional study, those screened as a result of	Impact of type of invitation on	Opportunistically screened participants showed higher CVD risk factors than letter invited	+

				opportunistic invitations compared with those responding to a letter invitation.	uptake and outcome	participants at baseline. Effectiveness of screening in lowering risk factors did not differ between the two groups.	
Jones 1993 <sup>25</sup>	Wales	53.4% female, mean age 42.5 years	254 2	Observational cross-sectional study, those not responding to initial invitations to screenings compared with those who did.	Differences between attenders and non-attenders	Non-attenders showed more risk factors than attenders.	+
Thomas 2002 <sup>26</sup>	England	100% male, Mean age 69.1 years,	565 5	Observational cross sectional study, Health characteristics of those who attended and did not attend a 20 year follow-up were compared.	Differences between attenders and non-attenders	Despite no differences at baseline in BMI and cholesterol, those who later dropped out of a longitudinal study had higher blood pressure at baseline and greater number of CVD and bronchial diagnoses, and	+

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

						adverse lifestyle factors (e.g. OR of smoking in non-attenders 2.33).	
--	--	--	--	--	--	---	--

For peer review only

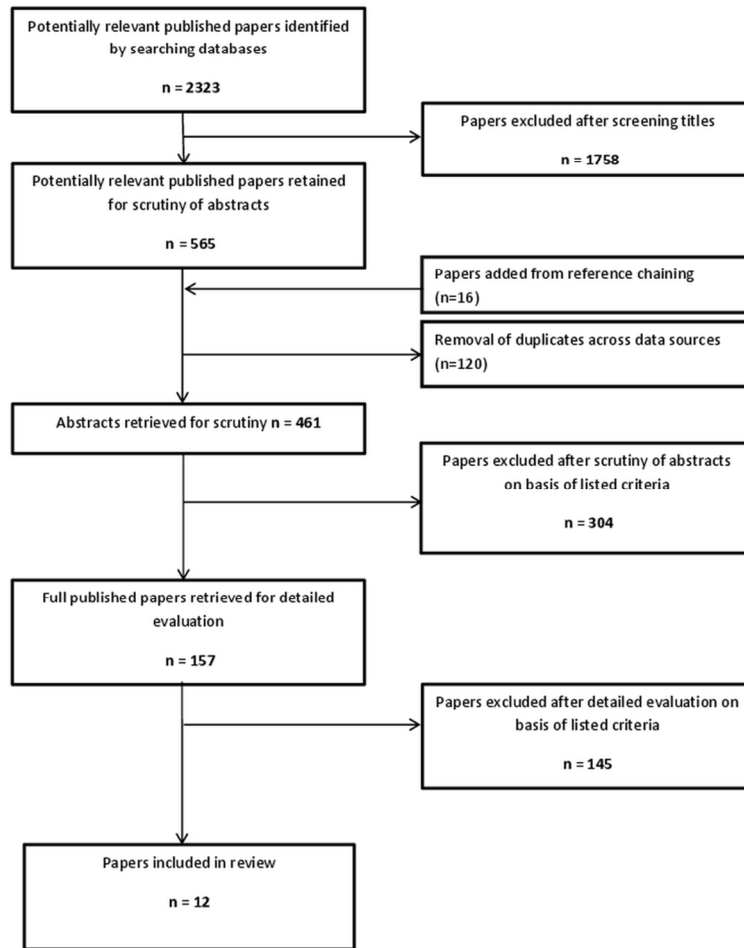
Note. SIGN 50 cohort checklist used to assess study quality. ++ = High quality study, + = Acceptable, 0 = Unacceptable.

1  
2  
3  
4  
5  
6 Appendix 1. Search terms used in search strategy  
7  
8  
9  
10

11 The following terms were used in all data sources: (cardiovascular OR vascular OR  
12 CVD OR “chronic heart disease” OR “coronary heart disease” OR CHD OR diabetes)  
13 AND (“mass screening” OR surveillance\*) AND (letter OR mail\* OR phone OR  
14 telephone OR “reminder system\*” OR “videotape recording\*” OR “audiotape recording\*”  
15 OR questionnaire\* OR strateg\* OR alert\* OR hotline OR community OR media) AND  
16 (intervention\* OR goal OR “behav\* change” OR “implementation intention\*” OR plans  
17 OR planned OR planning OR plan OR educat\* OR campaign\* OR barriers OR  
18 intention\* OR “behav\* outcome” OR outcome OR “lifestyle change” OR longitudinal OR  
19 “follow up” OR motivation\*) AND (satisf\* OR dropout\* OR “drop out” OR attrition OR  
20 uptak\* OR adher\* OR compliance OR complie\* OR comply\* OR “patient acceptance of  
21 health care” OR encourag\* OR improve\* OR improving OR increas\* OR promot\* OR  
22 particip\* OR nonattend\* OR “non attend” OR accept\* OR attend\* OR attitud\* OR  
23 utilisation OR utilization OR refus\* OR respond\* OR respons\* OR reluctan\* OR  
24 nonrespon\* OR “non respon\*” OR incidence OR prevalence OR prevelence OR  
25 satisfaction OR cooperat\* OR “co operat\*”) AND (findings OR interview\* OR qualitative  
26 OR experienc\* OR RCT OR “randomised controlled trial” OR trial).  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Figure 1 Flow chart of intervention studies included and excluded from this review



90x116mm (300 x 300 DPI)