QQUIP Quest for Quality and Improved Performance

Healthcare delivery models for prevention of cardiovascular disease (CVD)

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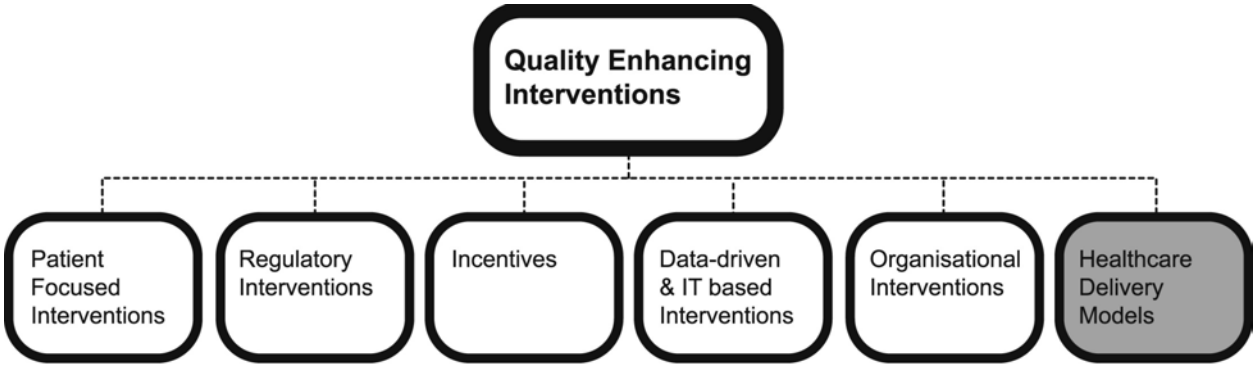
RTI International

The Health Foundation

QQUIP and the Quality Enhancing Interventions project

QQUIP (Quest for Quality and Improved Performance) is a five-year research initiative of The Health Foundation. QQUIP provides independent reports on a wide range of data about the quality of healthcare in the UK. It draws on the international evidence base to produce information on where healthcare resources are currently being spent, whether they provide value for money and how interventions in the UK and around the world have been used to improve healthcare quality.

The Quality Enhancing Interventions component of the QQUIP initiative provides a series of structured evidence-based reviews of the effectiveness of a wide range of interventions designed to improve the quality of healthcare. The six main categories of Quality Enhancing Interventions for which evidence will be reviewed are shown below.



For more information visit www.health.org.uk/qquip

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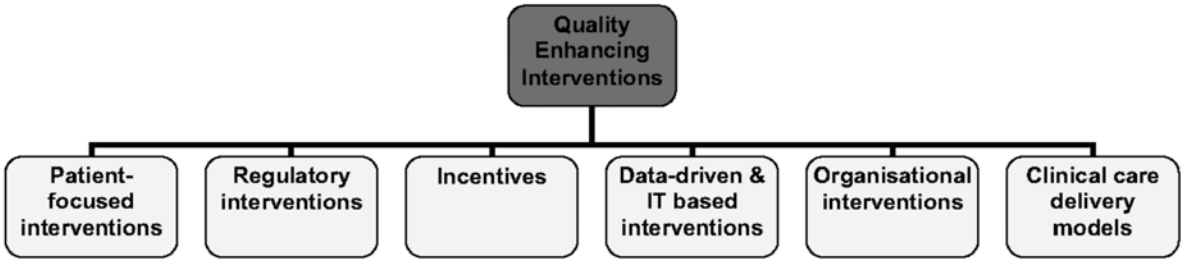
Contents

Executive summary

What works to improve quality in healthcare is a perennial question. Health services research, clinical medicine and social science literature all contain a sizeable number of studies that report on interventions designed to improve quality. The interventions vary widely in terms of design, underlying assumptions and the context in which they have been implemented. However, although the number of publications that discuss quality improvement is large and ever increasing, the empirical evidence about the effects such interventions have on healthcare processes and outcomes is sparse and difficult to access. The Quality Enhancing Interventions (QEI) project seeks to address these difficulties, and it will gather available evidence on a range of interventions designed to improve quality of care (see Figure 1).

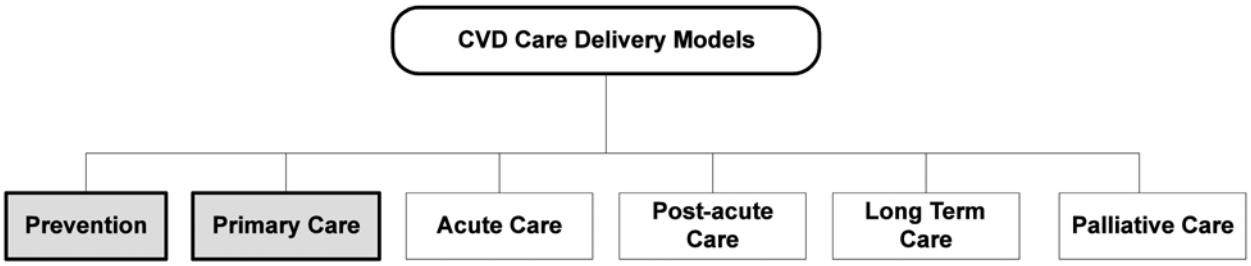
Figure 1: Quality Enhancing Interventions: Major themes



Our findings will form the basis of a searchable resource that will allow decision-makers to find relevant research evidence on particular interventions to improve quality and the context in which these interventions have been implemented. In addition, this resource will allow access to information on different approaches applied to a particular disease or population group.

Within each of the major themes, we develop sub-categories and clusters of specific interventions, building a taxonomy of QEIs. Figure 2 illustrates this for the clinical care delivery models and highlights the focus topics for this report.

Figure 2: Continuum of healthcare delivery



Clinical care delivery models vary for different diseases. Effective care processes will reflect the predisposing factors, the cause (aetiology), course and consequences of a particular disease, as well as available therapy options and their cost. Depending on the nature of the disease, care may most appropriately be delivered in primary, emergency or palliative care settings. It may be focused to different extents on prevention as well as management or cure; it may be characterised by an acute episode or by chronic symptoms. Figure 2 shows the main types of healthcare delivery settings (note that they are not mutually exclusive). For each of the clinical conditions on which we focus, we use the schematic shown to indicate the relative concentration of care processes within these settings. For this

review, care for cardiovascular disease is focused within two settings: prevention and primary care. Two earlier reports focused on acute care and post-acute care (Bernard, Brody, & Lohr, 2007a, 2007b).

Methods

We used a 'best evidence' approach to conduct our literature review. We focused primarily on evidence from review articles and guidelines issued by national professional organisations. We conducted electronic searches of MEDLINE®, focusing on articles classified as 'review' articles and included systematic evidence reviews issued by the Cochrane Collaboration. We conducted our searches using a series of steps to identify articles related to the following four main topic areas: cardiovascular disease prevention, health systems, healthcare quality and healthcare outcomes. The review includes a range of research designs: systematic reviews, randomised controlled trials (RCTs) and quasi-experimental and observational studies. We adopted broad inclusion criteria because of the methodological challenges inherent in assessing organisation and delivery models for chronic illness in general and stroke in particular.

Findings

Table A summarises the evidence.

Table A: Summary of evidence – Healthcare delivery models for cardiovascular disease

Area of focus	Summary of evidence
Screening and assessment of risk for CVD	• Evidence is strong that screening for cardiovascular disease (CVD) by general practitioners (GPs) is an effective way to identify unknown cases of patients with cardiovascular disease. • Primary care practices are able to implement sustainable office systems to provide preventive care services when using multimethod approaches; these include using triggers or reminder tools and having a dedicated staff member to coordinate prevention activities. • Some evidence suggests that in GP practices where multimethod systems are not available simple tools, such as family histories, acute events or a checklist, can be effective reminders that promote CVD screening. • There is some evidence that questions the accuracy of CVD risk assessment for individuals at high or low risk. • Evidence is mixed regarding the usefulness of a CVD risk score to improve patient outcomes. • Training and education of physicians and nurses in the general practice office who are involved in identifying, monitoring and providing risk reduction interventions related to CVD can promote the use of prevention practices.

Area of focus	Summary of evidence
Health promotion efforts to decrease CVD risk	• Good evidence supports health promotion interventions by non-physicians in the primary care setting. • Good evidence supports the use of provider reminder systems in conjunction with provider education about counselling patients to quit smoking. • Some evidence suggests that physician prescriptions for exercise increase physical activity among sedentary adults. • Some evidence supports the use of multifaceted interventions that include components such as improvement of nutrition education, prescriptions for aerobic and strength training exercises, behaviour modification training, self-study materials, tailored dietary prescriptions, and group or supervised exercise to prevent overweight and obesity among adults in workplace settings. • Evidence is mixed about the effectiveness of smoking cessation programmes in the workplace: a. some evidence supports use of tobacco bans to reduce cigarette smoking at the workplace during the day; however, the evidence does not support the effect of a workplace ban on total smoking rates b. some evidence supports the use of individual counselling and nicotine replacement therapy to help smoking cessation c. no evidence supports the effectiveness of multifaceted programmes that target smoking when used in conjunction with other CVD prevention. • Some evidence suggests that health information campaigns and targeted programmes, including those using community organisations, can increase knowledge and awareness of CVD prevention activities.
Health promotion efforts to decrease CVD risk (cont'd)	• Some evidence supports the use of a variety of physical activity interventions, in mixed settings, to increase physical activity and measured cardio-respiratory fitness. • There is good evidence to support the use of multistrategies, including individual or group counselling, environmental changes and incentives, to promote increased fruit and vegetable consumption among people with CVD risk. • There is some evidence that tailored self-help materials for individual smokers are effective and may increase quit rates. • Some evidence supports the positive effect of policy and environmental interventions that promote access to healthy food and access to information related to health behaviours.

Area of focus	Summary of evidence
Early interventions to reduce CVD risk among high-risk individuals	• While there is limited evidence of successful interventions to increase adherence to medication regimens to treat hyperlipidaemia, there is not enough evidence to recommend a specific intervention to increase patient use of lipid-lowering drugs (LLDs). • There is evidence to show that GP practices can use simple tools such as problem lists and flow sheets to address CVD risk reduction among high-risk patients. • There is some evidence to suggest that patient decision aids can help in the decision to initiate antihypertensive therapy but do not impact on the long-term effects on blood pressure or CVD risk. • There is evidence to support the use of single and multifaceted interventions to target primary and secondary CVD prevention risk factors, morbidity and mortality. • There is no good evidence to demonstrate that dietician advice produces better outcomes than self-help resources or nurses for cholesterol management among individuals with hyperlipidaemia. • There is little evidence to support the effectiveness of physician advice on the participation in physical activity by individuals with high risk for CVD. • While there are multiple strategies used to improve identification and control of hypertension, there is no good evidence for a specific strategy to use across settings due to the mixed quality of available evidence. • There is strong evidence to support the role of pharmacy-based (pharmacist-based) interventions in improving cholesterol management among patients at high risk for CVD. • Home blood pressure measurement by the patient is an effective and accurate means of monitoring and controlling blood pressure. • There is good evidence that counselling and referrals by public health staff can lower blood pressure in hypertensives and improve nutritional intake behaviours in those with hypercholesteraemia.

1 Introduction and methods

Cardiovascular disease (CVD), a term usually used to refer to conditions related to atherosclerosis (arterial disease) that include coronary heart disease (CHD) and stroke, is a leading cause of premature death in the United Kingdom (UK) and a major cause of morbidity and disability (Kelly, Frost, Whittaker, & Summerbell, 2004). CVD-related conditions contribute to one in three deaths each year and cost the economy annually an estimated £25.8 billion (DH Coronary Heart Disease Policy Team, 2007; Gemmell *et al*., 2006). Many risk factors are associated with CVD; some are non-modifiable risk factors that contribute to disease onset, including age (being older), sex (being male), family history and ethnicity. Other contributing factors are a consequence of lifestyle and can be modified or potentially reversed. These include smoking, elevated total or low density lipoprotein cholesterol (LDL-C) levels (labelled 'cholesterol' in the remainder of this report), obesity, high blood pressure, sedentary lifestyle and poor diet.

Guidelines for preventing CVD and managing risk factors are well established. However, many people at risk are not adequately identified and not effectively treated (Department of Health, 1999, 2000). This report focuses on healthcare delivery processes that address the prevention and management of modifiable CVD risk factors. It is important to note that, throughout this report, the terms 'cardiovascular disease' (CVD) and 'coronary heart disease' (CHD) are used interchangeably, often depending on whether the literature is from the UK or the United States of America (USA).

Background

CVD has been identified as a priority area for health improvement for the National Health Service (NHS) (Boyle, 2004; Department of Health, 2000), Wales ("Plan for Wales 2001. Improving Health and Care Services," 2001)` and Scotland (The Scottish Government, 2002). When the NHS announced its intention to modernise all aspects of care and treatment (Schwamm *et al*., 2006), the priority focused on dealing with England's biggest killers, including CVD-related conditions such as CHD and stroke. The National Service Framework for Coronary Heart Disease became the blueprint for tackling heart disease and setting out the standards and services that should be available throughout England (Department of Health, 2000). UK prevalence data on coronary heart disease for 2006–2007 show a national rate of 3.6 per cent (White, 2008). More recently the Prime Minister Gordon Brown allocated funding for a new national programme in which cardiovascular screening (as well as screening for diabetes, renal and stroke conditions) will be made available to everyone in the NHS (National Health Service, 2007).

Prevention and control of CVD conditions, such as hypertension, are essential to national strategies concerned with CVD. For that reason, the Faculty of Public Health and the National Heart Forum (NHF) produced *Easing the Pressure: Tackling hypertension* (Maryon-Davis & Press, 2005), a toolkit for local health improvement partnerships to enable them to develop effective strategies for hypertension prevention, detection and control.

The white paper, *Saving Lives: Our healthier nation,* was released in 1999 and outlined a government action plan aimed at tackling poor health, particularly for those who fare worst in society. The plan aims to reduce deaths caused by the four main killers: cancer, CHD and strokes, accidents and mental illness. Aggressive goals were set for CHD including reducing the CVD death rate for people under 75 by 40% since 1996 (Boyle, 2004). CVD mortality is decreasing at a rate exceeding goals set by the target, largely as a result of improved acute care and secondary prevention interventions after a CVD event. However, according to the results from the 2006 Health Survey for England prevalence is actually increasing

because more people are surviving CVD events (Roth 2008).[1] By contrast, the incidence of CVD is stable (Pearson, 2007). This finding supports the need to focus on preventing CVD and decreasing risk in the population.

Gemmell *et al* (2006) constructed a model to estimate the impact on the prevalence of CVD events of reducing cardiovascular risk among the population of England. Events included deaths due to CVD, acute myocardial infarctions (AMI) and strokes. The authors evaluated the effect of several interventions on the incidence of CVD events during a one-year period, using the following variables: population size, incidence of CVD events (for example, AMI), proportion of the population with each risk factor, relative risk of AMI associated with each risk factor and risk reduction associated with various interventions. The models showed that 73,522 CVD events could be prevented in England each year if CVD framework targets were met for smoking, physical activity, overweight, poor diet, high blood pressure and high cholesterol. Reducing cholesterol levels of all people to 6.5mmol/l or lower would prevent 59,680 CVD events; decreasing the percentage of the population with high systolic blood pressure (SBP) by 50 per cent would prevent 18,105 CVD events.

An action plan was developed to encourage physical activity among all UK residents, with a goal of increasing physical activity so that at least 50 per cent of all people conduct at least 30 minutes of activity on 5 days a week by 2010 (Department of Health, 2005). The plan includes specific objectives to support this increase in physical activity:

- facilitate understanding of the connections between activity and better health
- provide information about opportunities to be active
- establish sport programmes
- develop and maintain facilities for walking and cycling
- increase access to public spaces and countryside
- support health professionals to increase provision of routine and opportunistic advice to patients about physical activity
- establish services to provide long-term support of behaviour changes
- educate employers about ways to promote physical activity among employees.

Another NHS initiative in 2000 was the establishment of rapid access chest clinics to improve the time it took to get a cardiac diagnosis. Generally staffed by specialty-trained nurses, these clinics operate on a daily or weekly basis and serve as referral centres for patients with suspected cardiovascular problems. Prior to the implementation of these clinics, patients typically waited more than a year for outpatient assessments. Now, over 95 per cent of newly referred individuals who are served at these clinics are assessed within 2 weeks. Due to better case finding, the number of referrals for cardiac assessments has risen from 66,000 to 110,000 per quarter (Boyle, 2007).

The Department of Health programme, Putting Prevention First, launched in 2008, will build on the success of the National Service Frameworks by focusing on primary prevention of vascular disease starting earlier in life. The Department will work with stakeholders to create a universal risk assessment and management programme. Patients can use the results from this vascular assessment to proactively improve their health. (Department of Health, 2008)[2]

1 Roth M, Mindell J. Chapter 2 Cardiovascular Disease. In Health Survey for England 2006. Volume I Cardiovascular disease and risk factors in adults. National Centre for Social Research. Accessed from http://www.ic.nhs.uk/webfiles/publications/HSE06/HSE%2006%20report%20VOL%201%20v2.pdf 11/09/2008

2 Department of Health Vascular Programme, Putting prevention first. Vascular checks: risk assessment and management, April 2008. Accessed from www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_083822 11/9/2008.

In an effort to reduce health inequalities the NHS is employing other service delivery models that take place at the local level. Life Check is a recently developed initiative that makes use of health trainers who work with individual patients to assess their key risk factors, set personal goals for improving their overall health and point them to local services. This is part of the Prime Minister's Small Change, Big Difference initiative, which encourages people to take 'small, manageable steps towards a healthier lifestyle' (Rae, 2006).

By focusing on risk assessment and prevention this report has particular relevance to the standards espoused by CHD National Service Framework (Department of Health, 2000). The National Service Framework asserted that:

- the NHS and partner agencies should develop, implement and monitor policies which reduce the prevalence of coronary risk factors in the population and inequalities in risks of developing heart disease
- the NHS and partner agencies should contribute to a reduction in the prevalence of smoking in the local population
- general practitioners (GPs) and primary healthcare teams should identify all people who have significant risk of cardiovascular disease but have not developed symptoms and offer them appropriate advice and treatment to reduce their risks.

The annual reward and incentive programme of the Quality and Outcomes Framework (QOF) of the NHS provides bonus payments to GPs in return for recording/reporting disease prevalence and implementing high-quality clinical care for patients with chronic diseases. The QOF focuses on hypertension, not on overall primary CVD prevention with indicators for dyslipidaemia or smoking, nor on global risk, which would include age and sex criteria. Currently, the programme tracks the following quality indicators for patients with CHD:

- practice maintains a registry of patients at risk for or diagnosed with CVD
- (for those newly diagnosed with angina) referred for exercise testing and/or specialist assessment
- record of blood pressure measurement in the previous 15 months and last measure was 150/90 or less
- record of total cholesterol measurement in the previous 15 months and last measure was 5mmol/l or less
- record in the previous 15 months that aspirin, an alternative antiplatelet therapy, or an anticoagulant is being taken (unless a contraindication or side-effects are recorded)
- record that patient is currently treated with a beta blocker (unless a contraindication or side-effects are recorded)
- (for those with a history of myocardial infarction) treated with an ACE inhibitor or angiotensin II antagonist.

In addition, the QOF is monitoring the percentage of patients with CHD and hypertension, diabetes and other conditions whose records contain notations that smoking cessation advice or referral to a specialist service, where available, has been offered within the previous 15 months.

Gaps between guidelines and practice

Several key practice-related problems reflect less than adequate conformity with current ideas of appropriate practice patterns and procedures, including provider non-compliance with clinical guidelines. Interventions are needed to educate physicians about current guidelines and support physicians in their efforts to provide CVD prevention services. Patient non-compliance is also a problem. Patients may find it difficult to make lifestyle changes (for example, in their diets, patterns of exercise, tobacco use and so on) or may deliberately choose not to adhere to such advice. In addition, they may not be able to adhere to various medication regimens.

Service models for CVD prevention and early treatment

Major advances have been made during the past several decades in CVD prevention and risk-factor management. Nevertheless, obstacles remain to ensuring that scientific advances are consistently translated into effective clinical practice. In this review we focus primarily on three areas related to the organisation and delivery of services to prevent CVD:

- screening and assessment of risk for CVD
- health promotion efforts to decrease CVD risk that encourage patients to:
    - decrease smoking
    - increase healthy eating
    - increase physical activity
    - prevent high blood pressure
    - prevent elevated cholesterol levels
- early intervention to reduce CVD risk among high-risk individuals, including individuals who are obese, have hypertension or have high cholesterol levels.

