.

Workplace screening programs for chronic disease prevention: a rapid review

Bill Bellew
Alexis St George
Lesley King

An **Evidence Check** review brokered by the Sax Institute for the NSW Ministry of Health

May 2012

saxinstitute

NSW GOVERNMENT

This rapid review was brokered by the Sax Institute.

This report was prepared by Bill Bellew, Alex St George and Lesley King.

May 2012

Enquiries regarding this report may be directed to:
Knowledge Exchange Program
The Sax Institute
Level 2, 10 Quay Street Haymarket NSW 2000
PO Box K617 Haymarket NSW 1240 Australia
T: +61 2 95145950
F: +61 2 95145951
Email: knowledge.exchange@saxinstitute.org.au

Suggested Citation:
Bellew B, St George A, King L. Workplace screening programs for chronic disease prevention: an Evidence Check brokered by The Sax Institute (www.saxinstitute.org.au) for the NSW Ministry of Health, 2012.

A summary version of this report is also available.

Contents

LIST OF TABLES AND FIGURES

EXECUTIVE SUMMARY

This review examined the effectiveness of workplace screening programs for chronic disease prevention based on evidence retrieved from the main databases of biomedical and health economic literature published to March 2012, supplemented with relevant reports.

The review found:

1. Strong evidence of effectiveness of HRAs (when used in combination with other interventions) in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
2. Sufficient evidence for effectiveness of worksite programs to control overweight and obesity
3. Sufficient evidence of effectiveness for workplace HRAs in combination with additional interventions to have favourable impact on the use of healthcare services (such as reductions in emergency department visits, outpatient visits, and inpatient hospital days over the longer term)
4. Sufficient evidence for effectiveness of benefits-linked financial incentives in increasing HRA and program participation
5. Sufficient evidence that for every dollar invested in these programs an annual gain of $3.20 (range $1.40 to $4.60) can be achieved
6. Promising evidence that even higher returns on investment can be achieved in programs incorporating newer technologies such as telephone coaching of high risk individuals and benefits-linked financial incentives
7. Promising evidence that the next generation of more effective programs will combine a comprehensive approach together with interventions targeting high-risk individuals and incorporating a dose–response model of increasing levels of intensity.

To address observed gaps in research for workplace programs in Australia, recommended priorities include:

- Convening a high-level workshop, involving senior policymakers and researchers, to identify research priorities which would advance knowledge and implementation of effective strategies
- Encouraging the use of sound, theory-based approaches for the design, testing and development of workplace interventions
- Promoting the use of formative research (qualitative and quantitative) to inform the design of programs
- Supporting translational research with a requirement for the transparent reporting of 'RE-AIM': intervention reach, adoption, implementation, and maintenance.

A limitation of the review is that the majority of retrieved studies were conducted in North America or in Europe so that review findings may not always be generalisable to an Australian setting. In most cases, study subjects for whom the interventions 'worked' were self-selecting so that interventions proven to be 'effective' in the context of research trials with volunteers may encounter barriers in a subsequent 'real world' implementation process.

The information in this report is intended to help healthcare decision-makers and policymakers make well informed decisions. It is not intended to be a substitute for the application of clinical judgment. Those involved in decisions concerning the provision of clinical care should view the report as a reference to be used in conjunction with all other pertinent information and in the context of available resources and the circumstances of individual patients. A summary of additional statements with respect to review questions (where evidence was promising, insufficient) appear in the next section – ***Evidence findings at-a-glance.*** The issues are discussed in greater detail in the main body of the report.

EVIDENCE FINDINGS AT-A-GLANCE

Spectrum of workplace Health Risk Assessment (HRA)

- There is strong[a] evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol; there is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- Most workplace HRAs have been developed to address and improve general health and in particular to improve cardiovascular health
- HRA instruments are questionnaire-based tools designed specifically for the purpose of conducting HRA but rarely meeting any stipulated accreditation standards
- The majority of HRAs address a mixture of clinical/physical-based and questionnaire-based measures; a large proportion are purely questionnaire-based; whilst a minority address physical/clinical measurements only
- Frequency of follow-up post initial HRA varies across studies, with two follow-up contacts being the most common; best estimates are as follows: one contact – 27%; two contacts – 41%; three contacts – 18%; and four contacts 13%
- Feedback post-HRA appears to be provided most often (in order of frequency) in the form of (i) personalised HRA results on paper printout or in writing; (ii) in person; (iii) via posted mail; (iv) via telephone; (v) during group sessions; and (vi) email. There is some recent evidence to suggest that telephonic, web-enabled communications and social networking are becoming more commonly featured
- No correlation was found between degrees of feedback/frequency and program dropout rates which ranged from mostly low rates to as high as 80% in some studies
- The typical profile of HRA participants was: 30 to 50 years of age, higher probability of being female, displaying average health, although sometimes selected to represent groups with above average risk factors for chronic disease
- Information on the time required for completion of HRAs was generally not specified, however available studies suggest that it takes approximately 15 minutes for completion of an online HRA; analysis suggests that (i) in the typical self-report suite, physical activity was the most commonly used (38%), followed by dietary behaviour (30%), CVD/Multiple Risk (25%), smoking (12%) and alcohol (5%); and that in the physical/clinical measurement suite, BMI was the most commonly used (20%), followed by cholesterol (14%), diabetes/metabolic

> ▪ ***Strong evidence exists for effectiveness of HRAs used in combination with other interventions in relation to tobacco, alcohol, dietary fat, blood pressure and cholesterol; sufficient evidence for effectiveness ….to control overweight and obesity.***

[a] The terms 'Workplace Screening Program', 'Health Risk Assessment' and 'Health Risk Appraisal' (HRA) are used interchangeably to denote techniques or processes of gathering information to develop health profiles, using the profiles to estimate future risks of adverse health outcomes and providing persons with feedback on means of reducing their health risks. The term '*strong evidence*' is used when a causal relationship has been established between an intervention or program and improvement in one or more of the relevant risk factors, determinants or outcomes based on evidence from a systematic review; the term '*sufficient evidence*' is used when this relationship has been established from a variety of appropriate studies. interchangeably to denote techniques or processes of gathering information to develop health profiles, using the profiles to estimate future risks of adverse health outcomes and providing persons with feedback on means of reducing their health risks. The term '*strong evidence*' is used when a causal relationship has been established between an intervention or program and improvement in one or more of the relevant risk factors, determinants or outcomes based on evidence from a systematic review; the term '*sufficient evidence*' is used when this relationship has been established from a variety of appropriate studies.

syndrome (11%) and blood pressure (10%). Measurements of waist circumference (7%) skinfold (2%) other anthropometric or performance measures were infrequently reported.

Effectiveness of workplace health screens/HRA

- There is sufficient evidence of effectiveness for workplace HRAs in combination with additional interventions to have favourable impact on the use of healthcare services (such as reductions in emergency department visits, outpatient visits, and inpatient hospital days over the longer term)
- There is promising evidence for workplace HRAs to have a favourable impact on seeking additional preventive care services
- There is promising evidence that disease management programs focussing on high-risk individuals may be more likely than general health promotion programs to generate better returns on investment (ROI) because of the proximal impact on medical or related costs, such as absenteeism and productivity; the most promising future directions appear to be with disease management programs that combine comprehensive plus high-risk interventions that focus on a dose–response model of increasing levels of intensity
- There is sufficient evidence for effectiveness of benefits-linked financial incentives in increasing HRA and program participation; there is promising evidence for the effectiveness of financial incentives with respect to sustained risk reduction or health outcomes
- The implementation of HRAs used in isolation is not supported; when used in combination with other interventions, there is strong evidence of effectiveness.

- ***Sufficient evidence exists for effectiveness for workplace HRAs in combination with additional interventions to impact favourably on the use of healthcare services***
- ***Most promising future directions are for programs that combine comprehensive plus high-risk interventions that focus on a dose–response model of increasing levels of intensity***
- ***Sufficient evidence exists that for every dollar invested in these programs an annual gain of $3.20 (range $1.40 to $4.60) can be achieved***
- ***There is promising evidence that even higher returns on investment can be achieved in programs incorporating newer technologies such as telephone coaching of high risk individuals and benefits-linked financial incentives.***

Key components in workplace health screens associated with benefit and cost-effectiveness

- There is sufficient evidence that for every dollar invested in these programs an annual gain of $3.20 (range $1.40 to $4.60) can be achieved
- There is promising evidence that even higher returns on investment can be achieved in programs incorporating newer technologies and approaches such as:
  - use of the Transtheoretical Model
  - Internet-provided health information
  - tailoring
  - benefits-linked financial incentives
  - telephonic high risk intervention coaching; and
  - requiring annual morbidity-based HRAs for individual targeting of interventions
- Evidence indicates that the feedback and recommendations aspects of HRAs, more so than the specific forms of the HRAs, may be the most important component for success.

Evidence gaps in Australia

This review found a dearth of well-designed Australian studies. In addressing this gap the following four priorities are suggested:

1. Convene a high-level workshop on prevention of chronic disease in the workplace, involving senior policymakers and researchers, to identify research priorities which would advance knowledge and implementation of effective strategies to reduce chronic disease risk in Australia [b,1]
2. Encourage the use of sound, theory-based approaches for the design, testing and development of workplace interventions in NSW and in Australia generally
3. Promote the use of formative research (qualitative and quantitative) to inform the design of programs
4. Support translational research with a requirement for the transparent reporting of 'RE-AIM': intervention reach, adoption, implementation, and maintenance.

[b] perhaps modelled on the similar workshop convened in the United States in 2009 by the National Institutes of Health and the CDC (Sorensen et al., 2011)

BACKGROUND AND INTRODUCTION

Non-communicable diseases (NCDs) are a global health challenge

Of the estimated 57 million global deaths in 2008, 36 million (63%) were due to non-communicable diseases (NCDs). Driven in part by population growth and increased longevity, the total number of annual NCD deaths is projected to reach 55 million by 2030 — whereas annual infectious disease deaths are projected to decline over the next 20 years.[2] Globally, the largest proportion of NCD deaths is caused by cardiovascular disease (48%), followed by cancers (21%) and chronic respiratory diseases (12%). Diabetes is directly responsible for 3.5% of NCD deaths. Behavioural risk factors, including tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol, are estimated to be responsible for about 80% of coronary heart disease and cerebrovascular disease. Behavioural risk factors are associated with four key metabolic and/or physiological changes — raised blood pressure, increased weight leading to obesity, hyperglycaemia and hyperlipidaemia. These changes can have multiple effects. For example, in addition to its direct role in diabetes, raised fasting blood glucose also increases the risk of cardiovascular deaths, and has been estimated to cause 22% of coronary heart disease deaths and 16% of stroke deaths.[3]

Comprehensive approaches are required to tackle NCDs

The United Nations is taking action to address NCDs. To address the prevention and control of NCDs, with a particular focus on developing countries, the United Nations General Assembly convened a High-Level meeting on NCDs in September 2011. The Political Declaration adopted by the General Assembly represents a breakthrough in the global struggle against NCDs.[4] The Political Declaration recognises that in addressing NCDs:

- Prevention is the cornerstone
- Whole-of government and whole-of-society approaches are required
- Multi-sectoral, population wide and cost-effective interventions are required
- Public policies to create equitable health-promoting environments are emphasised.

Within the comprehensive approach, the workplace has emerged as one of several settings in which effective interventions may be deployed. In particular there is now compelling evidence that workplace-based programs incorporating Health Risk Assessments (HRAs) used in combination with other interventions are effective in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol, whilst there is also sufficient evidence to indicate the effectiveness of worksite programs to control overweight and obesity. The evidence reflects the four principles identified in the UN Political Declaration (prevention, comprehensive, population-wide, supportive environments) and is further elucidated in this report.[4]

Health Risk Assessment (HRA) in the workplace

No consensus definition exists for HRAs. A HRA may be a simple questionnaire eliciting self-reported information on risk factors, behaviours or diagnoses. Questionnaires may be supplemented with clinical examinations to obtain data on variables such as height, weight, body mass index (BMI), heart rate, blood pressure or cholesterol. Some HRAs may include performance tests such as grip strength, chair rise or walking tests. In health promotion, most observers agree that HRAs involve more than the collection of health information. HRAs are

techniques or processes of gathering information to develop health profiles, using the profiles to estimate future risks of adverse health outcomes and providing persons with feedback on means of reducing their health risks. For the purpose of this review our core definition for a HRA had three components: (1) participants provided self-reported information to identify individual risk factors for disease; (2) participants received individualised health-related feedback based on the information they provided; and (3) the information was used to give participants at least one recommendation or intervention to promote health, sustain function or prevent disease. The HRA may be supplemented with additional information based on physical measures or laboratory tests.

NSW Healthy Workers Initiative

As part of the National Partnership Agreement on Preventive Health (NPAPH), State and Territory governments have been funded by the Commonwealth to facilitate the delivery of programs to support a healthy lifestyle in the workplace. The aim of the NSW Healthy Workers Initiative (HWI) is to prevent lifestyle-related chronic diseases in people in paid employment and targets modifiable lifestyle risk factors (including healthy eating, physical activity, weight, smoking and harmful alcohol consumption.[5, 6]

The NPAPH Healthy Workers Scoping Statement and Guiding Policy Principles[c] indicate that funding is provided for secondary prevention including screening at asymptomatic stage to support the reduction of progression of disease through early intervention. It is recommended in the scoping statement that programs with a clinical risk assessment component have clear and appropriate referral pathways in place and include complementary support activities support a reduction in identified lifestyle risk factors. Further, programs should aim to be sustainable beyond the funding received and recognise the diversity of the NSW workforce and workplaces.[a]

The NSW workforce

In NSW, approximately 3,068,120 people are engaged in employment (1,627,594 males (53%) and 1,440,526 females (47%)). Workers aged 35–54 years (n=1,398,119), a particular focus of the HWI, make up 46% of the total workforce. Overall, 30% (n=906,409) of the workforce are employed part-time, the proportion of females employed part-time (45%) being higher than for males (17%). Of the 16 Australian Bureau of Statistics industry divisions, 'property and business', 'retail trade' and 'health and community services' employed the most workers. Combined, these three divisions represent 36.5% of the NSW workforce.[7-9]

NSW employers

The NSW workforce is evenly distributed across small (<20 employees), medium (20–199 employees) and larger employers (200+ employees). However, it is notable that whilst large employers employ 33% of the workforce (n=1,024,365) they comprise only 1% (n=2,377) of employers, likewise medium size employers make up only 8% of employers yet employ 35% of the workforce (n=1,087,894). The remaining NSW workers are employed in small enterprises (270,744 employers).[9]

[c] http://www.health.gov.au/internet/main/publishing.nsf/Content/B6C501E0D2D9F7FDCA2575EC00235F71/$File/HW%20Scoping%20Statement.pdf

Geographic location of NSW workforce and employers

The majority of the NSW workforce (66%, n=2,036,402) is located in Sydney metropolitan areas. This pattern is replicated across 15 of the 17 ABS industry divisions. The two industry divisions with a higher proportion of workers outside the Sydney metropolitan area are 'mining' and 'agriculture, forestry and fishing'.[10]

The prevalence of risk factors for chronic disease in the NSW workforce

The Healthy Workers Initiative is targeting five lifestyle risk factors in order to prevent chronic disease. Overall, 40.3% of the NSW workforces have three or more of these risk factors for chronic disease equating to approximately 1,236, 452 million individuals. In the Sydney metropolitan area, the proportion of the workforce with 3 three or more risk factors is 37.3% compared to 49.4% of those workers located in regional, rural and remote areas of the state. For males, the proportion of the workers in NSW with three or more risk factors is 47.2% and for females it is 31.9%. The occupation groups at highest risk of chronic disease (≥ three risk lifestyle risk factors) are 'machinery operators and drivers' (51%), and 'technicians and trades' (54.7%).

The burden of chronic disease in NSW

In Australia, 80% of the current total burden of disease is attributable to chronic disease. Cardiovascular disease (CVD) is the leading cause of death for both males and females and the prevalence of diabetes has also doubled over the past two decades. In 2010–2011 cardiovascular diseases was the primary reason for 163,710 hospitalisations in NSW (6% of all hospitalisations). The hospitalisation rate for cardiovascular disease in males was 1.6 times the female rate in 2009–2010.[11,12] Along with increasing risk of developing chronic diseases, there are concerns that risk factors such as obesity can impact on injuries in the workplace as well as on productivity.[13-16]

REVIEW METHODOLOGY

This section provides a summary description of the methodology used for searching and selecting research papers.

Evidence for this review was obtained from the main databases of biomedical and health economic literature published from January 2000 up to March 2012 as well as from a small number of published reports of direct relevance to the stipulated review questions.

The three key concepts forming the bases of the search were (i) ***Population/Target group***: (adults, risk factors and chronic disease); (ii) ***Intervention***: Health risk screening (screening and screening outcome); and (iii) ***Setting:*** (workplace or pharmacy). Search terms used are shown in detail in Appendix 1.

The quality of retrieved studies was assessed using guidance on levels of evidence provided by the National Health and Medical Research Council (NHMRC) together with the methodology used by the US Centers for Disease Control and Prevention/US Preventive Services Task Force. This approach takes account of a combination of (i) the suitability of the selected study design for assessing evidence of effectiveness; and (ii) whether the execution of the selected study was good, fair or poor.

The methodology is described in detail in Appendix 1.

OVERVIEW OF RETRIEVED STUDIES

This section provides a narrative overview of retrieved studies, stratified by the suitability of study design for evaluating evidence of effectiveness. The studies are also summarised in Table 2. For definitions of the study nomenclature refer to the Glossary. The categories of studies are summarised in their order of suitability for assessing evidence of effectiveness, noting that the manner in which a study is implemented (the execution) is an important aspect of making a final assessment of its quality and usefulness to inform the findings of this review.

Systematic reviews

This research design category includes studies which represent the highest level of suitability for assessing evidence of effectiveness. Of the retrieved studies 56 were systematic, semi-systematic or other well designed literature reviews relevant to the terms of reference for this review.[17-72] The 2012 study by Chapman[27] is an update of and should be read in conjunction with one earlier study;[26] the 2011 study by Pelletier[51] is an update of and should be read in conjunction with three earlier studies.[49-51,69] In that sense, the correct number of studies may be regarded as 52.

- Whilst all studies were of general relevance, 10 of these studies included more specific discussion of Health Risk Assessment/Appraisal (HRA)[30,37,39,56,59,62,65-67,72]
- Twelve studies addressed cost effectiveness or returns on investment in workplace health promotion programs (WHPP)[19,26,27,33,49-51,55,58,60,64,69]
- Nine studies examined productivity[23,25,38,41,53,64,67,68 71]
- Twenty-two studies addressed effectiveness of WHPP on health generally or on chronic disease risk factors and conditions, including
- Seven studies on dietary behaviour[17,28,31,44-46,61]
- Eight studies on physical activity[17,28,29,31,36,45,48,61]
- One study on alcohol[63]
- One study on smoking[24]
- Three studies on obesity or healthy weight[17,18,21]
- Four studies on diabetes or the metabolic syndrome[32,39,42,62] as well as
- Ten studies on CVD/heart health/overall health[20,33-35,47,49-51,57,69] including one study on the impact of financial incentives on personal health behaviour.[57]

Controlled trials and quasi-experimental studies

This research design category comprises studies which are strong to moderate in their level of suitability for assessing evidence of effectiveness. Seventy-nine of the retrieved studies were controlled trials[73-151] of which the vast majority were randomised controlled trials (RCTs) and a few were controlled studies.[92,96,118,125,137] After further screening for compliance with terms of reference/inclusion criteria, this number was reduced to 46 studies which addressed HRA.[78,81,83-85, 87-91,96-102,105,107-110,112,115,118,120, 121,124,125,129-131,134,135,137,139,140,142-149,151] Some of these studies reported on the same trial, such as 'PHLAME' (fire-fighters) trial[90,91,107,135], and 'Tools for Health' (construction workers)[98,139] so that this number may more correctly be reported as 42. Analysis of these publications revealed that:

- Eight studies included discussion of cost effectiveness or returns on investment[81,96,97,112,124,137,144,145]
- Ten studies included discussion of productivity[81,97,101,115,124,134,143-145,151]
- Eight studies included discussion of smoking[84,98,108,109,120,130,137,139]
- 23 studies included discussion of dietary behaviour[78,81,83-85,90,91,90,100,102,105,107,110,120,125,131,133,135,137,139,142,146,148]
- Twenty-two studies included discussion of obesity or healthy weight[78,83,85,87,91,96,100,105,107,108,110,112,115,129-131,133143,147-149,151]
- Five studies included discussion of diabetes or the metabolic syndrome[78,109,110,133,151]
- Five studies addressed alcohol[89,99,124,137,143]
- 28 studies included discussion of physical activity[78,81,83-85,88,90,91,100,102,105,107,108,110,112,118,120,121,129-131,133,135,137,142,146,148,151]
- 16 studies in total included discussion of CVD risk factors(6 studies)[87,97,109,118,120, 133] or multiple risk factors (dietary behaviour *and* physical activity *and* healthy weight/obesity (10 studies))[78,83,85,91,100,105,107,110,131,148]
- seven studies included measurement of blood pressure[78,83 85,96,108,112,131]
- 10 studies included measurement of cholesterol[83,87,90,96,102,108,109,118,125,131]
- 18 studies included measurement of body mass index (BMI)[78, 83, 87,96,100,102,108,110,112,115,129-131,133,147-149,151]
- Six studies included measurement of waist circumference.[78,85,87,100,129,148]
- Of the retrieved studies five incorporated **quasi-experimental designs** (see Glossary).[152-156] These addressed:
- Impact of a multicomponent program focussed on employee health risks and work productivity in a large UK multinational corporation[152]
- Evaluation of a Belgian interactive computer-tailored fat reduction intervention[153]
- Results from a Malaysian study focussed on dietary change, cholesterol, physical activity and smoking[154]
- Impact of a comprehensive North American program which included reimbursement for employees participating in the Health Risk Assessment and in wellness or fitness activities[155]
- Long-term impact of a North American program involving telephone-based interventions that target high risk, ready-to-change individuals in a mixture of public and private sector organisations.[156]

Of these quasi experimental designs, two addressed smoking and dietary behaviour,[154,156] one study addressed physical activity[154], and one did so for healthy weight, also including assessment of BMI.[153] Two included measurement of cholesterol[154,156] but none of the studies assessed ROI, alcohol, blood pressure or waist circumference or addressed diabetes/metabolic syndrome.

Cohort studies

This category comprises study designs which are moderately suitable for assessing effectiveness, although not as suitable as the categories noted above. Twenty-two of the retrieved studies were cohort studies (see Glossary).[157-178] Analysis of these reports revealed that:

- Four included discussion of cost effectiveness or returns on investment;[160,168,175,176]
- One included discussion of productivity[158]
- Four included discussion of smoking[158,165,168,174]
- Five included discussion of dietary behaviour[157,168,170,173,174]
- Nine included discussion of obesity or healthy weight[160,162,163,168-172,178]
- Four included discussion of diabetes or the metabolic syndrome[163,166,172,176]
- Nine included discussion of physical activity[157-159,163,165,168,170,173,174]
- Four studies included specific discussion of CVD risk factors (2 studies)[161,172] or multiple risk factors (dietary behaviour *and* physical activity *and* healthy weight/obesity (2 studies])[168,170]
- Five studies included measurement of blood pressure[163,166,167,169,171]
- Five studies included measurement of cholesterol[157,163,171-173]
- Five studies included measurement of body mass index (BMI[162,163,168,170,171]
- No studies referred to alcohol or to measurement of waist circumference.