For each of these three categories, we review interventions conducted in three settings: GP office, workplace and community.

Methods

The organisation and delivery of healthcare services are complex concepts that are challenging to define; the delivery system includes a variety of personnel, processes and infrastructure elements. Neither the organisation nor the delivery of healthcare is well indexed in existing reference databases of medical literature, such as MEDLINE®. Therefore, our strategy relied on using a variety of terms to find literature containing evidence of effective models of healthcare delivery and community support for preventing CVD.

Literature search strategy

We used a ‘best evidence’ approach to conduct our literature review, focusing primarily on evidence from review articles, RCTs and guidelines issued by national professional organisations. With respect to databases, we conducted electronic searches of MEDLINE®, focusing on articles classified as ‘review’ or ‘RCT’ articles; we included systematic evidence reviews issued by the Cochrane Collaboration (labelled as Cochrane Reviews in the text); and we searched CINAHL® (for materials more directly related to nursing and allied health). We limited our searches to articles in English published since 1998 that focused on adults aged 19 and older.

Article selection and review

Two project team members independently reviewed article titles and abstracts for approximately 1,300 articles. Based on the title/abstract reviews, we retained approximately 240 articles obtained electronically or by interlibrary loan. After independently reviewing these articles, the report authors selected 40 as meeting inclusion criteria, abstracted their findings and included them in this review.

Because medical literature databases do not index the healthcare delivery literature comprehensively, discretely or intuitively, our search strategy evolved during the project. We implemented an iterative process to identify relevant studies to inform models of healthcare service delivery for CVD prevention. We began by using lengthy search strings to identify all articles related to CVD prevention and (a) health systems, (b) manpower and (c) risk factors for CVD (Table 1).

Table 1: Initial search strategy to identify literature related to healthcare delivery for cardiovascular disease prevention

Search strategy
Cardiovascular disease prevention Cardiovascular diseases/epidemiology OR cardiovascular diseases/prevention and control OR coronary disease/prevention and control
Health systems Disease management OR national health programs OR community health planning OR community health services OR community networks OR delivery of health care OR center of excellence OR regionalisation OR regionalization OR referral management OR triage OR case management OR organizational case studies OR risk management OR service lines OR program evaluation OR regional health planning OR emergency treatment OR emergency medical services OR emergency service, hospital OR emergency medicine OR timeliness OR rehabilitation
Outcomes Health status OR outcome assessment health care OR mortality OR hospital mortality OR ambulatory care sensitive conditions OR morbidity OR complications OR sentinel surveillance OR fatal outcome OR self care OR activities of daily living OR outcome
Manpower Health personnel OR manpower OR health manpower OR health care facilities, manpower and services
Risk factors Smoking OR obesity OR diet OR exercise OR risk OR drug OR hypertension
Limitations English, publication date (1998+, last 5 years, last 3 years), adult, core clinical journals, review articles

In all, we reviewed approximately 1,300 article titles and abstracts. Appendix 1 contains specific search strategies and results.The initial search strategy revealed that the literature for CVD prevention is voluminous, and therefore we implemented a series of strategies to try to identify the most relevant and timely articles about the topic. For example, the health systems search (see #10 in the Cardiovascular Prevention Search in Appendix 1) yielded 9,443 articles, so we restricted the search to those articles found in the 'core clinical journals', a subset of the most respected peer-reviewed journals.[3] In addition, the initial CVD risk factors search (see #18 in the same search) yielded 59,197 citations, which was

3 See the website www.nlm.nih.gov/bsd/aim.html for a list of journals included in the 'core clinical journals'.

reduced to 16,473 when limited to core clinical journals. We further limited this search to articles published within the past 3 years indexed with CVD as a major heading.

This sequential approach yielded 669 title abstracts for review. We obtained full article text for further review for approximately 10 per cent of these citations. Following these steps, we executed several more search strategies to find additional articles about delivery systems for CVD prevention.

Because we were interested in identifying activities related to surveillance, risk assessment and health promotion among individuals without CVD risk factors as well as among those with CVD risk factors (referred to as 'early intervention' in this report) in three different settings (that is, GP office, workplace and community), we created a matrix of nine cells that paired each activity with each setting. We conducted nine corresponding literature searches (for example, risk assessment and GP office, health promotion and community and so on). We also searched for articles that MEDLINE® classified as systematic literature reviews. Further, we identified a recent health policy article (Pearson, 2007) about CVD prevention and reviewed the 31 citations that the MEDLINE® 'related articles' feature generated.

The quality of the evidence reviewed was generally acceptable. Many of the major issues in CVD prevention and early intervention were the topic of systematic literature reviews published by the Cochrane Collaboration; however, several of these publications focused on evidence related to treatment per se rather than delivery systems. We searched for assessments of the quality of other review articles included in the Database of Abstracts of Reviews of Effects published by the Centre for Reviews and Dissemination (CRD). Throughout this report, we note whether the CRD evaluated the reviews and, as appropriate, report the findings of these evaluations.

Because research that tests healthcare delivery models is often done with designs other than those used for RCTs, we discuss findings from reviews that included a variety of study designs, that is, RCTs, observational studies or both. Most review articles documented literature search strategies and inclusion and exclusion criteria. Several review articles employed multiple independent reviewers and grading systems to characterise the quality of the studies reviewed.

2 Healthcare delivery models for the prevention of CVD

Guidelines for CVD prevention are available in abundance. The challenge is to develop system-wide methods for the delivery of primary prevention services; these should encompass screening patients, assessing their individual risk, creating health promotion campaigns targeted at changing behaviours to mitigate risk and performing early interventions targeted at those with known risk. Efficient and effective means of identifying high-risk individuals and then providing the support that will enable them to modify their lifestyles to reduce risk requires a delivery system that is organised to place priority on preventive services rather than focusing solely on treatment.

In this report we present evidence on healthcare delivery models for CVD that encompass three main settings: GP offices, workplaces and the community. The evidence targets primary and secondary CVD risk identification and management. The evidence addresses screening and risk assessment, health promotion efforts and early intervention to reduce risk among high-risk individuals.

CVD screening and risk assessment

The American Heart Association, the Joint British Societies (JBS),[4] the Scotland Intercollegiate Guidelines Network (SIGN), and the European Society of Cardiology have published guidelines for screening and risk assessment for CVD. The US Preventive Services Task Force (USPSTF) has also issued reports specific to blood pressure screening and screening for lipid disorders, two important risk factors for CVD. More recently, the National Institute for Health and Clinical Excellence (NICE) guidance has addressed CVD prevention.

Screening guidelines generally focus on individuals between the ages of 20 and 40 years, whereas risk assessment guidance targets those aged 40 and older. Overall, screening provides an opportunity to educate people about risk factors for CVD. Every routine physical examination provides an opportunity to obtain information about health behaviours related to CVD risk, such as smoking, eating habits, alcohol consumption and physical activity, as well as family history of CVD. Indicators – such as pulse, blood pressure, body mass index (BMI) and waist circumference – need to be monitored routinely. Lipid levels should be evaluated every five years (or every two years if risk factors are present) (Petersen, Wright, Peterson, & Daley, 2002). The JBS guidelines recommend that screening for CVD among adults under 40 should be limited to those individuals who have a strong family history of CHD or stroke in early life; this generally means coronary disease in male first-degree relatives younger than age 55 or in female first-degree relatives younger than age 65 (British Cardiac Society *et al*., 2005). Other groups, such as SIGN, recommend that CVD risk assessment be conducted at least every 5 years among adults aged 40 and older (Pearson, 2002; Schwamm *et al*., 2006).

The preferred arena for conducting CVD risk assessment, according to the JBS, is the GP's office (British Cardiac Society *et al*., 2005). JBS guidelines also emphasise the importance of estimating global lifetime risk for CVD for several reasons: CVD is the result of multiple risk factors, these risk factors tend to cluster and coexistent risk factors often have a mutliplicative effect on CVD risk.

Table 2 shows that guidelines from Britain, Scotland, Europe and the USA contain similar factors to include in CVD risk assessment. All guidelines recommend consideration of age, sex, smoking status, SBP, high density lipoprotein cholesterol (HDL-C) and total cholesterol (British Cardiac Society *et al*., 2005; De Backer *et al*., 2004; Mosca, 2007; Pearson, 2002; Schwamm *et al*., 2006).

4 The Joint British Societies include the following organisations: British Cardiac Society, British Hypertension Society, Diabetes UK, HEART UK, Primary Care Cardiovascular Society and The Stroke Association.

Three of the four guidelines in Table 2 recommend measurement of BMI, waist circumference and glucose to assess CVD risk.

Table 2: Recommendations for factors to be included in CVD risk assessment

Risk factor	Joint British Societies (2005)	SIGN (2007)	European Society of Cardiology (2003)	American Heart Association (2002; 2007)
Age	●	●	●	●
Sex	●	●	●	●
Smoking status	●	●	●	●
SBP	●	●	●	●
Total cholesterol	●	●	●	●
HDL-C	●	●	●	●
Body mass index and/or weight	●	●		●
Waist circumference	●	●		●
Glucose	●	●		●
Diabetes			●	
Ethnicity	●			
Socioeconomic status		●		
Renal function		●		
Fasting lipoproteins				●
Symptoms of CVD				●

The US and British guidelines recommend calculating the global risk score to evaluate CVD risk based on results from the Framingham study, whereas the Scottish and European guidelines offer alternatives to this risk model. Specifically, the 2007 JBS guidelines acknowledge that alternative algorithms for risk score calculations have been developed since 1998; however, these algorithms do not offer CVD risk scores of significantly greater validity than those of the Framingham model to justify a change because the Framingham approach is widely used in the UK (British Cardiac Society *et al*., 2005).

In contrast, the Scottish guidelines note that the Framingham model excludes obesity, physical activity, family history of cardiovascular disease and social status, which are important factors related to CVD risk. Further, inclusion of family history could help account for ethnic differences in CVD risk.Therefore, the Scottish guidelines recommend using the ASSIGN score (that is, assessing cardiovascular risk using SIGN guidelines) (Schwamm *et al*., 2006), although it is important to note that ASSIGN also does not include obesity or physical activity in the risk assessment.

Similarly, the European guidelines recommend using the Systematic Coronary Risk Evaluation (SCORE) model. It can be customised to reflect CVD risk in individual countries (using national mortality data), allow for relative risk estimates and project CVD risk to age 60 years (De Backer *et al*., 2004).

Based on a database of UK primary care patients, a new CVD risk scoring system, called QRISK, was developed and validated. (Hippisley-Cox 2007)[5] QRISK serves as an online calculator to determine a patient's risk of cardiovascular disease. The developers believe that their tool calculates risk more appropriately for the contemporary UK population because it takes social deprivation and antihypertensive use into account. (Hippisley-Cox 2007) However, the newly released 2008 NICE Guidelines on the management of lipids recommends using the Framingham-based scoring system as the initial 10-year CVD risk assessment tool. (National Collaborating Centre for Primary Care and the Royal College of General Practitioners, 2008)[6] The guidance points out that these tools should be used in conjunction with clinical judgment in management of patients with CVD. (National Prescribing Centre 2008)[7] Where the Framingham risk score is built on age, sex, systolic blood pressure, total cholesterol, high density lipoprotein (HDL), cholesterol, smoking status and the presence of left ventricular hypertophy factors, QRISK includes socioeconomic status, obesity, recent smoking cessation and antihypertensive use or lipid-lowering treatments. (National Prescribing Centre 2008)

Generally, guidelines recommend that treatment (for example, medication to lower blood pressure, LLDs or aspirin) should be considered for persons with diabetes or a 10-year risk of CVD that is at least 20 per cent (British Cardiac Society *et al*., 2005; Pearson, 2002; Schwamm *et al*., 2006). The European guidelines recommend treatment for individuals with a current 5 per cent risk of a fatal CVD event or one that is projected to occur by age 60.

In addition, various guidelines indicate that risk assessment is unnecessary for individuals at high risk due to the following established risk factors:

- diabetes (British Cardiac Society *et al*., 2005; Schwamm *et al*., 2006) with microalbuminuria (De Backer *et al*., 2004)
- very high levels of individual risk factors (for example, total cholesterol at least 8mmol/l or blood pressure 180/110 mm HG or higher) (De Backer *et al*., 2004)
- previous CVD event (for example, myocardial infarction) (Schwamm *et al*., 2006)
- hypertension with organ damage (British Cardiac Society *et al*., 2005)
- familial hypercholesterolaemia (British Cardiac Society *et al*., 2005; Schwamm *et al*., 2006).

Additional methods (that is, CT scans of coronary artery calcification, ultrasounds of carotid arteries) are available to assist clinicians in their evaluation of CVD in patients. However, these new methods are not typically included in the widely used guidelines from Britain, Scotland, Europe or the USA (Naghavi *et al*., 2006).

The USPSTF evaluated the use of electrocardiography (ECG), exercise treadmill tests (ETT) and electron-beam computerised tomography (EBCT) scanning for coronary calcium for detecting severe coronary artery stenosis (CAS) or predicting future CHD events. The USPSTF did not find evidence that these screening tests offered significant benefits. High numbers of false–positive and false–negative results from these tests reduce what benefits they do offer (Calonge, 2004 Jun 15). Another USPSTF review examined the merits of ETT; observational cohort studies showed that ETT was able to detect asymptomatic CVD. But the range of detection rates varied from 1 per cent to 60 per cent across studies

5 Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M. Brindle P. Derivation and validation of QRISK, a new cardiovascular disease risk score for the United Kingdom: prospective open cohort study. BMJ. 2007 Jul 231;335(7611): 136.

6 National Collaborating Centre for Primary Care and the Royal College of General Practitioners. Lipid modification: cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease. NICE Clinical Guideline. May 2008. Accessed from www.nice.org.uk/nicemedia/pdf/CG67FullGuideline1.pdf on 11/09/2008

7 National Prescribing Centre. Assessing and communicating the risk of cardiovascular disease. National Health Service MeReC Bulletin. 2008, 19(1); 1-4. Accessed from http://www.npc.co.uk/MeReC_Bulletins/MeReC_Bulletin_Vol19_No1_main.pdf on 11/9/2008

(Fowler-Brown *et al*., 2004). An evidence-based practice review funded by the US Agency for Healthcare Research and Quality (AHRQ) and the US National Institutes of Health (NIH) found that the accuracy of myocardial perfusion imaging (MPHI) and echocardiography is limited (Grady, Chaput, & Kristof, 2003).

Blood pressure screening

Sheridan *et al* (2003) performed a systematic review for the USPSTF of recent systematic reviews and single observational studies or RCTs that examined the epidemiology of hypertension, accuracy and reliability of screening, benefits of pharmacological and non-pharmacological treatment on high blood pressure, and adverse effects of screening or treatment of elevated blood pressure. The authors of this systematic review found the following:

- Overall, strong indirect evidence supports blood pressure screening of adults because treatment of hypertension may reduce blood pressure levels and incidence of CVD events (that is, AMI, heart failure and stroke).
- Screening for high blood pressure would be beneficial if three conditions held: an accurate and acceptable screening method was available to detect hypertension, early treatment of hypertension resulted in better outcomes than late treatments, and the balance of potential benefits and harms was favourable. The authors found no RCTs comparing the outcomes of screening with no screening to obtain this information.
- Specifically, findings for different methods of screening included:
    - office-based screening: because of potential errors in blood pressure readings they found that a more accurate diagnosis of hypertension is made following two or more readings of elevated blood pressure on two or more occasions over a period of one to several weeks
    - home blood pressure monitoring: they found no definitive evidence for a recommendation on this practice
    - ambulatory blood pressure monitoring (that is, average blood pressure over 24 hours): they found insufficient evidence on this point but noted that this practice may be helpful for evaluating individuals with high blood pressure at clinic offices and normal pressures at home.
- Universal versus selective screening: the authors found no evidence to support recommendations for screening all persons.

The USPSTF recommended that clinicians screen all adults who are 18 years and older for high blood pressure (Khairy, O'Donnell, & Landzberg, 2003). It also recommended the following:

- high blood pressure (SBP of 140 Hg mm or higher, or diastolic blood pressure [DBP] of 90 Hg mm or higher) should be diagnosed by using at least two elevated blood pressure readings obtained on at least two visits over a period of one to several weeks
- ambulatory blood pressure measures that provide an average measure of blood pressure over a 24-hour period may be a better predictor of cardiovascular events than blood pressure monitored with a sphygmomanometer in the physician's office
- clinicians should consider the patient's overall cardiovascular risk by including age, sex, smoking, diabetes, elevated blood lipid levels, sedentary lifestyle and obesity in making treatment decisions; they should not rely only on elevated blood pressure levels

- although an optimal interval for screening adults for hypertension has not been established at the present time, adults with an SBP of 130 Hg mm and DBP of 85 Hg mm should be screened every two years; adults with higher values should be be screened more frequently
- treatment of hypertension should be targeted at maintaining SBP below 140 Hg mm and DBP below 90 Hg mm; DBP should be maintained below 80 Hg mm for adults with hypertension and diabetes
- non-pharmacological therapies such as reducing dietary sodium intake, weight, stress and alcohol intake while increasing potassium intake and physical activity are associated with reduced blood pressure, but their effects on cardiovascular events are unclear.

Screening for lipid disorders

A systematic review by Pignone *et al* (2001) found evidence for identifying all individuals (that is, adult men and women, older people and young adults) with lipid disorders (that is, elevated LDL-C, low levels of HDL-C). Those with risk factors can reduce the likelihood of CHD events with treatment, and those with greater than a 1.5 per cent risk of a CHD event can reduce the risk of death with treatment. The systematic review found the following:

- Total cholesterol (TC) measured from venous blood has good reliability with an analytic variability of less than 3 per cent and mean total biological variability of approximately 6 per cent; two measurements are needed to measure TC within 10 per cent of the actual value. TC can be measured at any time of day because the values for fasting and non-fasting periods do not differ considerably.
- HDL-C is accurate enough to be used for screening for CHD risk, but non-fasting measurements may marginally overestimate CHD risk because HDL-C in the non-fasting state is lower by 5 to 10 per cent than in the fasting state. HDL-C has an analytic and biologic variation of 6 per cent and 7.5 per cent respectively, and these values are higher than those for TC. Two or three measurements are needed to measure the actual value within 10 to 15 per cent.
- LDL-C calculated using the Friedewald equation (TC = HDL-C + LDL-C + [TC/5]) needs a fasting blood sample to ensure accurate values of tryglycerides because tryglyceride measurements vary by 20 to 30 per cent between fasting and non-fasting periods.
- Capillary blood samples can be used to measure TC and HDL-C if proper attention is paid to calibration and testing techniques; under these optimal conditions, the reliability is similar to that for venous blood samples.

Evidence for healthcare delivery models related to CVD screening and assessment

In this section we present evidence about processes and practices that support the delivery of CVD prevention interventions. As noted earlier we focus specifically on screening and assessment of risk in three main settings: GP offices, workplaces and the community.

GP office

The evidence regarding screening and preventive services in GP offices consistently demonstrates that the physician practice setting is an excellent one for screening patients as it identifies high-risk patients and provides the behavioural and educational services that can mitigate risk. Recent policy and guidance from the Department of Health states that GPs and primary care teams should ‘develop

a register of CVD patients through which they can review medication, offer advice on diet and lifestyle, and maintain the necessary contact with patients most at risk of suffering renewed heart problems' (Department of Health, 2007).

Within the GP office numerous multimethod systems and tools enable the practice to develop a consistent approach to increase screening and risk assessment. The evidence suggests that screening for cardiovascular disease by GPs is an effective way to identify unknown cases of patients with cardiovascular disease. However, given the time limitations that primary care practitioners face it is recognised that, even with such tools, screening and risk assessment can not be accomplished. Recent NICE guidance (2007) also suggests that routine screening of those who are frequent clinic attenders (that is, the 'worried well' or the affluent) is not as valuable as targeting those who are rarely seen (Hart, 2008).

Tools for supporting preventive services activities

Summary of evidence: Primary care practices are able to implement sustainable office systems to provide preventive care services when using multimethod approaches; these include using triggers or reminder tools and having a dedicated staff member to coordinate prevention activities.