Other studies and reports

This category comprises study designs which represent a lower level of suitability for assessing effectiveness when compared with cohort, controlled studies and systematic reviews. After screening, 50 studies and reports were included in this category.[1,179-227] This number includes four items which may be characterised as 'expert consensus' statements (policy statements, recommendations, expert opinion articles or reports which are informative and noteworthy, but which are not used formally in this review to determine evidence of effectiveness).[1,179,184,192] These four 'expert consensus' items aside, all studies in this category included discussion of HRA. Analysis of these other studies revealed that:

- 46 studies included discussion of HRA[180-183,185-191,193-228], of which 26 studies focussed more on methodological aspects of HRA[183,186-191,197,199,200,203,206,208,209,211,213-217,219-221,224,226,227], including six studies exploring instrument validity or reliability[186,208,214,216,220,226]
- Eleven included discussion of cost effectiveness or returns on investment[187,188,196,203,215,218, 219,221-224]
- Nine included discussion of productivity[180,186,196,214-216,220,226,227]
- Ten studies included specific discussion of CVD risk factors[180,190,193-195,198,201,210,212,217] and in addition
- Four included discussion of smoking[188,203,221,225]
- Three included discussion of dietary behaviour[185,208,225]
- One study included discussion of alcohol[225]
- Three included discussion of physical activity[185,197,221]
- Four included discussion of obesity or healthy weight[185,195,199,210], (noting that the Gracey et al.[210] study is in a remote Australian Aboriginal community setting rather than the workplace)

- Five included discussion of diabetes or the metabolic syndrome[200,207,208,210,219] (noting again the inclusion of Gracey et al.[210] and that Krass et al.[200] is located in the pharmacy setting
- Seven studies included measurement of blood pressure[193,195,199,201,207,208,221]
- Seven studies included measurement of cholesterol[193-195,201,208,212,221]
- Three studies included measurement of body mass index (BMI[193,199,212]
- One study included measurement of waist circumference.[207]

Australian studies

The review found a paucity of Australian intervention research or descriptive studies.[75,115,225,229-232] They had little influence on the overall findings of this review other than to note the need for future investment in Australian-based studies. For completeness, they are described briefly in this section.

Morgan and colleagues reported in 2012 on their small RCT evaluation of a workplace-based weight loss program (Workplace POWER (Preventing Obesity Without Eating like a Rabbit)) for male shift workers on a number of work-related outcomes which was implemented at the beginning of 2012.[115] One hundred and ten overweight/obese male employees at Tomago Aluminium (New South Wales) were randomised to either (i) Workplace POWER program (n=65) or (ii) a 14-week wait-list control group (n=45). The men were assessed at baseline and 14-week follow-up for weight, quality of life, sleepiness, productivity at work (presenteeism), absenteeism, and workplace injuries. Retention was 81% and the analysis revealed a significant intervention effect for weight, quality of life (mental), presenteeism, absentee-ism, and injuries.

Freak-Poli and colleagues produced three studies in 2010/11, all of which refer to the same workplace program implemented in April/May 2008, wherein 762 participants were recruited from ten Melbourne workplaces, taking part in the 'Global Corporate Challenge' a pedometer-based physical activity program.[229-231] Follow-up was limited to 4 months. Short-term improvements were found for physical activity (an increase of 6.5% in the proportion meeting guidelines, OR(95%CI): 1.7(1.1,

A PricewaterhouseCooper report on workplace wellness in Australia used four major summative themes:

1. ***The imperative for workplace wellness in Australia***
   The cost to individuals, employers and the health system of chronic disease and the ageing population is creating an imperative for action. In order to change the trajectory of chronic disease, health risk factors must be addressed as a matter of priority; the current imbalance in resources for the treatment of chronic diseases versus their prevention is no longer sustainable.
2. ***The converging aims of employers, health system payers and individuals***
   A cultural shift is gradually occurring in Australia. Employers, health system payers and individuals are now seeing the benefit of the workplace as a setting for optimising physical, psychological and social health.
3. ***Lessons learned from wellness implementation***
   While the 'Gold Standards' framework can be found in Australian companies, its use is not systematic and widespread. Demonstrating a return on investment for workplace wellness programs will require adequate resourcing, robust measures and holistic service offerings.
4. ***A call to action: make wellness 'business as usual'***
   Although the imperative for supporting workplace health is clear, the benefits are harder to quantify for employers. A suite of collaborative and interdependent actions are therefore required to enable effective workplace wellness. Ultimately, the sustainability of workplace wellness programs at an organisational level will depend on demonstrating a return on investment.

2.5)), fruit intake (4%, OR: 1.7(1.0, 3.0)), vegetable intake (2%, OR: 1.3(1.0, 1.8)), sitting time (–0.6(-0.9, –0.3) hours/day), blood pressure (systolic: –1.8(–3.1, –.05) mmHg; diastolic: –1.8(–2.4, –1.3) mmHg) and waist circumference (–1.6–2.4, –0.7) cm). In contrast, an increase was found for fasting total cholesterol (0.3(0.1, 0.4) mmol/L) and triglycerides (0.1(0.0, 0.1) mmol/L). Thus this four-month, pedometer-based, physical activity, workplace programme was associated with improvements in behavioural and anthropometric risk factors for diabetes and cardiovascular disease.[230]

Musich and colleagues reported in 2006 on a cross-sectional survey of 224 employees of a private insurance provider in Australia.[232] The researchers used a Health Risk Appraisal (HRA) to evaluate self-reported presenteeism and the prevalence of 12 health risks and eight medical conditions. Increased presenteeism was significantly associated with high stress, life dissatisfaction, and back pain, while increased illness absenteeism was significantly associated with overweight, poor perception of health, and diabetes. Excess presenteeism associated with excess health risks (productivity loss among those with medium- or high-risk status compared to those with low-risk status) was independently calculated at 19.0% for presenteeism and 12.8% for illness absenteeism. The authors concluded that an association exists between health metrics and self-reported work impairment (presenteeism) and measured absenteeism; and that their study provides a first indication of the potential benefits of health promotion programming to Australian employees in improving health and to the corporation in minimising health-related productivity loss.

Atlantis and colleagues reported in 2006 on a small randomised controlled trial conducted in one of Australia's casinos in 2002–2003, involving seventy-three employees (aged 32 +/– 8 years, 51% overweight/obese, 73% shift workers, 52% women). The study, which had a very poor participation rate (less than 7%) set out to investigate the effects of a comprehensive exercise and lifestyle intervention on physical fitness. No significant effects on body mass or body mass index were found, however despite an RCT design, the study was poorly executed.[75]

Simpson and her colleagues described in 2000 the design and baseline findings for the Australian national workplace health project.[225] The authors report that 61% of employees attended the health risk appraisal; the sample was predominantly male, English speaking, married, blue-collar workers. Overall, 12% reported unsafe alcohol consumption, 26% were current smokers, 44% were physically inactive, 74% ate at most one piece of fruit per day, and 26% ate at most one serving of vegetables per day.[225]

Other relevant Australian Reports include the 2011 publication of a set of case studies by the Government of Victoria[181] and the 2010 report on *Workplace Wellness in Australia* by PricewaterhouseCoopers.[204] The latter report, commissioned by Medibank Health Solutions through its subsidiary Fitness2live, describes the evolution of workplace wellness in Australia from the employer's perspective and discusses the issues and enablers for growth and sustainability (see text box above).[204]

Offering	Health and safety	Human capital	Engagement
Online information, assessments and behaviour change programs	●	●	●
Executive and senior management health assessments	●	●	
Annual health checks	●		●
Voluntary one-on-one coaching for individuals with multiple risk factors	●	●	●
Vaccinations	●	●	
Health insurance subsidies		●	
Employee Assistance Program	●	●	
Work/life balance arrangements		●	●
Training	●		●
Issue-specific offerings (e.g. weight loss programs)	●		●
Events and challenges (e.g. Global Corporate Challenge)		●	●
Physical environment (e.g. accessible stairwells)	●		
Provision of fruit		●	
Service availability (e.g. onsite gym)	●	●	

Table 1 Key driver characteristics of workplace wellness program offerings in Australia (Source: PricewaterhouseCooper 2010 Report–Workplace Wellness in Australia)

Studies conducted in smaller businesses

The overwhelming majority of higher quality retrieved studies were conducted in large companies (those with 500 or more employees); there is evidence that about half of companies with more than 750 employees offer HRAs.[56] This section identifies selected studies dealing with smaller businesses.

Taitel and colleagues investigated factors associated with employee participation rates in health risk assessments; they conducted a cross-sectional study involving 124 employers with 882,275 eligible employees who completed 344,825 health and productivity assessments (HPAs) — that is, a type of HRA.[233] Incentive value and Communications and Organizational Commitment Level (Com/Org Level) were the strongest predictors of HPA completion rates but employer size was also a significant predictor. To achieve a 50% HPA completion rate, employers with a low Com/Org Level will need an incentive value of approximately $120 whereas employers with a high Com/Org Level only need approximately $40 — a difference of $80 dollars (Figure 1).

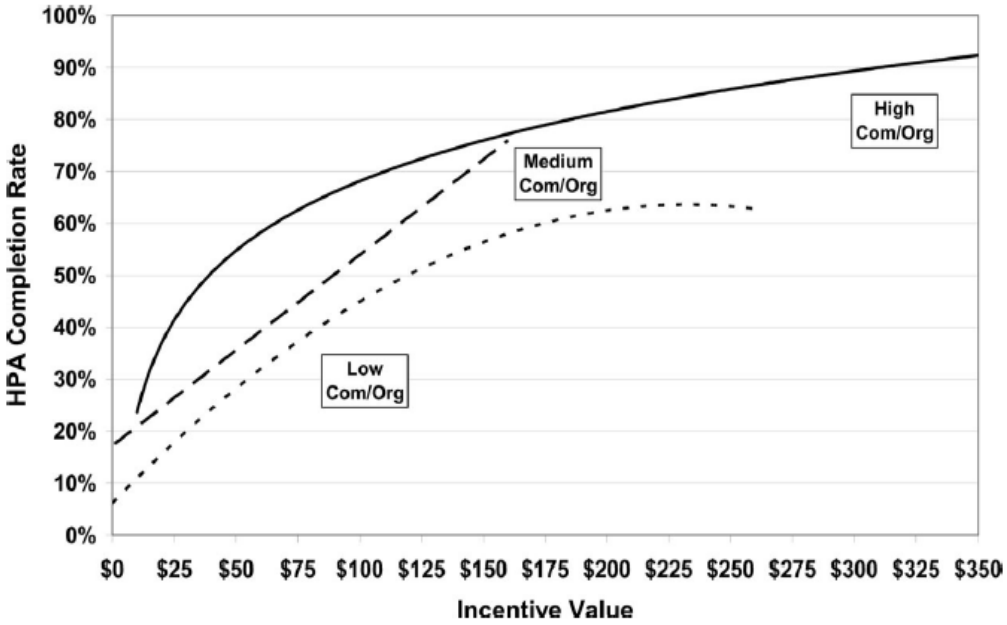

Figure 1 HRA ('HPA') completion rate by incentive value and by Communications/Organization commitment level (Source: Taitel et al., 2008)

Merrill and colleagues 2011 study in the USA purported to evaluate the level of participation and effectiveness of a worksite wellness program in a small business setting. Three years of wellness participation and risk data from Lincoln Industries was analysed. All Lincoln Industry employees participated in at least some level of wellness programming. Significant improvements in body fat, blood pressure, and flexibility were observed across time. The largest improvements in risk were seen among older employees and those with the highest baseline values. The researchers concluded that replication of this program in other small business settings could have a large impact on public health.[169] The company size was around 500 employees, so that this example was arguably of a medium rather than small business.

In another North American study, Saleh and colleagues reported in 2010 on a Wellness Network in a rural area in Upstate New York.[137] The Network was formed as a broad-based partnership of health providers and employers to offer employees in the local setting the opportunity to receive health improvement services. The project was inaugurated in 2001, when the Network started providing a range of wellness services including health risk assessment, screenings, worksite wellness programming, and referrals to a very limited number of area employees in partnership with employers. In 2004, a decision was made to expand the program to include more employment sites and to conduct a formal evaluation of its activities. This study reports the effectiveness and cost-effectiveness of the Network wellness activities over a 4-year period (2004–2007). Six rural employers were categorised into 3 groups: a control group and 2 intervention groups with varying degrees of wellness activities. Participants were asked to complete an annual health risk assessment (HRA) that addressed 16 wellness areas. At the conclusion of 4 years, HRA and effectiveness data were utilised to examine program effectiveness and combined with program costs to estimate cost-effectiveness. The 'Coaching and Referral' group (the highest in intensity of participant engagement) exhibited superior improvement in several wellness areas and in percentage of employees with good health indicators compared to the control and the Trail Marker (lower-intensity intervention groups). However, the Trail Markers had more favourable cost-effectiveness ratios. The researchers concluded that rural worksite wellness programs show great potential in their effectiveness and cost-effectiveness; such programs need not be too aggressive, tedious, and costly to generate a favourable return for employers and funders.

However, employers should be encouraged to experiment with different levels of wellness program intensities until a more favourable outcome can be realised.[137]

Sorensen and colleagues have also reported promising results in 2005 from a US-based cancer prevention intervention designed to improve health behaviours among working-class, multiethnic populations employed in small manufacturing businesses.[138] Twenty-six worksites were randomly assigned to an intervention or (minimal-intervention) control. The 18-month intervention targeted fruit and vegetable consumption, red meat consumption, multivitamin use, and physical activity. Response rate at follow-up was 77%; employees in the intervention group showed greater improvements for every outcome compared with employees in the control group and were statistically significant for multivitamin use and physical activity. Intervention effects were larger among workers than among managers for fruit and vegetable consumption and for physical activity. The researchers concluded that the approach held promise but further research was required to improve effectiveness.

Studies pertaining to the pharmacy setting

Overall, there were very few studies in the pharmacy setting that were of direct relevance to the terms of reference for the current review. For completeness, the more important studies are described briefly in this section.

Evans et al. reported in 2011 a systematic review of studies evaluating community pharmacist interventions for preventing or managing diabetes or cardiovascular disease (CVD) and/or their major risk factors.[32] The review (which was not workplace specific) reported that all included studies contained interventions focused at the patient level and the majority of studies (34/40) involved interventions directed at both the physician and patient. No specific intervention emerged as superior, and study quality was generally poor, making it difficult to determine the true effect of the interventions. The researchers concluded that poor study quality, time-intensive interventions, and unproven clinical significance warrant the need for further high-quality studies of community pharmacist interventions for preventing or managing diabetes or CVD and/or their major risk factors.

Nkansa et al. reported in 2010 a Cochrane systematic review which examined the effect of outpatient pharmacists' non-dispensing roles on patient and health professional outcomes.[234] Pharmacist interventions resulted in improvement in most clinical outcomes, although these improvements were not always statistically significant. Most included studies supported the role of pharmacists in medication/therapeutic management, patient counseling, and providing health professional education with the goal of improving patient process of care and clinical outcomes, and of educational outreach visits on physician prescribing patterns. There was great heterogeneity in the types of outcomes measured across all studies. Heterogeneity in study comparison groups, outcomes, and measures makes it challenging to make generalised statements regarding the impact of pharmacists in specific settings, disease states, and patient populations.

Horgan and colleagues reported in 2010 their simple descriptive evaluation study of a targeted cardiovascular (CVD) assessment pilot conducted in 23 community pharmacies in Birmingham, UK.[198] A CVD risk assessment service was administered by pharmacists to screen clients aged 40–70 without known CVD. Complete data were available for 1,130 of 1,141 clients; 679 (60%) male, 218 (19%) smokers and 124 (11%) had a family history of CVD. Overall, 792 (70%) of clients were referred to their general practice: 201 (18%) at CVD risk of 20% or more, remainder with individual risk factor(s). Greater representation from Black (7.4%) and Asian (24.8%) communities and from average and less deprived quintiles than the affluent and most deprived was observed. The researchers concluded that a pharmacy service can support (UK) GP practices in identifying and managing the workload of around 30% of clients.

In Liu and colleagues 2009 descriptive study, a USA pharmacist-managed cardiovascular disease (CVD) risk screening program coordinated by a health benefit consulting company identified union workers and their dependents with modifiable risk factors for CVD.[201] Patients were able to self-select screening services for systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, or high-density lipoprotein (HDL). Considerable risk of CVD existed among the 452 participants, as 45.2% had high blood pressure readings and 24.0% high total cholesterol levels. The authors concluded that a pharmacist-managed health screening program was a tool to identify patients at risk of CVD. At-risk individuals could be potential participants in a cardiovascular risk management service.

Krass and colleagues 2007 report on the Pharmacy diabetes care program provided an analysis from an RCT of two screening methods for undiagnosed type 2 diabetes in Australian community pharmacy.[200] The RCT compared (i) tick test only (TTO); or (ii) sequential screening (SS) method finding that SS is the superior method from a cost and efficacy perspective and should be considered as the preferred option for screening by community based pharmacists in Australia.

In 2009, Detloff and colleagues reported a cross sectional study of a HRA conducted by pharmacists in United States.[193] The HRA involved point-of-care cholesterol screening (with a follow-up risk factor questionnaire) conducted by pharmacist employees of the employer group (a regional supermarket chain). Those eligible for the screening were employees of the supermarket chain and their dependents covered by the participating managed care organisation (MCO). A total of 12,915 completed HRA questionnaires were received. Mean age of the employees participating was approximately 44 years. Of note, 14%, 24%, 21%, and 69% of questionnaires had abnormal values for total cholesterol, high-density lipoprotein (HDL) cholesterol, blood pressure, and body mass index (BMI), respectively. Compared with national benchmarks, low HDL cholesterol and BMI more than 30 kg/m^2 were more common in this screened population. More than one-fourth of the employees in this analysis were identified as being at high risk for a coronary heart disease event. The demonstration allowed for an expanded role of pharmacists to implement a quality improvement program. In response, the employer decided to continue the HRA screening and offer an employee contribution reduction-based health incentive to covered members. The employer reportedly was in the process of offering cardiovascular disease management interventions that would be performed by the supermarket chain's pharmacists and targeted toward the identified risk factor trends.

Wibowo et al. conducted a simple cross sectional study to evaluate the provision of enhanced pharmacy services in rural Western Australian (WA) pharmacies in 2006 by comparing results with findings from a national survey conducted in 2002.[235] Enhanced pharmacy services (EPS) are health related services above those normally available with the supply of medicines. The study found that WA rural pharmacies offered a range of EPS. There were marked increases in weight testing and weight management services. The availability of smoking cessation services increased from 52% of rural pharmacies in 2002 to 63% in 2006. Other EPS (asthma, diabetes, hypertension, hyperlipidaemia), which correspond to the Australian Government National Health Priorities Areas were offered by 20% to 50% of pharmacies and had not increased between surveys. A continued shortage in the pharmacist workforce was a major barrier to EPS provision. The researchers opined that provision of EPS in rural pharmacies is more important than in metropolitan pharmacies because there is often a lack of other sources for these services in rural and remote locations. Rural pharmacies could provide a diversity of EPS in response to the limited access and reduced health. Government and pharmacy bodies would accordingly need to implement rural practice models to address identified pharmacist workforce barriers and improve access to EPS to rural communities.

In a 2004 US study, Boyle et al. conducted a 12-week, prospective cohort study using convenience sampling among men who visited participating pharmacies.[236] The patients were 382 men aged 25–74 years with potential health risks that were untreated or uncontrolled, or who had not had a physical examination within the past year. They were screened for specific health

risks with or without telephone follow-up. Of the 382 men identified by the Men's Health Risk Assessment Tool (MHRAT) as being at risk for 1,194 significant health conditions (mean, 3.1 conditions per patient), 69% had not received a physical examination from a physician for a period ranging from more than 1 year to 22.6 years. Of men who were recommended to make an appointment, 64% were seen by a physician or were waiting on a scheduled appointment at the end of the study. No differences were seen between the telephone intervention group and the control group in rates of obtaining a physician examination. The researchers concluded that community pharmacists had a significant impact on motivating men to see a physician for follow-up care once a potential health risk was identified. The MHRAT and the pharmacist recommendation or patient education were the motivating factors and not follow-up telephone interventions by the pharmacist.

Overall quality of retrieved studies in the review

Protocols for screening and quality assessment of studies in the review are described in detail at Appendix 1. Participation rates reported in studies of HRA programs ranged from 20% to more than 80%[59,159,161,237,238], with higher participation associated with financial incentives in recent studies and a general finding that females, older employees, and mainly the 'worried well' tend to be attracted.[59] Virtually all studies were of participants who were volunteers. The consequent possibility of selection bias was a very common limitation in the assessment of quality. Despite a large number of studies being in the categories of higher suitability for evaluating evidence of effectiveness (Table 2), almost all controlled studies were judged to be poor quality in terms of execution with the exception of good execution in a multi-centred RCT by Nurminen et al.[121] and fair execution in the studies by Sternfeld et al.[142] and Block et al.[81] (both being studies of The ALIVE Program (USA) which is discussed in detail in the report). The quasi-experimental pre-post intervention-control study by Mills et al.[152] was also of fair quality. By contrast, cohort studies were judged to be fair quality with some being of good quality such as Angotti et al.[157] or Pescatello et al.[172]

Study Design Suitability		HRA	ROI	Productivity	Smoking	Dietary behaviour	Alcohol	Physical Activity	CVD/ multiple risk factors	Diabetes/ Metabolic syndrome	BP	Cholesterol	BMI
Least	*No. of studies*	46	11	9	4	3	1	3	10	5	7	7	3
	References	180–183, 185–191, 193–227	187, 188, 196, 203, 215, 218, 219, 221–224	180, 186, 196, 214–216, 220, 226, 227	188, 203, 221, 225	185, 208, 225	225	185, 197, 221	180, 190, 193–195, 198, 201, 210, 212, 217	200, 207, 208, 210, 219	193, 195, 199, 201, 207, 208, 221	193–195, 201, 208, 212, 221	193, 199, 212
Moderate	*No. of studies*	22	4	1	4	5	0	9	4	4	5	5	5
	References	157–178	160, 168, 175, 176	158	158, 165, 168, 174	157, 168, 170, 173, 174	-	157–159, 163, 165, 168, 170, 173, 174	161, 172 168, 170	163, 166, 172, 176	147, 150, 151, 153, 155	157, 163, 171–173	162, 163, 168, 170, 171
Greatest	*No. of studies*	61	20	20	11	32	6	37	26	9	7	12	19
	References	30, 37, 39, 56, 59, 62, 65–67, 72, 78, 81, 83–85, 87–91, 96–102, 105, 107–110, 112, 115, 118, 120, 121, 124, 125, 129–131, 134, 135, 137, 139, 140, 142–149, 151, 152–156	19, 26, 27, 33, 49–51, 55, 58, 60, 64, 69, 81, 96, 97, 112, 124, 137, 144, 145	23, 25, 38, 41, 53, 64, 67, 68, 71,81, 97, 101, 115,124, 134, 143–145, 151, 152	24, 84, 98, 108, 109, 120, 130, 137, 139, 154, 156	17, 28, 31, 44–46, 61, 78, 81, 83–85, 90, 91, 98, 100, 102, 105, 107, 110, 120, 125, 131, 133, 135, 137, 139, 142, 146, 148, 154, 156	63, 89, 99, 124, 137, 143	17, 28, 29, 31, 36 45, 48, 61, 78, 81, 83–85, 88, 90, 91, 100, 102, 105, 107, 108, 110, 112, 118, 120, 121, 129–131, 133, 135, 137, 142, 146, 148, 151, 154	20, 33–35, 47, 49–51, 57, 69, 87, 97, 109, 118, 120, 133, 78, 83, 85, 91, 100, 105, 107, 110, 131, 148	32, 39, 42, 62, 78, 109, 110, 133, 151	78, 83, 85, 96, 108, 112, 131	83, 87, 90, 96, 102, 108, 109, 118, 125, 131, 154, 156	78, 83, 87, 96, 100, 102, 108, 110, 112, 115, 129–131, 133, 147–149, 151, 153

Table 2 Overview of retrieved studies stratified by suitability of study design for evaluating evidence of effectiveness

ANSWERING THE REVIEW QUESTIONS

The spectrum of workplace Health Risk Assessment (HRA)

Key Question 1 **What types of workplace health screens have been implemented with the primary goal of screening, and identifying risk, for chronic disease?**

Summary Statement

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- Most workplace HRAs have been developed to address and improve general health and in particular to improve cardiovascular health
- HRA instruments are questionnaire-based tools designed specifically for the purpose of conducting HRA but rarely meeting any stipulated accreditation standards
- The majority of HRAs address a mixture of clinical/physical-based and questionnaire-based measures, a large proportion are purely questionnaire-based, whilst a minority address physical/clinical measurements only
- Frequency of follow-up post initial HRA varies across studies, with two follow-up contacts being the most common; best estimates are as follows: one contact–27%; two contacts – 41%; three contacts–18%; and four contacts–13%
- Feedback post HRA appears to be provided most frequently in the form of (i) personalised HRA results on paper printout or in writing; (ii) in person; (iii) via posted mail; (iv) via telephone; (v) during group sessions; and (vi) email. There is some evidence in more recently published studies that telephonic, web-enabled communications and social networking are becoming more commonly featured
- In well designed studies, no correlation was found between degrees of feedback/ frequency and program dropout rates which ranged from mostly low rates to as high as 80% in some studies
- Typical characteristics of persons involved in the HRAs was 30 to 50 years of age, a higher probability of being female, displaying average health, although sometimes selected to represent groups with above average risk factors for chronic disease
- There is insufficient evidence to identify other specific characteristics of HRAs that are associated with better health outcomes, other than to note that the feedback/recommendations component appeared to produce motivation among participants to modify behaviours
- Information about time required for completion of HRAs was generally not specified in studies, however based on two very recently published studies it is estimated to take approximately 15 minutes for completion of an online HRA
- Analysis of HRA measurement items in retrieved studies incorporating suitable research designs suggest that in the typical self-report suite, physical activity was the most commonly used (38%), followed by dietary behaviour (30%), CVD/Multiple Risk (25%), smoking (12%) and alcohol (5%); in the physical/clinical measurement suite, BMI was the most commonly used (20%), followed by cholesterol (14%), diabetes/metabolic syndrome (11%) and blood pressure

(10%). Measurements of waist circumference (7%) and skinfold (2%) were less frequently reported.