McBride *et al* (2000) tested the use of medical record tools and changes in the documentation procedures of screening of CVD risk factors in a multisite clinical trial known as the Health Education and Research Trial (HEART). They found that primary care practices are capable of implementing sustainable prevention systems. The trial included 45 primary care practices in four regional medical centres in the USA. Practices were randomised to one of four intervention groups: conference-only group (n = 12 practices), consultation group (n = 11), prevention coordination group (n = 11) and combined intervention (conference, consultation and prevention coordinator) group (n = 11). The study included approximately 10,000 patients between the ages of 21 and 70.

All practices participated in a one-day conference and were provided a HEART kit. It contained tools such as a workbook describing how to implement a practice prevention system, a patient education manual, medical record tools, patient education material and professional reference material that practices could easily adapt, reproduce and use in their practices if desired. The intervention groups had the following attributes:

- although all groups showed an increase in the number of goals set to enhance preventive services, the number of goals set was greatest in the combined intervention and consultation groups
- compared to the conference-only control group, the combined intervention group showed a substantial increase in the use of patient history questionnaires (24 per cent), problem lists (35 per cent) and medical record labels (21 per cent) to document CVD risk
- the prevention coordinator group had the largest increase in the use of flow sheets (22 per cent) and the second largest increase in the use of patient questionnaires (20 per cent), problem lists (13 per cent) and chart labels (10 per cent); these figures were maintained at follow-up after 18 months.

Ornstein *et al* (2004) conducted a cluster RCT to evaluate a multimethod intervention to improve provider adherence to clinical practice guidelines for CVD and stroke prevention. The study results indicate that the multimethod intervention is only marginally more effective than a less intensive intervention.

Twenty office-based primary care practices in the USA that were part of a practice-based research network (using an electronic record system) were randomised into intervention and control groups. The study included a total of 45,571 (intervention) and 41,720 (control) subjects.

The multimethod quality improvement intervention included practice site visits (for academic detailing and quality improvement facilitation) and network meetings (for sharing best practices) in addition to guideline dissemination, audit and feedback. The control group received the less intensive quality improvement method that included only guideline dissemination together with audit and feedback (already shown to improve the practice of healthcare professionals, especially in prescribing and ordering tests). Quality indicators used to measure adherence to clinical guidelines included 14 process measures and 7 outcome measures that determined if patients achieved recommended treatment goals. Practices in the intervention and control groups improved from an average of 11.3 to 33.7 per cent and 6.3 to 22.7 per cent respectively of quality indicators that were at or above target levels. A significantly greater improvement was observed in the intervention than in the control group for 2 of the 21 indicators, using 3 measurements of elevated blood pressure to diagnose hypertension ($p = 0.001$) and controlling blood pressure among patients with hypertension ($p = 0.047$). After secondary analysis, statistically significant improvements were observed in eight indicators in the intervention group and six indicators in the control group.

Triggers and simple reminders to promote screening within a general practice

Summary of evidence: Some evidence suggests that in GP practices in which multimethod systems are not available simple tools, such as family histories, acute events or a checklist, can be effective reminders that promote CVD screening.

Marks *et al* (2000) reviewed literature and constructed a model to study the cost-effectiveness of different forms of screening for specific population groups (universal versus opportunistic). Cost-effectiveness was measured by increased cost per year of life gained. Systematic screening for family history is feasible because the information is relatively reliable and acceptable. The most cost-effective method was to identify relatives of patients who reported at least one family member with a relevant history or patients with an acute event (that is, admitted to hospital with myocardial infarction). Universal screening was found to be least cost-effective; for example, screening men over the age of 35 is least cost-effective because the expected gains in life expectancy are relatively small. The CRD evaluated the quality of this systematic review and concluded that the findings are reasonable.

Researchers from Canada found that the use of a single checklist reminder form (PERFORM) improved preventive health services in primary care (Dube *et al*., 2007). The sex-specific forms were developed from evidence-based guidelines. Recording alcohol use and smoking history, and providing smoking cessation advice, all increased significantly through the use of the form, although the change in blood pressure measurement was not significant. This low-cost checklist helped prompt family practice physicians to ask the right questions during complete health check-ups (Dube *et al*., 2007).

Use of risk assessment scores and tools in general practice

Summary of evidence: Risk assessments have been found to be reasonably accurate for those at moderate risk but are less accurate at either extreme: overestimating CVD risk in low-risk groups and underestimating it in high-risk groups. Evidence is mixed regarding the usefulness of a CVD risk score to improve patient outcomes, although evidence is strongest in those at moderate risk.

A systematic review of published literature by Brindle *et al* (2006) found evidence that the accuracy of cardiovascular risk assessment using Framingham risk scores is highly variable. It also found that

there is little evidence that CVD risk assessment performed by a clinician improves health outcomes. Specifically, CVD risk was overestimated in people with low risk, leading to unnecessary treatment; moreover, CVD risk was underestimated in people with high risk, leading to inadequate treatment. For CHD, the predicted-to-observed cardiovascular risk score ratios ranged from underprediction of 0.43 (95 per cent confidence interval [CI] 0.27–0.67) in a high-risk population to overprediction of 2.87 (95 per cent CI 1.91–4.31) in a low-risk population. This finding is based on evidence from an external validity analysis based on 27 studies with 71,727 subjects who had data on predicted and observed risk for CHD or CVD. The studies had been conducted in Australia, Europe (France, Germany, Northern Ireland, Scotland and the UK), New Zealand and the USA, and were published between 1998 and 2004. The review team reported that, although the populations varied in age range, sex, date of recruitment and outcomes measured, the 'groups were representive samples of men and women, and people with diabetes, raised cholesterol, treated hypertension, no CHD determined by angiography and a family history of CVD'.

In addition, the authors searched for evidence of the effectiveness of using CVD risk scores to improve patient outcomes. Only four RCTs addressed this issue by comparing patient treatment and outcomes among intervention groups of patients whose charts included risk score data and control groups whose charts did not. Two studies found that in high-risk subgroups of patients the intervention groups were significantly more likely to receive drugs for lower blood pressure or cholesterol; the other two studies found no differences in treatment or patient outcomes.

Jacobson *et al* (2006) conducted an RCT to determine the effects of global risk scores on the prescription of lipid-lowering therapy to clinicians for patients with increased risk for CHD. Although the results indicated that a simple global risk educational tool did not improve targeting of statin therapy to patients with high absolute risk of CHD, the intervention tool may benefit individuals at moderate absolute risk for CHD. Between September 2000 and January 2001 the study enrolled 368 patients from a primary care setting (general medical clinics of Grady Memorial Hospital in Atlanta, Georgia, USA) who:

- did not have a history of CHD or vascular disease
- had no evidence of cancer treatment during the time of the study
- had a lipid profile done within the previous year and who were not then on statin therapy.

For the intervention group (n = 186), the investigators reviewed medical charts, computed10-year absolute risk and then communicated the information to physicians using a simple educational tool attached to patients' charts. For the control group (n = 182) the investigators attached a form describing general information on CHD prevention methods to patients' charts. The frequency of statin prescriptions did not differ between high-risk individuals in the intervention and those in the control groups (40 per cent versus 37.9 per cent; p = 0.86). Among individuals at moderate risk, who were not eligible for lipid-lowering medication under National Cholesterol Education Program-Adult Treatment Panel II (NCEP-ATP II) guidelines, the proportion receiving a statin prescription was higher in the intervention group than in the control group (28.8 per cent versus 12.5 per cent; p = 0.041). This finding was interpreted as indicating that the intervention may be beneficial to target individuals who are at moderate risk for CHD but who do not have high levels of LDL-C.

Sheridan *et al* (2006) performed a pilot randomised trial to test the effectiveness of a computerised decision aid tailored to individuals in preventing CHD. They found evidence that such aids may increase the likelihood that patients will discuss CHD prevention and risk-reduction strategies with their doctors. The pilot used a convenience sample of men and women between the ages of 35 and 75 who had no previous history of CVD and who were receiving care at an internal medicine clinic at the University of North Carolina, USA. A total of 75 subjects were randomised into the intervention (n = 41) and control (n

= 34) groups. Patients in the intervention group received a computerised decision aid (Heart to Heart) that provided:

- the individual's 10-year global risk of CHD events calculated using Framingham equations and information about their age, sex, blood pressure, total and high-density lipoprotein cholesterol, smoking, diabetes and left ventricular hypertrophy (LVH)
- a list of their personal risk factors
- advantages and disadvantages of CHD risk-reducing therapies
- encouragement to participate in long-term risk-reducing therapies.

The control group received only a list of CHD risk factors that they could give their physician. Unadjusted absolute differences indicated that, compared with the control group, 16 per cent more patients (95 per cent CI -4 per cent–37 per cent) in the intervention group discussed CHD risk reduction with their physician and 13 per cent more patients (95 per cent CI -7 per cent–34 per cent) had a specific plan to reduce their CHD risk. A pre–post analysis showed that patients in the decision aid intervention group planned to use more risk reduction strategies after the interventions compared with baseline. There were too few patients to perform an analysis adjusted for CHD risk, number of options for risk reduction, desire for independent decision-making and self-reported concerns about communicating with their physician. These factors could have biased the result towards a larger difference in the decision aid group.

Education and training of physicians and nurses to provide risk reduction interventions

Summary of evidence: Training and education of physicians and nurses in GP offices who are involved in identifying, monitoring and providing risk reduction interventions related to CVD can promote the use of prevention practices.

De Muylder *et al* (2004) studied the effect of training primary care providers (PCPs) on a three-step approach – detection, classification and management – to improve physician knowledge and management of cardiovascular risk among patients. This approach was presented to PCPs in Brussels and Namur, Belgium, during their monthly continuing medical education (CME) meeting in November 2000. A total of 343 PCPs from 20 CME groups were randomly assigned to three groups. The intervention included distribution and training of a global CV risk assessment tool and education on CV burden, risk factors and therapy. PCPs in the intervention group were more knowledgeable about a global CV risk-factor tool than those in the control group (93 per cent versus 76 per cent, $p = 0.011$) and more likely to use the risk-factor tool (76 per cent versus 52 per cent, $p = 0.003$). Trained PCPs were also significantly more knowledgeable about several items related to the incidence of coronary artery disease, CV risk factors and therapeutic attitudes. When asked about changes in the practice of CV prevention after 16 months, 58 per cent of the trained PCPs reported a change in their practice. This study demonstrated that PCPs can integrate strategies taught during CME meetings on CV prevention into their practices (De Muylder *et al*., 2004).

Davies (1999) studied the extent to which practice nurses use research-based evidence in heart disease and stroke prevention. The study was performed in two stages. In the first stage, 1187 practice nurses working in 11 health authorities in the UK were requested to complete a questionnaire to determine their role in identifying, monitoring and reducing risk factors for CVD and stroke. The results indicated that practice nurses were involved in activities targeted at CVD and stroke prevention to a great extent, but over one-third of the sample indicated that they needed additional training. The results also revealed the following:

- The gaps in knowledge identified by the practice nurses included the inability to identify risk factors for CVD and stroke (40 per cent), lack of awareness of the benefits of risk reduction, lack of training on CVD and stroke prevention in the previous 2 years (50 per cent) and lack of access to a medical library (25 per cent).
- There was a statistically significant association between the amount of research used by practice nurses and individual factors (for example, clinical grade, time in post, time in general practice), organisational factors (such as amount of time spent in activities related to CVD and stroke prevention) and use of protocols to guide practice related to smoking, hypertension and exercise.
- The barriers to good prevention practice identified by the practice nurses included organisational barriers, such as lack of time and lack of access to patient information, patient-related barriers, such as lack of readiness to change and social circumstances, and inadequate preparation (that is, insufficient relevant training).
- Factors identified as aiding good prevention practice were availability of computerised patient information, using measurable goals and working in a primary care team.
- Protocols also facilitated practice improvement by standardising care, but use of protocols varied widely and nurse involvement in developing protocols and practice guidelines was low.

Van Steenkiste *et al* (2007) performed a cluster randomised trial in the Netherlands to study the effectiveness of using a decision support tool to increase patient involvement in decisions related to managing risk of CVD. The intervention group included 276 patients (aged 40 to 75) cared for by 17 GPs from 16 practices, while the control group included 214 patients belonging to 17 GPs from 13 practices.

The intervention was targeted at both the GPs and patients. Initially the GPs participated in educational sessions about CVD risk assessment and guidelines for effective management of that risk. Following that, GPs met individually with their patients participating in the study and provided an individualised educational workbook that was specific to the person's own CVD risk along with a description, in lay terms, of various ways the patient could decrease their risk.[8] Patients were to note interventions that they might be interested in completing. Approximately two weeks later patients discussed their CVD risk and actions for moderating this risk with the GP. The control group GPs received written education material on the guidelines for cholesterol management.

Multilevel regression analysis was used to evaluate physician clinical performance[9] and self-reported patient outcomes. Overall, clinical performance in both intervention and control groups was good and did not differ significantly between the study groups (86 per cent in intervention versus 76 per cent in control). At six-month follow-up, patient perception of CVD risk and anxiety among intervention group members was not significantly different from that observed among the control group. In addition, a larger number of patients in the intervention group had quit smoking compared with the control group; however, these results were not statistically significant. There was a statistically significant increase in physical activity among men in the intervention group compared with men in the control group (OR = 3.8 95 per cent CI 1.7–8.7) (van Steenkiste *et al*., 2007).

Workplace

We examined the literature to explore whether any workplace practices can effectively promote screening and assessment of CVD risk. We found no evidence on delivery system changes within the workplace to promote screening and assessment.

8 Two versions of the decision-support workbook were developed: one targeting patients with diabetes that used a 'persuasive' voice, the other for patients without diabetes that employed a 'reassuring' manner.

9 Clinical performance was assessed using five measures related to determine patient risk of CVD: underuse of cholesterol testing in high risk patients; overuse of cholesterol testing in all patients, assessment of patient risk factors, smoking cessation advice and adoption of a healthy diet.

Community

Use of other healthcare providers

A review of information regarding the prevention, diagnosis, or treatment of CVD revealed that dental care providers can have an important role in screening healthy patients for CVD risk factors, monitoring conditions that could lead to the development of CVD or deterioration of existing CVD and providing education to patients regarding CVD (Glick, 2002). Most individuals visit their physicians only when they are sick but visit the dentist when they are healthy, thereby providing oral healthcare providers an opportunity to target primary prevention of CVD in relatively healthy patients. According to Glick, a complete medical history that includes age, smoking habits, family history of CVD and diabetes, presence of hypertension, serum glucose levels and presence of diabetes, serum cholesterol levels, weight, height and physical activity should be obtained from all patients visiting the dentist's office to enable the detection of risk factors for CVD. Oral healthcare professionals should not diagnose CVD in their patients; their important role is to screen for risk factors, determine the presence or risk of disease and provide a referral to an appropriately qualified medical professional.

Health promotion to prevent CVD, its risk factors or its sequelae

The second major step for health system action to prevent CVD and its sequelae involves various health promotion efforts to decrease CVD risk. The major lifestyle risk factors for CVD are well known: smoking, a poor diet and physical inactivity. Among the more important strategies are those involving:

- decreasing smoking
- increasing healthy eating
- increasing physical activity
- preventing high blood pressure
- preventing high cholesterol levels.

These risk factors are endemic throughout the developed world; the UK is no exception. For example, more than 25 per cent of the English population – about 10 million people – smoke. Overall, approximately 22 per cent of men and 23 per cent of women in England are obese.

The fact that a healthy diet and regular physical activity can reduce the risk of cardiovascular disease is well established. The challenge is how to educate and motivate people to adopt health behaviours that promote cardiovascular health. Several schemes are under way in the UK to help people reduce lifestyle risks and promote a healthier lifestyle. These include NHS stop smoking services and the '5-a-day' programme, including the national fruit scheme which provides a free piece of fruit each school day to more than a million children aged between four and six years. Other efforts include healthy living centres and local exercise pilots (LEAPS) (CHD Framework). Both the popular press and policy interventions target the need for individuals to have information about healthy practices and the tools to make healthy choices.[10] In this section we first briefly note existing guidelines for clinical interventions to reduce CVD risk; we then turn to the evidence about organisational interventions for health promotion.

Health promotion guidelines

JBS, SIGN, the European Society of Cardiology and the American Heart Association have all published guidelines for promoting the adoption of health behaviours to reduce risk for CVD. These

10 Examples of this include www.guardian.co.uk/society/2005/mar/17/NHS1 (Guardian, 2005) and http://news.bbc.co.uk/1/hi/health/3715539.stm; accessed October 7, 2007 (BBC News, 2004).

guidelines reflect the substantial consensus about which health behaviours are important to maintain cardiovascular health; therefore, we summarise the recommendations below and attribute them to all four guideline documents.

Eliminate tobacco use and exposure

Smoking promotes heart disease by causing damage to arteries and blood vessels, encouraging blood clotting and raising heart rate and blood pressure (World Heart Federation, 2008) Therefore, current guidelines recommend that tobacco users should quit smoking and that all individuals should limit their exposure to second-hand smoke. Smokers should therefore have access to support to quit smoking such as nicotine replacement therapy and guidance from healthcare providers, for example, physicians (Ranney, Melvin, Lux, McClain, Morgan *et al*., 2006).

Maintain a healthy weight

Being overweight or obese increases the risk of developing type 2 diabetes and hypertension, and hence CVD. In particular, intra-abdominal fat (that is, fat in the belly area) increases blood pressure and can decrease the body's ability to use insulin (World Heart Federation, 2008). Therefore, CVD prevention guidelines recommend that adults maintain a healthy weight, as indicated by a BMI between 18.5 and 25.0 and a waist circumference of less than 88cm in women and 102cm in men.

Eat a healthy diet

Fruits, vegetables and whole grains have a protective effect against developing CVD. Individuals should eat a diet with a variety of fruits and vegetables (five servings per day), grains, low-fat or non-fat dairy products, fish (at least two servings per week), legumes, poultry and lean meat (British Cardiac Society *et al*., 2005). Saturated and trans fats increase abnormal blood lipid levels and increase the risk of CVD (World Heart Federation, 2008). Therefore, individuals should limit total fat intake to a maximimum of 30 per cent of calories and decrease saturated fat to 10 per cent of daily calories. Unsaturated fats and essential fatty acids can promote heart health and should be consumed in moderation. Salt intake is directly related to risk of hypertension; for that reason, salt consumption should be limited to less than five grams per day.

Be physically active

Physical activity reduces risk of CVD by helping the body to use insulin effectively and by promoting maintenance of a healthy weight (World Heart Federation, 2008). Guidelines for prevention of CVD include participating in at least 30 minutes of moderate-intensity activity – including both occupational and leisure time activity – on most days (at least five) of the week. The recommended levels of activity can be achieved either by doing all the daily activity in one session or through several shorter bouts of activity of 10 minutes or more. The activity can be lifestyle activity, structured exercise or sport, or a combination of these.

More specific activity recommendations for adults are made for beneficial effects for individual diseases and conditions. All movement contributes to energy expenditure and is important for weight management. For many people, 45 to 60 minutes of moderate-intensity physical activity a day is likely to be necessary to prevent obesity.

The recommendations for adults are also appropriate for older adults. Older people should take particular care to keep moving and retain their mobility through daily activity. Specific activities that promote improved strength, coordination and balance are particularly beneficial for older people.

Evidence of delivery system interventions for health promotion related to CVD

GP office

Use of non-physician staff to conduct health promotion

Summary of evidence: Good evidence supports health promotion interventions by non-physicians in the primary care setting.

Rice and Stead (2004) conducted a Cochrane Review to evaluate the effectiveness of nurse-delivered smoking cessation interventions. They included 25 RCTs of smoking cessation interventions delivered by a nurse or health visitor (qualified and registered nurse or midwife who works as a member of the primary healthcare team) with at least a six-month follow-up period in their meta-analysis. These studies were conducted between 1987 and 2003 in Australia (1), Canada (1), Denmark (1), Japan (1), Netherlands (1), Spain (1), Sweden (1), the USA (13), and the UK including Scotland and Wales (10). The participants were adult smokers (or users of some form of tobacco), 18 years or older and recruited from a healthcare setting.