The Evidence

- A systematic review on health risk appraisal was (HRA) undertaken for the US Department of Health and Human Services — Agency for Healthcare Research and Quality (AHRQ) was published mid-year 2011, reviewing RCTs and cohort studies to June 2010.[59] The review did not consider cost effectiveness or productivity-focussed studies. The scope of this HRA-specific review was broader than, but encompassed and had a major focus on the workplace, including 56 studies located in that setting. The review found that:
- most HRAs were developed to address and improve general health and that a major objective was to improve cardiovascular health
- HRA instruments themselves were questionnaire-based tools designed specifically for the purpose of conducting HRAs
- Other questionnaires used as HRAs were originally developed to measure constructs such as self-reported disease risk factors or behaviours such as food intake and physical activity
- Some HRAs addressed physical or clinical assessments such as blood pressure and cholesterol
- A minority of HRAs addressed physical/clinical measurements only (nine articles), while a greater proportion (48 articles) addressed questionnaire-based HRAs and the majority (61 articles) addressed a mixture of clinical/physical-based and questionnaire-based measures
- 42 miscellaneous HRA questionnaires were identified, comprising compilations of measures from various sources, author-developed instruments, vaguely described scales, or groups of questionnaires 'stitched together; to form a single HRA instrument'[59]
- Only two HRA instruments (The Personal Wellness Profile[4] and the *Insight*® Health Risk Appraisal Survey[164] met any stipulated accreditation standards such as being certified by the US National Committee for Quality Assurance (NCQA)
- In terms of methods of method and frequency of follow-up post HRA, feedback was most commonly provided (i) in the form of personalised HRA results on paper printout (n=97) or in writing (N=68); (ii) in person (n=80); via telephone (n=33) or email (n=19); (iii) during group sessions; or via posted mail (n=52) – see Figure 2[59]
- Frequency of follow-up varied across studies: 72% involved between one and four follow-up contacts and two follow-up contacts was the most common scenario, as follows: one contact (27%, 22 studies), two contacts (41%, 34 studies), three contacts (18%.15 studies), four contacts (13%, 11 studies)
- No correlation was found between degrees of feedback/frequency and dropout rates (which ranged from mostly low rates to as high as 80% in some studies)
- Typical characteristics of persons involved in the HRAs was 30 to 50 years of age, with a higher probability of being female, displaying average health, although sometimes selected to represent groups with above average risk factors for disease
- This robust systematic review could not identify specific characteristics of HRAs that are associated with better health outcomes, other than to note that the feedback/ recommendations component appeared to produce motivation among participants to modify behaviours

[4] http://www.wellsource.com/home.html

- Information about time required for completion of HRAs was generally not specified in studies (one recent study reports 10–15 minutes completion time for an online HRA comprising 60 copyrighted questions regarding demographics, medical history, preventive screenings, diagnosed conditions, men's/women's health, personal assessment of health, exercise, tobacco usage, nutritional habits, safety, alcohol/substance use, emotional health, interest in making changes to personal health, medical care, and self-care;[178] another recent study also mentions a 15-minute completion time for online HRA[159]).

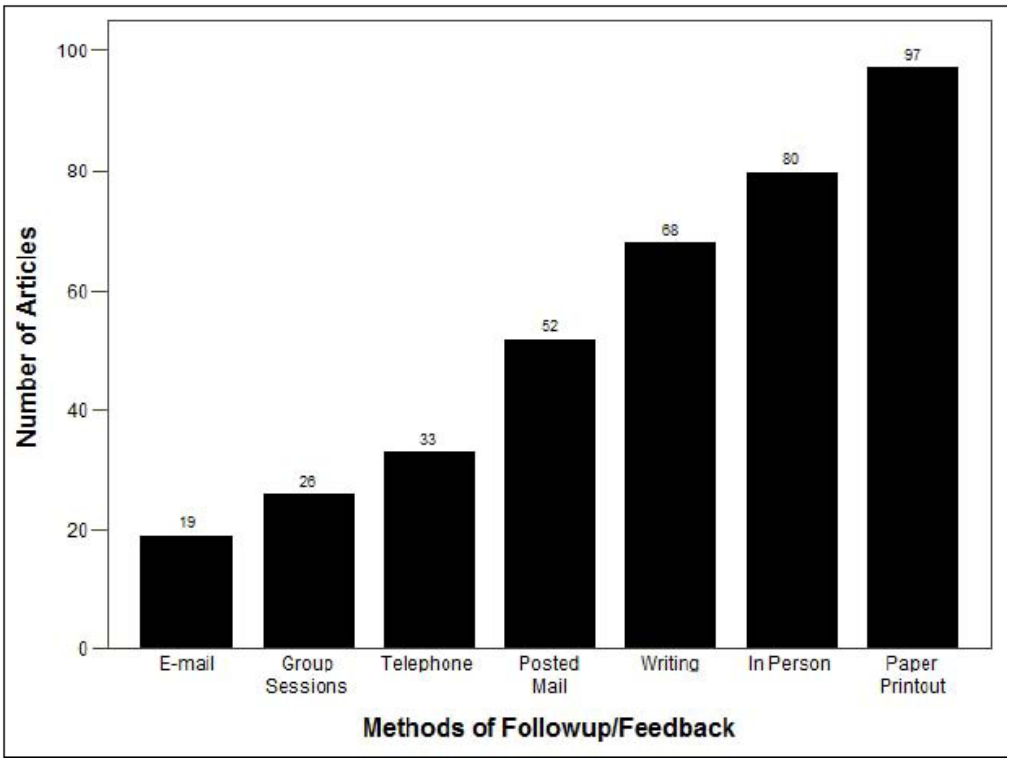

Figure 2 Methods of follow-up and feedback in HRAs (Source: USDHHS)

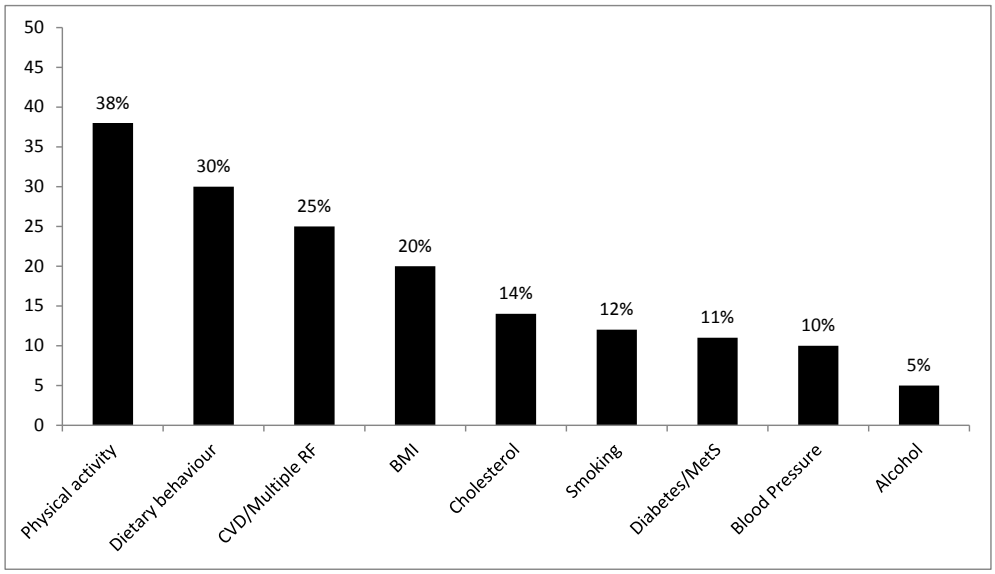

Figure 3 Estimated use of HRA items in better designed studies published since 2000

Analysis of HRA measurement items in studies incorporating the more suitable design for evaluating evidence of effectiveness (moderate/greatest categories in Table 2) allowed estimation of their frequency of use. In the typical self-report suite, physical activity was the most common (38%), followed by dietary behaviour (30%), CVD/Multiple Risk (25%), smoking (12%) and alcohol (5%). Amongst the physical/clinical measurement suite BMI was the most common (20%), followed by cholesterol (14%), diabetes/metabolic syndrome (11%) and blood pressure (10%). Measurement of waist circumference (7%) and skinfold (2%) was infrequent.

A systematic review by Soler and colleagues was published early in 2010, reviewing studies to mid-2005 on the effectiveness of interventions that use a Health Risk Assessment with Feedback (HRAF) when used alone or as part of a broader worksite health promotion program to improve the health of employees.[56] There was insufficient evidence to determine the effectiveness of HRAF when implemented alone, however when used in combination with other interventions there was strong evidence of effectiveness in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol. These additional interventions may include health education (to be included as a unique intervention component, the educational efforts must last for longer than 1 hour or occur in multiple sessions over time), enhanced access to physical activity, nutritious food alternatives, medical care, or policy interventions such as smoking bans or restrictions.

A meta-evaluation (semi-systematic review) of Worksite Health Promotion Program (WHPP) economic return studies up to November 2011 was published in March 2012.[27] This review reported that more recent studies (published in the last 10 years) reflect a trend of using newer prevention technologies including:

- Use of the Transtheoretical Model
- Internet-provided health information
- Tailoring
- Benefits-linked financial incentives
- Telephonic high risk intervention coaching
- Annual required morbidity-based health risk appraisals used for individual targeting of interventions.

The meta-evaluation reported that these more recent technologies were associated with higher levels of economic impact and return; their incorporation in the studies published in the past 10 years reportedly resulted in slightly more than double the average cost-benefit or Return on Investment (ROI) ratio reported in studies of traditional program models; that is, instead of the typical 3:1 ROI ratio they report a ROI of 6.1:1.[27]

Researchers have reported that US employers have redirected their efforts at population health management to incorporate health promotion and disease prevention programs alongside more traditional case and disease management.[159] Tools used by employers for population health management typically include:

- Extensive awareness building through health education
- Health risk assessments (HRAs)
- In-person risk reduction interventions
- Telephonic health coaching
- Web-enabled communications
- Social networking

- Establishment of data warehouses.

Because of the trend for use of new technologies reported in the 2012 meta-evaluation,[27] this theme was examined in further detail within studies retrieved in the current review. These are discussed below.

Analysis of all better designed studies ('moderate' or 'greatest' suitability) retrieved for the current review found 19 studies including Internet/e-mail or website,[81,87,89,100,110,125,129,130,142,148,149,152,153,156,161,165,173,174,176] of which more than half (11 studies) were published in 2009 or later[87,100,110,129,142,148,149,161,173,174,176] and were selected for further examination. Two controlled trials involved very small numbers of participants are not discussed.[110, 129] Two studies applied RCT and cohort designs (Robroek et al.) to the same program (in the Netherlands) and are grouped together for discussion.[173, 174] Three studies dealt with the initial and longer term results of the same program (the ALIFE@Work study – also in the Netherlands, van Wier, Dekker et al.) and are discussed together.[87,148,149]

Robroek and colleagues investigated initial and sustained participation in an Internet-delivered physical activity and healthy nutrition program in the Netherlands using both RCT and longitudinal designs to (i) gain more insight in the use of the website component of a worksite behaviour change intervention and (ii) identify demographic, behavioural, and psychosocial factors associated with website use.[173,174] Six workplaces participated in a two-year cluster randomised controlled trial involving health care organisations (n=2), commercial services (n=2), and executive branches of government (n=2),12,895 employees were invited by email to participate. In companies not restricting eligibility, participation rate ranged from 36 percent to 61 percent. Throughout the period, all participants had access to a website with information on lifestyle and health, and to fully automatic personalised feedback on the HRA questionnaire results. Only participants in the intervention received monthly email messages to promote website visits during the first year and had access to web-based tools (self-monitors, a food frequency questionnaire assessing saturated fat intake, and the possibility to ask questions) to support behaviour change. The RCT reported only modest initial participation and high attrition in program use. Workers with a low intention to change their behaviour were less likely to participate, but once enrolled they were more likely to sustain their participation. Lifestyle and health indicators were not related to initial participation, but those with an unhealthy lifestyle were less likely to sustain participation which is an important consideration with respect to bias of results as well as overall program effectiveness. Regular email messages prompted website use, but the use of the web-based tools was modest. Complete HRA baseline data were available for 924 employees (intervention: n=456, reference: n=468). From the longitudinal study, logistic regression analyses were conducted to identify characteristics of employees who visited and used the website. 43 percent of the participants visited the website after an email message to promote website visits. Participants who were insufficiently physically active were less likely to visit the website (odds ratio (OR) 0.63, 95% confidence interval (CI) 0.45–0.88), whereas individuals with an elevated total cholesterol level visited the website more often (OR 1.44, 95% CI 1.05–1.98). Monthly emails in the intervention group resulted in almost quadrupling of website use during a 3-month period (18% versus 5% in the reference group, OR 3.96, 95% CI 2.30–6.82). Participants with a positive attitude toward increasing physical activity were about half as likely to visit the website (OR 0.54, 95% CI 0.31–0.93) or to use the self-monitor and FFQ (OR 0.50, 95% CI 0.25–0.99). Female workers were more than twice as likely as males to visit the website to monitor their behaviour and to receive advice on fat intake (OR 2.36, 95% CI 1.14–4.90). Study limitations include (i) volunteer participants (possible selection bias); (ii) lack of information as to what extent the participants read the available information or how much time they spent on the website; (iii) participation levels as well as the populations of the participating workplaces differed; (iv) employees had variable access to use computers and email during their workday (nonetheless, the group spending a major part of the day with computer work was not found to have an increased website use compared with workers with less or no computer work); (v) reasons for drop-out are unknown so we cannot determine whether individuals stopped participating because they did

not need the program anymore, because they were dissatisfied with the program, or because of some another reason; (vi) no information was available on the use of any other lifestyle-related websites during the intervention.

For the ALIFE@Work study in the Netherlands van Wier and colleagues conducted a randomised controlled trial of a 6-month program comparing two modes of intervention delivery (phone, n=462; Internet, n=464) with self-directed materials (control, n=460), among overweight but otherwise healthy employees which was followed up at the end of the program[148] and after 2 years.[149] In addition, Dekkers and colleagues conducted a randomised controlled trial with a random sub-sample (n=276) of participants to examine the effectiveness of a distance-counseling lifestyle intervention program, delivered by either phone or Internet/e-mail to modify cardiovascular risk factors.[87] Employees came from seven Dutch companies (two IT-companies, two hospitals, an insurance company, the head office of a bank and a police force). For the main study 2,615 employees were eligible to take part in the study, of whom 1,454 were willing to participate and received an appointment for baseline measurement, which was kept by 1,397 employees. At baseline 11 employees were excluded and 1,386 employees were randomised to the phone group (N=462), Internet group (N=464) and control group (N=460). Participation in the study as a percentage of estimated number of eligible employees varied between 20% and 32% per company. Among complete cases, weight loss in the Internet group was 1.2 kg (95% confidence interval (CI), –1.9 to –0.4) and in the phone group 0.8 kg (95% CI, –1.5 to 0.03), compared with the control group. Multiple imputation of missing body weight resulted in comparative weight losses of –0.9 kg (95% CI, –2.0 to 0.3) and –0.4 kg (95% CI, –1.4 to 0.7). Among 'complete' cases, the Internet intervention showed modest long-term weight loss, but among all participants neither program version was more effective than self-help. The main study is limited by (i) volunteer participants (likely selection bias); and (ii) the rate of loss to follow-up: 29% at 6 months and 43% at 2 years. This is, unfortunately, in line with rates of attrition seen in other worksite weight-control studies.[17] The sub-sample study by Dekker et al. found limited evidence for the effectiveness of the intervention in reducing cardiovascular risk, with no evidence for one of the two communication modes to be more effective than the other. Effects at 6 months were in favour of counseling by phone and at 24 months in favour of e-mail counseling. Limitations of this sub-sample RCT include (i) the high proportion (135/276) of subjects lost to follow-up (subjects retained may have experienced greater weight loss than subjects lost); (ii) analysis was limited to participants with complete data (who had completed more modules); (iii) voluntary participation in this study may have resulted in selection bias.

Tarride and colleagues conducted a one-year prospective observational study to evaluate the My Health Matters! (MHM) program, a multifaceted intervention focused on early detection and disease management with a focus on risk factors for metabolic syndrome.[176] The program, which was offered to 2,000 public servants working in more than 30 worksites in Canada, included a web-based HRA combined with an opportunity to attend an on-site screening and face-to-face call back visits as well as related on-site educational programs. The researchers commented that interventions relying on healthcare professionals for the initial assessment of risk factors and follow-up of employees may be more effective than prospective interventions relying solely on educational material, HRA or other web-based media. Forty three per cent of employees (N=857) completed the online HRA and 23 per cent (N=447) attended the initial clinical visit with the nurse. Risk factors for metabolic syndrome were identified in more than half of those attending the clinical visit. The number of risk factors significantly decreased by 15 per cent over six months (N=141). The study had several limitations such as (i) not including any comparative arm but rather using a pre-post study design; (ii) employees were invited to participate in the follow-up study only if they had one risk factor for metabolic syndrome (e.g. cholesterol); (iii) although almost 20 per cent of employees attended the initial clinical visit (447 out of 2,000), less than half of those who met the inclusion criteria did attend the clinical visit at six months (116 out of 253 employees with at least one risk factor for metabolic syndrome or 46%). Study results may therefore not be representative of the full workforce — self-selection bias may have been present as employees attending the six month follow-up visit may have been more motivated to reduce

risk factors than those who did not; and (iv) voluntary participation in this study may also have resulted in selection bias.

Hughes and colleagues conducted a one-year, single-site, prospective, randomised controlled trial with 423 participants aged 40 years and older.[100] Participants (older support and academic staff at the University of Illinois at Chicago) were categorised into three study arms: (i) the COACH intervention which combined web-based risk assessments with personal coaching support; (ii) the RealAge intervention (http://www.realage.com) which used a web-based risk assessment and behaviour-specific modules; and (iii) a control group which received printed health-promotion materials. HRAs were completed in face-to-face interviews at baseline, 6 months, and 12 months. At 6 and 12 months, COACH participants showed significantly increased fruit and vegetable consumption (p=0.026; p<.001) and participation in physical activity (p=0 0.05; p=0 0.013), and at 12 months they showed decreased percentage of energy from fat (p=0.027). RealAge participants showed significantly decreased waist circumference at 6 and 12 months (p=0.05; p=0.018). The study reported that COACH participants were twice as likely to use the COACH intervention as RealAge participants were to use the RealAge intervention. COACH participants experienced twice the number of positive outcomes that control participants experienced. Limitations in the study include (i) the COACH intervention was proactive, and the RealAge intervention was reactive, relying on the consumer to initiate follow-up; these inherent differences may themselves explain the study findings and the study design did not allow this issue to be examined; (ii) interventions were tested with staff at an inner-city university who may have had higher levels of education than do workers in other industries. Thus, the findings may not be generalised to workers in other settings; (iii) neither participants nor researchers were blinded to study group; (iv) voluntary participation may have resulted in selection bias.

Colkesen and colleagues conducted a prospective follow-up study of 368 employees who voluntarily participated in a Web-based HRA program at a single Dutch worksite in 2008.[161] The intervention included a multicomponent HRA through a web-based electronic questionnaire, biometrics, and laboratory evaluation. The results were combined with health behaviour change theory to generate tailored motivational and educational health advice. On request, a health counseling session with the program physician was available.

Follow-up data on CVD risk collected on 176 employees 1 year after initial participation indicated a graded relation between CVD risk changes and baseline risk, with a relative reduction of 17.9% (p=0.001) in the high-risk category (baseline CVD risk >=20%). Changes were not explained by additional health counseling, medication, or an increase in knowledge. The study concluded that voluntary participation in a web-based HRA with tailored feedback at the worksite reduced CVD risk by nearly 18% among participants at high CVD risk and by nearly 5% among all participants. Limitations of the study included (i) participation rate: of 1,108 early invited employees 368 (33%) participated in the program, compared with 404 (39%) of 1,041 later invited employees; (ii) participants were volunteers, predominantly well-educated males; (iii) no data were available on whether employees regularly visited their primary care physician outside the HRA program so that some improvements could be from usual primary care management and not from the HRA.

In the North American evaluation of ALIVE (A Lifestyle Intervention via E-mail) Program Sternfeld et al. conducted a RCT involving 787 volunteer employees from the administrative offices of a large healthcare organisation (Kaiser Permanent in Northern California). These 787 participants received HRA with individualised feedback followed by randomisation to a 16-week e-mail program offered individually tailored, small-step goals; a personal homepage with tips; educational materials; and tracking and simulation tools. Intervention participants one of three paths: increasing physical activity; increasing fruits and vegetables; or decreasing fats and sugars. Messages subsequently received were specific to the chosen path – Figure 4. During this time, there was no contact with the control group. At the end of the 4-month intervention period, all baseline HRA questionnaire items were repeated.

During this time, there was no contact with the control group. At the end of the 4-month intervention period, all baseline HRA questionnaire items were repeated. Following 4 months of no contact with either the intervention or control group, all baseline questionnaires were repeated again (8 months after baseline). In intent-to-treat analyses (conducted in 2007 and 2008) that set change in non-responders to the follow-up questionnaire to zero, the intervention group reported increases of 28.0 minutes/week (min/wk) of MPA (SE=7.4, p=0.0002); 12.5 min/week of VPA (SE=5.7, p=0.03); and 21.5 min/week of walking (SE=5.5, p=0.0003) relative to the control group. Intake of both saturated and trans fats (grams/day (g/day)) declined (–0.95, SE=0.36, p=0.01; –0.29, SE=0.12, p=0.02, respectively). The consumption of fruits and vegetables increased significantly (p=0.03), and the consumption of added sugars decreased marginally (p=0.08). The largest changes were in participants who did not meet behavioural recommendations at baseline (increase of 55.4 min/week of MPA and decrease of 1.15 g/day of trans fats, relative to the control group). Differences between the intervention and control groups were still observed 4 months after the intervention ended. The researchers concluded that ALIVE is an effective program for achieving significant improvement in diet and physical activity. Participant self-selection may limit generalisability of the findings, self-report rather than any objective measures were used for dietary and physical activity behaviours, intervention exposure paths were self-selected rather than randomly assigned. Nonetheless the large sample size provided adequate statistical power to test the effectiveness of the intervention. There was a low initial participation rate but study limitations are well discussed and defended by the study authors and this RCT was of fair quality and does provide some evidence of effectiveness.

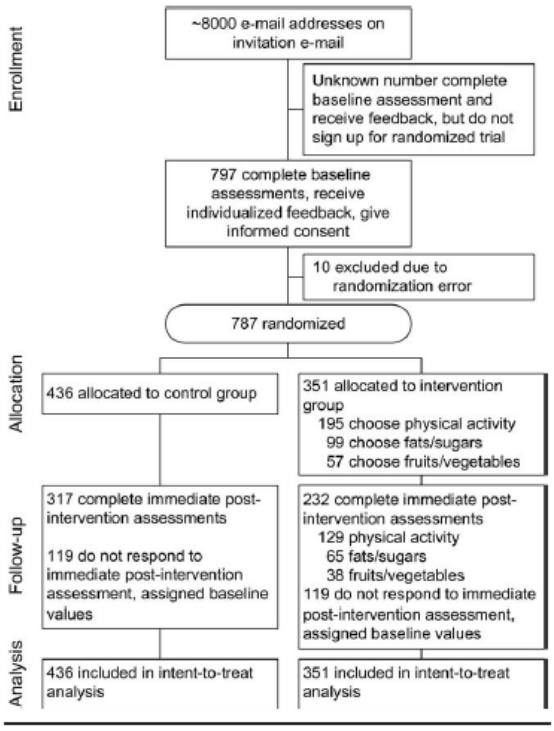

Figure 4 Recruitment/randomisation for the ALIVE Progam (USA) (Sternfeld, et al. 2009)

Summary Statement

Taking account of the suitability of study design and the strength of execution of reviewed studies, it is conclude that:

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- Most workplace HRAs have been developed to address and improve general health and in particular to improve cardiovascular health
- HRA instruments are questionnaire-based tools designed specifically for the purpose of conducting HRA but rarely meeting any stipulated accreditation standards
- The majority of HRAs address a mixture of clinical/physical-based and questionnaire-based measures, a large proportion are purely questionnaire-based, whilst a minority address physical/clinical measurements only

- Frequency of follow-up post initial HRA varies across studies, with two follow-up contacts being the most common; best estimates are as follows: one contact–27%; two contacts – 41%; three contacts–18%; and 4 contacts–13%
- Feedback post HRA appears to be provided most frequently in the form of (i) personalised HRA results on paper printout or in writing; (ii) in person; (iii) via posted mail; (iv) via telephone; (v) during group sessions; and (vi) email. There is some evidence in more recently published studies that telephonic, web-enabled communications and social networking are becoming more commonly featured
- In well designed studies, no correlation was found between degrees of feedback/ frequency and program dropout rates which ranged from mostly low rates to as high as 80% in some studies
- Typical characteristics of persons involved in the HRAs was 30 to 50 years of age, a higher probability of being female, displaying average health, although sometimes selected to represent groups with above average risk factors for chronic disease
- There is insufficient evidence to identify other specific characteristics of HRAs that are associated with better health outcomes, other than to note that the feedback/recommendations component appeared to produce motivation among participants to modify behaviours
- Information about time required for completion of HRAs was generally not specified in studies, however based on two very recently published studies it is estimated to take approximately 15 minutes for completion of an online HRA
- Analysis of HRA measurement items in retrieved studies incorporating suitable research designs suggest that (i) in the typical self-report suite, physical activity was the most commonly used (38%), followed by dietary behaviour (30%), CVD/multiple risk (25%), smoking (12%) and alcohol (5%); in the physical / clinical measurement suite, BMI was the most commonly used (20%), followed by cholesterol (14%), diabetes/metabolic syndrome (11%) and blood pressure (10%). Measurements of waist circumference (7%) and skinfold (2%) were less frequently reported.

Effectiveness of workplace health screens

Key Question 2a **What is the effectiveness of workplace health screening for providing new knowledge of chronic disease indicators, at point of screen? ((i) for those identified at risk of chronic disease; (ii) for those with a known diagnosis of chronic disease)**

Summary statement

- There is insufficient evidence to determine specific or relative effectiveness of workplace HRAs with respect to those with identified risk factors or with a known diagnosis
- Effectiveness of HRAs when implemented alone is not supported by the available evidence, however when used in combination with other interventions there is strong evidence of effectiveness in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is insufficient evidence on which to determine specific or relative effectiveness of workplace HRAs in identifying new knowledge amongst those with identified risk factors or with a known diagnosis.

Additional comment

Disease management programs are thought to be more likely than general health promotion programs to generate better Return on Investment (ROI) because they focus on high-risk individuals who typically impact medical or related costs, such as absenteeism and productivity, in the near term. Evidence in that domain is promising, but as yet insufficient to warrant a recommendation of effectiveness. Recent cross-sectional research suggests (i) that HRAs with laboratory testing might identify a newly diagnosed identified medical condition (such as chronic kidney disease, hyperlipidaemia or diabetes) in approximately one-third of those screened; and (ii) males, especially of lower educational attainment, may be more likely to have such a new diagnosis. However these possibilities in term of the effectiveness of a high-risk focus or the identification of new disease have yet to be demonstrated by rigorous research studies.

The Evidence

A systematic review on health risk appraisal was (HRA) undertaken for the US Department of Health and Human Services.[59] This review could not identify specific characteristics of HRAs that are associated with better health outcomes, other than to note that the feedback/recommendations component appeared to produce motivation among participants to modify behaviours. The review could not determine specific or relative effectiveness with respect to those with identified risk factors or with a known diagnosis. The preponderance of health outcomes in included studies were intermediate markers such as blood pressure or cholesterol level; people in HRA intervention groups tended to show positive benefit on these outcomes.

A systematic review by Soler and colleagues was published early in 2010, reviewing studies to mid-2005 on the effectiveness of interventions that use a Health Risk Assessment with Feedback (HRAF) when used alone or as part of a broader worksite health promotion program to improve the health of employees.[56] There was insufficient evidence to determine the effectiveness of HRAF when implemented alone, however when used in combination with other interventions there was strong evidence of effectiveness in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol. HRAF involved the collection of information on at least two individual health behaviours, transformation of this information into an individual risk score or description of health status and transmission of this information back to individuals from whom the data originated.

Within the systematic review by Soler et al., a component that dealt with HRAF alone scrutinised eleven studies (eight employing before-and-after study designs), which evaluated changes in indicators of health risks. The review did not determine specific or relative effectiveness with respect to those with identified risk factors or with a known diagnosis.

Six studies reported changes in health-risk scores that were based on the presence or absence of select physiologic and behavioural indicators such as high blood pressure or tobacco use. Three of these used an algorithm based on the Framingham index, one weighted three risk factors on a four-point scale and summed the weights, and the other two created a sum based on present risk factors. The median relative decrease in these health risk scores was 3.8% (range: –18.4% to 3.0%). Four studies found favourable results of moderate magnitude for various other measures, including appraised age, a measure of healthy lifestyles, and the proportion of employees with a positive change in the number of risk factors reported. In general, the findings represent moderate changes in favour of the intervention in these health-risk estimates. The other component of the systematic review examined HRAF In combination with other interventions, where there was strong evidence of effectiveness in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol.[56]

Lin and colleagues reported in 2010 on a five-year follow-up observational study conducted for 1384 middle-aged Taiwanese employees not fulfilling criteria for having metabolic syndrome (MetS). The purpose of the study was to explore whether initial screening records can be efficiently applied for the prediction of the occurrence of metabolic syndrome in healthy middle-aged employees. Within five years, 13% (175 out of 1,384) participants fulfilled MetS criteria. The odds ratios (ORs) for MetS development among adults initially having one or two MetS components were 2.8 and 7.3, respectively (both $p<0.01$), versus the adults having zero MetS component count at screening. Central obesity carried an OR of 7.5 ($p<0.01$), which far exceeded other risk factors (all ORs < 2.7). Synergistic effects on MetS development existed between coupling MetS components: (i) High blood pressure plus low-HDL demonstrated an OR of 11.7 ($p<0.01$) for MetS development and an SI of 4.7 (95% CI, 2.1–10.9); (ii) High blood pressure plus hyperglycaemia had an OR of 7.9 ($p<0.01$), and an SI of 2.7 (95% CI, 1.2–6.4). The researchers concluded that MetS component count and combination can be used in predicting MetS development for participants potentially at risk. Therefore worksite screening programs simultaneously allow for finding out cases and for assessing risk of MetS development.

Kaufman and colleagues conducted a cross-sectional analysis to evaluate the ability of HRA-laboratory testing to provide new disease-risk information to participants, and found that 36% of participants had laboratory evidence of at least one medical condition newly identified.[228] This cross-sectional study included 52,270 first-time HRA participants aged 20 to 64 years using the Quest Diagnostics Blueprint for Wellness® HRA. The program was sponsored by 15 employers representing diverse industries between 2003 and 2010 with participants from across the United States. Twenty-four percent (12,392) self-reported one or more of these medical conditions: 21.1% (11,017) self-identified as having hyperlipidaemia, 4.7% (2,479) self-identified as having diabetes, and 0.7% (352) self-identified as having chronic kidney disease. Overall, 36% (n=18,540) of participants had laboratory evidence of at least one medical condition newly identified: 30.7% (16,032) had laboratory evidence of hyperlipidaemia identified, 1.9% (984) had laboratory evidence of diabetes identified, and 5.5% (2,866) had laboratory evidence of chronic kidney disease identified. Of all participants with evidence of hyperlipidaemia 59% (16,030 of 27,047), were newly identified through the HRA. Among those with evidence of diabetes 28% (984 of 3,463) were newly identified. The highest rate of newly identified disease risk was for chronic kidney disease: 89% (2,866 of 3,218) of participants with evidence of this condition had not self-reported it. Men (39%) were more likely than women (33%) to have at least one newly identified condition ($p<0.0001$). Among men, lower levels of educational achievement were associated with modestly higher rates of newly identified disease risk ($p<0.0001$); the association with educational achievement among women was unclear. Even among the youngest age range

(20 to 29 year olds), nearly one in four participants (24%) had a newly identified risk for disease. Whilst the Kaufman et al. study provides only speculative evidence in the overall context of this review it is worth noting (given the comment on chronic kidney disease) that an Australian pilot study of screening for chronic kidney disease in the community and workplace was published in 2010.[239] The pilot program Kidney Evaluation for You (KEY) aimed to establish community-based screening protocols, assess efficacy in promoting changes in risk-factor management, and explore participant CKD awareness. KEY offered free cardiovascular and kidney checks using point-of-care testing for on-site pathology measurements (estimated glomerular filtration rate, haemoglobin A1c, cholesterol, haemoglobin, albuminuria), lifestyle assessment, and exit interviews. Participants were telephoned at 3 months to ascertain whether KEY advice had been followed. Community and health professional support was strong; 99% of participants rated involvement as beneficial. Of 402 high-risk individuals recruited, findings were suggestive of CKD in 20.4%. Of these, 69% had hypertension, 30% diabetes, and 40% elevated total cholesterol. All participants with CKD stage 3b or higher were aged >61 years. Overall, 58% of participants were referred to their primary care providers for further action; of these, 82% saw their doctors in the next 3 months and 94% discussed KEY results. Follow-up telephone contact was successful for 82% of participants. A change in management occurred for 67%. The researchers concluded that the KEY approach to early detection of CKD and selected referral of participants was largely successful.

A systematic review was published by Pelletier in 2011, being the latest update in a series of reviews examining the clinical and cost-effectiveness studies of comprehensive, multifactorial, health promotion, and disease management programs conducted in corporate worksites.[51] This review concluded that providing individualised risk reduction for all employees including high-risk employees within the context of comprehensive programming is the critical element of worksite interventions.

The Pelletier review noted that the current generation of worksite programs, include a greater emphasis upon disease management with high-risk employees, combinations of public health and individualised behavioural risk management, and utilisation of telemedicine delivery technologies. Disease management programs may be more likely than general health promotion programs to generate Return on Investment (ROI) because they focus on high-risk individuals who typically impact medical or related costs, such as absenteeism and productivity, in the near term. However this possibility has yet to be demonstrated by rigorous research.

Wald and colleagues reported in 2011 a modelling study which compared screening for future CVD events using age alone with screening using age and multiple risk factors based on regular Framingham risk assessments.[190] The study was not specific to the workplace setting; ten-year CVD risk was estimated using Framingham risk equations in a hypothetical sample population of 500,000 people aged 0–89 years. Age screening using a cut-off of 55 years detected 86% of all first CVD events arising in the population every year and 72% of CVD-free years of life lost for a 24% false-positive rate; for five yearly Framingham screening the false-positive rate was 21% for the same 86% detection rate. The estimated cost per CVD-free year of life gained was GBP2,000 for age screening and GBP2,200 for Framingham screening if a Framingham screen costs GBP150 and the annual cost of preventive treatment is GBP200. The researchers concluded that age screening for future CVD events is simpler than Framingham screening with a similar screening performance and cost-effectiveness and avoids blood tests and medical examinations. The advantages of age screening in the prevention of heart attack and stroke warrant considering its use in preference to multiple risk factor screening.

Conclusions

Taking account of the suitability of study design and the strength of execution of reviewed studies, it is conclude that:

- There is insufficient evidence to determine specific or relative effectiveness of workplace HRAs with respect to those with identified risk factors or with a known diagnosis
- Effectiveness of HRAs when implemented alone is not supported by the available evidence, however when used in combination with other interventions there is strong evidence of effectiveness in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is insufficient evidence on which to determine specific or relative effectiveness of workplace HRAs in identifying new knowledge amongst those with identified risk factors or with a known diagnosis.

Key Question 2b **What is the effectiveness of workplace health screening in prompting relevant action (e.g. visit to GP, accessing other information)? ((i) for those identified at risk of chronic disease; (ii) for those with a known diagnosis of chronic disease)**

Summary statement

- There is sufficient evidence of effectiveness for workplace HRAs in combination with additional interventions to have favourable impact on the use of healthcare services (such as reductions in emergency department visits, outpatient visits, and inpatient hospital days over the longer term)
- There is promising, but as yet insufficient evidence of effectiveness for workplace HRAs to have a favourable impact on seeking additional preventive care services
- There is a lack of evidence on which to determine specific or relative effectiveness of workplace HRAs in relation to healthcare services with respect to those with identified risk factors or with a known diagnosis.

The Evidence

A 2010 systematic review by Soler and colleagues, considered the issue of impact on healthcare use in the context of (i) HRA in the absence of other intervention programs; and (ii) HRA in combination with additional interventions.[56] The review considered studies published to mid-2005 and found sufficient evidence of effectiveness for HRA in combination with additional interventions to have favourable impact on the use of healthcare services. The review did not determine specific or relative effectiveness with respect to those with identified risk factors or with a known diagnosis.

Healthcare use: HRA in the absence of additional interventions (Soler et al.)

Six study arms from five studies measured changes in the use of healthcare services. The goal of HRA with feedback was taken to be to increase use of necessary medical services (such as preventive care visits) and decrease the use of unnecessary medical services (hard to determine) or services suggestive of notable acute or chronic health events (such as hospital days). Three studies, all using before-and-after designs, assessed changes in the proportion of employees reporting use of necessary or preventive care services among participants who had not recently followed recommended guidelines (all baseline rates were zero). One study found increases in the proportion of employees reporting having a rectal exam or Pap test of 23 percentage points and 40 percentage points, respectively; one found increases in breast self-exam or breast palpitation by physician of 42.3 percentage points and 21.5 percentage points, respectively; and one found a 35.0-percentage point increase in employees who complied with recommendations regarding cancer screenings. Two studies reported findings related to other medical service use, including self-reported change in hospital days per year, with no change reported in one study and a negligible increase of 0.05 days (1.7% relative increase) in another. Doctors' visits per year decreased, but it is not clear if these visits were for treatment or preventive care (–1.6 visits, 23.5% relative decrease). The review judged the preventive care results as 'promising', but the findings on other medical care services were difficult to interpret.

Healthcare use: HRA combined with additional interventions (Soler et al.)

Seven study arms from six studies included measures of healthcare service use. One study reported a 12.2-percentage point decrease in the proportion of employees who were not following preventive care guidelines, and another reported increases in the proportion of people who had a digital rectal screening for colon cancer following recommendations made during the intervention. A third study reported a decrease of just over 0.5 doctor visits attributable to the

intervention in the two study arms included in the systematic review. Fielding reported an increase in new users of blood pressure medication in favour of the intervention. Two studies reported a decrease in hospital bed days in favour of the intervention group. One of these studies also reported that the intervention group had a decrease in the number of annual lifestyle-related hospital admissions relative to the comparison group (adjusted for age and gender). Finally, Goetzel assessed emergency department visits, outpatient visits, and inpatient hospital days over several years. He found that the number of such visits increased in the early years of exposure to HRA combined with additional interventions, and subsequently decreased well below initial usage rates. In contrast, inpatient days showed a steady decline in use over the entire study period. In summary, the six studies reporting healthcare service use were in favour of the intervention.

The systematic review on health risk appraisal (HRA) undertaken for the US Department of Health and Human Services did not identify specific characteristics of HRAs that are associated with better health outcomes, other than to note that the feedback/recommendations component appeared to produce motivation among participants to modify behaviours.[59] The preponderance of health outcomes in included studies were intermediate markers such as blood pressure or cholesterol level; people in HRA intervention groups tended to show positive benefit on these outcomes.

Deutekom and colleagues reported in 2011 a review of randomised controlled trials (RCTs) published up to mid-2008, comparing the effects of screening on health behaviour in screened and unscreened groups.[30] The stated aim of this review was to summarise evidence of the effects of screening, either risk factor screening or screening for early detection of disease, on health behaviour: smoking habits, diet, exercise, alcohol consumption and adherence to guidelines for healthy living. Whilst the scope was broader than the workplace setting, this review is important in that it is the first to summarise all existing evidence on the relation between screening and health behaviour including adhere to follow-up recommendations. The trials on screening for risk factors suggest a positive effect on health behaviour, while the number of trials on screening for early detection of disease was too small to allow for conclusions on effects on health behaviour.

Seven trials were included, five on screening for risk factors (four cardiovascular; one ALDH2) and two on screening for early detection of disease (colorectal cancer and hearing loss). A summary of the results for health behaviour variables (smoking, diet, exercise, alcohol consumption and adherence) is shown below in Table 3 which lists whether the outcome was better, equal or worse in the screened group compared with the unscreened group.

	Risk factor screening					Early detection of disease screening	
	Wood at al	Hutchison et al	OXCHECK	Strychar et al	Komiya et al	Karismose et al	Larsen et al
Smoking	+		=				−
Diet			+	=,*			−
Exercise			+				−
Alcohol consumption			=		=		
Adherence		+=				=	

+, health behaviour better in screened compared to unscreened group; −, health behaviour worse in screened compared to unscreened group; =, no difference in health behaviour between screened and unscreened group; *, worse health behaviour in screen negatives compared to screen positives.

Table 3 Summary of results in screened vs unscreened participants for smoking, diet, exercise and alcohol consumption

Two studies investigated the effects of screening for cardiovascular screening on **smoking**. Screened individuals in the British Family Heart Study showed a significantly lower smoking prevalence than unscreened individuals (19 versus 23%, p<0.001) after 1 year. No difference

between screened and unscreened participants was found in the OXCHECK study. The smoking prevalence after 3 years was 25% in the screened group compared with 26% in the unscreened group (p=0.44).

The effect on **diet** was measured in two studies. The OXCHECK group studied the use of full cream milk and the use of butter or margarine. Both were significantly lower in the screened group (respectively 23% and 22%) after 3 years compared with the unscreened group (31% and 31%, respectively; p<0.01). In the study of Strychar et al., after 4 months no differences were detected in nutrient intake (e.g. total energy, % energy of (saturated) fat and dietary cholesterol) between the participants that received their blood cholesterol test results compared with those not receiving their results. However, in individuals with normal blood cholesterol levels (< 5.2 mmol/l), those who did not receive their blood test results had greater decreases in saturated fat intake defined as % of total energy intake (21.6%, 95% CI: 22.7 to 20.5; baseline: 13%) than did those who received their blood test results (20.3%, 95% CI: 21.3 to 0.7, baseline: 12%).

Changes in **physical activity** after screening were investigated in the OXCEHCK study. The proportion of patients reporting vigorous exercise more than once a month was, after 3 years, significantly higher in the group screened for cardiovascular diseases (29%) than in unscreened individuals (22%) (p=0.01).

Two studies investigated the effect of screening on **alcohol consumption**. In the cardiovascular screening study, no significant difference between the screened and unscreened group was observed. High alcohol use defined as 'reported weekly intake of 0.21 units for men and 0.14 for women' was 11% in the control group and 10.4% in the screened group (p=0.55). No difference in weekly alcohol intake (measured in grams) was observed between individuals screened for ALDH2 and individuals not screened. At follow-up, alcohol intake in the screened group at low risk increased by 22 g (baseline: 269 g) and in the control group by 19 g (baseline: 288 g; p-value not calculable; study authors reported it not significant). High-risk individuals in the screened group decreased their intake by 21 g (baseline: 211 g) whereas the control group increased their intake by 34 g (baseline: 218 g). However, overall there was no significant difference in change between the screened and unscreened group (p-value not calculable; not significant according to the study authors).

A study by Hutchison et al. investigated **adherence**—the extent to which screening follow-up recommendations were followed. In this study the effect of screening for hypercholesterolemia by means of a risk appraisal questionnaire on meeting the criteria for cholesterol testing was investigated. Of those without pre-existing coronary heart disease who met the criteria for cholesterol testing, 45 of 421 subjects in the screened group (11%) versus nine of 504 subjects in the unscreened group (1.8%) had a cholesterol test performed during the 3 months after the initial questionnaire posting (p<0.0001). Of the patients without a history of coronary heart disease who did not meet the criteria for testing, 30 of 1128 subjects in the screened group (2.7%) and 18 of 1099 subjects in the unscreened group (1.6%) had a cholesterol test during the 3 month follow-up period (p=0.175).

Conclusions

Taking account of the suitability of study design and the strength of execution of reviewed studies, it is conclude that:

- There is sufficient evidence of effectiveness for workplace HRAs in combination with additional interventions to have favourable impact on the use of healthcare services (such as reductions in emergency department visits, outpatient visits, and inpatient hospital days over the longer term)
- There is promising, but as yet insufficient evidence of effectiveness for workplace HRAs to have a favourable impact on seeking additional preventive care services

- There is a lack of evidence on which to determine specific or relative effectiveness of workplace HRAs in relation to healthcare services with respect to those with identified risk factors or with a known diagnosis.

Key question 2c **What are the potential benefits and impacts associated with workplace health screening as a mechanism for reducing risk for chronic disease (i.e. as an early intervention)? ((i) for those identified at risk of chronic disease; (ii) for those with a known diagnosis of chronic disease)**

Summary statement

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- There is sufficient evidence for effectiveness of benefits-linked financial incentives in increasing HRA and program participation
- There is promising, but as yet insufficient evidence to determine the effectiveness of financial incentives with respect to sustained risk reduction or health outcomes
- There is insufficient evidence to determine specific or relative effectiveness of workplace HRAs amongst those with identified risk factors or with a known diagnosis.

Additional comment

The review identified six observational studies—all conducted in North America since 2010, which provide positive and consistent finding on the use of financial incentives. It is clear that these incentives can greatly boost participation rates but limitations in execution of the studies preclude a definitive conclusion of a causal relationship with regard to risk reduction or health outcomes. The studies are discussed in detail in this section.