The two interventions differed by intensity: 'low intensity' involved an initial visit lasting 10 minutes or less with one follow-up visit, and 'high intensity' included an initial visit of more than 10 minutes, more than one follow-up visit and the provision of additional material on smoking such as leaflets and manuals. Smoking cessation and reduction in the number of cigarettes smoked were the main outcome measures.

Of the 25 studies included, 20 studies comprising more than 10,000 subjects assessed the effects of nursing intervention compared with no nursing intervention in outpatient, primary care or community settings. The analysis indicated that verbal advice to stop smoking provided by nurses significantly increased the probability that subjects would give up smoking compared with control subjects receiving usual care and no smoking cessation advice (odds ratio [OR] 1.47; 95 per cent CI 1.29–1.67). Of 11 trials in non-hospital settings, patients who were not hospitalised benefited from nursing interventions (OR 1.90 95 per cent CI 1.48–2.43). Other analysis indicated greater but limited advantages for hospital patients with cardiovascular disease compared with patients with other illnesses (OR 1.44 95 per cent CI 1.16–1.78 versus OR 95 per cent CI 0.92–1.56). Five studies examining different nurse-delivered interventions did not find any significant differences between the intervention and control groups.

Tulloch *et al* (2006) reviewed physical activity counselling studies in primary care settings to determine the types of interventions that providers are currently using and how effective they are relative to one another in increasing physical activity. The 19 studies evaluated were RCTs and quasi-experimental studies. Sample sizes of individual studies ranged between 63 and 1,658 people, subjects' ages ranged from 18 to more than 80 years, and both short-term (less than six months) and long-term (greater than six months) outcomes were measured.

Interventions reviewed were conducted by physicians (37 per cent), allied health professionals such as nurses, health educators, exercise consultants and behaviour health specialists (37 per cent), or a combination of providers (26 per cent). Compared with past reviews, the number of interventions conducted only by physicians declined, and the number offered by allied health professionals rose. In several reviews conducted between 1998 and 2005 the number of physician-only interventions gradually declined from 67 per cent to 60, 50 and, finally, to 37 per cent in this analysis. The authors suggested that this trend towards a greater use of non-physician clinicians may indicate that physical activity counsellors who have specialised training and more time may be able to provide more effective counselling for longer-lasting behaviour changes related to physical activity. The physician-only

interventions were conducted at primary care facilities; allied health professional and combined provider interventions were conducted by telephone (37 per cent) while combined in-person meetings were conducted in primary care settings and by telephone (25 per cent), at local leisure centres (17 per cent) and at medical centres (8 per cent). Although all interventions reviewed resulted in some improvement in physical activity, the interventions led by allied health professionals appeared to generate the best long-term results lasting more than six months. Specifically, short-term (less than six months) improvements were observed in 50 per cent of physician-only, 67 per cent of combined provider and 100 per cent of allied health professional interventions. Long-term improvements were found in 50 per cent of physician-only, 67 per cent of combined provider and 71 per cent of allied health professional interventions.

Staten *et al* (2004) conducted the Well-Integrated Screening and Evaluation for Women Across the Nation (WISEWOMAN) trial in Arizona in the USA. Interventions using combinations of provider counselling (PC), health education (HE) and community health workers (CHWs) all resulted in increased physical activity, but only the most intensive intervention group increased the intake of fruits and vegetables. A total of 217 mostly Hispanic women who were over the age of 50 and uninsured were randomised into the following three intervention groups:

- lowest intensity intervention group (PC group), also considered the active control group, received counselling based on the patient–provider communication model (n = 77)
- middle intervention group (PC+HE group) received provider counselling and health education classes based on the social cognitive theory model; they also received a monthly newsletter (n = 73)
- most intensive intervention group (PC+HE+CHW group) received provider counselling, health education and social support from CHWs (n = 67).

At twelve months all three groups displayed significant increases in the duration (minutes) of moderate-to-vigorous physical activity ($p \leq 0.05$, $p \leq 0.01$ and $p \leq 0.001$ respectively). The PC+HE+CHW group showed a significant increase in the percentage of women (7.4) meeting the recommended daily fruit and vegetable intake ($p \leq 0.05$). The percentage of hypertensive women decreased in the PC group and the PC+HE+CHE group (11 per cent and 21.2 per cent respectively; $p \leq 0.05$). SBP significantly decreased in the PC+HE+CHW group (5.1 Hg mm; $p \leq 0.01$). Total cholesterol significantly decreased in both the PC+HE group (10.9 mg/dl; $p \leq 0.05$) and the PC+HE+CHW group (8.3 mg/dl; $p \leq 0.05$).

Provider reminder systems as part of a multipronged approach

Summary of evidence: Good evidence supports the use of provider reminder systems in conjunction with provider education about counselling patients to quit smoking.

In 2006, AHRQ published a systematic review of the effectiveness of community-based and population-based interventions to quit smoking and increase consumer demand for implementing effective cessation interventions (Ranney, Melvin, Lux, McClain, & Lohr, 2006; Ranney, Melvin, Lux, McClain, Morgan *et al*., 2006). The review drew on findings from a total of 102 studies, including previously conducted systematic reviews, meta-analyses and individual studies published later than the review studies. Pertinent findings of this report include:

- Multifaceted programmes that include face-to-face or telephone counselling increase the number of tobacco users attempting to quit.
- Counselling and pharmacotherapy used alone or in combination can improve success rates of attempts to quit.

- Self-help strategies are not effective when used independently of other strategies.
- Provider reminder systems in conjunction with provider education about counselling patients to quit smoking can be effective.
- Academic detailing that includes provider education, audit and feedback improves delivery of cessation treatments but does not necessarily lead to higher quitting rates among patients.

Karwalajtys *et al* (2005) conducted a small RCT to assess different methods (that is, mail and telephone) of inviting patients to attend cardiovascular health awareness sessions at a family physician's office and to measure the cost-effectiveness of each method. A group of 235 community-based patients aged 65 years and older were recruited from one family physician practice in Dundas, Ontario, Canada and randomised to the mail invitation group (n = 119) or the telephone invitation group (n = 116). All participants were invited to attend one of five blood pressure monitoring sessions held at five pharmacies in the same area during a 10-day period in April 2001. Letters were mailed to patients with the physician's electronic signature; a member of the physician's staff called patients using a structured script and making a maximum of three repeat calls. Patients who were unreachable using either method were included in the intent-to-treat analysis.

Overall attendance at the cardiovascular health awareness sessions was 58 per cent (Karwalajtys *et al*., 2005). Of these, 44 per cent of patients invited by mail and 72 per cent of those invited by telephone attended (OR = 3.3; 95 per cent CI 1.9–5.7; $p < 0.001$). Patients with a family history of CVD were more likely to attend than those with no family history (OR = 1.9; 95 per cent CI 1.1–3.5; $p = 0.049$). Of the attendees who completed a questionnaire, 80 per cent indicated that they were interested in attending again and 70 per cent preferred to attend a session in the morning. The difference in the cost per person between the mail and telephone invitation groups was small (US$2.18 by mail versus US$2.02 by telephone).

Prescription for lifestyle change

Summary of evidence: Some evidence suggests that physician prescriptions for exercise increase physical activity among sedentary adults.

Little *et al* (2004) evaluated the effectiveness of three approaches to increase physical activity. Their RCT enrolled 151 sedentary patients over the age of 18 years who had at least one CVD risk factor based on computerised medical records. The subjects were recruited from four general practice settings in Southampton and Salisbury in the UK: deprived inner city (n = 30), rural small town (n = 48), market town (n = 53) and cathedral city (n = 20). Patients were randomised into eight groups based on the following three intervention characteristics in a balanced '2 x 2 x 2' factorial design:

- booklet (*Getting Active, Feeling Fit* by the Health Education Authority) versus no booklet
- counselling session (provided by a nurse based on attitudes, perceived control of behaviour and techniques for implementing behaviour) versus no counselling session
- exercise (brisk exercise such as walking that does not require a leisure facility for 30 minutes a day, 5 days a week) prescribed by a GP versus no exercise prescription.

Interventions using exercise prescription and counselling based on psychological theory can initiate increases in physical activity. Primary analysis indicated that counselling and booklet together increased the distance participants walked more than each of the interventions did on their own ($p = 0.034$). Secondary analysis indicated that, although single interventions had marginal success, only the intensive intervention group (prescription exercise and behaviour counselling) produced significant

changes in fitness and physical activity at one month compared with baseline (walking distance 28.5 metres; $p < 0.002$). Counselling based on psychological theory had the greatest effect on increasing physical activity for patients who were not highly motivated. Subjects with high intention to exercise at baseline did not increase their intention ($p = 0.46$) or actual exercise ($p = 0.40$), but those with low intention increased their intention ($p = 0.012$) and exercise ($p = 0.008$).

Duncan *et al* (2005) found evidence that physical activity counselling with a prescription for high-intensity and high-frequency walking improve fitness and blood lipid values. This RCT recruited a total of 429 healthy, sedentary men and women between the ages of 30 and 69 years with normal blood pressure in Florida in the USA. The subjects were randomised to a control group (n = 93) or one of four intervention groups: the moderate-intensity/low-frequency group (n = 93), the moderate-intensity/high-frequency group (n = 107), the high-intensity/low-frequency group (n = 97) and the high-intensity/high-frequency group (n= 102). All intervention group participants received counselling in two phases (exercise adoption and exercise maintenance) and performed 30 minutes of walking at varying intensities and frequencies based on the group to which they were assigned. The low- and high-frequency groups were instructed to walk three to four days per week and five to seven days per week respectively. The moderate- and high-intensity groups were instructed to walk at a pace of 45–55 per cent of their heart rate reserve and 65–75 per cent of their heart rate reserve respectively, as measured by a heart rate monitor. The control group received advice from a physician on physical activity and a booklet on heart health. At six months the high-intensity/high-frequency group had significantly better HDL-C levels, ratios of total cholesterol to HDL-C and physical fitness as measured by oxygen consumption ($p < 0.03$, $p < 0.04$ and $p < 0.01$ respectively) compared with the control group.

Workplace

Multicomponent interventions

Summary of evidence: Some evidence supports the use of multifaceted interventions that include components such as improvement of nutrition education, prescriptions for aerobic and strength training exercises, behaviour modification training, self-study materials, tailored dietary prescriptions and group or supervised exercise to prevent overweight and obesity among adults in workplace settings.

A systematic review of 20 studies revealed that a combination of nutrition- and physical activity-related programmes led to a reduction in prevalence of overweight and obesity (Katz *et al*., 2005). In the analysis of workplace studies, effectiveness was defined as a mean weight loss of at least four pounds (1.8kg) across all studies at six or more months into the intervention. Interventions reviewed included:

- improvement of nutrition education
- prescriptions for aerobic and strength training exercises
- behaviour modification training
- self-study materials
- tailored dietary prescriptions
- group or supervised exercise.

Multifaceted interventions that include two or more of these components can effectively prevent overweight and obesity among adults in workplace settings. The annual cost per employee per year to involve 1 per cent of the population at high risk for developing overweight and obesity in worksite

weight loss programmes was estimated to be less than US$1 based on two studies that performed cost-effectiveness analyses.

Matson Koffman *et al* (2005) reviewed worksite interventions and healthcare services that help employers improve the cardiovascular health and productivity of their employees and decrease the cost of employer-sponsored health benefits. The authors reviewed 19 studies in workplace settings and 33 studies in healthcare settings in the USA published between 1990 and 2003. The studies (RCTs, pre–post tests, experimental and quasi-experimental, literature reviews and meta-analyses) examined interventions with positive outcomes related to CVD, high blood pressure, elevated cholesterol and employer costs. Health promotion programmes implemented in workplace settings can yield financial savings. For example, a meta-analysis of 42 studies revealed that evidence-based health promotion programmes that were designed and implemented appropriately produced a 25 per cent saving per employee with regard to absenteeism, health plan costs, and disability and worker's compensation costs over a two- to five-year period. Evidence from another review of 32 studies that assessed the impact of worksite health promotion programmes on medical costs found that comprehensive workplace health programmes produced a US$3–6 return on investment for each dollar invested by the employer during a two- to five-year period.

The authors also found that, generally, comprehensive health promotion programmes and strategies with long-term follow-up customised to the specific needs of each individual were found to be most effective for managing cardiovascular risk (for example, hypertension and high cholesterol). Environmental interventions have been found to increase healthy eating and exercise. In the USA employers, as high-volume purchasers of healthcare, can support employees by choosing healthcare insurance and corresponding providers that provide guideline-concordant preventive care and care management services.

Emmons *et al* (1999) conducted a randomised matched-pair study to assess behaviour change among employees participating in the Working Healthy Project (WHP). The study matched 22 manufacturing worksites in Rhode Island and southern Massachusetts in the USA into pairs; worksites were then randomised within pairs into intervention and control groups. Workers in the intervention group actively participated in designing and implementing the specific diet, physical activity and smoking-related intervention activities aimed at improving nutrition, increasing physical activity and fostering smoking cessation. Each intervention site established an Employee Advisory Board to assist with planning and tailoring intervention activities for the site, and the sites appointed a worksite coordinator to adapt the intervention to the worksite and to be the WHP advocate for the site.

A total of 2055 employees participated in the study and completed three health behaviour assessments at baseline, interim and end-of-intervention. Employees in the intervention group significantly increased their physical activity compared with the control group worksites at 15- and 30-month follow-up assessments ($p < 0.0001$ and $p < 0.03$ respectively). By the final assessment the intervention group employees had marginally increased their intake of fruits and vegetables ($p < 0.0001$) and substantially increased their fibre intake ($p < 0.0001$) compared with the control group worksites. The two groups did not differ in fat intake and smoking behaviour at either interim or final assessment.

Smoking cessation programmes in the workplace

Summary of evidence: Evidence is mixed about the effectiveness of smoking cessation programmes in the workplace:

- some evidence supports use of tobacco bans to reduce cigarette smoking at the workplace during the day; however, the evidence does not indicate that a workplace ban has an effect on total smoking rates
- some evidence supports the use of individual counselling and nicotine replacement therapy to help smoking cessation
- no evidence supports the effectiveness of multifaceted workplace programmes that target smoking when used in conjunction with other CVD prevention.

Moher *et al* (2005) performed a Cochrane Review of RCTs, observational studies and quasi-experimental studies that provided evidence regarding smoking cessation intervention programmes in the workplace to assess how effective they were in helping employees to stop or reduce smoking. The review included 64 studies from Australia, Canada, Europe, Japan and the UK. Only RCTs on smoking cessation with randomisation of individuals, worksites or companies, or studies of various designs on smoking restrictions or bans at worksites, were included. Studies had to address post-intervention smoking behaviour such as cessation and prevalence of quit attempts at six months or more as a primary outcome.

Of the 31 individually focused interventions, smoking cessation rates increased in those who received counselling (both group and individual) or nicotine replacement therapy interventions in comparison with those who received self-help materials or no treatment. Of the 33 workplace smoking cessation strategies, tobacco bans reduced cigarette smoking at the workplace during the day, but total smoking rates were not reduced. Incentives increased employees attempts to stop smoking; however, these studies yielded only marginal evidence that these quit attempts were maintained over time leading to permanent cessation. Social and environmental support and multifaceted programmes produced no evidence of increased quitting rates or decreased prevalence rates.

Community

Information and knowledge about multiple CVD risk factors

Summary of evidence: Some evidence suggests that health information campaigns and targeted programmes, including those using community organisations, can increase knowledge and awareness of CVD prevention activities.

Boylan *et al* (2003) performed a group randomised trial to examine the effects of a community-based primary prevention programme to reduce CVD risk factors in women between the ages of 20 and 50 who were recruited from the areas of Duluth, Minnesota and Superior, Wisconsin in the USA. A total of 364 women were recruited using community contacts such as religious institutions, academic institutions, health clinics and local employers. Study activities were conducted at places of worship in the neighborhood over a two-year period. All participants completed assessments of CVD knowledge and lifestyle behaviours that contribute to CVD risk (for example, stress, exercise habits and smoking behaviour). In addition, members of both groups participated in meetings with staff to discuss assessment results. They also received a letter documenting assessment results and recommendations about behaviour changes to manage CVD risk factors, and the Healthy Heart Handbook for Women containing information on heart disease in women and health-promoting behaviours.

Women in the lifestyle intervention group were also invited to participate in four different classes ('dealing with stress in healthy ways', 'eating and cooking for a healthier heart', 'healthy levels of physical exercise' and 'dropping the smoking habit'). In addition, members of the intervention group also received a telephone call to remind them about setting goals and making changes as well as giving them an opportunity to ask questions and find out additional information. After the call a letter was sent to inform them about smoking cessation resources in the community, exercise facilities for disabled women, nutritional and fitness assessment resources, and articles on stress management and menopause.

At 12-month follow-up, CVD knowledge increased significantly among both study groups compared with the baseline assessment; however, knowledge did not differ significantly by study group. There was a significant difference between the proportion of women who set goals and made changes in diet, physical activity and stress management in the intervention group compared with the control group ($p < 0.05$).

Will *et al* (2001) conducted a randomised study to assess the effectiveness of a programme to reduce CVD in low-income women using blood pressure monitoring and nutrition and physical activity interventions tailored to the study population. The investigators randomly assigned 42 sites in Massachusetts and North Carolina (covering approximately 3000 women) in the USA to either an enhanced intervention (EI) group (n = 22) or a minimal intervention (MI) group (n = 20) where participants received a brochure with information about prevention. EI interventions were based on behavioural change theory and intended to address the socioeconomic needs of the populations (for example, low literacy). In North Carolina, participants were invited to attend three one-on-one counselling sessions. In Massachusetts, participants had the opportunity to participate in two individual counselling sessions and various group activities (for example, walking programmes or cooking demonstrations).

Results of a mixed models analysis indicated that blood pressure, total cholesterol and HDL-C levels decreased significantly among both intervention and control groups. In addition, the prevalence of smoking decreased in both groups. The 10-year estimated CHD death rate for the EI group (64.8 per 1000 at baseline) showed a statistically significant decrease of 3.5 per 1000 after a 1-year period. For the MI group, the CHD death rate (61.9 per 1000 at baseline) decreased by 0.7 per 1000 after the intervention; this drop was not statistically significant and did not differ significantly from the change observed in the intervention group.

The North Carolina WISEWOMAN programme was an intervention aimed at improving attitudes, beliefs and behaviours related to healthy eating and exercise (Jacobs *et al*., 2004). The study included 511 low-income women between 50 and 64 years of age who participated in the intervention from January to December 1998 at local health departments. Women were non-randomly assigned either to an enhanced intervention (EI) – in which they received an evaluation and intervention programme called New Leaf... Choices for Healthy Living – or to a minimum intervention (MI), in which they received the standard health department services. The EI group received computer-tailored health messages and telephone counselling sessions. At 12-month follow-up, when compared with those in the control group, subjects in the intervention group were more likely to:

- move forward to later stages of behaviour change (action and/or maintenance) (OR = 1.65; 95 per cent CI 1.07–2.56; p = 0.02)
- report that their diet was effective (OR = 1.48; 96 per cent CI 0.97–2.27; p = 0.07)
- report heightened dietary self-efficacy (OR = 1.48; 95 per cent CI 0.97–2.27; and p = 0.07).

Overall, this study provides evidence of some benefits to using customised computer messages and telephone calls when targeting physical activity. However, when compared to usual care, there were no considerable advantages to other psychosocial or behavioural outcomes.

Interventions to promote physical activity in adults

Summary of evidence: Some evidence supports the use of a variety of physical activity interventions, in mixed settings, to increase physical activity and measured cardio-respiratory fitness.

Hillsdon *et al* (2005) conducted a Cochrane Review to examine benefits and harms of interventions that promote physical activity in adults. The authors reviewed 17 RCTs of a variety of physical activity interventions, which followed subjects for at least 6 months and used either an intent-to-treat analysis or had a minimum of 80 per cent participation. The subjects enrolled in the trials were community-dwelling, sedentary adults over the age of 16; there were no subjects, or fewer than 10 per cent, with pre-existing medical conditions that could limit engagement in physical activity.

A myriad of multicomponent interventions were conducted by a physician, nurse, health educator, counsellor, exercise leader or peer. They included individual or group counselling, physical activity (for example, self-directed or prescribed, supervised or unsupervised, home-based or facility-based), ongoing support (for example, in person, via telephone or written educational or motivational material) and self-monitoring. (Hillsdon *et al*., 2005)

The main outcome measure was the change in self-reported physical activity. Other outcomes assessed were cardio-respiratory fitness (when available) and adverse circumstances such as job- or exercise-related musculoskeletal injury and cardiovascular events. The studies included were conducted in workplace, community, university or primary healthcare settings, and the results were mixed.

An analysis of 11 studies (3940 subjects) that published self-reported measures of physical activity found a moderate increase in the intervention groups compared with the control groups (pooled standardised mean difference 0.31; 95 per cent CI 0.12–0.5). Although five studies found these positive effects, the other six found no statistically significant effects. Seven studies (1406 subjects) revealed that increased physical activity improved cardio-respiratory fitness (pooled standardised mean difference 0.4; 95 per cent CI 0.09–0.7). Of the six studies (2313 subjects) that assessed the achievement of a preset physical activity goal, one study found evidence that frequent telephone calls (10 calls over 12 weeks) significantly increased walking behaviour compared with no calls (OR = 10.95; 95 per cent CI 1.42–84.15); however, the other five studies failed to find a statistically significant relationship compared with the control group. Four studies reported adverse effects; one of these studies found that job-related injuries were four times higher in the control group than in the physical activity intervention group. (Hillsdon *et al*., 2005)

AHRQ commissioned a systematic review of the effectiveness of behavioural interventions for increasing physical activity in the general population. The 47 studies included in the review contained the following characteristics:

- 41 studies included adults only – 31 had men and women, 8 had women only and 2 had only men, 4 included children only, and 2 included both adults and children
- 1 or a combination of 2 or more of 72 different physical activity interventions were studied
- 24 interventions were conducted in healthcare settings, 20 in the workplace, 12 in homes, 8 in schools, 7 in the community and 11 in government institutions, religious institutions, sports centres or child care centres
- the length of follow-up ranged between 3 months and 10 years
- a total of 99 physical activity outcomes were evaluated in the various studies

For the purposes of the review, the authors assigned an activity level to each study as follows: 23 studies were classified as 'total activity', 50 as 'vigorous activity', 25 as 'moderate activity' and 1 as 'other activity'.

The authors analysed the statistically significant positive effects for each outcome separately, the pooled outcomes of one intervention and pooled outcomes of all interventions in a single study. The following observations were obtained for the general population:

- subjects were able to maintain an increase in physical activity three months post-intervention
- in 45 per cent of the studies they found at least one statistically significant positive effect on physical activity
- the overall effect of interventions in increasing physical activity was small
- the setting did not play a role in the success of an intervention
- interventions were successful at all intensity levels; there was no indication that more intensive interventions were more successful compared with less intensive interventions
- more than 25 per cent of studies that followed subjects for at least one year found a statistically significant increase in physical activity
- studies that assessed 'moderate activity' were more likely to show a statistically significant increase in physical activity than those that assessed 'total activity'.

Interventions to promote better nutrition and diet

Summary of evidence: There is good evidence to support the use of multiple strategies – including individual or group counselling, environmental changes and incentives – to promote increased fruit and vegetable consumption among people with risk of CVD.

Pomerleau *et al* (2005) performed a systematic review of evidence on the efficacy of interventions designed to promote increased fruit and vegetable consumption among adults. The authors reviewed 44 studies that:

- had interventions aimed at increasing fruit and vegetable intake
- included community-dwelling adults with no acute illnesses
- followed up with subjects for at least three months post-intervention
- had a control group for comparison.

The studies were conducted in France, India, Japan, Netherlands, New Zealand, the UK and the USA. The study settings included communities, African–American churches, workplaces and supermarkets. Sample sizes of each study ranged from approximately 250 to 3800 individuals; length of follow-up varied from as short as three months to greater than one year. Intervention strategies included meeting in person (for example, individual counselling/meetings, group counselling/education, lectures, workshops and speakers), telephone calls, computer-based interactive education methods, tailored and non-tailored printed educational materials, environmental changes (for example, nutrition displays, healthy cafeteria food choices, community activities and social marketing techniques), monetary incentives and coupons, and social support.

Among primary prevention interventions, an overall increase in fruit and vegetable intake by 0.1 to 1.4 servings per day was observed in intervention groups compared with control groups. Interventions

that targeted people with pre-existing health conditions showed an even greater increase in fruit and vegetable intake among intervention group members compared with those in the control group (0.27–4.9 servings/day), with the highest increase seen in subjects with cardiovascular risk factors (3.9–4.2 servings/day) and suspected myocardial infarction (4.9 servings per day). The literature reviewed also provided evidence that direct contact with people as well as telephone education or counselling interventions can be effective. Generally, materials customised to individual characteristics or specific subgroups are more effective for increasing fruit and vegetable intake than generic materials. Further, culturally sensitive educational materials targeting specific subgroups have also been found to be effective.

Havas *et al* (1998) performed a randomised crossover trial to assess the efficacy of nutrition education in increasing vegetable and fruit consumption of participants in the US Special Supplemental Nutrition Program for Women, Infants and Children (WIC). In Phase I of the trial, eight WIC sites were randomised into intervention and control groups. In Phase II, the sites were switched and the intervention sites became control sites and vice versa. New subjects were enrolled at all 16 sites during Phase II so that each site functioned as a control for itself.

The primary outcome measure was the increase in vegetable and fruit intake, while secondary outcome measures were moving in a positive direction in the stages of change, increase in self-efficacy, improvement in attitudes and a reduction in the number of barriers encountered to adopt healthier eating habits. Two months after the end of the intervention the following outcomes were observed:

- at the end of Phases I and II the increase in mean daily servings of fruits and vegetables consumed by the intervention group was significantly higher than that of the control group (0.56 versus 0.11; $p = 0.002$)
- there was a positive trend associated with the number of education sessions attended and the increase in mean daily servings of fruits and vegetables eaten
- although both groups showed an increase from baseline, a higher proportion of intervention group members were aware of the recommendation to eat five or more daily servings of fruits and vegetables compared with the control group at follow-up (57 per cent versus 46 per cent; $p < 0.0001$)
- more subjects in the intervention group had moved to higher stages of change (from pre-contemplation, contemplation and preparation stages at baseline) compared with the control group, and this change was statistically significant.

One year after the two-month, post-survey follow-up there was an additional increase in mean fruit and vegetable servings of 0.27 in both groups, which resulted in a 0.83 increase in the intervention group compared with a 0.38 increase in the control group ($p = 0.004$).

Reger *et al* (2000) assessed the effects of three community-based demonstration projects that promoted drinking low-fat milk (1 per cent or fat-free/skim milk) instead of high-fat milk (2 per cent or whole milk) by spreading the ‘1 per cent or less’ message in three rural communities in West Virginia in the USA. Each of the 3 communities used different intervention methods. Martinsburg ($n = 14,000$) functioned as the control community, Parkersburg ($n = 34,000$) used a public relations (PR) campaign and community-based educational programmes, and Beckley ($n = 18,000$) used paid advertisements to get the message out to residents.

A higher proportion of people reported switching to low-fat milk at the end of the campaign in both intervention communities compared with the control community (19.6 versus. 6.8 per cent and $p < 0.01$ for Parkersburg; 12.8 versus 6.8 per cent and $p < 0.0001$ for Beckley). After the end of the campaign milk

sales in the advertisement-only site were not maintained at 6-month follow-up (28 per cent before the campaign, 34 per cent after the campaign and 27 per cent at 6-month follow-up). The observed changes in milk sales were not statistically significant, and low-fat milk sales did not differ significantly between the two intervention communities.

Interventions to promote smoking cessation

Summary of evidence: There is some evidence that tailored self-help materials for individual smokers are effective and may increase quit rates.

Lancaster and Stead (2005) performed a Cochrane Review to assess evidence of the effects of self-help interventions on smoking cessation, including: the effects of self-help material versus no intervention, the effects of different types of self-help programmes and the effects of personalised self-help materials versus non-personalised material. The review included 60 RCTs that included at least one self-help intervention in the absence of repeated in-person interaction with a therapist. Study subjects were adult smokers who were not pregnant. Of the selected studies, 33 compared the outcomes of self-help materials with outcomes obtained in the absence of the intervention or evaluated self-help materials accompanied by counselling. The other 27 studies compared personalised and non-personalised materials. The studies were conducted in Australia (4), Canada (2), Finland (1), Hong Kong (1), Netherlands (2), Norway (1), Spain (2), Switzerland (1), the UK (8) and the USA (38). The settings of the interventions included communities, hospitals, clinics, managed care organisations, health maintenance organisations (HMOs), outpatient clinics, worksites, GP offices, family practices, university health centres, chest clinics, cancer screening centres and smoking cessation hotlines. The sample sizes of the studies varied from 40 to 4492 subjects and the duration of follow-up ranged from 6 to 24 months.

Some of the studies tested multiple interventions, some tested different types of self-help material and others tested varying degrees of a single intervention (for example, increasing the amount of self-help material provided). The interventions used written, audio, video or computerised self-help materials. Of the written material, leaflets were provided to control-group members while more detailed manuals were distributed to intervention group members. Self-help material was customised based on subjects' gender, ethnic group, age and, in some cases, an individual's smoking characteristics. 'Self-help only' interventions included a single in-person meeting to provide the materials to intervention subjects, with no further contact.

The primary outcome measure of interest was smoking cessation maintained for at least two follow-up time points, as indicated by self-report or validated with biochemical testing of saliva. In 11 trials (n = 13,733) that compared self-help with no intervention there was a (slightly) statistically significant increase in smoking cessation in the group that received self-help materials compared with no intervention (OR = 1.24; 95 per cent CI 1.07–1.45). In the 17 trials (n = 20,414) that compared non-tailored material with material individualised to smoker characteristics, the group receiving tailored material showed an increase in quit rates compared with the group receiving non-tailored material (OR = 1.42; 95 per cent CI 1.26–1.61). No differences in cessation rates were observed in the groups receiving in-person advice or nicotine replacement therapy in addition to self-help resources compared with the self-help only group.

Policy and environmental interventions to promote health behaviours

Summary of evidence: Some evidence supports the positive effect of policy and environmental interventions that promote access to healthy food and access to information related to health behaviours.

Matson Koffman *et al* (2005) performed a comprehensive, systematic literature review of policy interventions and environmental interventions[11] on increasing physical activity and improving nutrition aimed at promoting consumption of healthy foods. The authors reviewed a total of 65 articles that were published between 1970 and 2003 that used a variety of study designs including RCTs, observational studies, cross-sectional studies, pre- and post-test studies, case studies and quasi-experimental studies. The studies involved interventions performed at the following different types of community settings: worksite, school, restaurant, community and rural health centres, naval base, subway station, library, industrial plant, national agency, farmer's market, outpatient clinic and university. Most studies were conducted in the USA; a few were undertaken in Australia, Canada, England, Scotland, Sweden and Switzerland. Follow-up periods varied from 2 weeks to 10 years.

The review included a large number of environmental and policy interventions, and revealed more evidence related to programmes aimed at improving eating habits than those focused on increasing physical activity. The interventions most likely to increase consumption of healthy foods included the following:

- easy access to healthy foods
- 'point of purchase' strategies (that is, prominent display of nutritional information for foods on food labels, posters, menus or pamphlets in grocery and restaurant settings, and for items sold in vending machines)
- coupons or other methods of decreasing price – the impact of these interventions is increased when accompanied by educational information
- physician education on providing dietary counselling and routine reminders to review eating habits with patients.

Generally, physical activity increased when exercise locations were convenient and when opportunities to exercise were presented. Substantial evidence from RCTs has shown that signs about using stairs significantly increase the frequency of stair use. Further, multifaceted worksite interventions have been found to greatly increase exercise (for example, employee education, on-site gyms, incentives and encouragement from peers).

Early intervention for prevention of CVD among high-risk individuals

Summary of evidence: Although there is limited evidence of successful interventions to increase adherence to medication regimens to treat hyperlipidaemia, there is no sufficient evidence to recommend a specific intervention to increase patient use of LLDs.

The growth in the prescription of statins to lower cholesterol among people with CVD in the UK has been rising steadily by 30 per cent per year (Department of Health, 2000). In 2004, the expert Committee of Safety of Medicines advised that one statin, simvastatin, should be available without prescription in a 10mg dose. Under this scheme, beginning in 2004, pharmacists ask people a series of questions and, when appropriate, offer a range of health tests to ensure that they can safely dispense this drug. This move is intended to give pharmacists a greater role in screening and intervention, and provide greater public access to primary prevention treatment.

11 Environmental interventions are physical, social, economical or organisational changes that promote behaviour change in an individual. These interventions are distinguished from those that are delivered directly to a person.

Schedlbauer *et al* (2004) performed a Cochrane Review to identify and evaluate the effects of interventions to increase adherence to medication regimens to treat hyperlipidaemia. The review examined the following types of interventions:

- simplifying drug regimens
- providing information to patients and educating patients
- intensifying patient care by increasing follow-up and sending reminders
- implementing a behavioural approach by increasing motivation using group sessions and rewards
- building decision support systems
- improving administrative involvement through audits, documentation and information technology.

Results from 8 RCTs involving a total of 5943 patients – sample sizes of individual studies varied from 30 to 4548 patients – did not provide sufficient evidence for the authors to recommend a specific intervention to increase patient use of LLDs. However, a limited number of individual studies found evidence of successful interventions. Simplifying the drug regimen improved medication intake in two studies. Reducing drug intake from 4 times a day to 2 times a day improved the mean medication intake by 11 per cent (96 per cent in the intervention group versus 85 per cent in the control group; $p = 0.01$), which led to a decline in serum cholesterol levels.

Another trial showed that videotapes, booklets and newspapers distributed by the local pharmacy, followed up by an educational newsletter sent by mail, improved adherence by 13 per cent (92 per cent in the intervention group versus 79 per cent in the control group; $p = 0.005$). Another study found that weekly telephone calls to provide reinforcement and reminders to patients about taking their statin drugs increased the adherence by 24 per cent. Overall, the authors note that the quality of these studies is low.

Few diabetic patients are screened and targeted for maintaining healthy LDL-C levels even though treating dyslipidaemia drastically decreases CHD in diabetic patients. Mehler *et al* (2005) conducted an RCT to evaluate an educational detailing intervention aimed at provider behaviour about lipid management in diabetic patients. This trial found that providing education to clinicians – either electronically or directly – increased the proportion of patients with diabetes who received lipid testing as recommended by care guidelines. A total of 884 patients from 12 sites in the Denver, Colorado metropolitan area in the USA were enrolled in the study using a stratified randomisation scheme; 5 sites of 323 patients were randomised to the control group, 4 sites of 415 patients were assigned to the electronic detailing intervention group and 3 sites of 146 patients were assigned to the direct detailing intervention group. During a one-year period, physicians at the two intervention group sites were given educational guidelines on lipid control in diabetic patients with hypercholesterolaemia, while physicians at the control sites were informed about the goals of the study and the importance of lipid management in diabetic patients. Favourable provider behaviour increased in the intervention group compared with the control group (22 per cent versus 6 per cent; $p = 0.01$). Specifically, lipid testing increased at interventions sites (23 per cent for combined direct and electronic detailing) compared with the control group (11 per cent; $p = 0.06$). An increase in lipid testing was observed with electronic detailing (OR = 3.0; 95 per cent CI 1.6 to 5.7) and direct detailing (OR = 1.8; 95 per cent CI 0.9 to 3.7) in patients who did not receive an LDL-C test prior to the intervention.

There were some limitations to the study. The data was abstracted from patients' charts and this resulted in missing demographic information such as race and smoking status for 40 per cent of the subjects. The stratified randomisation used resulted in unequal numbers of patients in each group reducing the statistical power to observe differences between the intervention and control groups. The

stratified randomisation also resulted in substantial differences in race and insurance between the two intervention groups which, even with attempting to control during the analysis, may have influenced the differences in outcomes.

Evidence of early interventions for preventing CVD among high-risk individuals

GP office

Tools for the medical record

Summary of evidence: There is evidence to show that GPs can use simple tools such as problem lists and flow sheets to address CVD risk reduction among high-risk patients.

McBride *et al* (2000) tested the use of medical record tools and changes in the documentation procedures of management of CVD risk factors in the multisite clinical trial known as HEART. As described earlier (see 'Tools for supporting preventive services activities') they found that primary care practices are capable of implementing prevention systems that are sustainable. Medical record tools included patient history questionnaires, problem lists, medical record labels and flow sheets. At 12 months, there was a statistically significant increase in the documentation of risk factor management in the combined intervention group compared with the control group ($p < 0.05$). At the 18-month follow-up all three intervention groups showed an increase in risk factor management documentation, but the increase was statistically significant only in the consultation ($p < 0.05$) and prevention coordination ($p < 0.01$) groups.

Patient decision aids

Summary of evidence: There is some evidence to suggest that patient decision aids can help in the decision to initiate antihypertensive therapy but does not impact long-term effects on blood pressure or CVD risk.

Montgomery *et al* (2003) performed an RCT to evaluate the impact of two different interventions consisting of simple and complex tools to aid decisions on whether to initiate use of antihypertensive medication among patients who had been diagnosed recently with hypertension. A study population of 217 patients between the ages of 30 and 80 years, who had consistently elevated blood pressure and were not on antihypertensive drugs, were recruited from 21 general practices in the Avon Health Authority in England between March 2000 and May 2001. There were four study groups: one with neither intervention (control group), one with the complex decision analysis aid, one with the simple video/leaflet aid (informational about hypertension) and one with both aids.

The first study observed the following outcomes:

- participants who received both the decisional analysis and video/leaflet interventions had the lowest conflict and difficulty in making a decision to start medication
- both decision analysis and video/leaflet interventions decreased total conflict related to making a decision to start hypertensive medication; however, decision analysis had a greater effect
- intervention groups had significantly greater cardiovascular risk knowledge than controls immediately following exposure, but three months later, there was a decline in knowledge

in all study groups (only the differences between the video/leaflet groups were statistically significant)

Emmett *et al* (2005) conducted a long-term follow-up study on a cohort from the Montgomery trial. They obtained follow-up data on blood pressure measurement at three years, CVD risk factors, current antihypertensive drugs, consulting data and self-reported adherence to medication for 216 out of the original cohort of 217 subjects. The risk factor data was used to calculate the 10-year absolute risk of having a CVD event using Framingham risk equations.

Emmett's research team found an overall decline in mean blood pressure (from 168/99 Hg mm to 148/85 Hg mm) and a reduction in mean 10-year CVD risk from 26 to 22 per cent in the study cohort as a whole over the three-year follow-up period. However, there was no difference in SBP or DBP, 10-year CVD risk, number of consultation visits related to hypertension or number of consultation visits resulting in change in management of hypertension between the decision analysis aid and video/leaflet interventions groups. Although the two interventions reduced conflicts in making decisions related to initiating antihypertensive therapy, they did not yield any long-term effects on blood pressure and 10-year CVD risk.

Atthobari *et al* (2004) conducted an observational cross-sectional study to evaluate the impact of sending letters recommending the use of blood pressure lowering drugs (BPLDs) and/or LLDs to individuals and their providers following a population-based screening for hypertension and hypercholesterolaemia. A population of 7567 patients from an outpatient clinic at the Groningen University Hospital in the Netherlands participated in the first screening of the Prevention of Renal and Vascular Endstage Disease (PREVEND) study and served as the intervention group. Clinical data were obtained from the outpatient clinic records, and data on the use of blood pressure and LLDs were obtained from the community pharmacies for the year before and after the screening. The control group was sourced from the InterAction Database (IADB) consisting of pharmacy-dispensing data for about 200,000 subjects after standardising the data for population characteristics of the intervention group.

Approximately 5.2 per cent of the intervention group was found to have elevated blood pressure, 4.3 per cent screened positive for hypercholesterolaemia and 0.04 per cent (3 patients) were found to have both conditions. As appropriate, individuals and their physicians were sent a letter advising them about the benefits of BPLDs, LLDs or both; individuals were encouraged to start taking these medications. The authors observed the following results:

- The use of BPLD increased in the intervention group compared with the control group (19.4 per cent versus 17 per cent; $p < 0.001$) one year after the screening and intervention letter, and a higher proportion of patients started on BPLD the year after screening in the PREVEND intervention group compared with the control group (3.4 per cent versus 2.5 per cent; $p < 0.001$).
- The use of LLDs increased in the intervention cohort compared with the control cohort (7.1 per cent versus 5.4 per cent; $p < 0.001$), and a greater percentage of individuals in the intervention cohort began using an LLD after the intervention letter compared with the control cohort (2.1 per cent versus 1 per cent).
- The decision to follow the advice of the letter was influenced by the blood pressure and cholesterol levels rather than by other cardiovascular risk factors.