The Evidence

Benefits

A systematic review by Soler and colleagues was published early in 2010, reviewing studies to mid-2005 on the effectiveness of interventions that use a Health Risk Assessment with Feedback (HRAF) when used alone or as part of a broader worksite health promotion program to improve the health of employees.[56] HRAF involved the collection of information on at least two individual health behaviours, transformation of this information into an individual risk score or description of health status and transmission of this information back to individuals from whom the data originated. There was strong or sufficient evidence for meaningful effects on the following outcomes: tobacco use, alcohol use, dietary fat intake, blood pressure cholesterol, summary health risk estimates, worker absenteeism, and healthcare service use. The review did not determine specific or relative effectiveness with respect to those with identified risk factors or with a known diagnosis.

The Soler et al. review found insufficient evidence to determine effectiveness for intake of fruits and vegetables, body composition, and physical fitness, due to a combination of small and inconsistent effect estimates. However a separate systematic review examined the effectiveness of worksite nutrition and physical activity programs to promote healthy weight among employees. The review found sufficient evidence to recommend worksite programs designed to control overweight and obesity. Analysing studies published up to 2005, the review found that worksite nutrition and physical activity programs achieve modest improvements in employee weight status at the 6–12-month follow-up. A pooled effect estimate of 2.8 pounds (95% CI=4.6, 1.0) was found based on nine RCTs, and a decrease in BMI of 0.5 (95% CI=0.8, 0.2) was found based on six RCTs. The findings appear to be applicable to both male and female employees,

across a range of worksite settings. There was sufficient evidence to recommend worksite programs designed to control overweight and obesity and this recommendation has been adopted by the U.S. Preventive Services Task Force.

Adverse effects

Reporting of adverse effects is virtually non-existent in reviewed studies located in the workplace setting. Whilst some might argue that few adverse effects could be expected from HRA program it is possible that these could apply to some individuals such as those whose recommendations arising from a HRA include specific medical treatments.[59] Programs in the workplace may be justified on the grounds of beneficence, but the method of implementation could potentially raised concerns about employer paternalism overriding employee autonomy, the possibility of coercion and lack of justice in applying the same financial incentives to employees with different income levels, and the potential invasion of privacy through HRAs, biometric measurement, and telephone inquiries to monitor compliance.[205]

Petticrew and colleagues conducted a systematic review of screening programs.[70] Although broader than the workplace setting and in the context of the English NHS, it raises pertinent issues. The review was designed (i) to determine the consequences of false-negative findings; (ii) to investigate how their adverse effects can be minimised; (iii) to assess their implications for the NHS, including the impact of false-negatives on public confidence in screening programmes; and (iv) to identify relevant theoretical perspectives that may be potentially useful when considering the implications of false-negative results.[70] The review concluded that (i) false-negatives are evident in all screening programmes, even when the quality of the service provided is high; (ii) they may have the potential to delay the detection of breast and cervical cancer in those programs, but there is little evidence to help assess their psychological consequences in these or other screening programmes; (iii) false-negatives are likely to lead to legal action being taken by those individuals affected, and potentially may reduce public confidence in screening.

Use of financial and other incentives

The use of incentives in workplace programs is a noticeable trend in some recent studies of workplace health promotion programs, but is one which has proven controversial and which raises a number of important ethical issues. In general, previous literature has merely indicated anecdotal evidence that incentives act as a strong influence on participation rates. This section elucidates more important recent studies of effectiveness of using financial incentives and identifies some of the ethical issues involved in their use. In particular, six observational studies (with fair execution) all conducted in North America since 2010 are discussed in detail.

A 2012 meta-evaluation of economic studies conducted by Chapman reported that some recent approaches (including the use of benefits-linked financial incentives) were associated with higher levels of economic impact and return; their incorporation in the studies published in the past 10 years reportedly resulted in slightly more than double the average cost-benefit or Return on Investment (ROI) ratio reported in studies of traditional program models; that is, instead of the typical 3:1 ROI ratio they report a ROI of 6.1:1.11.[27]

A 2011 review by Archer and colleagues found sufficient evidence that behavioural practices (behavioural management skills, modelling or demonstration, participatory skill development, and individual goal setting) together with incentives (in-kind or financial incentives, typically given for participation or completion of the program) are promising in the worksite setting for the prevention and control of obesity as measured by change in weight.[18] A limitation of the review is that the level of evidence differs from that used for the Community Guide (and this review) in that it included studies with lesser quality of execution and so this finding was not deemed legitimate for the current review.

Rothstein et al. conducted a non-systematic literature review and assessment of available proprietary HRAs.[52] The review found that financial incentives may increase participation rates but the long-term effects of financial incentives on health outcomes were not as definitive and may even be negative when compared with other interventions.

Scoggins and colleagues reported in 2011 on an observational study to compares changes in the body mass index (BMI) of participants in Healthy Incentives Program with changes in the BMI of a national sample of people insured through their employers.[178] In 2006, the government of King County, Washington, in which the city of Seattle is located, initiated the Healthy Incentives wellness program for its 13,000 employees (and their spouses/partners). Participation in the program was voluntary, and all eligible employees and their spouses/partners received the same medical benefits coverage. However, the Program involved an incentive scheme – a colour-coded system (gold, silver, bronze) where program participation was rewarded through lower out-of-pocket expenses (Table 4).

	Preferred Provider Organization		Health Maintenance Organization	
Color/Yrs	**Individual**	**Family**	**Individual**	**Family**
Gold				
2007–2009	$2400	$3400	$1000	$2000
2010–2011	$2600	$5400	$1000	$2000
Silver				
2007–2009	$2800	$4400	$2000	$4000
2010–2011	$3100	$6800	$2000	$4000
Bronze				
2007–2009	$3200	$5400	$3000	$6000
2010–2011	$3500	$7800	$3000	$6000

Table 4 Healthy Incentives Program annual out-of-pocket maximum expenses by colour status

Reductions in out-of-pocket expenses were earned annually through activity done in the prior year. Bronze status, the highest out-of-pocket expenses option, was for eligible members who chose not to participate in the program. Silver-status members paid the second highest out-of-pocket expenses in exchange for completing a Health Risk Assessment (HRA) questionnaire near the start of the year**.** To achieve gold status, the lowest out-of-pocket expense option, members were required to complete HRAs, and 10-week individual action plans targeting health risks identified in the HRA. Individual action plans focussed on weight management, physical activity, nutrition, stress management, and tobacco cessation. Importantly, through collective bargaining the county agreed to forego charging premiums for health insurance coverage to gain support for the wellness program. The county and the unions agreed that the different levels of out-of-pocket expenses tied to the bronze-, silver-, and gold-level plans were solely dependent on employees' participation in the program. Members did not have to achieve certain results, such as a specified amount of weight loss, to earn lower out-of-pocket expenses.

To create a comparison group that was not subjected to Healthy Incentives[SM] during this time period, observations from the panel 11 (2006 to 2007) and panel 12 (2007 to 2008) longitudinal Medical Expenditures Panel Survey (MEPS) were used (a stratified random sample survey conducted annually by the Agency for Healthcare Research and Quality). Of 23,256 health plan members who completed HRAs for at least two consecutive years, 19,559 answered the height and weight questions. The year 1 participants amounted to 81.3% of all eligible employees — and their spouses and partners — who were employed at least one full calendar year from 2006 to 2011. The full 5-year cohort included 10,432 participants and represented 77.1% of all the eligible employees, spouses, and partners who were employed over the full 5-year period. The 5-year cohort subset of members who completed an HRA in each year from 2006 to 2011 numbered

7840. One striking characteristic of this well executed program evaluation is the high participation rate. More than 90% of employees participated in the program in some form. Approximately 80% of employees participated in the program and answered the height and weight questions in the HRA. Thus, the study was less prone to self-selection bias to the degree noted in other studies. The program increased the number of obese participants who lost at least 5% of their body weight during their first year in the program by 5.3% points compared with a national sample of people insured through an employer. That amounts to 284 obese members who achieved significant weight loss during their first year in the program who otherwise would not have lost 5%. Over the full 5 years of the program, 38.0% of obese participants lost at least 5% of their body weight. The program was most successful for women, members older than 60 years, African Americans, and members who did not graduate from college. African American Healthy Incentives℠ participants lost weight at nearly three times the rate of white participants. Study limitations include (i) self-reported weight and height data; and (ii) inexact timing of control data (Healthy Incentives HRA data were collected from 2006 to 2011 while MEPS sample data were collected from 2006 to 2008).

Merrill and colleagues reported in 2011 on their within-group study design to evaluate the Reaping Rewards Program.[240] In a North Carolina (USA) agribusiness company, Reaping Rewards included financial incentives for numerous 'good-health behaviours', such as periodic physical examinations, activities like educational lunch programs focused on nutrition, fitness, and related topics; screenings for early detection of glaucoma, diabetes, skin conditions, and other problems; classes in cardiopulmonary resuscitation and first aid; aerobic exercise and strength-training classes; and other programs that promote wellness and healthy behaviours. Employees who participated in the program earned points that could be exchanged for cash up to an annual maximum of $150 (subsequently increased to $250). Assessment was based on 3,737 continuously employed workers at a large agribusiness during 2007–2009. More than 80% of employees participated in the program, with a higher percentage of women participating. Clinically significant improvements occurred in those who were underweight, those with high systolic or diastolic blood pressure, high total cholesterol, high low-density lipoprotein, low high-density lipoprotein, high triglycerides, and high glucose. Among obese employee participants, significant improvements occurred in selected mental health and dietary variables. Among those who lowered their BMI, significant decrease occurred in fat intake, and significant increase resulted in weekly aerobic exercise and feelings of calmness and peace, happiness, ability to cope with stress, and more physical energy. About 80% of all employees participated in the Reaping Rewards Program during the years 2007 through 2009. The high level of participation was attributed to the influence of the monetary incentive structure of the program. Program participation and level of participation within the program was greater among women than men, as consistent with other studies. Age was not associated with participation, but was related to the level of participation among those in the program. This may be because the monetary incentives for program participation similarly attracted all age groups, but once in the program, the reward structure most benefitted those in the age range 30–59. The program led to improved biometric scores among those with the poorest health status at baseline. It also resulted in maintenance of good biometric scores among those with good health classifications at baseline. Study limitations include (i) failure to have a distinct comparison group limited an evaluation of the efficacy of the monetary incentive structure for encouraging participation; (ii) without a comparison group, health maintenance, and beneficial behaviour change scores observed in the study may have been influenced by more than just the wellness program; and (iii) HRA-item responses were self-reported allowing potential for bias.

Merrill and colleagues again reported in 2011 on a separate study to evaluate the impact of the Healthy Lifestyle Incentive Program (HLIP), a worksite health program, on lowering prescription drugs and medical costs.[241] The program included free annual screenings, tailored feedback on screening results, financial incentives for maintaining and modifying certain behaviours, and periodic educational programs and promotions to raise awareness of health topics. Health care cost data for Salt Lake County employees for the period 2004 through 2008 were linked with HLIP

enrolment status. Additional program information was obtained from a cross-sectional survey administered in 2008. Participation increased from 16% to 23% in men and 34% to 45% in women over the 5-year study period and was associated with a significantly greater level of physical activity and improved general health. Participants were generally satisfied with the HLIP (43% very satisfied, 51% satisfied, 5% dissatisfied, and 1% very dissatisfied). The primary factors contributing to participation were financial incentives (more so among younger employees), followed by a desire to improve health (more so among older employees). Over the study period, the cost savings in lower prescription drug and medical costs was $3,568,837. For every dollar spent on the HLIP the county reportedly saved $3.85. Study limitations include: (i) The lack of baseline health information for non-participants; (ii) representativeness of sample: a greater percentage of survey respondents were women and older than the Salt Lake County employees in general. The survey also underrepresented maintenance and grounds workers because many of these workers were not housed in a government building and had less direct supervision.

Byrne and colleagues reported in 2011 on a retrospective cohort study to assess long-term changes in health risks for employees participating in Vanderbilt University's (Tennessee, USA) incentive-based worksite wellness program over a 7-year period.[159] The most consistent improvements were found in increased physical activity, decreased poor nutrition, decreased smoking rates. The largest improvements occurred in the first 2 years of the program, particularly for overall wellness score, percentage of low risk, poor nutrition, and physical activity. Of 22,505 employees (18,772 staff and 3733 faculty), 95% were eligible for the 'Go for the Gold' (GFTG) Program (active, fulltime, regular faculty and staff enrolled in the Vanderbilt Health Plan). High annual participation rates in GFTG were reported, averaging 75.5%. Non-participants were more likely to be older, male, and African-American. The program was voluntary and multi-tiered. The tiers consisted of (i) completing an HRA with the goal of identifying health risks; (ii) completing a self-directed lifestyle management tool for setting goals to maintain health or improve health risks; and (iii) viewing an annual educational video featuring local experts who discussed both the importance of reducing a particular health risk and ways to manage improving that risk. This incentive-based wellness program (GFTG), was initiated in 2003, aimed to engage faculty and staff at the university in identifying their lifestyle risks and maintaining or improving those risks through dynamic programming. Underpinning GTFG was a general program designed to support the health and productivity of employees, including availability of a fitness facility; behaviour change counseling/health coaching; biometric testing; and a variety of educational programs, including newsletters, web tools, video and podcasting, lectures, workshops, and individual consultations.

A central objective of the program was to achieve high annual participation rates. The 'Personal Wellness Profile Concise Plus Questionnaire' version of the Wellsource HRA[242] (www.wellsource.com) was used consistently throughout the program. As an incentive for participation, up to $20 per month was added to an employee's pay check during the following calendar year for completing all three tiers of the program. Before GFTG was introduced, the annual HRA completion rate was less than 24%. This increased to 68% in the first year after introduction of the incentive program and continued to increase to 80% and more in years 4 to 7. Also during this time, a greater proportion of participants enrolled in the highest level, the gold level, compared with the silver and bronze levels. Of the 17,335 GFTG Program participants in 2009, 71% achieved gold, 6% silver, and 23% bronze levels (HRA only). Descriptive longitudinal trends were examined for employees' health risk profiles for the period 2003 to 2009. The largest decrease in the proportion of high risk status employees occurred between years 1 and 2 (–1.2%) and then remained relatively stable for the next 5 years. The mean overall wellness score increased from 52.5 to 57.9 from year 1 to year 7. Eleven behavioural and psychosocial risk factors decreased across the 7 years: physical inactivity; poor nutrition; smoking; lack of seat belt use; excess alcohol use; high stress; poor perception of health; life dissatisfaction; job dissatisfaction; use of drugs for relaxation or sleep; and five or more illness days (Table 4). The percentage of sedentary employees showed the greatest improvement over the 7-year period, both in the percentage decrease and the average annual percentage difference. At baseline,

employees who reported not exercising one or more days per week was 27.3%. The greatest decrease occurred between years 1 and 2 when this rate dropped from 27.3% to 20.9%. The percent of inadequate physical activity decreased from year 1 to year 7 by 10.7% percentage points (a 1.8 percentage point annual average decrease). Poor nutrition, smoking, safety belt non-usage, and high stress followed a similar pattern to physical activity as risks decreased over the 7-year study period, with percentage point reductions of 4.4%, 3.3%, 7.9%, and 3.5%, respectively, across the entire time period. The researchers note that frequent programming changes were required to retain employee interest and continue to move them through the stages of change. Limitations of the study include (i) use of self-reported risk factors which are potentially biased (although are generally reliable for these purposes); (ii) the potential for dropout bias–drop-outs tended to be younger, males, smokers, those not wearing a seat belt, and employees with hypertension (the bias associated with this attrition could lead to trends that are overly optimistic however the authors provide a supportive analysis to suggest that the bias is minimal; and (iii) the absence of a true control group to provide information on trends in health risk factors for employees not participating in the Program (data were contrasted with national and state norms for specific risk factors but a direct cause–effect relationship may not be inferred in the absence of a control or comparison group).

Neville and her colleagues reported in 2011 on a repeated-measures longitudinal time-series study conducted over 8 years using prospectively collected annual data from program participants.[171] The study included clinical measures of weight, blood pressure, cholesterol, and body fat percent. The (USA) Salt Lake Valley Health Department established a worksite intervention called the Healthy Lifestyle Incentive Program (HLIP) in 1988. After 2 years of implementation, impact on health risk factors was assessed in a prospective study reported by Poole et al. (significant improvements in body fat, cholesterol, blood pressure, physical activity and smoking prevalence).[243] The Neville et al. study revisited the same program, involving a new cohort 8 years later, to consider how level of program participation, health behaviours, and biometric measures changed from 1998 to 2006 according to baseline health status. In 2006, 1,671 employees (711 (43%) men and 960 (57%) women) were enrolled in the Salt Lake County HLIP program. This number of enrolees represented slightly over 52% of all county employees. A majority of employees did participate, but this field sample did not represent all Salt Lake government employees because participants self-selected into the program. Women and White employees were overrepresented in those that enrolled. Approximately 60% of participants were women compared with 48% in the Salt Lake County workforce and 91% of participants were White compared with 86% White in the workforce. Among these participants, 365 had also participated in the program in 1998 (145 (40%) men and 220 (60%) women), of which 308 (130 (42%) men and 178 (58%) women) were continuously enrolled over these years. Thus approximately 24% (n=89) of enrolees participated in the program with their spouse. Analysis was based on these 365 participants. At initial enrolment and in each subsequent year, employees completed a Health Risk Appraisal, answering questions about health behaviours such as smoking, fruit and vegetable intake, frequency of physical activity, and others. They also completed a Blood Pressure/Cholesterol Screening Form answering additional questions about family history of chronic diseases. At the time of assessment, clinical measurements were taken including blood pressure, weight, total cholesterol, and body fat using bioelectrical impedance. Each participant was counselled individually about personal health risks according to their answers to the Health Risk Appraisal and given corresponding printed information with basic information such as guidelines for lowering blood pressure or cholesterol. HLIP program staff also presented periodic educational programs in brown-bag classroom settings and conducted seasonal promotions to raise awareness of health topics (for example *Go Red for Women*). At the end of each year, another assessment was done with another Health Risk Appraisal, screening form, and repeated clinical measurements. Individuals' points were summed annually, including totals from monthly submitted logs. Resulting point totals reflected an aggregate of physical activity and healthy behaviours all year. At the end of each program year, points were redeemed for cash by participants at the rate of $1.00 per 5 points, with a typical cash award of between $75 and $250 per employee. During each year of the program, participants could earn

points based on their level of participation; points were not cumulative (i.e., not carried over) from year to year. There were a number of ways to earn points; for example

- 250 points for attendance at a 10-week weight loss or tobacco cessation class
- 50 points for having a mammogram or prostate exam during the year
- 15 points for a pap smear, colorectal exam, or early prenatal exam during the year
- 100 points for having followed up with a health care provider after elevated cholesterol or blood pressure
- Up to 54 points per month for submitting monthly logs showing 20 days of exercise, breast/testicular self-exam, and 100% seat belt use
- Smokers could earn points per consecutive month of not smoking
- Participants with high cholesterol, high blood pressure, percent body fat in the unhealthy range, and excessive body weight could earn points by improving these cardiovascular risk scores.

Outcomes were compared to level of participation, for which annual points earned was a surrogate. Participants had lower increases in body mass index (BMI) than the general population had during the same time period. Greatest improvements in BMI, blood pressure, and cholesterol were seen in those at highest risk levels at baseline and in those whose physical activity increased over time. It was found that long-term participation in this program improved BMI, blood pressure, and cholesterol. Most benefits were found for those in high-risk groups. There are several study limitations, including: (i) this single group pre-experimental design did not allow the investigators to determine whether the HLIP caused the changes in the participants because it does not fully control for all of the threats to internal validity of the outcomes (the impact of historical effects on the total local population are not controlled for, nor are other plausible alternative explanations for the results such as maturation, mortality or sample attrition, and regression to the mean); (ii) the study was conducted only within one county health department wellness program so that the generalisability of the results is limited to only similar populations; and (iii) researchers did not use an intent-to-treat design that would include all participants and the research questions concerned only the impact of the HLIP on long-term participants and not the impact on all employees, regardless of participation.

Loeppke and colleagues reported in 2010 on the impact of The Prevention Plan™ on employee health risks after 1 year of integrated primary and secondary prevention interventions (including incentives) in a cohort of 2606 individuals.[167] Participants from a variety of USA employer groups completed a baseline health risk appraisal, blood tests, and biometric screening in 2008 and were reassessed in 2009. Participants came from three employer groups — a health services company, a hospital, and a global insurance brokerage — ranging in size from approximately 139 employees to 7661 employees with a total eligible population of 10,899. The Prevention Plan™ (HRA, biometrics, and blood tests) was offered to these employees by their employers, resulting in a 52% registration (5667 people). Within their personal password-protected account, a scoremeter showcased The Prevention Score for a member, providing an instant snapshot of his or her own prevention efforts as well as progress toward completion of educational tutorials, screenings, and participation in other activities and adherence to recommended programs. As the member engaged in The Prevention Plan™ during the course of the year — via challenges, action programs, activity trackers, registered nurse coaching, among others — his or her Prevention Score increased. While protecting employee personal health information, the score level achieved was then linked to customised rewards and incentives such as prizes, gift cards, or health insurance premium reductions, which further drove both enrolment in The Prevention Plan™ and engagement in the program during the course of the year. The final sample for the study consisted of a smaller cohort of 2606 employees, registered in The Prevention Plan™, who completed an HRA, blood tests, and biometric screening in both 2008 and 2009, and had a

complete set of the 15 health risk data points in both years. The cohort showed significant reduction in 10 of the health risks measured (9 at $p \leq 0.01$ and 1 at $p \leq 0.05$). The most noticeable changes in health risks were a reduction in the proportion of employees with high-risk blood pressure (42.78%), high-risk fasting blood sugar (31.13%), and high-risk stress (24.94%). There was an overall health risk transition among the cohort with net movement from higher risk levels to lower risk levels ($P<0.01$). There was a net increase of 9.40% of people in the low-risk category, a decrease of 3.61% in the moderate-risk category, and a 5.79% decrease in the high-risk category.

The Prevention Plan™ study investigators concluded that this program reduces key employee health risk factors and effectively moves employees to lower overall health risk categories. They took the view that comprehensive, evidence-based primary and secondary prevention programs can begin achieving measurable health improvements in the first year of intervention. The program yielded strong levels of employee participation, personalised prevention recommendations, and health coach advocacy, which may well have had an impact on the level of individual engagement and progress and, therefore, the level of results. This study also provides insight into the health risks that can be most quickly addressed through comprehensive health management. The most significant were a reduction in the proportion of employees with high-risk blood pressure and high-risk fasting blood sugar (data points obtained through actual measurements—blood pressure reading and a blood glucose test and not a self-reported questionnaire. Limitations of the study include (i) voluntary participation (selection bias); (ii) possible lack or representativeness of the sample; (iii) no reported analysis of the possible effect of incentives on participation and adherence levels in the program; and (iv) short duration (1-year outcome measurements) meaning that these positive changes over 1 year may not necessarily translate into real outcomes that indicate sustained health improvements. Execution was fair in this cohort study which does contribute limited evidence of effectiveness; however despite promising results the study did not attempt to disentangle the contribution of incentives (for example as might be undertaken through a regression analysis).