Overall CVD risk

Summary of evidence: There is evidence to support the use of single and multifaceted interventions to target primary and secondary CVD prevention risk factors, morbidity and mortality.

A 2006 update of a 1999 Cochrane Review on primary prevention (Ebrahim, Beswick, Burke, & Davey Smith, 1999, 2006) concluded that multiple risk factor interventions had no effect on mortality for the general population. However, the authors also noted that a 10 per cent reduction in CHD mortality may have been missed (due to design or analysis flaws) in the high-risk hypertensive populations studied in the 39 trials included in this review. Counselling and education were found to be more effective at reducing risk factors (and therefore mortality) in this population.

Ketola *et al* (2000) performed a systematic review of RCTs to investigate the effects of lifestyle interventions such as diet, physical activity, reduced alcohol intake and smoking cessation on the reduction of CVD risk factors, morbidity and mortality. Single and multifaceted interventions targeting primary and secondary prevention were found to be successful in reducing risk factors, morbidity and mortality. The review included 42 trials – 20 primary prevention and 22 secondary prevention, 21 single factorial and 21 multifactorial – published between 1966 and 1999. Three studies primarily included adults between the ages of 18 and 65 who were followed for at least 1 year. Sample sizes of the individual trials varied from 31 to 12,866 subjects and 15 of these studies included only men. The countries where the studies were conducted were not stated in the article.

The review yielded the following findings:

- In both primary and secondary prevention trials the pooled mean decrease for SBP and DBP were greater in the intervention group compared with the control group, but the differences were not statistically significant.
- In the secondary prevention studies the mean reduction in total cholesterol was higher in the intervention group compared with the control group in the single-factorial diet study (mean change -0.47mmol/L versus -0.02mmol/L; p = 0.037) and the multifactorial diet studies (mean change -0.43mmol/L versus -0.07mmol/L; p = 0.007).
- In three multifactorial primary prevention studies the mean weight reduction was higher in the intervention group compared with the control group (weight change -0.9kg versus +1.2kg; p = 0.023); in multifactorial secondary prevention studies the pooled mean weight change was -0.6kg for intervention subjects and +1.3kg for control subjects (p = 0.026).

In interventions targeting secondary prevention both single and multifaceted lifestyle interventions reduced morbidity, mortality and cholesterol levels. Weight reduction was more successful in multifactorial interventions targeted at primary prevention compared with secondary prevention. However, findings should be considered with caution because the study effects observed were not statistically significant, which is likely to be due to the small sample size of study participants. A quality assessment of the review conducted by the CRD found that the methods used to conduct this review were sound and the authors' conclusions were feasible.

Edelman *et al* (2006) conducted an RCT of a multidimensional integrative medicine intervention to reduce CHD risk and increase physical activity and weight loss. Patients of primary care physicians at a university-based centre for integrative medicine in the USA were eligible to participate if they were over the age of 45 and had one or more CVD risk factors such as diabetes, hypertension, dyslipidaemia, smoking or BMI greater than 25kg/m2. The intervention comprised risk education followed by the development and implementation of a personalised health plan (PHP). The PHP intervention arm had 77 subjects while the control arm had 66 subjects receiving usual patient care (UPC). At baseline, the 10-year CHD risk was 11.1 per cent in the UPC control group and 9.3 per cent in the PHP intervention group. This risk decreased to 9.8 per cent in the UPC control group and 7.8 per cent in the PHP intervention group at 10-month follow-up. There was a statistically significant difference in the improvement of risk between the intervention and control groups (p = 0.04). The intervention group had more days of physical activity per week compared with the control group (3.7 versus 2.4; p = 0.002)

and subjects in the PHP intervention group who were overweight at baseline lost more weight than overweight patients in the control group (p = 0.06).

Lobo *et al* (2004) performed an RCT to evaluate the effectiveness of a comprehensive intervention programme targeting GP staff that was intended to improve health-related quality of life among patients at high risk for cardiovascular disease either due to known CVD or increased risk as a result of diabetes, hypercholesterolaemia or hypertension. During the period between November 1996 and February 1999, 124 physician practices in southern Netherlands that had a computer system adequate for electronic medical record keeping were randomised into the intervention and control groups. The intervention group practices (n = 62) received a 21-month intervention promoting practice organisation, registration and task delegation aimed at optimising case finding and diagnosis of CVD; these interventions were conducted by an outreach visitor. Control group practices (n = 62) received baseline and post-intervention measurements at the same time as the intervention group practices. Using results from the Medical Outcomes Study (MOS) 36-Item Short Form Health Survey/SF-36 conducted with patients at the studied practices, there was an observed health related quality of life (HRQL) decline for patients in both intervention and control groups. However, the decline was greater among the control group. Among patients with CVD, significant differences during the post-intervention period were observed between the intervention and control groups (that is, physical functioning [3.57; 95 per cent CI 0.71–6.43], vitality [3.01; 95 per cent CI 0.72–5.3] and social functioning [3.96; 95 per cent CI 0.5–7.42]). Results indicated that the implementation of a comprehensive intervention programme in the general practice setting could have a positive effect on many domains of the HRQL for patients with CVD risk.

Promoting healthy eating among those with hyperlipidaemia

Summary of evidence: There is no good evidence to demonstrate that dietician advice produces better outcomes than self-help resources or nurses for cholesterol management among individuals with hyperlipidaemia.

Thompson *et al* (2003) conducted a Cochrane Review to examine evidence on the effects of dietician-delivered interventions for cholesterol management compared with interventions conducted by doctors or other health professionals and self-help resources.[12] The review included 12 RCTs of community-dwelling adults without CHD or a history of myocardial infarction, ranging in size from 59 to 431 participants. This study was conducted in Australia (2), Canada (1), England and France (1), Sweden (1), the UK (1) and the USA (6); studies varied from 6 weeks to 2 years.

The interventions included dietary advice aimed at lowering blood cholesterol. Most interventions provided advice only on diet, while two studies also included advice about physical activity. Three studies included subjects taking lipid lowering medication; one study performed separate analyses for medication and non-medication groups, while the other two studies added the lipid lowering medication only after the initial six weeks. The interventions by dieticians consisted of group sessions (one intervention included fewer than ten meetings while three interventions included more than ten), one-on-one meetings and a combination of group and individual sessions. The subjects receiving advice from a physician met less frequently and had shorter sessions compared with subjects receiving advice from dieticians. The self-help resources were leaflets providing information on heart disease and lowering blood lipid levels.

The review considered primary and secondary outcome measures. The primary measure was the change in blood cholesterol. The secondary measures were changes in HDL-C, LDL-C, BMI or weight, blood pressure and patient satisfaction with the intervention. Random effects analyses yielded

12 The review included interventions conducted by nutritionists and dieticians, because they also have training to provide dietary counselling.

evidence that dieticians were more successful in producing short- and medium-term reductions in blood cholesterol in patients compared with doctors (-0.25mmol/L; 95 per cent CI -0.37 to -0.12mmol/L). However, the review did not find evidence to suggest that dietician advice produced better outcomes than self-help resources or nurses (-0.1mmol/L; 95 per cent CI -0.22 to 0.03mmol/L). In addition, one study showed that the reduction in blood cholesterol was marginally less for the dietician's advice group compared with the nurse's advice group (0.08mmol/L; 95 per cent CI -0.11 to 0.27mmol/L). The same study found no statistically significant difference was observed between subjects receiving advice from a dietician compared with a counsellor. Of the secondary outcome measures, subjects receiving a dietician's advice showed a larger reduction in HDL-C compared with those getting advice from a nurse (-0.06mmol/L; 95 per cent CI -0.11 to -0.01mmol/L), and subjects in the dietician's advice group observed a larger reduction in body weight compared with the counsellor's advice group (-5.8kg; 95 per cent CI -8.91 to -2.69kg). None of the other secondary outcomes indicated a statistically significant association. The analysis included data from a limited number of trials and the trials were not of a high quality.

Willaing *et al* (2004) conducted a cluster randomised trial of two different strategies of nutritional counselling for patients at high risk for ischaemic heart disease (IHD) in a primary healthcare setting. Sixty GPs in Copenhagen County, Denmark were randomised to give nutritional counselling to patients (control group) or to refer patients to a dietician (intervention group). After opportunistic screening, 503 patients in the two groups received counselling from GPs (n = 191) or dieticians (n = 312) over a 1-year period. Outcomes were determined by changes in weight, waist circumference and blood lipid levels. Among those who completed the interventions (n = 339), those who received physician counselling intervention had a significantly larger weight loss in the first month ($p = 0.04$) than those who received counselling from a dietician. However, overall, weight loss was greater in the dietician-counselled intervention group compared with the GP-counselled control group (4.5kg versus 2.4kg; $p = 0.01$). These differences were not observed in an intent-to-treat analysis. The increase in HDL-C was higher among those who received counselling from their GP compared with the control group (mean 0.13mmol/L versus 0.03mmol/L; $p = 0.003$), and the reduction in the CVD risk score observed in the GP-counselled group was significantly greater than that of the dietician-counselled group ($p = 0.01$). Overall, counselling from a GP had a significant impact on reducing risk for IHD; however, obese patients had better outcomes from long-term nutritional counselling from a dietician.

Verheijden *et al* (2004) conducted an RCT to evaluate the effect of web-based nutrition counselling and social support on the measures of social support, anthropometry,[13] blood pressure, and serum cholesterol in patients at increased risk for CVD. A total of 146 patients in Canadian practices who were at high risk for CVD were randomised into intervention (n = 73) and control (n = 73) groups, and both groups were provided with usual care during the 8-month study period. The intervention group also received access to web-based nutrition counselling and a social support tool named Heartweb. Only one out of three members of the intervention group used the Heartweb site, and users were significantly younger than those who did not use the website ($p < 0.03$). There were no significant differences between the intervention and control groups in social support, anthropometry, blood pressure or serum cholesterol.

Physical activity

Summary of evidence: There is mixed evidence to support the effectiveness of physician advice on the participation in physical activity by individuals with high risk for CVD.

13 Anthropometry is the study of the measurement of the human body in terms of the dimensions of bone, muscle and adipose (fat) tissue.

Van Sluijs *et al* (2005) conducted an RCT to evaluate the impact of a minimal intervention physical activity strategy on physical activity and body weight among patients between 18 and 70 years old who were diagnosed with hypercholesterolaemia or non-insulin-dependent diabetes mellitus. The study was conducted in 29 volunteer rural and city general practices in the Netherlands during a 1-year period. To be included in the study patients had to be able to participate in moderately intense physical activity and could not have been regularly physically active within the six months prior to study.

The intervention consisted of two physician visits and two follow-up telephone calls from a physical activity counsellor. During the first physician's visit patients completed a questionnaire so that providers could assess their stage of readiness to begin a physical activity programme, and the provider made available counselling tailored to each patient's stage of readiness (that is, pre-contemplation, contemplation/preparation or action/maintenance). Two weeks later a physical activity counsellor provided encouragement and discussed barriers to exercise by telephone. Physicians reviewed participant progress and conducted additional counselling as needed during a patient visit four weeks after the initial visit. Another four weeks later, participants received a second call from the physical activity counsellor. In contrast, those in the control group were briefly questioned about physical activity by their providers who encouraged them to begin to be more physically active, as appropriate.

The duration of physical activity significantly increased from baseline to one-year follow-up in both intervention and control groups. Specifically, a statistically significant increase was observed in total physical activity (mean increase of 61.6 minutes; 95 per cent CI 7.5–115.6) and leisure time physical activity (mean increase 61.8 minutes; 95 per cent CI 24.5–99.1). A statistically significant decrease in waist circumference was observed in the intervention group (adjusted change from baseline, 2cm; 95 per cent CI 0.92-3.07) compared with the control group. In summary, the intervention was as effective as standard advice from physicians to increase physical activity. Therefore, the authors recommended that physicians offer counselling and training to encourage patients to exercise.

Marshall *et al* (2005) conducted an RCT to examine the impact of physician advice to engage in physical activity on behaviour among physically inactive patients between the ages of 40 and 70 years in the context of managing hypertension versus general health promotion. A total of 767 patients visiting 75 physicians' practices in Australia were recruited for the study and randomised to one of four treatment groups:

1 health promotion intervention group (HP intervention), which received material and advice to encourage more physical activity focused on promoting general health
2 health promotion control group (HP control), which received routine medical care
3 risk factor intervention group (RF intervention), which received material and medical advice to encourage more physical activity centred on managing their hypertension
4 risk factor control group (RF control), which received routine medical care.

At two-month follow-up, there were no differences in self-reported physical activity between the two intervention groups or between each intervention and its respective control group. Similarly, at six-month follow-up there was no difference between the RF intervention group and its control or the HP and RF intervention groups. A significantly higher proportion of individuals in the HP intervention group reported exercising at the six-month follow-up compared with the corresponding control group ($p = 0.009$). Since there were no significant differences between the outcomes observed for the two intervention groups this study provides evidence that physician advice increases physical activity for approximately one-half to two-thirds of individuals, regardless of the context of the information.

Strategies for hypertension control

Summary of evidence: While there are multiple strategies used to improve identification and control of hypertension, there is no good evidence for a specific strategy to use across settings due to the mixed quality of available evidence.

Commissioned by AHRQ, an evidence-based practice review of quality improvement (QI) interventions targeted at improving hypertension screening and managing primary hypertension in non-pregnant adults found that the majority of QI interventions are aimed at improving identification and control of hypertension (Pignone *et al*., 2001). Because most studies use more than one intervention, it is impossible to determine the strategy with the greatest effect, and all of the interventions may be effective in varying degrees. The review included 63 articles containing randomised and quasi-randomised controlled trials, controlled before and after studies, and interrupted time series designs in which at least one reported outcome measured change in blood pressure and provider or patient adherence to a process of care. The provider interventions were categorised into the following groups: provider reminders, provider education, patient reminders, promotion of patient self-management, audit and feedback, organisational change or financial incentives. Positive results were seen in the majority of clinic-based screening studies where the most common QI intervention was patient and/or provider reminders. Across all studies the median decreases in SBP and DBP were 4.5 Hg mm (IQ range 1.5 to11) and 2.1 Hg mm (IQ range -0.2 to 5). The median increases in the proportion of patients in the target range for SBP and DBP were 16.2 per cent (IQ range 10.3 to 32.2) and 6 per cent (IQ range 1.5 to 17.5) respectively. The median improvement of overall adherence was 2.8 per cent (IQ range 1.9 to 3). The review did not reveal a specific strategy that could be recommended to improve identification or control of hypertension across settings due to the mixed quality of available evidence in the literature.

Bosworth *et al* (2005) conducted an RCT to determine if a nurse-administered intervention tailored to patients with known hypertension was able to better control blood pressure. A total of 588 veterans with hypertension from the Durham area, North Carolina, USA were randomised into intervention (n = 294) and control (n = 294) groups. Members of the control group received routine care and the intervention group received information about hypertension management by telephone with a nurse case manager every two months for two years. Nurse support was provided for nine specific topics: hypertension knowledge, memory, literacy, social support, patient–provider communication, side-effects of therapy, medication refills, missed appointments with providers and health behaviours. The nurse uses specific scripts and algorithms to standardise the delivery of the intervention; however, the decision to address the various topics was based on the needs of the patient.

At six months after enrolment patients in the intervention group had more confidence in following treatment for hypertension than the control group ($p < 0.007$). Initial results found evidence that there was an increased awareness of blood pressure control among patients. Early results also indicated that the intervention was easy to implement: the average telephone call lasted 3.7 minutes, and at the end of one year 97 per cent of individuals in the intervention group were still participating in the intervention.

Hunt *et al* (2004) performed a single-blinded RCT to evaluate the effect of an educational mailing on knowledge of hypertension, blood pressure control and satisfaction with care among patients with mild hypertension (SBP 140–159 Hg mm and DBP 90–99 Hg mm). Approximately 5500 patients from 9 clinics that were part of a primary care practice-based network in Portland, Oregon, USA were randomised into intervention and control groups. The control group received standard care, while each member of the intervention group received two packets of educational material by mail three months apart.

For this study the authors obtained data from 312 individuals: 162 from the intervention group and 150 from the control group. Patients in the intervention arm scored higher on a hypertension knowledge test than those in the control group (7.48 points ± 1.6 versus 7.06 points ±1.6; p = 0.019). Overall, there was no significant difference between the study groups in the prevalence of owning a home blood pressure monitoring device, the frequency of measuring blood pressure or blood pressure levels at follow-up. When comparing a subset of the intervention group who reported receiving the intervention materials (n = 111), those in the intervention group reported that they checked their blood pressure 9.6 times, on average, during the past 30 days compared with only 5.7 times among those in the control group (p < 0.05).

Tobe *et al* (2006) conducted an RCT to assess the effectiveness of a community-based treatment strategy implemented by home care nurses in managing hypertension in a First Nations population with hypertension and type 2 diabetes mellitus. First Nations people over the age of 18 years and registered with the Battlefords Tribal Council Indian Health Services in Ontario, Canada were recruited for the study via community clinics and visits by home care nurses and aids between September 2001 and March 2003. Approximately 100 individuals were assigned to the intervention (n = 50) and control groups (n = 49). For patients in the intervention group, drug treatment regimens were monitored and adjusted by home care nurses using a prescribed algorithm. In contrast, patients in the control group received medication therapy from their physicians. All patients received classes on adopting a healthy lifestyle, including issues such as diet, physical activity (30 minutes per day, 5 days a week), smoking cessation and drug adherence, and they participated in periodic visits with a home care nurse and hypertension specialist. Blood pressure readings of both the intervention and control groups decreased significantly from baseline to follow-up (p < 0.001). Although there was no significant difference in SBP of the intervention and control groups, the intervention group had a larger reduction in DBP over the one-year period compared with the control group (11.6 Hg mm and SD = 10.6 versus 6.8 Hg mm and SD = 11.1; p = 0.05). Medication management conducted by home care nurses had a similar effect on blood pressure reduction, with slightly better improvement in DBP compared with usual care provided by a physician.

Appel *et al* (2003) conducted an RCT to evaluate the impact of comprehensive lifestyle modification on blood pressure control among individuals with high blood pressure who were not using BPLDs. Between January 2000 and June 2001, 810 adults at 4 clinical centres in the USA were stratified by clinic and hypertension status and randomised into the following three groups:

1 behavioural intervention only – 268 individuals participated in a behavioural intervention that followed established traditional lifestyle recommendations (weight loss, reduced sodium intake, reduced alcohol intake, increased physical activity and so on)
2 behavioural intervention and the Dietary Approaches to Stop Hypertension (DASH) diet – 269 people participated in the behavioural intervention and received information and counselling on the DASH diet
3 comparison group – 273 individuals received 30 minutes of counselling and educational material about factors that affect blood pressure.

The comparison group received information and counselling only at baseline, while the two intervention groups participated in meetings and counselling sessions, and recorded food intake and physical activity throughout the six-month follow-up period.

Overall, individuals who received either intervention (behavioural intervention or behavioural intervention and DASH diet) had significantly greater reductions in both SBP and DBP than the comparison group (p < 0.01). Similarly, the prevalence of hypertension was significantly lower among the intervention groups compared with the advice-only group. Compared with hypertension prevalence of 38 per cent at baseline, prevalence at 6 months was 26 per cent in the advice-only group, 17 per cent in the

behavioural intervention-only group ($p < 0.001$ compared with advice only) and 12 per cent in the behavioural intervention and DASH diet group ($p < 0.001$ and $p = 0.12$ compared with the advice-only and recommendations-only group respectively). In addition, the proportion of individuals who had achieved optimal blood pressure levels was significantly greater among the intervention groups compared with the advice-only group. The prevalence of optimal blood pressure was 19 per cent in the advice-only group, 30 per cent in the recommendations-only group ($p = 0.005$ compared with advice-only group) and 35 per cent in the recommendations and DASH diet group ($p < 0.001$ compared with the advice-only group, and $p = 0.24$ compared with the recommendations-only group). Both intervention groups were able to substantially decrease sodium intake, increase fitness and lose weight. The group that used the DASH diet was also able to significantly increase the intake of fruits, vegetables and dairy products.

Workplace

We did not identify any empirical research that focused solely on early interventions for persons already at risk for CVD that were offered or provided in workplace settings. As a general proposition, such care may tend to be more medical or pharmaceutical compared with services aimed at screening or health promotion for generally healthy populations. Early interventions for at-risk and especially high-risk patients may require some clinical oversight beyond general population screening or health promotion efforts. Workplaces would probably tend not to have such health professionals readily available.

Community

Pharmacy-based interventions

Summary of evidence: There is strong evidence to support the role of pharmacy-based interventions in improving cholesterol management and promoting smoking cessation among patients at high risk for CVD.

Tsuyuki *et al* (1999; 2002) examined data from the Study of Cardiovascular Risk Intervention by Pharmacists (SCRIP), an RCT that was conducted at 54 community pharmacies in the Canadian provinces of Alberta and Saskatchewan to assess the effectiveness of a community pharmacist-led intervention for cholesterol management in patients who were at high risk for secondary prevention CHD.

Pharmacists classified potential study participants as high-risk for CHD if they had atherosclerosis-related vascular disease, including myocardial infarction, stable or unstable angina, bypass surgery for coronary revascularization, cerebral or peripheral vascular disease or diabetes with one CHD risk factor. A total of 675 individuals were recruited and randomised to the intervention (n = 344) or usual care control (n = 331) groups. The intervention group received the following intervention:

- pharmacists evaluated patient CHD risk via interview and measurement of total cholesterol
- pharmacists discussed CHD risk factors with participants and provided patient education about CHD, including a booklet on heart attack and stroke from the Alberta Medical Association (AMA) and the Clinical Quality Improvement Network (CQIN), and brochures and teaching aids from the Heart and Stroke Foundation
- pharmacists facilitated discussion of CHD risk among participants and their physicians by suggesting that participants make an appointment with their provider and by the pharmacist faxing their physician the results from the CHD risk assessment conducted, as well as recommendations for additional testing and treatment.

Control group subjects received usual care consisting of the booklet on heart attack and stroke from the AMA and CQIN explaining the modifiable risk factors related to CHD such as lack of exercise, diabetes, hypertension, high cholesterol, obesity and smoking. The study was terminated early because preliminary data analyses from the first 400 patients found strong evidence of an improvement in the intervention group when compared with the control group.

Yamada *et al* (2005) evaluated the effectiveness of a pharmacist intervention on lipid control among individuals identified as being at very high risk of cardiovascular events one year after the end of the intervention.[14] This study, the second Study of Cardiovascular Risk Intervention by Pharmacists (SCRIP-plus), randomised 419 patients into intervention and control groups. The intervention group participated in face-to-face visits with a pharmacist at baseline, and three- and six-month follow-ups. Pharmacists assessed lipid levels, provided patient education and, as needed, provided physicians with recommendations regarding medication management. Pharmacists also contacted patients by telephone two and four weeks after the initial visit to monitor progress. The control group received usual care. At six-month follow-up, the intervention group had a significant reduction in average LDL-C level from 135.2 mg/dl to 116.0 mg/dl ($p < 0.0001$). A total of 162 of the 359 patients who completed the final six-month follow-up in SCRIP-plus visited their community pharmacy and had their fasting LDL-C levels measured at one-year follow-up. Patients managed to maintain reduced levels of LDL-C for 14 months and that continuation of the SCRIP intervention was necessary to help patients still not at target LDL-C levels to achieve them. The results indicated that 38 per cent of the patients were at the target LDL-C level of less than 96.7 mg/dl.

Blenkinsopp *et al* (2003) performed a systematic review of evidence on the effects of pharmacy-based interventions for smoking cessation and lipid management among adults at risk of cardiovascular disease. The 12 studies reviewed (6 RCTs and 6 non-randomised designs) were conducted in Canada, Sweden, Switzerland, the UK and the USA, and were published between January 1990 and February 2001. Studies ranged in size from 25 to 616 individuals and lasted between 6 weeks and 2 years.

This review provides evidence of the effectiveness of community pharmacy services for promotion of smoking cessation. For example, in one study 124 community pharmacists in Northern Ireland and London conducted a structured counselling intervention that included follow-up contact with participants on a weekly basis for 4 weeks, followed by monthly interactions on an as-needed basis. Compared to a control group that did not receive counselling, the intervention group had a significantly higher rate of self-reported smoking cessation at 12-month follow-up (14.3 per cent and 7 per cent respectively; $p < 0.001$). A cost-effectiveness analysis of an RCT conducted in Scotland showed that the cost to achieve one successful smoking cessation attempt was substantially more when using rigorous interventions versus standard pharmaceutical support (£300 or £83 per year of life saved).

The results from the studies on lipid management in CHD also demonstrated the effectiveness of using community pharmacy services. For instance, an RCT conducted in the USA evaluated the impact of a 'screening day' conducted at a pharmacy during which participants' cholesterol levels were tested and a pharmacist provided counselling on eating habits, physical activity and LLDs. At 6-month follow-up, 32 per cent of intervention participants had attained lipid-level goals compared with only 15 per cent of the control group. A CRD assessment of this review suggested that the quality of the review may be compromised by the fact that the reliability of the results is uncertain and several sections of the article are confusing.

Home blood pressure measurement

Summary of evidence: Home blood pressure measurement by the patient is an effective and accurate means to monitor and control blood pressure.

14 Results from the original study had been reported previously: see Tsuyuki *et al* (1999; 2002).

Verberk *et al* (2005) published a systematic review of papers that studied home blood pressure measurement (HBPM) and office blood pressure measurement (OBPM). For the purposes of the systematic review, studies were grouped into five different categories and five analyses were performed to determine the following:

- the number of measurements required for HBMP (4 studies)
- the upper limit of normal values for HBPM (7 studies)
- the difference between HBPM and OBPM in untreated hypertensive patients (18 studies)
- the difference between HBPM and OBPM in treated hypertensive patients (13 studies)
- HBPM and OBPM in relation to the efficacy of antihypertensive drug treatment (8 studies).

The sample sizes for individual studies ranged from 10 to 5211 subjects. The locations where the studies were conducted and the types of studies were not provided in the review.

Using HBPM, evidence indicates that valid blood pressure measurements can be obtained in the following way: take blood pressure twice in the morning and twice in the evening for three consecutive days and discard measurements from the first day. Overall, the trials reviewed found that HBPM is a better indicator of cardiovascular mortality and the outcome of cardiovascular events than OBPM, because HBPM correlated better with target organ damage, especially left ventricular hypertrophy and renal damage. HBPM measurements were generally lower than those obtained in office-based settings.

Cappuccio *et al* (2004) performed a meta-analysis of 18 RCTs to study the effects of HBPM on blood pressure levels and hypertension control and found that HBPM enabled people with hypertension to control their blood pressure and attain their targets better compared with the OBPM conducted in the healthcare system. These trials were performed in the USA (10), Canada (3), Australia (2), Germany (1) and Switzerland (1).[15] The length of interventions reviewed varied from 6 to 36 months. People with hypertension were allocated into two groups: the intervention group who measured their own blood pressure at home (n = 1359) and the control group who had their blood pressure checked by a provider in the healthcare system (n = 1355). The major outcome measures were differences in SBP (13 studies), differences in DBP (15 studies), differences in mean blood pressure (3 studies) and proportions of patients achieving the target blood pressure (6 studies).

People using HBPM had lower SBP (a mean difference of 4.2 mm; 95 per cent CI 1.5 to 6.9), lower DPB (a mean difference of 2.4 mm Hg, 95 per cent CI 1.2 to 3.5), and lower mean blood pressure (a mean difference of 4.4 mm Hg; 95 per cent CI 2.0 to 6.8) than people using standard OBPM in the healthcare system. HBPM also decreased the risk of patients having blood pressure higher than targeted levels (RR = 0.9; 95 per cent CI 0.8 to 1.0); the difference in the mean was 2.2 mm Hg (95 per cent CI -0.9 to 5.3) for SBP and 1.9 mm Hg (95 per cent CI 0.6 to 3.2). Patients have found HBPM to be acceptable and physicians have found it to be a reliable method to help improve patients' awareness of their blood pressure levels and to enable them to closely monitor and effectively manage their own blood pressure.

Staessen *et al* (2004) conducted a blinded RCT to evaluate patient outcomes associated with HBPM compared with OBPM. The trial took place at 56 primary care practices and 3 hospital-based outpatient clinics in Belgium, and 1 hypertension clinic in Ireland during the 5-year period between 1997 and 2002. The study enrolled 400 adults with high blood pressure (that is, DPB ≥ 95 mm Hg [measured in the physician's office]) that was either untreated or treated with two or less antihypertensive medications. Follow-up was conducted at 1 month, 2 months and every 2 months after that for a period of 1 year. The HBPM group (n = 203) obtained an average of three consecutive measurements taken twice a day (in

15 The location of one study was not noted in the article.

the morning and at night) over the 7 days prior to each follow-up visit. For the OBPM group (n = 197), a physician obtained an average of three consecutive measurements taken at the office during regular business hours.

As found in other studies, blood pressure measurements using HBPM were generally lower than those obtained from OBPM. The average difference in SBP and DBP between groups was 6.8 and 3.5 mm Hg using OBPM, and 4.9 and 2.9 mm Hg using 24-hour HBPM. Twice as many HBPM patients (25.6 per cent versus 11.3 per cent OBPM patients; $p < 0.001$) were able to permanently stop antihypertensive medications at the end of the one-year follow-up period. Fewer HBPM patients proceeded to multiple-drug treatment (38.7 per cent versus 45.1 per cent OBPM patients); however, this finding was not statistically significant. The study also helped to identify patients with 'white-coat hypertension', or those whose blood pressure increases when measured at the physician's office. Further, the cost (per 100 patients seen for 1 month) was slightly lower for the HBPM group than for the OBPM group.

Kisioglu *et al* (2004) conducted an RCT to determine the ability of a health training course to teach middle-aged women in low socioeconomic groups in Yenice, Turkey how to better control hypertension. A total of 400 women aged between 20 and 50 years were randomised into intervention and control groups. The intervention study arm received health education pamphlets and training on hypertension and weight reduction from a public health expert. Prior to receiving the training the women had their blood pressure, weight and body size measured. Additionally, community leaders paid individual visits to women in the intervention group in order to encourage participation. Members of the control group received no training.

At the end of the six-month intervention period the researchers observed the following outcomes:

- The number of women in the intervention group with normal BMI significantly increased ($p = 0.001$); similarly, there were significantly more women in the intervention group than in the control group with normal BMI at the conclusion of the study ($p = 0.009$).
- The percentage of women in the intervention group who engaged in physical activity increased significantly from baseline to follow-up (17 to 46.5 per cent, $p < 0.001$), whereas no significant change in exercise behaviour was observed in the control group.
- The intake of foods high in sodium decreased by 5.5 per cent in the control group and by 72.2 per cent in the intervention group.
- Women in the intervention group increased boiling food by 15.7 per cent and reduced frying food by 31.9 per cent.

Based on these results the public health training programme was a cost-effective method to promote lifestyle changes such as increased physical activity and healthier diet, which can lead to decreased blood pressure and obesity among this population of women.

Community health departments and public health nurses

Summary of evidence: There is good evidence that counselling and referrals by public health staff can lower blood pressure in hypertensives and improve nutritional intake behaviours in those with hypercholesteraemia.

Hill *et al* (2003) designed a 36-month RCT that compared the effectiveness of two interventions for controlling blood pressure. The study population consisted of 309 hypertensive African–American men from the Baltimore area, Maryland, USA between the ages of 21 and 54 with blood pressure

greater than 140/90 Hg mm. Subjects were randomised into two different education interventions. The first was a more intensive comprehensive educational/behavioural/pharmacologic intervention by a nurse practitioner/community health worker/physician team (NP/CHW/MD). Participants received comprehensive individualised attention from the NP/CHW/MD team including free medication and therapeutic decisions from the NP, referrals for social services, job training and housing assistance from the CHW, and consultation on the management of hypertension from the MD (as needed) (n = 157). The second was a less intensive education and referral intervention which provided participants with information about sources of hypertensive care in the community (n = 152).

At 36 months the proportion of men with target blood pressure levels was 44 per cent in the more intensive intervention group compared with 31 per cent in the less intensive intervention group (p = 0.045). Over time improvements in blood pressure rates were significantly greater in the more intensive group. Among individuals in both study groups, cigarette smoking and high salt intake declined and antihypertensive medication use increased, but high rates of obesity and illicit drug use remained unchanged during the 36-month study period.

Ammerman *et al* (2003) conducted a randomised clinical trial to assess the effectiveness of a dietary counselling intervention implemented by public health nurses for rural residents with high cholesterol levels who did not have access to nutrition counselling for hypercholesterolaemia. The investigators assigned 468 individuals in rural North Carolina, USA with high cholesterol to special intervention or minimal intervention groups with random assignment conducted at the health department level (that is, eight health departments assigned to the special intervention group and nine assigned to the minimal intervention group). Members of the special intervention group received:

- three individualised counselling sessions from a public health nurse on how to follow a structured dietary intervention called Food for Heart Program (FFHP) aimed at low-income individuals with hyperlipidaemia
- referral to a nutritionist if lipid targets were not attained within three months
- telephone calls and newsletters to monitor progress and reinforce dietary change.

Members of the minimum intervention group received routine hyperlipidaemia counselling from nurses. At 3 and 12 months the average decrease in the self-reported Dietary Risk Assessment (DRA) score in the special intervention group was significantly larger than that in the minimum intervention group (3.7 units; 95 per cent CI 1.9–5.5; p = 0.0006 and 2.1 units; 95 per cent CI 0.8–3.5; p = 0.005 respectively). A larger weight loss was observed in the special intervention group at 3 months (0.86kg; 95 per cent CI 0.14–1.55; p = 0.022) and 6 months (0.95kg; 95 per cent CI 0.04–1.86; p = 0.04); however, differences in weight loss were not maintained at 12-month follow-up. Throughout the follow-up period, reductions in cholesterol levels did not differ significantly between the groups.

3 Conclusions and recommendations

The evidence base for healthcare delivery models to address the prevention of cardiovascular disease is sparse, even though there are a number of high-quality clinical guidelines available. We lack good evidence to translate what we know about diet and exercise into how the delivery system can help motivate and influence individual practices.

Additional research that includes larger, more diverse populations and healthcare settings, especially in the workplace, is needed. In addition, that research should be supported by sophisticated information systems that can accurately capture specific details of the interventions delivered so that they can be replicated. The QEI project seeks to address these difficulties and will gather available evidence on a range of interventions designed to improve quality of care. Finally, investigators must provide rigorous documentation of 'usual care' received by comparison groups.

Screening and assessment of risk

The evidence regarding screening and preventive services in GPs' offices consistently demonstrates that the physician practice setting is an excellent one for screening patients, identifying high-risk patients and providing behavioural and educational services that would mitigate risk. As we have noted earlier, we recognise that GPs face time limitations in being able to implement these screening practices with everyone who attends their clinic (see Table 3).

Within GPs' offices, reminder tools or flags can be added to paper medical charts (or electronic medical records) to help trigger prevention actions by care providers. These tools might include flagging key information from family histories, noting certain acute events or using a checklist to monitor certain chronic conditions. We have also found that designating someone within the office to coordinate prevention activities helps to keep the process on track and more effective.

CVD risk assessments that develop a risk score are still being questioned because they may not be accurate for those at low or high risk and the link to improved health outcomes has not been consistently demonstrated. However, there is evidence that shows that proper training and education of staff can improve CVD prevention practices.

We found no evidence on workplace delivery system changes to promote screening and assessment. However, within the community setting, we did find supporting evidence that dental care providers could play an important role in screening healthy patients for CVD risk factors or in monitoring conditions that could lead to CVD.

Health promotion efforts to decrease CVD risk

We found good evidence that health promotion efforts need not only come from GPs – there are others in the primary care setting, including nurses, dentists and other allied health professionals, who can deliver messages effectively.

Smoking cessation

Educating providers about how to counsel their patients to quit smoking has been shown to be helpful. Establishing reminders within the office medical record system will help prompt the healthcare provider to pursue smoking cessation with their patients that are smokers. Within the workplace, the evidence on the effectiveness of on-site interventions is mixed. The combination of individual counselling and nicotine replacement therapy has been shown to help smoking cessation; however, there is no supporting evidence that multifaceted programmes that target smoking when done in conjunction with other CVD prevention activities are effective. In addition, researchers found that smoking bans may stop people smoking when they are at work, but they do not effect total smoking rates.

Increasing physical activity

Sedentary patients responded to GPs' prescriptions for brisk exercise combined with behaviour counselling based on psychological theory. Within the workplace, multifaceted interventions that combine nutrition and physical activity goals have been found to be effective in preventing overweight and obesity. We found some evidence that a variety of physical activity interventions (that is, directed physical activity, ongoing support, motivational materials or self-monitoring) increase physical activity and measure cardio-respiratory fitness.

Within the community setting some evidence exists to support the view that using community organisations to deliver health information campaigns can supplement health knowledge from other sources. Policies and environmental interventions, including those that promote access to healthy food and information on health behaviours, have demonstrated a positive effect.

Early interventions to reduce CVD risk among high-risk individuals

Within the primary practice setting, patient decision aids can assist the patient in deciding to begin antihypertensive therapy; however, it was not found to impact on long-term effects on blood pressure or CVD risk. No specific strategy to use across settings was found to improve the identification and control of hypertension, although mixed evidence for multiple strategies exists. Home blood pressure monitoring was found to be an effective and accurate means of monitoring and controlling blood pressure.

Pharmacy-based community interventions demonstrated success in promoting smoking cessation.

In general, physician advice alone was not found to increase physical activity in those with high-risk CVD.

With respect to treatment of hyperlipidaemia, pharmacy-based interventions provided strong evidence to improve cholesterol management among patients at high risk for CVD. Evidence was limited in regard to increasing patient compliance with medication regimens, and we cannot recommend a specific intervention to increase patient adherence. We found no good evidence to support the notion that advice from a dietician produced better cholesterol-management outcomes than that provided by a nurse or self-help resources.

Overall, the evidence suggests that, if adopted, both single or multifaceted interventions can be effective in primary and secondary prevention of CVD.

Table 3: Summary of evidence

Area of focus	Summary of evidence
Screening and assessment of risk for CVD	• Evidence is strong that screening for CVD by GPs is an effective way to identify unknown cases of patients with cardiovascular disease. • Primary care practices are able to implement sustainable office systems to provide preventive care services when using multimethod approaches; these include using triggers or reminder tools and having a dedicated staff member to coordinate prevention activities. • Some evidence suggests that, in GP practices for which multimethod systems are not available, simple tools such as family history, acute events or a checklist can be effective reminders that promote CVD screening. • There is some evidence that questions the accuracy of CVD risk assessment for individuals at high or low risk. • Evidence is mixed regarding the usefulness of a CVD risk score to improve patient outcomes. • Training and education of physicians and nurses in the general practice office who are involved in identifying, monitoring and providing risk reduction interventions related to CVD can promote the use of prevention practices.

Health promotion efforts to decrease CVD risk	• Good evidence supports health promotion interventions by non-physicians in the primary care setting.
	• Good evidence supports the use of provider reminder systems in conjunction with provider education about counselling patients to quit smoking.
	• Some evidence suggests that physician prescriptions for exercise increases physical activity among sedentary adults.
	• Some evidence supports the use of multifaceted interventions to prevent overweight and obesity among adults in workplace settings.
	• Evidence is mixed about the effectiveness of smoking cessation programmes in the workplace:
	  • some evidence supports use of tobacco bans to reduce cigarette smoking at the workplace during the day; however, the evidence does not support the workplace ban effect on total smoking rates
	  • some evidence supports the use of individual counselling and nicotine replacement therapy to help smoking cessation
	  • no evidence supports the effectiveness of multifaceted programmes that target smoking when used in conjunction with other CVD prevention.
	• Some evidence suggests that health information campaigns, including those using community organisations, can supplement the health knowledge that individuals acquire from other outlets.
	• Some evidence supports the use of a variety of physical activity interventions, in mixed settings, to increase physical activity and measure cardio-respiratory fitness.
	• Some evidence supports the positive effect of policy and environmental interventions that promote access to healthy food and access to information related to health behaviours.