Seaverson and colleagues reported in 2009 on a cross-sectional study to examine the impact of financial incentives, communications strategy, and worksite culture on health risk assessment (HRA) participation rates.[244] The study involved 36 North American employers (n=559,988 employees) that provided financial incentives to promote employee HRA participation. These were primarily large companies (those with ≥10,000 employees) across a broad range of private- and public sector industries, including manufacturing, service, finance and insurance, retail, and utility. Participation in the HRA was voluntary for all of the organisations included in the study. Organisations implemented the HRA as part of a more comprehensive worksite health promotion strategy that included follow-up interventions and a variety of other components. The primary outcome of interest was employee HRA participation. Approximately 58.3% of the sample had one full year of HRA and programs, 22.2% had two full years of HRA and programs, and 19.4% had more mature programs that had been in place for three or more years. Most organisations used cash-based incentives (44%) or incentives integrated into the health plan (44%), and the remainder used nonfinancial incentives of low monetary value (<$25). The mean incentive value was just over $100, and most organisations offered incentives valued between $50 and $100. Regression models were used to examine the extent to which factors influence HRA participation independently and when controlled for other factors. When all factors were included in the model, incentive value ($p=0.001$) and communications strategy ($p=0.023$) were significantly associated with HRA participation. Variance accounted for by all factors combined was $R^2=0.584$. The study authors suggest that incentive value, incentive type, supportive worksite culture, and comprehensive communications strategy may all play a role in increasing HRA participation. Study limitations include (i) self-reported information collected from a source outside of the organisation; (ii) post hoc creation of scoring and of definitions used for communications strategy and worksite culture factors; and (iii) findings may not be generalisable to all employer settings because of the relatively small sample.

Taitel and colleagues reported in 2008 on a cross-sectional study using multiple regression analysis of data from 124 North American employers with 882,275 eligible employees who completed 344,825 health and productivity assessments (HPAs).[233] Incentive value and Communications and Organizational Commitment Level (Com/Org Level) were the strongest predictors of HPA completion rates. Employer size was also a significant predictor. To achieve a 50% HPA completion rate, employers with a low Com/Org Level needed an incentive value of approximately $120 whereas employers with a high Com/Org Level needed only approximately $40. Study limitations include the heterogeneity of HPAs studied which may not necessarily be representative.

Ethical issues and controversies

Recent commentary on worksite wellness from The American Cancer Society, the American Diabetes Association, and the American Heart Association — Byers et al.;[179] as well as by O'Donnell[184] are outside the formal scope of this review, but are very helpful reading in identifying the pertinent ethical issues regarding financial incentives. These include:

- Issues about the use of family health history and genetic profiling in health risk assessments (HRAs) when financial incentives are provided to complete the HRAs
- Controversy about HRA schemes that allow employers to charge differential health plan premiums to workers based on achieving health status goals (such as body mass index, blood pressure, or blood glucose) or participating in health promotion programs to achieve those goals; without sufficient safeguards; the concern is that outcomes-based incentives can be equivalent to medical underwriting — the practice of using health status factors to determine a person's health insurance costs
- The risk that racial and ethnic minorities or workers who are less educated, older, or low income, might be disproportionately impacted by penalties tied to health outcomes because they often suffer higher rates of traditional risk factors
- Balancing the need for program effectiveness with the need to protect employees from workplace discrimination and infringement on medical privacy rights
- The risk that some employers will hold employees and their families accountable for unreasonable health metrics without the benefit of any meaningful support or assistance
- The risk that worksite program may simply end up charging a worker more for poor health status, thereby arguably discriminating based on health status even if the stated rationale for doing so is motivating workers to improve their health.

Significant financial incentives tend to lead individuals to attribute the cause of their behaviour changes to the extrinsic financial incentive, which decreases the likelihood they will make the intrinsic causal attributions necessary to sustain long term behaviour change. Additionally, financial incentives have the potential to create psychological reactance if they are perceived as coercive attempts by the employer to limit the employee's freedom of choice. This reactance can take the form of open resistance to change, negative attitudes about the change agent, or both. Such complex motivational factors suggest that financial incentives should be used thoughtfully and judiciously, with careful evaluation informing incentive design decisions, and that alternative strategies for driving engagement should be identified that focus on increasing intrinsic motivation and avoiding the potential pitfalls of relying primarily on financial incentives.[244]

Conclusions

Taking account of the suitability of study design and the strength of execution of reviewed studies, it is conclude that:

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- There is sufficient evidence for effectiveness of benefits-linked financial incentives in increasing HRA and program participation
- There is promising, but as yet insufficient evidence to determine the effectiveness of financial incentives with respect to sustained risk reduction or health outcomes
- There is insufficient evidence to determine specific or relative effectiveness of workplace HRAs amongst those with identified risk factors or with a known diagnosis.

Key components in workplace health screens associated with benefit and cost-effectiveness

Key Question 3 **What are the key components associated with the most effective and cost-effective implementation of workplace health screens, as defined by provision of new knowledge and/or future action on that knowledge?**

Summary statement

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- There is sufficient evidence that for every dollar invested in these programs an annual gain of $3.20 (range $1.40 to $4.60) can be achieved
- There is insufficient evidence to define precisely the key components associated with the most effective and cost-effective implementation.

Additional comment

Available evidence indicates that the feedback and recommendations aspects of HRAs, more so than the specific forms of the HRAs, may be the most important component for success.[59]

From recent studies reviewed, the most promising future directions appear to be with disease management programs that combine comprehensive plus high-risk interventions that focus on a dose–response model of increasing levels of intensity.[51]

There is preliminary evidence[27] that more favourable ROI ratios may be realised through the incorporation of newer technologies prevention technologies including:

- Use of the Transtheoretical Model
- Internet-provided health information
- Tailoring
- Benefits-linked financial incentives
- Telephonic high risk intervention coaching
- Using annual required morbidity-based HRAs used for individual targeting of interventions.

It is possible to identify success factors and recommendations for promising approaches in a variety of reports, articles and consensus statements.[20, 181, 192, 204, 245] However these do not carry the weight of scientific evidence necessary to meet the criteria required by this review to underpin definitive statements of effectiveness.

The Evidence

A systematic review carried out for the US Department of Health and Human Services — Agency for Healthcare Research and Quality (AHRQ) was published mid-year 2011, reviewing RCTs and Cohort studies to June 2010.[59] The review found that the *feedback and recommendations components* of HRAs, more so than the specific forms of the HRAs, their method of administration, nature of follow-up or characteristics of the participants were what appeared to produce encouragement and motivation among participants to modify behaviours. The review found no correlation between degrees of feedback/frequency and dropout rate and was unable to find patterns in the evidence that would suggest whether certain characteristics of HRAs are associated with better health outcomes.

Chapman's 2012 meta-evaluation of Worksite Health Promotion Economic Return Studies considered available evidence to November 2011.[27] Despite the use of these widely varying methods and approaches, the results were congruent. The summary evidence indicates average reductions in sick leave, health plan costs, and workers' compensation and disability insurance costs of around 25%. The review concluded that more recent studies reflecting the use of newer prevention technologies interventions were associated with higher levels of economic impact and return. Their incorporation in the studies published in the past 10 years has resulted in slightly more than double the average cost-benefit ratio reported in studies of traditional program models; in other words, instead of the typical 3:1 ROI ratio (Return on Investment, also known as a benefit-to-cost ratio) they report a ratio of 6.1:1. These stipulated newer technologies were (i) use of the Transtheoretical Model; (ii) Internet-provided health information; (iii) tailoring; (iv) benefits-linked financial incentives; (v) telephonic high risk intervention coaching; and (vi) annual required morbidity-based health risk appraisals used for individual targeting of interventions. Limitations of the study include: (i) the inclusion criteria are more lenient than for formal systematic reviews and the weighting of evidence by study design is not as stringent; and (ii) there is variability among studies in the methods for calculating return on investment with only recent discussion on how to improve standardisation.[55]

Within the 2010 systematic review reported by Soler et al. of workplace HRAs with feedback and additional interventions, summary ROI estimates (across averted medical costs and productivity losses) ranged from 1.4:1 to 4.6:1 (median 3.2:1) based on an analysis of six studies. Evidence from this systematic review forms the basis of recommendations by the US Preventive Services Task Force.[56]

Baicker and colleagues reported in 2010 a meta-analysis of the literature on costs and savings associated with workplace wellness programs.[19] The focus of this review was on health plan cost savings and sick leave absenteeism savings. The analytic process involved combining the raw data or the reported outcomes from multiple studies to perform new statistical analysis. The authors limited their analysis to data from studies with experimental or quasi-experimental study designs for health care cost savings. This included data from 22 studies that examined health plan cost savings associated with worksite health promotion programs and 22 studies that examined sick leave absenteeism savings associated with worksite health promotion programs (some of the studies addressed both economic variables). The authors calculated ROIs of $3.27 for medical cost savings and $2.73 for absenteeism reduction. Limitations of the study include: (i) the possibility that included companies are those with the highest expected returns and not representative of most employers; (ii) difficulty in gauging publication bias whereby only more positive studies get published; (iii) the preponderance of larger organisations in the finally retrieved studies and the uncertainty as to whether smaller companies may have the resources and economies of scale to achieve the suggested benefits; and (iv) as noted above, the variability among studies in the methods for calculating return on investment with only recent discussion on how to improve standardisation.[55]

Nonetheless the Baicker et al. study involved a robust and systematic approach, providing more conservative estimates of ROI than two earlier reviews — one by Chapman in 2005[26] which reported an average gross ROI of 5.81:1 based on a review of 22 studies; and another by Aldana in 2001[64] which reported gross ROI of 3.48–5.82 across 7 studies.

Recent corroborative evidence for the systematic and meta-evaluation reviews noted above was provided by Serxner and colleagues who reported in 2012 reported on a quasi-experimental pre/post intervention study conducted in a Large North American Financial Services Corporation.[175] The participants were a cohort population of employees enrolled in medical plans (n=49,793). The study cohort was selected from n=75,475. By year 3 of the program, there were 28,818 who had participated in at least one program and 8574 non-participants. The intervention was comprehensive health and productivity (HPM) program, which addressed health risks, acute and chronic conditions, and psychosocial disorders from 2005 to 2007. Incentives were used to encourage HRA participation in years 2 and 3. Program participation and medical claims data were collected for members at the end of each program year to assess the change in total costs from the baseline period. Participation in any program in year 1 was low at 18%. With the addition of incentives in years 2 and 3, participation in any program increased significantly to 64% and 77%, respectively. Overall, the highest participation rate in any program was for HRA completion in year 3 at 76%. Multivariate analyses for participation categories were conducted comparing baseline versus program year cost differences, controlling for demographics. All participation categories yielded a lower cost increase compared to nonparticipation and a positive Return on Investment (ROI) for years 2 and 3, resulting in a 2.45:1 ROI for the combined program years. Study limitations include: (i) self-selection bias; (ii) researchers may not have been able to adjusted adequately for potential selection bias with controls in the multivariate regression; and (iii) the study design used a closed cohort which resulted in attrition from the analysis cohort (however, there was no evidence to suggest that those who dropped out of the cohort were sicker or healthier than those who remained).

Conclusions

Taking account of the suitability of study design and the strength of execution of reviewed studies, it is conclude that:

- There is strong evidence of effectiveness of HRAs used in combination with other interventions in relation to tobacco use, alcohol use, dietary fat intake, blood pressure and cholesterol
- There is sufficient evidence for effectiveness of worksite programs to control overweight and obesity
- There is sufficient evidence that for every dollar invested in these programs an annual gain of $3.20 (range $1.40 to $4.60) can be achieved
- There is insufficient evidence to define precisely the key components associated with the most effective and cost-effective implementation.

APPENDICES

Appendix 1. Search strategy for the review

1 DATA SOURCES

The following databases were searched (January 2000–current):

- Cochrane reviews
- Web of Science
- Health Technology Assessment (HTA)
- MEDLINE (general medicine)
- MEDLINE in process and non-indexed citations (Pre-Med)
- NHS Economic Evaluation Database
- University of York Centre for Reviews and Dissemination
- UK National Institutes for Health and Clinical Effectiveness (NICE)
- US Guide to Community Preventive Services
- EMBASE (general medicine)
- CINAHL (nursing & allied health)
- Scopus
- Psycinfo (psychology and related behavioural and social sciences)
- Google scholar

2 SEARCH TERMS

The three key concepts forming the bases of the search were:

- **Population/Target group**: (adults, risk factors and chronic disease)
- **Intervention**: Health risk screening (screening and screening outcome)
- **Setting**: (workplace or pharmacy)

Key search terms, mapped to appropriate subject headings in each database and searched as a key word in title and abstract. *MeSH: Medical subject heading (Medline medical index term); the dollar sign ($) stands for any character(s); the question mark (?) = to substitute for one or no characters.*

Search Terms Set 1: Population/Target group:

Subset 1.1 Population/Target Group Adults	
MeSH Term (Medline)	Key Word (phrase searching)
1. Adult	Adult$

Subset 1.2 Lifestyle risk factors	
MESH Term (Medline)	Key Word (phrase searching)
1. Obesity	Obese, obesity
2. Overweight	Overweight
3. Elevated waist circumference	Waist circumference, central obesity
4. Weight loss	Weight loss, diet reducing, dietary changes
5. Dietary fats	Dietary fat$, saturated fat$, polyunsaturated fat$
6. Dietary fiber	Dietary fibre, dietary fiber
7. Energy intake	Energy intake$
8. Food habits	Food habit$, eating habit$, diet$ modification, diet$ habit$
9. Physical inactivity	Physical inactivity, exercise, physical activity
10. Sedentary	Sedentary
11. Risk factors	

1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11

Subset 1.3 metabolic risk factors and chronic disease	
MeSH Term (Medline)	Key Word (phrase searching)
1. Glucose intolerance	Glucose intoleran$, impaired fasting glucose, impaired fasting blood glucose, impaired fasting glyc?emia, impaired glucose toleran$, impaired glucose metab$, IGT,
2. Metabolic syndrome X	Metabolic syndrome
3. Insulin resistance	Insulin resistan$
4. Prediabetic state	Pre-diabet$, Pre diabet$, Prediabet$
5. Hyperlipdemia	Cholesterol
6. Diabetes mellitus, type 2	Type 2 diabet$, type II diabet$, non insulin depend$, noninsulin depend$, niddm, adult onset diabet$, late onset diabet$, matur$ onset diabet$, slow onset diabet$
7. Hypertension	Elevated blood pressure, hypertens$
8. Cardiovascular disease	Cardiovascular disease, heart disease
9. Chronic disease	

1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9

Search Terms Set 2: Health Risk Screening

Subset 2.1: Screening	
MESH Term (Medline)	Key Word (phrase searching)
1. Health risk screening	Health risk screening, screening
2. Health risk appraisal	Health risk appraisal
3. Health status	Health risk status
4. Health risk assessment	Health risk assessment, risk assessment
5. Chronic disease screening	Chronic disease screening
6. Questionnaires	Question$
7. Health survey	Health survey
8. Health status indicators	Health status indicator
9. Health promotion	Health promotion
1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9	

Subset 2.2 Screening outcome	
MESH Term (Medline)	Key Word (phrase searching)
1. Health behaviour	Health behaviour, risk reduction behaviour, health, behaviour
2. Intervention studies	Lifestyle, tailored intervention$
3. Health communication	Tailored communication,
4. Persuasive communication	Persuasive communication
5. Health education	Health education, education,
6. Patient education as a topic	Patient education
7. Health knowledge, attitude, beliefs	Health knowledge
8. Computer assisted instruction	Web-based, computer assisted, online, web
9. Tailored	Tailoring
10. Referral and consultation	Referral, consultation, intervention,
11. Risk factor modification	Risk factor modification
12. Feedback	Feedback
13. Risk reduction behaviour	Risk reduction behaviour, behaviour change, lifestyle
1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8	

Search Terms Set 3: Setting – workplace/pharmacy

MESH Term (Medline)	Key Word (phrase searching)
1. Workplace	Workplace, employees, worksite, organisation, company, workers, employers
2. Employee performance appraisal	Employee health appraisal
3. Incentive plans	Incentive plans
4. Health benefit plans	Health benefits, health benefit plans
5. Occupational health	Occupational health, occupational health services
6. Occupational health services	Occupational health services
7. Pharmacy	Pharmacy, pharmacist

1 OR 2 OR 3 OR 4 OR 5 OR 6

Final Set: (Subset 1.1 AND Subset 1.2 AND Subset 1.3) AND Set 2 AND Set 3 AND Set 4 and Set 5

Snowballing

Citation searching of sentinel papers was undertaken including those identified by key experts, relevant systematic reviews and studies identified from the primary searches. Potential papers identified in this way were then subjected to the review screening process to determine their eligibility.

3 INCLUSION AND EXCLUSION CRITERIA

Study Designs

The review aimed to include a range of study designs including:

- Randomised controlled trials
- Quasi-experimental studies
- Before and after studies (no control group)
- Descriptive studies of program delivery (quantitative or qualitative)
- Systematic reviews (with or without meta-analyses)
- Cost-effectiveness studies
- Grey literature — reports and case studies.

Types of Participants and Settings

The review included:

i) Studies of adults (18 years and older) undertaking health risk screening in the workplace or delivered through the workplace

ii) Studies of workplace health programs/interventions with a health risk screening component

iii) Studies of describing interventions or effects that occur post health risk screening

iv) Studies reporting on cost-effectiveness of health risk screenings (health or business indicators)

v) Studies involving linkages with the pharmacy setting.

The review included health risk screenings targeting **general population, individuals with risk factors or chronic conditions.** The review excluded studies of:

- Individuals with diagnosis of cancer
- Children/families
- Individuals based in institutional settings such as hospitals, psychiatric units, nursing homes, jails etc.

Types of Health Risk Screening Studies

The review included studies where the health risk screening assessed:

- Lifestyle risk factors for chronic disease including physical activity, diet, smoking, alcohol intake; and
- Risk factors for chronic diseases (including physical inactivity, fruit and vegetable intake, overweight and/or obesity, waist circumference, smoking, hypertension, impaired glucose tolerance and impaired fasting glucose).

The review included studies where the health risk screening is administered:

- Face to face
- Self-completed online
- Self-completed paper based.

The review included studies where participants completing health risk screening received:

- Individual tailored feedback (based on HRS) face to face
- Automatically generated individually tailored feedback (based on HRS) in online or hardcopy format
- Generic health information, education or advice
- No feedback on their assessment
- No health information, education or advice.

The review included studies where participants completing a health risk screening were:

- Offered an intervention (education or behavioural)
- Referred to a service
- Not offered an intervention (education or behavioural) or referral to an intervention.

The review excluded studies of health risk screenings assessing:

- Stress management only
- Mental health only
- Vision, hearing.

Other Criteria

The search was confined to English language, published studies involving humans, and published from January 2000 to the end of March 2012.

4 SCREENING AND ASSESSMENT OF STUDY QUALITY

Screening of Titles and Abstracts

All papers (title and abstracts) identified from the above search process were imported into an EndNote® database and duplicates removed into a duplicate folder. One researcher screened the title and abstracts (and full paper if necessary) to identify papers meeting the review inclusion and exclusion criteria. There were four possible outcomes from the screening process:

1. 'Exclude' – fails to meet the review inclusion criteria (in this case the reason for exclusion will be coded according to the screening checklist)
2. 'Exclude' – duplicate
3. 'Include'
4. 'Unsure'.

Studies in the 'Unsure' category were reviewed by the lead researcher and one other for final inclusion.

Study Verification and Data Extraction

Copies of the full text of papers were obtained for each of the included studies. The screening criteria were re-applied in assessing the content of the papers. Any studies not meeting the review exclusion/inclusion criteria were excluded. One researcher extracted information from the studies using a data extraction template (excel file) based on data collection categories listed below. Information extracted was recorded using a Microsoft Excel database.

Assessment Tool

For intervention studies, a validated assessment tool was used as a reference to assist the review team in judging the quality of studies retrieved. The ***Effective Public Health Practice Project Quality Assessment Tool*** provides a rating of overall study quality and individual components related to internal study validity (available online at http://www.ephpp.ca/tools.html). For non-intervention studies, the team used a short narrative notation on study quality.

Quality assessment was designed to be consistent with the guidance on levels of evidence provided by the National Health and Medical Research Council (NHMRC) – Table 5.[246-248] In addition the team incorporated the methodology used for the CDC Community Preventive Services Task Force – Tables 6 and 7.[249, 250]

In keeping with the hierarchy of evidence, systematic reviews were examined in the first instance to determine the comprehensiveness of evidence and to inform the exploration of the lower levels of the hierarchy. Systematic reviews were required to have (a) a defined review protocol that sets out the research question being addressed and the methods to be used; (b) a defined search strategy that aims to detect as much of the relevant literature as possible; (c) explicit documentation of the search strategy to enable an assessment of its rigour and completeness; (d) explicit inclusion and exclusion criteria to assess each potential primary study; and (e) specification of the information to be obtained from each primary study including the quality criteria by which the primary studies were to be evaluated. Thereafter, other study designs in the hierarchy were examined.

NHMRC Level of Evidence	Study design
I	A systematic review of level II studies (RCTs)
II	A randomised controlled trial
III-1	A pseudo-randomised controlled trial (i.e. alternate allocation or some other method)
III-2	A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group
IV	Case series with either post-test or pre-test/post-test outcomes

Table 5 Categorising included studies according to a hierarchy of the levels of evidence

Suitability of study design for assessing effectiveness	
Suitability	**Attributes**
Greatest	Concurrent comparison groups and prospective measurement of exposure and outcome
Moderate	All retrospective designs or multiple pre or post measurements but no concurrent comparison group
Least	Single pre and post measurements and no concurrent comparison group or exposure and outcome measured in a single group at the same point in time

Table 6 Suitability of study design for assessing effectiveness (Preventive Services Task Force)

Evidence of effectiveness[a]	Execution—good or fair[b]	Design Suitability—Greatest, moderate, or least	Number of studies	Consistent[c]	Effect size[d]	Expert opinion[e]
Strong	Good	Greatest	At Least 2	Yes	Sufficient	Not Used
	Good	Greatest or Moderate	At Least 5	Yes	Sufficient	Not Used
	Good or Fair	Greatest	At Least 5	Yes	Sufficient	Not Used
	Meet Design, Execution, Number and Consistency Criteria for Sufficient But Not Strong Evidence				Large	Not Used
Sufficient	Good	Greatest	1	Not Applicable	Sufficient	Not Used
	Good or Fair	Greatest or Moderate	At Least 3	Yes	Sufficient	Not Used
	Good or Fair	Greatest, Moderate, or Least	At Least 5	Yes	Sufficient	Not Used
Expert Opinion	Varies	Varies	Varies	Varies	Sufficient	Supports a Recommendation
Insufficient[f]	A. Insufficient Designs or Execution		B. Too Few Studies	C. Inconsistent	D. Small	E. Not Used

[a]The categories are not mutually exclusive; a body of evidence meeting criteria for more than one of these should be categorized in the highest possible category.
[b]Studies with limited execution are not used to assess effectiveness.
[c]Generally consistent in direction and size.
[d]Sufficient and large effect sizes are defined on a case-by-case basis and are based on Task Force opinion.
[e]Expert opinion will not be routinely used in the *Guide* but can affect the classification of a body of evidence as shown.
[f]Reasons for determination that evidence is insufficient will be described as follows: A. Insufficient designs or executions, B. Too few studies, C. Inconsistent. D. Effect size too small, E. Expert opinion not used. These categories are not mutually exclusive and one or more of these will occur when a body of evidence fails to meet the criteria for strong or sufficient evidence.

Table 7 Assessing the strength of a body of evidence on effectiveness of interventions

Data collection/extraction categories

To inform the assessment of study quality and meet the review specifications, details were determined for the following items (as available):

- Citation
- Year of study
- Country
- Study design
- Setting(workplace/pharmacy, metropolitan, rural and country)
- Target population (demographics), sample size
- # of participants targeted/invited to participate in HRS
- # of participants completing HRS
- Items forming the workplace health screen
- Risk factors and conditions targeted
- Method of HRS administration/duration of screening /HRS provider
- post-HRS intervention (feedback, education, referral pathway)
- Results: screening outcomes including proportions of persons identified at risk, intervention identified/received and any data about risk reduction or health outcomes.