Table 3. Summary of evidence (continued)

Area of focus	Summary of evidence
Early interventions to reduce CVD risk among high-risk individuals	• There is some evidence to suggest that patient decision aids can help in the decision to initiate antihypertensive therapy, but they do not impact long-term effects on blood pressure or CVD risk. • While there is limited evidence of successful interventions to increase adherence to medication regimens to treat hyperlipidaemia, there is not sufficient evidence to recommend a specific intervention to increase patient use of LLDs. • There is evidence to support the use of single and multifaceted interventions to target primary and secondary CVD prevention. • There is no good evidence to demonstrate that dietician advice produces better outcomes than self-help resources or nurses for cholesterol management among individuals with hyperlipidaemia. • There is little evidence to support the effectiveness of physician advice on the participation in physical activity by individuals with high risk for CVD. • While there are multiple strategies used to improve identification and control of hypertension, there is no good evidence for a specific strategy to use across settings due to the mixed quality of available evidence. • There is strong evidence to support the role of pharmacy-based interventions in improving cholesterol management among patients at high risk for CVD. • There is good evidence to support the role of community pharmacy services for promotion of smoking cessation. • Home blood pressure measurement by the patient is an effective and accurate means to monitor and control blood pressure.

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Appendix 1. Literature search results

Search strategy	Matrix search strategy	Results
	Cardiovascular prevention search	
#5	Cardiovascular Disease: ('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH]	209,195
#6	('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH] Limits: English, Publication Date from 1998, Humans	79,605
#7	Disease Management: 'Disease Management'[MeSH] OR 'National Health Programs'[MeSH] OR ('Community Health Planning'[MeSH] OR 'Community Health Services'[MeSH] OR 'Community Networks'[MeSH] OR 'Delivery of Health Care'[MeSH]) OR center of excellence [tw] OR regionalisation [tw] OR regionalization OR referral management [tw] OR 'Triage'[MeSH] OR ('Case Management'[MeSH] OR 'Organizational Case Studies'[MeSH]) OR 'Risk Management'[MeSH] OR 'service lines' [tw] OR 'Program Evaluation'[MeSH] OR 'Regional Health Planning'[MeSH] OR 'Emergency Treatment'[MeSH] OR 'Emergency Medical Services'[MeSH] OR 'Emergency Service, Hospital'[MeSH] OR 'Emergency Medicine'[MeSH] OR timeliness [tw] OR 'Rehabilitation'[MeSH]	1,047,638
#8	#6 AND #7	15,449
#9	Health Status: 'Health Status'[MeSH] OR 'Outcome Assessment (Health Care)'[MeSH] OR 'Mortality'[MeSH] OR 'Hospital Mortality'[MeSH] OR ambulatory care sensitive conditions [tw] OR 'Morbidity'[MeSH] OR 'complications'[Subheading] OR 'Sentinel Surveillance'[MeSH] OR 'Fatal Outcome'[MeSH] OR 'Self Care'[MeSH] OR 'Activities of Daily Living'[MeSH] OR outcome [tw]	2,067,920
#10	#8 AND #9	9,443
#11	#8 AND #9 Limits: Core clinical journals	2,545
#13	Health Personnel: 'Health Personnel'[MeSH] OR ('manpower'[Subheading] OR 'Health Manpower'[MeSH] OR 'Health Care Facilities, Manpower, and Services'[MeSH])	1,514,228
#14	#6 AND #13	13,789
#15	#6 AND #13 Limits: Core clinical journals	3,747
#17	Risk Behaviours/Conditions: Smoking OR obesity OR diet OR exercise OR risk OR drug OR hypertension	4,465,091
#18	#6 AND #17	59,197
#19	#6 AND #17 Limits: Core clinical journals	16,473
#20	'Cardiovascular Diseases/prevention and control'[MeSH])	96,471
#21	#19 AND #20	6,548
#22	#19 AND #20 Limits: published in the last 5 years	3,952
#23	#19 AND #20 Limits: All Adult: 19+ years, published in the last 3 years	1,104

	Risk assessment search	
#4	Cardiovascular Disease: (Cardiovascular Diseases) or (Coronary Disease) Limit: Systematic reviews, English, Publication Date from 1998, Humans	8,307
#7	Prevention: (‘prevention and control’[Subheading] OR ‘Primary Prevention’[MeSH])	72,0282
#8	‘Cardiovascular Disease’ and ‘Prevention’	2,226
#13	‘Coronary Disease’[MAJR] OR ‘Cardiovascular Diseases’[MAJR]	1,149,614
#14	‘Cardiovascular Disease’ and ‘Prevention’ Limits: articles with the main topic of cardiovascular disease	1785
#15	Surveillance: (‘Epidemiology’[MeSH] OR ‘epidemiology’[Subheading] OR ‘Population Surveillance’[MeSH] OR ‘Sentinel Surveillance’[MeSH])	977,851
#16	‘Cardiovascular Disease’ and ‘Surveillance’	528
#18	Worksite: (‘Occupational Health Services’[MeSH] OR ‘Occupational Health Nursing’[MeSH] OR ‘Occupational Health’[MeSH]) OR worksite OR workplace	40,297
#19	‘Cardiovascular Disease’ and ‘Surveillance’ and ‘Worksite’	1
#24	General Practitioner (GP): ‘Health Personnel’[MeSH] OR (‘Family Nursing’[MeSH] OR ‘Physicians, Family’[MeSH] OR ‘Family Practice’[MeSH]) OR ‘Physician’s Practice Patterns’[MeSH]	328,269
#25	‘Cardiovascular Disease’ and ‘Surveillance’ and ‘General Practitioner’	21
#28	Community: (‘Community Health Planning’[MeSH] OR ‘Community Health Services’[MeSH] OR ‘Community Health Centers’[MeSH] OR ‘Community Health Nursing’[MeSH])	358,728
#29	‘Cardiovascular Disease’ and ‘Surveillance’ and ‘Community’	55
#35	Health Promotion: ‘Preventive Health Services’[MeSH] OR ‘Health Knowledge, Attitudes, Practice’[MeSH] OR (‘Patient Education’[MeSH] OR ‘Patient Education Handout’[Publication Type])	317,871
#36	‘Cardiovascular Disease’ and ‘Health Promotion’ and ‘Worksite’	2
#38	‘Cardiovascular Disease’ and ‘Health Promotion’ and ‘General Practitioner’	25
#39	‘Cardiovascular Disease’ and ‘Health Promotion’ and ‘Community’	57
#41	(‘Risk’[MeSH] OR ‘Risk Assessment’[MeSH] OR ‘Risk Management’[MeSH] OR ‘Risk Reduction Behavior’[MeSH] OR ‘Risk-Taking’[MeSH])	489,579
#42	#39 AND #41	141

	Systematic reviews search	
#9	Cardiovascular Disease: (Cardiovascular Diseases) AND systematic[sb]	12,265
#10	(Coronary Disease) AND systematic[sb]	2,032
#12	'Cardiovascular Disease' or 'Coronary Disease' Limits: systematic review, English, Publication Date from 1998, Humans	8,331
#13	Health Systems: 'Disease Management'[MeSH] OR 'National Health Programs'[MeSH] OR ('Community Health Planning'[MeSH] OR 'Community Health Services'[MeSH] OR 'Community Networks'[MeSH] OR 'Delivery of Health Care'[MeSH]) OR center of excellence OR regionalisation OR regionalization OR referral management OR 'Triage'[MeSH] OR ('Case Management'[MeSH] OR 'Organizational Case Studies'[MeSH]) OR 'Risk Management'[MeSH] OR 'service lines' OR 'Program Evaluation'[MeSH] OR 'Regional Health Planning'[MeSH] OR 'Emergency Treatment'[MeSH] OR 'Emergency Medical Services'[MeSH] OR 'Emergency Service, Hospital'[MeSH] OR 'Emergency Medicine'[MeSH] OR timeliness OR 'Rehabilitation'[MeSH]	1,060,414
#14	CVD and Health Systems: #12 and #13	2,155
#15	Outcome: 'Health Status'[MeSH] OR 'Outcome Assessment (Health Care)'[MeSH] OR 'Mortality'[MeSH] OR 'Hospital Mortality'[MeSH] OR ambulatory care sensitive conditions OR 'Morbidity'[MeSH] OR 'complications'[Subheading] OR 'Sentinel Surveillance'[MeSH] OR 'Fatal Outcome'[MeSH] OR 'Self Care'[MeSH] OR 'Activities of Daily Living'[MeSH] OR outcome	2,092,270
#16	CVD and Health System and Outcome: #14 and #15	1,216
#17	Manpower: 'Health Personnel'[MeSH] OR ('manpower'[Subheading] OR 'Health Manpower'[MeSH] OR 'Health Care Facilities, Manpower, and Services'[MeSH])	1,527,271
#18	CVD and Manpower: #12 AND #17	1,721
#19	Risk Factors: smoking OR obesity OR diet OR exercise OR risk OR drug OR hypertension	4,508,365
#20	CVD and Risk Factors: #12 AND #19	5,822
#22	Prevention: ('prevention and control'[Subheading] OR 'Primary Prevention'[MeSH])	720,972
#23	CVD and Health System and Outcome and Prevention: #16 AND #22	348
#24	CVD and Manpower and Prevention: #18 AND #22	584
#25	CVD and Risk Factors and Prevention: #20 AND #22	1,837
#26	CVD and Health System and Outcome and Prevention – Review Articles: #16 AND #22 AND Reviews	164
#27	CVD and Manpower and Prevention – Review Articles: #18 AND #22 AND Reviews	281
#28	CVD and Risk Factors and Prevention – Selected Study Types: #20 AND #22 Limits: Meta-Analysis, Comparative Study, Evaluation Studies, Multicenter Study	609
#29	CVD and Risk Factors and Prevention – Selected Study Types, Review Articles: #20 AND #22 Limits: Meta-Analysis, Comparative Study, Evaluation Studies, Multicenter Study AND Reviews	224

	Cochrane search strategy	
#3	Cardiovascular Disease: (‘Cardiovascular Diseases/epidemiology’[MeSH] OR ‘Cardiovascular Diseases/ prevention and control’[MeSH]) OR coronary disease/prevention and control	212,386
#4	Cardiovascular Disease: Limits: English, Publication Date from 1998, Humans	82,206
#5	Health Systems: ‘Disease Management’[MeSH] OR ‘National Health Programs’[MeSH] OR (‘Community Health Planning’[MeSH] OR ‘Community Health Services’[MeSH] OR ‘Community Networks’[MeSH] OR ‘Delivery of Health Care’[MeSH]) OR center of excellence OR regionalisation OR regionalization OR referral management OR ‘Triage’[MeSH] OR (‘Case Management’[MeSH] OR ‘Organizational Case Studies’[MeSH]) OR ‘Risk Management’[MeSH] OR ‘service lines’ OR ‘Program Evaluation’[MeSH] OR ‘Regional Health Planning’[MeSH] OR ‘Emergency Treatment’[MeSH] OR ‘Emergency Medical Services’[MeSH] OR ‘Emergency Service, Hospital’[MeSH] OR ‘Emergency Medicine’[MeSH] OR timeliness OR ‘Rehabilitation’[MeSH] Limits: English, Publication Date from 1998, Humans	409,620
#6	Outcomes: ‘Health Status’[MeSH] OR ‘Outcome Assessment (Health Care)’[MeSH] OR ‘Mortality’[MeSH] OR ‘Hospital Mortality’[MeSH] OR ambulatory care sensitive conditions OR ‘Morbidity’[MeSH] OR ‘complications’[Subheading] OR ‘Sentinel Surveillance’[MeSH] OR ‘Fatal Outcome’[MeSH] OR ‘Self Care’[MeSH] OR ‘Activities of Daily Living’[MeSH] OR outcome Limits: English, Publication Date from 1998, Humans	760,217
#7	‘Cardiovascular Disease’ and ‘Health Systems’ and ‘Outcomes’ Limits: English, Publication Date from 1998, Humans	9,880
#9	‘Cochrane Database Syst Rev’[Journal:__jrid21711] Limits: English, Publication Date from 1998, Humans	4,289
#10	‘Cardiovascular Disease’ and ‘Health Systems’ and ‘Outcomes’ Limits: English, Publication Date from 1998, Humans, from the Cochrane Database of Systematic Reviews	6
#11	Select 6 document(s)	6
#12	‘Health Personnel’[MeSH] OR (‘manpower’[Subheading] OR ‘Health Manpower’[MeSH] OR ‘Health Care Facilities, Manpower, and Services’[MeSH]) Limits: English, Publication Date from 1998, Humans	430,112
#13	#4 AND #12 AND #9 Limits: English, Publication Date from 1998, Humans	8
#14	Select 8 document(s)	8
#15	smoking OR obesity OR diet OR exercise OR risk OR drug OR hypertension Limits: English, Publication Date from 1998, Humans	1,112,762
#16	#4 AND #9 AND #15 Limits: English, Publication Date from 1998, Humans	136

	Risk outcomes search	
#2	Cardiovascular Disease: ('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH]	212,746
#6	Health Systems: 'Disease Management'[MeSH] OR 'National Health Programs'[MeSH] OR ('Community Health Planning'[MeSH] OR 'Community Health Services'[MeSH] OR 'Community Networks'[MeSH] OR 'Delivery of Health Care'[MeSH]) OR center of excellence OR regionalisation OR regionalization OR referral management OR 'Triage'[MeSH] OR ('Case Management'[MeSH] OR 'Organizational Case Studies'[MeSH]) OR 'Risk Management'[MeSH] OR 'service lines' OR 'Program Evaluation'[MeSH] OR 'Regional Health Planning'[MeSH] OR 'Emergency Treatment'[MeSH] OR 'Emergency Medical Services'[MeSH] OR 'Emergency Service, Hospital'[MeSH] OR 'Emergency Medicine'[MeSH] OR timeliness OR 'Rehabilitation'[MeSH]	
#7	Health Outcomes: 'Health Status'[MeSH] OR 'Outcome Assessment (Health Care)'[MeSH] OR 'Mortality'[MeSH] OR 'Hospital Mortality'[MeSH] OR ambulatory care sensitive conditions OR 'Morbidity'[MeSH] OR 'complications'[Subheading] OR 'Sentinel Surveillance'[MeSH] OR 'Fatal Outcome'[MeSH] OR 'Self Care'[MeSH] OR 'Activities of Daily Living'[MeSH] OR outcome	2,097,516
#10	Manpower: 'Health Personnel'[MeSH] OR ('manpower'[Subheading] OR 'Health Manpower'[MeSH] OR 'Health Care Facilities, Manpower, and Services'[MeSH])	1,530,173
#13	Risk Factors: smoking OR obesity OR diet OR exercise OR risk OR drug OR hypertension	4,518,044
#14	Cardiovascular Disease: ('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH] Limits: All Adult: 19+ years, English, Publication Date from 1998, Humans	47,945
#15	'Health Outcomes' and 'Risk Factors' and 'CVD' #14 AND #13 AND #7	24,413
#20	Prevention: promotion OR prevention OR screening	3,887,437
#21	'Health Outcomes' and 'Risk Factors' and 'CVD' and prevention #15 AND #20	13,647
#24	'Outcome and Process Assessment (Health Care)'[MAJR]	19,908
#25	'Health Outcomes' and 'Risk Factors' and 'CVD' and prevention Limited to articles directly related to outcome and process assessment in health care	175
#26	'Health Outcomes' and 'Risk Factors' and 'CVD' and prevention – Limited to selected study types	7
#27	#21 AND #24 Limits: Meta-Analysis, Practice Guideline, Review	7

	Coronary workplace search	
#2	('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH]	212,746
#14	CVD with Limits: ('Cardiovascular Diseases/epidemiology'[MeSH] OR 'Cardiovascular Diseases/prevention and control'[MeSH]) OR 'Coronary Disease/prevention and control'[MeSH] Limits: All Adult: 19+ years, English, Publication Date from 1998, Humans	47,945
#28	Workplace: ('Occupational Health Services'[MeSH] OR 'Occupational Health Nursing'[MeSH] OR 'Occupational Health'[MeSH]) OR worksite OR workplace	40,467
#29	#14 AND #18	0
#30	coronary OR cardiovascular OR 'metabolic syndrome'	1,146,367
#31	#28 AND #30	974
#32	#28 AND #30 Limits: All Adult: 19+ years, English, Publication Date from 1998, Humans	268

	Matrix RCTs search	
#26	CVD as Major Heading: 'Coronary Disease'[MAJR] OR 'Cardiovascular Diseases'[MAJR]	1,152,679
#27	Prevention: ('prevention and control'[Subheading] OR 'Primary Prevention'[MeSH])	723,009
#28	#26 AND #27	91,288
#29	CVD and prevention: Limits: English, Publication Date from 2003, Humans	17,821
#31	RCTs: ('Random Allocation'[MeSH] OR 'Randomized Controlled Trials'[MeSH] OR 'Randomized Controlled Trial'[Publication Type]) OR 'Single-Blind Method'[MeSH] OR 'Double-Blind Method'[MeSH] Limits: English, Publication Date from 2003, Humans	79,407
#32	CVD and prevention – Limited to RCTs: Limits: English, Publication Date from 2003, Humans	3,396
#33	Workplace: ('Occupational Health Services'[MeSH] OR 'Occupational Health Nursing'[MeSH] OR 'Occupational Health'[MeSH]) OR worksite OR workplace Limits: English, Publication Date from 2003, Humans	7,762
#34	GP: 'Health Personnel'[MeSH] OR ('Family Nursing'[MeSH] OR 'Physicians, Family'[MeSH] OR 'Family Practice'[MeSH]) OR 'Physician's Practice Patterns'[MeSH] Limits: English, Publication Date from 2003, Humans	51,238
#35	Community: ('Community Health Planning'[MeSH] OR 'Community Health Services'[MeSH] OR 'Community Health Centers'[MeSH] OR 'Community Health Nursing'[MeSH]) Limits: English, Publication Date from 2003, Humans	59,697

#36	Workplace or GP or Community: #33 OR #34 OR #35 Limits: English, Publication Date from 2003, Humans	109,233
#37	CVD and Prevention and (workplace or GP or community) – limited to RCTs #32 AND #36 Limits: English, Publication Date from 2003, Humans	199
#39	Surveillance: ('Epidemiology'[MeSH] OR 'epidemiology'[Subheading] OR 'Population Surveillance'[MeSH] OR 'Sentinel Surveillance'[MeSH]) Limits: English, Publication Date from 2003, Humans	207,598
#40	Health Promotion: 'Preventive Health Services'[MeSH] OR 'Health Knowledge, Attitudes, Practice'[MeSH] OR ('Patient Education'[MeSH] OR 'Patient Education Handout'[Publication Type]) Limits: English, Publication Date from 2003, Humans	60,278
#41	Risk Assessment: ('Risk'[MeSH] OR 'Risk Assessment'[MeSH] OR 'Risk Management'[MeSH] OR 'Risk Reduction Behavior'[MeSH] OR 'Risk-Taking'[MeSH]) Limits: English, Publication Date from 2003, Humans	140,374
#42	Surveillance or Health Promotion or Risk Assessment: #39 OR #40 OR #41 Limits: English, Publication Date from 2003, Humans	321,616
#43	CVD and prevention and (surveillance or health promotion or risk assessment) – limited to RCTs #32 AND #42 Limits: English, Publication Date from 2003, Humans	1,619
#44	CVD and Prevention and (workplace or GP or community) and (surveillance or health promotion or risk assessment) #43 AND #37 Limits: English, Publication Date from 2003, Humans	169
#45	Select 169 document(s)	169

CINAHL search strategy

S1	(coronary OR cardiovascular OR 'metabolic syndrome')	43,883
S2	(((coronary OR cardiovascular OR 'metabolic syndrome')) and DE 'Adult')	7,172
S3	(((coronary OR cardiovascular OR 'metabolic syndrome')) and DE 'Adult') and ('health promotion' OR prevention)	1,407
S4	(((((coronary OR cardiovascular OR 'metabolic syndrome')) and DE 'Adult') and ('health promotion' OR prevention))and (DE 'Cardiovascular Diseases--Prevention and Control'))	300
S5	(((((coronary OR cardiovascular OR 'metabolic syndrome')) and DE 'Adult')and ('health promotion' OR prevention))and (DE 'Cardiovascular Diseases--Prevention and Control'))	18
	Limiters – Publication Year: 1998–2007; Publication Type: Review; Language: English	