Additional information was also included, where available on the following:

- Provision of incentives/any other strategies to increase completion/uptake rates
- Whether the health risk screening was provided/offered to all employees
- Size of workplaces (# employees) in studies implementing health risk screenings
- Whether organisations provided health insurance to employees
- Whether health risk screening items were self-report only or also included objective measures

- Rates of participation/uptake of referrals and interventions post health risk screening completion
- Factors influencing recruitment/reach and/or retention
- Any evaluation of participant feedback.

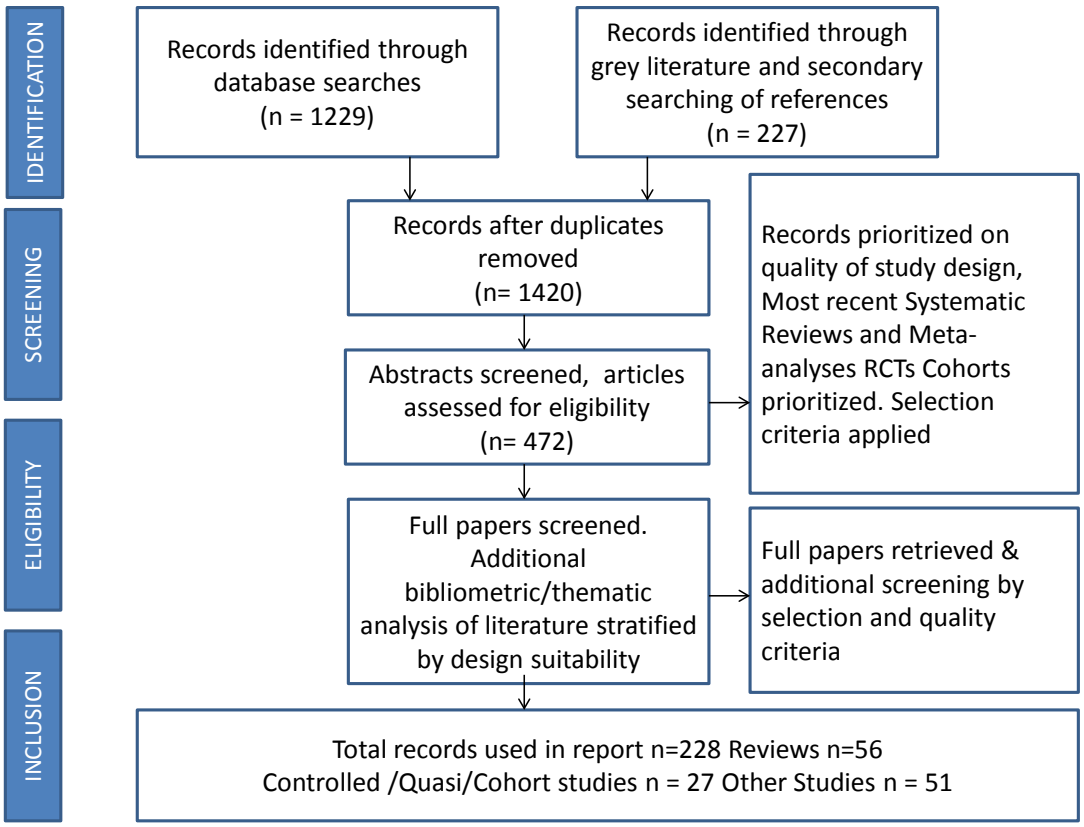

Figure 5 Flow chart for the literature review: identification, screening, eligibility and inclusion phases

Appendix 2. Glossary of terms

Absenteeism
An employee's voluntary non-attendance at work, without valid reason. Absenteeism means either habitual evasion of work, or wilful absence; it does not include involuntary or occasional absence due to valid causes, or reasons beyond one's control, such as accidents or sickness.

Bias*
Systematic error or deviation in results or inferences from the truth. In studies of the effects of health care, the main types of bias arise from systematic differences in the groups that are compared ("selection bias"), the care that is provided, exposure to other factors apart from the intervention of interest ("performance bias"), withdrawals or exclusions of people entered into a study ("attrition bias") or how outcomes are assessed ("detection bias"). Reviews of studies may also be particularly affected by "reporting bias", where a biased subset of all the relevant data is available.

Cohort study*
A study in which a defined group of people (the cohort) is followed over time. The outcomes of people in subsets of this cohort are compared, to examine people who were exposed or not exposed (or exposed at different levels) to a particular intervention or other factor of interest. A prospective cohort study assembles participants and follows them into the future. A retrospective (or historical) cohort study identifies subjects from past records and follows them from the time of those records to the present.

Control group*
A group whose characteristics are similar to those of the programme but who do not receive the programme services, products, or activities being evaluated. Participants are randomly assigned to either the experimental group (those receiving programme services) or the control group. A control group is used to assess the effect of programme activities on participants who are receiving the services, products, or activities being evaluated. The same information is collected for people in the control group and those in the experimental group.

Controlled studies*
Studies that include a control group.

Counter-balanced design*
A study design that involves reversing the order of conditions for equal number of research subjects.

Indicative evidence (expert opinion)
Insufficient empirical information is supplemented by expert opinion. An association only has been established between exposure to the intervention or program and improvement in one or more of the relevant risk factors or determinants. The association may or may not be causal but the limitations of the primary study(ies) preclude this determination.

Insufficient evidence
Available studies do not provide sufficient evidence to assess effectiveness.

* Source: Canadian Best Practices Portal http://cbpp-pcpe.phac-aspc.gc.ca/selection-eng.html

Strong to definitive evidence
A causal relationship has been established between exposure to the intervention or program and improvement in one or more of the relevant risk factors or determinants. In the context of this review this assessment is obtained from a systematic review of all relevant randomised trials.

Sufficient evidence
A causal relationship has been established between exposure to the intervention or program and improvement in one or more of the relevant risk factors or determinants through weight of evidence from a variety of appropriate studies. Study results must generally be consistent in direction and size and comply with the criteria set out at Table 7. This category excludes the use of expert opinion.

Presenteeism
Presenteeism refers to the decrease in productivity in employees whose health problems have not necessarily led to absenteeism and the decrease in productivity for the disabled workers before and after their absence period. It is defined as being present at work, but limited in some aspects of job performance by a health problem, and it is often a hidden cost for employers.

Quasi-experimental studies*
These are controlled studies without random assignment, but with control groups, comparison groups, or counter-balanced designs.

Appendix 3. Tabulation of papers

Systematic reviews/Longitudinal designs: selected studies

Citation	Year	Country	Study design	Purpose/ Setting	Studies included/ quality issues	Coverage of risk factors, conditions, other	Additional information	Results
van Dongen, J.M., et al., A systematic review of the cost-effectiveness of worksite physical activity and/or nutrition programs. Scand J Work Environ Health, 2012	2012	Global	Systematic Review [to 14 January 2011]	Appraise and summarize the evidence on the cost-effectiveness of worksite physical activity and/or nutrition programs.	Ten studies (18 programs) were included. Substantial need for improvement of the quality of studies and particularly on the handling of uncertainty	Nutrition, PA		Cost-effectiveness of more costly and more effective programs depends on the "willingness to pay" for their effects. It is unknown how much decision-makers are willing to pay for reductions in body weight, cholesterol level, and cardiovascular disease risks
Chapman, L.S., Meta-evaluation of worksite health promotion economic return studies: 2012 update. Am J Health Promot, 2012. 26(4): p. TAHP-1-TAHP-12	2012	Global	Systematic Review [to November 2011]	Provide an assessment of the methodological quality of workplace health promotion economic return studies and summarize their effect size. Despite methodlogical issues, the results show a lot of congruence	2003 report examined 42 studies; 2005 report examined 56 studies. This 2012 update examines 10 additional studies; weaker studies were dropped and a total of 62 studies are assessed in this 2012 report	Broad coverage including modifiable NCD risk factors, multicomponent programs	Meta-evaluation illustrates a lack of standardization in the methodology used in economic analysis of worksite health promotion programs. Different measurement methods, varying categories of economic variables used for measuring economic return, use of alternative research designs and statistical tests, all highlight the lack of consistency in research methodology	More recent studies tend to use newer prevention technologies including : use of the Transtheoretical ModelTM, Internet-provided health information, tailoring, benefits-linked financial incentives, telephonic high risk intervention coaching, self-directed change, and annual required morbidity-based health risk appraisals used for individual targeting of interventions. These newer prevention technologies were associated with higher levels of economic impact and return. Their use in the studies that have been published in the past 10 years has resulted in slightly more than double the average cost-benefit ratio reported in studies of traditional program models; in other words, instead of the typical 1:3.0 cost-benefit ratio they report 1:6.1
Sherman, B.W. and R.J. Fabius, Quantifying the value of worksite clinic nonoccupational health care services: a critical analysis and review of the literature. J Occup Environ Med	2012	Global	Literature Review [to April 2011]	Characterize and critically evaluate existing methods to quantify the value of worksite nonoccupational care services	Nineteen studies and two methodologic reviews met criteria for further analysis	Only one study evaluated the impact of worksite clinics on health care cost trend among clinic users, and none assessed the impact on total health and productivity costs	Return-on-investment calculations were commonly based on the comparative cost-effectiveness of worksite clinic services relative to community health care	Significant variability exists among current methods for calculating return on investment of nonoccupational worksite health care services; methodologic approaches are poorly aligned with employer health care cost containment objectives

Pelletier, K.R, A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VIII 2008 to 2010. J Occup Environ Med, 2011. 53(11): p. 1310-31 (also Pelletier 2009, 2005, 2001)	2011	Global	Systematic Review [to end 2010]	Review and analysis of the clinical and cost-effectiveness research conducted in workplace setting	For the 2004 to 2008 review, 7 of 16 new studies reported positive ROI. In the current review of studies between 2008 and 2010, 8 of the 27 studies reported positive cost benefits	Broad coverage including modifiable NCD risk factors, multicomponent programs	Subsumes/ to be read in conjunction with 3 other systematic reviews by Pelletier in 2009, 2005 and 201	Providing individualized risk reduction for high risk employees within the context of comprehensive programming is the critical element of worksite interventions. Despite methodological limitations , the vast majority of the research indicates positive clinical and cost outcomes
Verweij, L.M., et al., Meta-analyses of workplace physical activity and dietary behaviour interventions on weight outcomes. Obes Rev, 2011. 12(6): p. 406-29	2011	Global	Meta-analysis [to November 2009]	Critically examine the effectiveness of workplace interventions targeting physical activity, dietary behaviour or both on weight outcomes	Data could be extracted from 22 studies published between 1980 and November 2009 for meta-analyses	Nutrition, PA, weight	Results show moderate quality of evidence that workplace physical activity and dietary behaviour interventions significantly reduce body weight (nine studies; mean difference [MD]-1.19 kg [95% CI -1.64 to -0.74]), body mass index (BMI) (11 studies; MD -0.34 kg m(2) [95% CI -0.46 to -0.22]) and body fat percentage calculated from sum of skin-folds (three studies; MD -1.12% [95% CI -1.86 to -0.38]).There is also low quality of evidence that workplace physical activity interventions significantly reduce body weight and BMI. Subgroup analyses showed a greater reduction in body weight of physical activity and diet interventions containing an environmental component	Clinical relevance of the pooled effects may be substantial on a population level; workplace physical activity and dietary behaviour interventions, including an environment component, in order to prevent weight gain are recommended
US Department of Health and Human Services - Agency for Healthcare Research and Quality (AHRQ) Health Risk Appraisal - Technology Assesment Report. 2011	2011	Global	Systematic Review [to June 2010]	Describe key features of HRAs, examine which features were associated with successful HRAs, discuss applicaility of HRAs to the (US) Medicae population (65 years and over)	118 articles representing 114 unique studies	Coverage was of HRA in general and not confined to the workplace setting; however a substantial proportion of the evidence pertained to that setting	Frequency of follow-up varied across studies: 72% involved between 1 and 4 follow-up contacts and 2 follow-up contacts was the most common scenario. No correlation was found between degrees of feedback/ frequency and dropout rates (which ranged from mostly low rates to as high as 80% in some studies)	Most HRAs were developed to address and improve general health and that a major objective was to improve cardiovascular health; HRA instruments themselves were questionnaire-based tools designed specifically for the purpose of conducting HRAs; Other questionnaires used as HRAs were originally developed to measure constructs such as self-reported disease risk factors or behaviours such as food intake and physical activity; Some HRAs addressed physical or clinical assessments such as blood pressure and cholesterol; A minority of HRAs addressed physical/clinical measurements only, while a greater proportion (48 articles) addressed questionnaire-based HRAs and the majority, addressed a mixture of clinical/physical-based and questionnaire-based measures

Maes, L., et al., Effectiveness of workplace interventions in Europe promoting healthy eating: a systematic review. Eur J Public Health, 2011 Jul 23 [Epub ahead of print]	2011	European countries	Systematic Review [to October 2010]	Summarize evidence of workplace intervention studies promoting a healthy diet solely and in combination with increasing physical activity	Seventeen studies solely focusing on promotion of a healthy diet were identified. Eight were educational, one used worksite environmental change strategies, and eight used a combination of both (multi-component)	Nutrition, PA	None of the interventions were rated as 'strong'; seven met the criteria for 'moderate' quality. The reviewed studies show moderately evidence for effects on diet. Thirteen studies focusing both on nutrition and physical activity (nine educational and four multi-component studies) were identified. Ten were rated as having 'weak' and three as having 'moderate' methodological quality, providing inconclusive evidence for effects	Limited to moderate evidence for positive effects of nutrition interventions implemented at the workplace
Jensen, J.D., Can worksite nutritional interventions improve productivity and firm profitability? A literature review. Perspect Public Health, 2011. 131(4): p. 184-192	2011	Global	Systematic Review	Investigates whether and how worksite nutrition policies can improve employee productivity	The search identified 2,358 publications, 30 of which were found suitable for the review	Nutrition	Several of the reviewed studies suggest that diet-related worksite interventions have positive impacts on employees' nutritional knowledge, food intake and health and on the firm's profitability, mainly in terms of reduced absenteeism and presenteeism	Well-targeted and efficiently implemented diet-related worksite health promotion interventions may improve labour productivity by 1%-2%; mainly through reduced absenteeism and presenteeism
Cancelliere, C., et al., Are workplace health promotion programs effective at improving presenteeism in workers? A systematic review and best evidence synthesis of the literature. [Review]. BMC Public Health, 2011. 11(395)	2011	Global	Systematic Review [1990 to 2010]	Determine if WHP programs are effective in improving presenteeism; identify characteristics of successful programs and potential risk factors for presenteeism	2,032 titles and abstracts were screened, 47 articles were reviewed, and 14 were accepted (4 strong and 10 moderate studies)	Broad coverage including modifiable NCD risk factors, multicomponent programs	Successful programs offered organizational leadership, health risk screening, individually tailored programs, and a supportive workplace culture. Potential risk factors contributing to presenteeism included being overweight, a poor diet, a lack of exercise, high stress, and poor relations with co-workers and management	There is preliminary evidence that some WHP programs can positively affect presenteeism and that certain risk factors are of importance (being overweight, a poor diet, a lack of exercise, high stress, and poor relations with co-workers and management)

Soler, R.E., et al., A Systematic review of selected interventions for worksite health promotion the assessment of health risks with feedback. Am J Prev Med, 2010. 38(2): p. S237-S262	2010	Global	Systematic Review	Review effectiveness of interventions that use an Assessment of Health Risks with Feedback (AHRF) when used alone or as part of a broader WHP program			This review forms the basis of recos. by the US Task Force on Community Preventive Services	Strong evidence of effectiveness of AHRF used with health education with or without other intervention components for five outcomes. [xxxxx] Sufficient evidence of effectiveness for four additional outcomes assessed [xxxx] Insufficient evidence to determine effectiveness for changes in body composition and fruit and vegetable intake
Groeneveld, I.F., et al., Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease-a systematic review. Scand J Work Environ Health, 2010. 36(3): p. 202-15	2010	Global	Systematic Review	Summarize the evidence for an effect of lifestyle-targeted interventions at the workplace on the main biological risk factors for cardiovascular disease	Included 31 RCTs, describing a diversity of interventions (e.g. counseling, group education, or exercise). Of these, 18 were of high quality. Intervention compliance and lifestyle changes achieved should be reported in future studies to elucidate mechanisms	Main biological risk factors for cardiovascular disease (CVD)		Strong evidence for the effectiveness of workplace lifestyle-based interventions on body fat and, in populations at risk for CVD, body weight. Populations with an elevated risk of CVD seemed to benefit most from lifestyle interventions; supervised exercise interventions appeared the least effective intervention strategy
Hosking, J., et al., Organisational travel plans for improving health. Cochrane Database Syst Rev, 2010(3): p. CD005575	2010	Global	Systematic Review [to 2008]	Travel plans are interventions that aim to reduce single-occupant car use and increase the use of alternatives such as walking, cycling and public transport, with a variety of behavioural and structural components. Review focuses on organisational travel plans for workplaces schools & tertiary institutes	Seventeen studies were included of which five were in workplaces	PA, sedentary behaviour	One RCT in the workplace setting, conducted in a pre-selected group who were already contemplating or preparing for active travel, found improved health-related quality of life on some sub scales, and increased walking	Insufficient evidence to determine whether organisational travel plans are effective for improving health or changing travel mode. Given the current lack of evidence, organisational travel plans should be implemented in the context of robustly-designed research studies, such as well-designed cluster randomised trials

Citation	Year	Country	Study design	Purpose/ Setting	Studies included/ quality issues	Coverage of risk factors, conditions, other	Additional information	Results
Chau J. (2009) Evidence module: Workplace physical activity and nutrition interventions. Physical Activity Nutrition and Obesity Research Group, University of Sydney.	2009	Global	Semi-Systematic Review (synthesis); Focussed on PA and nutrition interventions in the workplace	Evidence Module for policymakers and health promotion professionals in NSW and Australia	Synthesise information from multiple reviews and studies; allow mixed methodological quality. Consider applicability of findings to Australian and NSW contexts. 27 references; several systematic reviews, meta-analyses	PA, Nutrition	Effective physical activity strategies include: • providing prompts to encourage stair use; • providing access to places or opportunities for physical activity; and • providing education or peer support Effective nutrition strategies are those that modify the food environment, including • food labeling; • point-of-purchase promotions; and • providing access and improving availabilityof healthy food choices such as in canteens and vending machines	There is strong evidence that multi-component workplace interventions that address physical activity, nutrition or both are effective for increasing physical activity, promoting healthy eating and preventing non-communicable illnesses like obesity
Rothstein, M.A. and H.L. Harrell, Health risk reduction programs in employer-sponsored health plans: Part I-efficacy. J Occup Environ Med, 2009. 51(8): p. 943-50	2009	USA	Semi-Systematic Review; Focussed on studies published in previous 10 years	Determine whether workplace health risk reduction programs (HRRPs) using health risk assessments (HRAs), individually focused risk reduction, and financial incentives succeeded in improving employee health and reducing employer health benefit costs		Broad coverage including modifiable NCD risk factors		HRAs are associated with some markers of better health and lower health care costs, although this might be the result of self –selection bias. Studies indicate that individualized approaches are mo re effective than generalized approaches Financial incentives may increase participation rates however, the long-term effects of financial incentives on health outcomes are not as definitive and may even be negative when compared with other interventions
Schultz, A.B. and D.W. Edington, Employee health and presenteeism: a systematic review. J Occup Rehabil 2007. 17(3): p. 547-579	2007	Global	Non-Systematic review (to October 2006)	Explore the link between employee health and presenteeism	37 studies from peer-reviewed. Weak study designs, mostly cross sectional and a few longitudinal	PA, Weight		Health risks traditionally measured by a health risk appraisal (HRA), especially physical activity and body weight, show an association with presenteeism. Health conditions such as allergies and arthritis are also associated with presenteeism

Ogilvie, D., et al., Interventions to promote walking: Systematic review. BMJ, 2007. 334(7605): p. 1204-1207	2007	Global	Systematic review	Assess the effects of interventions to promote walking in individuals and populations	19 randomised controlled trials and 29 non-randomised controlled studies were included; Evidence for workplaces, typically from isolated studies or subgroup analysis	PA, Sedentary behaviour	The most successful interventions could increase walking among targeted participants by up to 30-60 minutes a week on average (in the short term)	Interventions tailored to people's needs, targeted at the most sedentary or at those most motivated to change, and delivered either at the level of the individual (brief advice, supported use of pedometers, telecommunications) or household (individualised marketing) or through groups, can encourage people to walk more
Novak, B., et al., Blue-collar workplaces: a setting for reducing heart health inequalities in New Zealand? NZ Med J 2007. 120(1261): p. U2704	2007	Global with NZ focus		Review evidence for the effectiveness of workplaces as settings for cardiovascular health promotion and reduction of heart health inequalities in New Zealand	154 articles included; 1 review and 3 trials addressed cardiovascular interventions specifically; 4 systematic reviews addressed effectiveness of WHPP generally		programmes ranked highest in both clinical and cost-ffectiveness targeted industries employing large numbers of blue-collar workers, tackled multiple risk factors, intervened at both individual & environmental levels and incorporated occupational safety components	workplaces have good potential as settings for health promotion. We found mixed but largely supportive evidence that workplace interventions can lead to improvements in health outcomes, workplace environments, lifestyles, and productivity
Matson-Koffman, D.M., et al., A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: what works?. Am J Health Promot 2005. 19(3): p. 167-93	2005	Global	Systematic review (to 2003)	Determine whether policy and environmental interventions can increase people's physical activity or improve their nutrition Policy and environment relevant settings, including workplaces				Policy and environmental strategies may promote physical activity and good nutrition. Strongest evidence for: prompts to increase stair use (N = 5); access to places and opportunities for physical activity (N = 6), comprehensive work-site approaches, including education, employee and peer support for physical activity, incentives, and access to exercise facilities (N = 5)

Citation	Year	Country	Study design	Purpose/ Setting	Studies included/ quality issues	Coverage of risk factors, conditions, other	Additional information	Results
Engbers, L.H., et al., Worksite health promotion programs with environmental changes: a systematic review. Am J Prev Med, 2005. 29(1): p. 61-70	2005	Global	Systematic review (to January 2004)	Assess the effectiveness of WHPPs with environmental modifications, on physical activity, dietary intake, and health risk indicators	13 RCTs mostly multicenter included. All studies aimed to stimulate healthy dietary intake, and three trials focused on physical activity. Quality of most trials was rated as poor	PA, Nutrition	Quality of most included trials was rated as poor. However, strong evidence was found for an effect on dietary intake, inconclusive evidence for an effect on physical activity, and no evidence for an effect on health risk indicators	There is evidence that WHPPs that include environmental modifications can influence dietary intake
Lofland, J.H., L. Pizzi, and K.D. Frick, A review of health-related workplace productivity loss instruments. Pharmacoeconomics, 2004. 22(3): p. 165-84	2004	Global: mainly USA focus	Non-systematic review (to 2002); supplemented with a telephone-administered survey of business leaders and researchers	Identify health-related workplace productivity loss survey instruments, with particular emphasis on those that capture a metric suitable for direct translation into a monetary figure	Study identified 11 x health-related workplace productivity measurement survey instruments	Focus on productivity from societal perspective; across the range of instruments items included Angina, refers to WHO Health and Work Performance Questionnaire (**HPQ**)	WHO Health and Work Performance Questionnaire (HPQ) has an employee version which includes: Smoking, Alcohol, cholesterol, blood pressure, heart disease, asthma, bronchitis, COPD, Diabetes, Cancers. No coverage of PA/sedentary behaviour. Covers many other issues http://www.hcp.med.harvard.edu/hpq/	Review provides a comprehensive overview of the published, peer-reviewed survey instruments available to measure health-related workplace productivity loss. As the field of productivity measurement matures, tools may be developed that will allow researchers to accurately calculate lost productivity costs when performing cost-effectiveness and cost-benefit analyses. Using data captured by these instruments, society and healthcare decision makers will be able to make better informed decisions concerning the value of the medications, disease management and health promotion programmes that individuals receive

Longitudinal designs: selected studies

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Serxner, S., A. Alberti, and S. Weinberger, Medical cost savings for participants and nonparticipants in health risk assessments, lifestyle management, disease management, depression management, and nurseline in a large financial services corporation. Am J Health Promot, 2012. 26(4): p. 245-252	2012	USA	Quasi-experimental pre/post intervention study	Compare changes in medical costs between participants and nonparticipants: five different health and productivity management (HPM) programs	Cohort population of employees enrolled in medical plans (n= 49,793)	Comprehensive HPM program, which addressed health risks, acute and chronic conditions, and psychosocial disorders	Medical cost savings exceeded program costs in a wide variety of health and productivity management programs by the second year ***Refer to Page 55 of main report for further discussion***	All participation categories yielded a lower cost increase compared to nonparticipation and a positive return on investment (ROI) for years 2 and 3, resulting in a 2.45:1 ROI for the combined program years
Robroek, S.J., D.E. Lindeboom, and A. Burdorf, Initial and sustained participation in an Internet-delivered long-term worksite health promotion program on physical activity and nutrition. J Med Internet Res, 2012. 14(2): p. e43	2012	Netherlands	Longitudinal and RCT combined studies	Investigate initial and sustained participation in an Internet-delivered physical activity and healthy nutrition program in the Netherlands	Complete HRA baseline data were available for 924 employees (intervention: n=456, reference: n=468). From the longitudinal study, logistic regression analyses were conducted to identify characteristics of employees who visited and used the website	Physical Activity, Nutrition	***Refer to Page 28 of main report for further detailed discussion***	Modest initial participation and high attrition in program use were found. Workers with a low intention to change their behavior were less likely to participate, but once enrolled they were more likely to sustain their participation. Lifestyle and health indicators were not related to initial participation, but those with an unhealthy lifestyle were less likely to sustain. Regular email messages prompted website use, but the use of important Web-based tools was modest. There is a need for more appealing techniques to enhance retention and to keep those individuals who need it most attracted to the program

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Tarride, J., et al., Partnership in employee health. A workplace health program for British Columbia Public Service Agency (Canada). Work. 2011. 40(4): p. 459-471	2011	Canada	One-year prospective observational study	Evaluate the My Health Matters! (MHM) program, a multifaceted intervention focused on early detection and disease management with a focus on risk factors for metabolic syndrome	Program was offered to 2,000 public servants working in more than 30 worksites in Canada; Forty three per cent of employees (N = 857) completed the online HRA and 23 per cent (N = 447) attended an initial clinical visit with a nurse	Metabolic syndrome	***Refer to Pages 29/30 of main report for further detailed discussion***	The number of risk factors significantly decreased by 15 per cent over six months (N = 141). The cost per employee completing the HRA was $205 while the cost per employee attending the initial clinical visit was $394. Eighty-two per cent of employees would recommend the program to other employers.
Scoggins, J.F., et al., Short-term and long-term weight management results of a large employer-sponsored wellness program. J Occup Environ Med, 2011. 53(11): p. 1215-20	2011	USA	Observational Cohort study	Evaluate the weight management results of Healthy Incentives, an employer-sponsored wellness program started in 2006 by King County, Washington	The full 5-year cohort included 10,432 participants and represented 77.1% of all the eligible employees, spouses, and partners who were employed over the full 5-year period	Changes in BMI	Healthy Incentives achieved significant weight management benefits for both first-year and 5-year participants. ***Refer to Page 44 of main report for further detailed discussion***	A total of 19,559 first-year participants lost weight on average, while the comparative sample gained weight, -0.80% versus 0.31% (P < 0.01). A total of 10,432 5-year participants also lost weight on average but not as much as during the first year, -0.47% versus -0.80% (P = 0.01). More obese first-year participants lost 5% of BMI than the comparative sample, 28.5% versus 23.2% (P < 0.01). Thirty eight percent of obese 5-year participants lost 5%

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Neville, B.H., R.M. Merrill, and K.L. Kumpfer, Longitudinal outcomes of a comprehensive, incentivized worksite wellness program. Eval Health Prof, 2011. 34(1): p. 103-23	2011	USA	Repeated-measures longitudinal time-series study	Evaluated health benefits of long-term participation in an employer-based wellness program, focusing on chronic disease risk factors: Healthy Lifestyle Incentive Program (HLIP)	In 2006, 1,671 employees (711 [43%] men and 960 [57%] women) were enrolled in the Salt Lake County HLIP program	Range of NCD Risk Factors; including clinical measures of weight, blood pressure, cholesterol, and body fat percent	***Refer to Pages 49/50 of main report for further detailed discussion***	Participants had lower increases in body mass index (BMI) than the general population had during the same time period. Greatest improvements in BMI, blood pressure, and cholesterol were seen in those at highest risk levels at baseline and in those whose physical activity increased over time. It was found that long-term participation in this program improved BMI, blood pressure, and cholesterol. Most benefits were found for those in high-risk groups.
Merrill, R.M., et al., The impact of worksite wellness in a small business setting. J Occup Environ Med, 2011. 53(2): p. 127-31	2011	USA	Observational Cohort study	Evaluate level of participation and effectiveness of a worksite wellness program in a small business setting		Body fat, Blood pressure, Flexibility	***Refer to Pages 18 of main report for further discussion***	All Lincoln Industry employees participated in at least some level of wellness programming. Significant improvements in body fat, blood pressure, and flexibility were observed across time. The largest improvements in risk were seen among older employees and those with the highest baseline values
DeJoy, D.M., et al., Combining environmental and individual weight management interventions in a work setting: results from the Dow chemical study. J Occup Environ Med, 2011. 53(3): p. 245-52	2011	USA	A quasi-experimental design compared outcomes for two levels of environmental interventions and for participants who did or did not self-select into an individually focused weight loss intervention	Evaluate the comparative effectiveness of environmental weight loss interventions alone versus in combination with an individual intervention	More than 10,000 employees were involved in the study	BMI	Study authors concluded that simple worksite environmental modifications may help with weight maintenance, but are not likely to result in substantial weight reductions even when combined with low-intensity individual interventions	Employees who participated in the individually focussed weight loss intervention were no more successful at losing weight than those exposed to only the environmental interventions. Approximately, 13.5% of each group lost at least 5% of their body weight; overall changes in mean body weight and body mass index were negligible in both groups

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Colkesen, E.B., et al., Effects on cardiovascular disease risk of a web-based health risk assessment with tailored health advice: a follow-up study. Vascular Health & Risk Management, 2011. 7: p. 67-74	2011	Netherlands	Prospective cohort tudy	Evaluate a web-based health risk assessment (HRA) with tailored feedback for individual health promotion focussed on CVD	n = 368 employees	CVD risk factors/ CVD risk score (Framingham)	Follow-up data on CVD risk were collected 1 year after initial participation. The primary outcome was a change in Framingham CVD risk at 6 months relative to baseline. Voluntary participation in a Web-based HRA with tailored feedback at the worksite reduced CVD risk by nearly 18% among participants at high CVD risk and by nearly 5% among all participants. Web-based HRA could improve CVD risk in similar populations. ***Refer to page 31 of the main report for further discussion***	176 employees completed follow-up measurements after a mean of 7 months. There was a graded relation between CVD risk changes and baseline risk, with a relative reduction of 17.9% (p = 0.001) in the high-risk category (baseline CVD risk >= 20%). Changes were not explained by additional health counseling, medication, or an increase in health consciousness within the company
Carls, G.S., et al., The impact of weight gain or loss on health care costs for employees at the Johnson & Johnson Family of Companies. J Occup Environ Med, 2011. 53(1): p. 8-16	2011	USA	Longitudinal study	Quantify the impact of weight gain or weight loss on health care costs	Employees completing at least two health risk assessments during 2002 to 2008 were classified as adding, losing, or staying at high/low risk for each of nine health risks including overweight and obesity	BMI, other NCD Risk Factors	Study authors concluded that preventing weight gain through effective employee health promotion programs is likely to result in cost savings for employers	Employees who developed high risk for obesity (n = 405) experienced 9.9% points higher annual cost increases (95% confidence interval: 3.0%-16.8%) than those who remained at lower risk (n = 8015). Employees who moved from high to lower risk for obesity (n = 384), experienced annual cost increases that were 2.3% points lower (95% confidence interval: -7.4% to 2.8%) than those who remained high risk (n = 1699)

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Byrne, D.W., et al., Seven-year trends in employee health habits from a comprehensive workplace health promotion program at Vanderbilt University. J Occup Environ Med, 2011. 53(12): p. 1372-81	2011	USA	Retrospective cohort study	Assess long-term changes in health risks for employees participating in Vanderbilt University's incentive-based worksite wellness program	Of 22,505 employees (18,772 staff and 3733 faculty), 95% were eligible for the GFTG Program (active, full-time, regular faculty and staff enrolled in the Vanderbilt Health Plan)	NCD Risk Factors, Seatbelt use	Before 'Go For The Gold' (GFTG) was introduced, the annual HRA completion rate was less than 24%. This increased to 68% in the first year after introduction of the incentive program and continued to increase to 80% and more in years 4 to 7 ***Refer to Pages 4-7 of main report for further detailed discussion***	Majority of risk factors improved over time; most consistent change occurring in physical activity. The proportion of employees exercising one or more days per week increased from 72.7% in 2003 to 83.4% in 2009. Positive annual, monotonic changes were also observed in percentage for nonsmokers and seat belt usage. Although the largest improvements occurred between the first two years, improvements continued without significant regression toward baseline
Merrill, R.M., D.E. Bowden, and S.G. Aldana, Factors associated with attrition and success in a worksite wellness telephonic health coaching program. Educ Health (Abingdon), 2010. 23(3): p. 385	2010	USA	Cohort study	Identify factors associated with attrition and improvements in body mass index (BMI) in a telephonic health coaching program	A cohort study design was used with 6,129 employees aged 21-88 years, enrolled in telephonic health coaching sometime during 2002 through 2008	BMI, PA	Attrition in the telephonic health coaching program was greatest among those least in need of behavior change. Of those who continued in the program, the greatest decrease in BMI occurred in those in greatest need for behavior change. Among those continuing with health coaching through 12 months, the percent decrease in BMI between baseline and 12 months was: 1.5% for normal weight, 2.7% for overweight, 4.1% for class I & II obesity and 7.2% for class III obesity; 4.3% for high confidence to lose weight, 3.5% for medium confidence to lose weight and 3.1% for low confidence to lose weight; and 3.8% for very good or good general health, 4.5% for average general health and 6.8% for poor/very poor general health	Attrition through 3, 6 and 12 months of follow-up was 13%, 17% and 36%, respectively. Those currently making changes in physical activity or nutrition had the highest BMI, lowest levels of exercise and the poorest overall health at baseline. They were also most likely to continue with health coaching through 12 months. Those not ready to make changes at this time or having maintained an appropriate level of physical activity or nutrition for more than six months were least likely to continue with health coaching through 12 months. They also had the lowest BMI, highest levels of exercise and the best overall health

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Long, D.A. and P. Sheehan, A case study of population health improvement at a Midwest regional hospital employer. Popul Health Manag, 2010. 13(3): p. 163-73	2010	USA	Longitudinal study	Review health improvement initiative of a Midwest regional hospital employer where services included health risk assessments, health education, and motivational health coaching conducted telephonically	4402 members who took HRAs during this 4-year period, 784 took it all 4 years, 969 took it 3 of 4 years, 957 took it 2 of 4 years, and 1692 took it just 1 year	NCD Risk Factors, Mental Health	Participants averaged $40.65 PM savings over the control population. Program return on investment, including incentive costs and vendor fees, was 2.87:1	Body mass index showed nonsignificant improvements during the years of greatest participation (years 2 to 4). Indicators of productivity demonstrated improvements as well. These gains were noted for employees across all health risk statuses, which suggests population health improvement strategies can influence productivity even for healthy employees
Loeppke, R., D.W. Edington, and S. Bég, Impact of the prevention plan on employee health risk reduction. Popul Health Manag, 2010. 13(5): p. 275-284	2010	USA	Cohort study	Evaluate the impact of The Prevention Plan™ on employee health risks after 1 year of integrated primary prevention and secondary prevention (biometric and lab screening as well as early detection) interventions	Participants came from 3 employer groups—a health services company, a hospital, and a global insurance brokerage, ranging in size from approx 139 employees to 7661 employees with a total eligible population of 10,899	Wide range of NCD risk factors including physical measures	***Refer to Pages 49-50 of main report for further detailed discussion***	The cohort showed significant reduction in 10 of the health risks measured (9 at P?0.01 and 1 at P?0.05). The most noticeable changes in health risks were a reduction in the proportion of employees with high-risk blood pressure (42.78%), high-risk fasting blood sugar (31.13%), and high-risk stress (24.94%). There was an overall health risk transition among the cohort with net movement from higher risk levels to lower risk levels (P<0.01). There was a net increase of 9.40% of people in the low-risk category, a decrease of 3.61% in the moderate-risk category, and a 5.79% decrease in the high-risk category

Citation	Year	Country	Study design	Purpose/Setting	Target population, sample	Coverage of risk factors, conditions, other	Additional information	Results - Screening outcomes, Risk Reduction, Health Outcomes
Lin, Y.C., et al., Worksite health screening programs for predicting the development of Metabolic Syndrome in middle-aged employees: a five-year follow-up study. BMC Public Health, 2010. 10(747)	2010	Taiwan	Observational Cohort study	Explore whether initial screening records can be efficiently applied on the prediction of the MetS occurrence in healthy middle-aged employees	Utilizing health examination data, a five-year follow-up observational study was conducted for 1384 middle-aged Taiwanese employees not fulfilling MetS criteria	Metabolic syndrome (MetS)	MetS component count and combination can be used in predicting MetS development for participants potentially at risk. Worksite MetS screening programs simultaneously allow for finding out cases and for assessing risk of MetS development. Synergistic effects on MetS development existed between coupling MetS components: 1. High blood pressure plus low-HDL demonstrated an OR of 11.7 ($p < 0.01$) for MetS development and an SI of 4.7 (95% CI, 2.1-10.9). 2. High blood pressure plus hyperglycemia had an OR of 7.9 ($p < 0.01$), and an SI of 2.7 (95% CI, 1.2-6.4)	Within five years, 13% (175 out of 1384) participants fulfilled MetS criteria. The ORs for MetS development among adults initially having one or two MetS components were 2.8 and 7.3, respectively (both $p < 0.01$), versus the adults having zero MetS component count at screening. Central obesity carried an OR of 7.5 ($p < 0.01$), which far exceeded other risk factors (all ORs < 2.7)
Faghri, P.D., et al., The role of tailored consultation following health-risk appraisals in employees' health behavior. J Occup & Environ Med 2008. 50(12): p. 1378-85	2008	USA	Pre-test post-test control group design consisting of two groups of worksite employees who self-selected either into the experimental group (HRA and with tailored consultation by a health professional) or the control group (HRA without consultation)	Evaluates employees' health and lifestyle changes following health risk appraisal only and health risk appraisal with a consultation (HRAC) based on the constructs of Transtheoretical model (TTM)	Sixty employees, of which 14 were men (mean SD, 47.0 10.4 years) and 46 were women (mean SD, 43.9 10.2 years) were recruited from a public sector agency of 650 employees	PA, nutrition, weight, height, body mass index, blood pressure, blood glucose, cholesterol	The study authors concluded that HRA with a consultation (HRAC) based on TTM constructs is effective in promoting behavior change in high-risk employees	Second health risk appraisal showed improvements in nutrition, fitness, and overall health in both groups ($P < 0.05$). Significant improvements were found between HRAC group and their SOC for exercise, nutrition, and overall lifestyle. Also, group differences in SOC for exercise, amount of snack food, fruits and vegetables consumed, and physical activity ($P < 0.05$) were significant

USEFUL WEBSITES

The Community Guide: Assessment of Health Risks with Feedback to Change Employees' Health
http://www.thecommunityguide.org/worksite/ahrf.html

Centers for Disease Control and Prevention: Workplace Health Promotion
http://www.cdc.gov/workplacehealthpromotion/index.htm

CDC Healthier Worksite Initiative: Health Risk Appraisals
http://www.cdc.gov/nccdphp/dnpao/hwi/programdesign/health_risk_appraisals.htm
http://www.cdc.gov/nccdphp/dnpao/hwi/downloads/HRA_checklist.pdf

World Health Organization Health and Work Performance Questionnaire (HPQ)
http://www.hcp.med.harvard.edu/hpq

The European Network for Workplace Health Promotion (ENWHP)
http://www.enwhp.org/the-enwhp.html

Government of Tasmania: Healthy at Work
http://www.people.tas.gov.au/themes/people_performance/healthyatwork

Government of Victoria: Promoting a Healthy Workplace
http://www.health.vic.gov.au/prevention/healthy_workplace.htm

Wellsource HRA and Wellness Program (USA – Private Sector)
http://www.wellsource.com/home.html

The Prevention Plan (USA – Private Sector)
http://www.thepreventionplan.com/Home.aspx

Private Healthcare UK – Workplace Health (UK – Private Sector)
http://www.privatehealth.co.uk/workplace-health/

Business In The Community (UK – Private Sector)
http://www.bitc.org.uk/resources/publications/healthy_people_.html

QHS Corporate Health (Australia – Private Sector)
http://www.qhscorporatehealth.com.au/

REFERENCES

1. Sorensen, G., et al., *Preventing chronic disease in the workplace: a workshop report and recommendations.* Am J Public Health, 2011. 101 Suppl 1: p. S196–S207.
2. World Health Organization, *World health statistics 2012: WHO Geneva*. 2012.Available at http://who.int/gho/publications/world_health_statistics/EN_WHS2012_Full.pdf Accessed 23 May 2012.
3. World Health Organization, *Global health risks: mortality and burden of disease attributable to selected major risks. Geneva, World Health Organization,* 2009. Available at http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf Accessed 23 May 2012.
4. United Nations General Assembly, *Political Declaration of the High-level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases*. 2011. Available at http://www.who.int/entity/nmh/events/un_ncd_summit2011/political_declaration_en.pdf Accessed 23 May 2012.
5. National Preventative Health Taskforce, *Australia: The Healthiest Country by 2020 - National Preventative Health Strategy - the roadmap for action. Barton ACT: Commonwealth of Australia.* 2009.
6. Council of Australian Governments (COAG) *National Partnership Agreement on Preventive Health*. 2009. Available at http://www.coag.gov.au/intergov_agreements/federal_financial_relations/docs/national_partnership/national_partnership_on_preventive_health.rtf. Accessed 24 May 2012.
7. St. George, A., et al., *Implementing workplace health promotion initiatives: who should we target?* Health Promot J Austr, 2012 (in press).
8. Australian Bureau of Statistics, *Table 1 Work, National summary, 1997–2007, Australian social trends, data cube: Excel spreadsheet, Cat. no. 4102.0. Canberra: ABS;.* 2008.
9. Australian Bureau of Statistics, *Businesses by Industry Class by Main State by Employment Size Ranges 2006-7, Counts of Australian Businesses, including Entries and Exits, data cube: Excel spreadsheet, Cat. no. 8165.0. Canberra: ABS;.* 2007.
10. Australian Bureau of Statistics, *Locations of Work. Cat No. 6275.0 Nov 2008. Canberra: ABS;.* 2008.
11. NSW Health Centre for Epidemiology and Research *The health of the people of New South Wales - Report of the Chief Health Officer. Summary Report Sydney: NSW Department of Health.* 2010. Available at http://www.health.nsw.gov.au/pubs/2010/pdf/chorep_summary_2010.pdf. Accessed 24 May 2012.
12. NSW Ministry of Health, *Healh Statistics New South Wales*. 2012. Available at http://www.healthstats.nsw.gov.au/. Accessed 24 May 2012.
13. Kowlessar, N.M., et al., *The relationship between 11 health risks and medical and productivity costs for a large employer.* J Occup Environ Med, 2011. 53(5): p. 468–477.
14. Goetzel, R.Z., et al., *A multi-worksite analysis of the relationships among body mass index, medical utilization, and worker productivity.* J Occup Environ Med, 2010. 52 Suppl 1: p. S52–S58.
15. Durden, E.D., et al., *Economic costs of obesity to self-insured employers.* J Occup Environ Med, 2008. 50(9): p. 991–997.
16. Østbye, T., J.M. Dement, and K.M. Krause, *Obesity and workers' compensation: results from the Duke Health and Safety Surveillance System.* Arch Intern Med, 2007. 167(8): p. 766–773.
17. Anderson, L.M., et al., *The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review.* Am J Prev Med, 2009. 37(4): p. 340–357.
18. Archer, W.R., et al., *Promising practices for the prevention and control of obesity in the worksite.* Am J Health Promot, 2011. 25(3): p. e12–26.
19. Baicker, K., D. Cutler, and Z. Song, *Workplace wellness programs can generate savings.* Health Aff (Millwood), 2010. 29(2): p. 304–311.

20. Bellew, B., *Primary prevention of chronic disease in Australia through interventions in the workplace setting: an Evidence Check rapid review brokered by the Sax Institute <http://www.saxinstitute.org.au> for the Chronic Disease Prevention Unit, Victorian Government Department of Human Services,* 2008.

21. Benedict, M.A. and D. Arterburn, *Worksite-based weight loss programs: a systematic review of recent literature.* Am J Health Promot, 2008. 22(6): p. 408–416.

22. Brouwer, W., et al., *Which intervention characteristics are related to more exposure to internet-delivered healthy lifestyle promotion interventions? A systematic review.* J Med Internet Res, 2011. 13(1): p. e2.

23. Brown, H.E., et al., *Does physical activity impact on presenteeism and other indicators of workplace well-being?* Sports Medicine, 2011. 41(3): p. 249–252.

24. Cahill, K., M. Moher, and T. Lancaster, *Workplace interventions for smoking cessation.* Cochrane Database Syst Rev, 2008(4): p. CD003440.

25. Cancelliere, C., et al., *Are workplace health promotion programs effective at improving presenteeism in workers? A systematic review and best evidence synthesis of the literature.* BMC Public Health, 2011. 11(395).

26. Chapman, L.S., *Meta-evaluation of worksite health promotion economic return studies: 2005 update.* Am J Health Promot, 2005. 19(6): p. 1–11.

27. Chapman, L.S., *Meta-Evaluation of Worksite Health Promotion Economic Return Studies: 2012 Update.* Am J Health Promot, 2012. 26(4): p. TAHP-1-–TAHP-12.

28. Chau, J., *Evidence module: Workplace physical activity and nutrition interventions. Physical Activity Nutrition and Obesity Research Group, University of Sydney,* 2009.

29. Chau, J.Y., et al., *Are workplace interventions to reduce sitting effective? A systematic review.* Prev Med, 2010. 51(5): p. 352–356.

30. Deutekom, M., et al., *The effects of screening on health behaviour: a summary of the results of randomized controlled trials.* J Public Health, 2011. 33(1): p. 71–79.

31. Engbers, L.H., et al., *Worksite health promotion programs with environmental changes: a systematic review.* Am J Prev Med, 2005. 29(1): p. 61–70.

32. Evans, C.D., et al., *Diabetes and cardiovascular disease interventions by community pharmacists: a systematic review.* Ann Pharmacother, 2011. 45(5): p. 615–628.

33. Goetzel, R.Z. and R.J. Ozminkowski, *The health and cost benefits of work site health-promotion programs.* Annu Rev Public Health, 2008. 29: p. 303–323.

34. Groeneveld, I.F., et al., *Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease: a systematic review.* Scand J Work Environ Health, 2010. 36(3): p. 202–215.

35. Hooper, P. and F. Bull, *Healthy active workplaces: Review of evidence and rationale for workplace health. Department of Sport and Recreation, Western Australia Government*. 2009. Available at http://www.dsr.wa.gov.au/assets/files/Healthy_Active%20Workplaces/Convincer%20Document%20-%20Review%20of%20Evidence%20of%20Workplace%20Health%20Programs.pdf Accessed 24 April 2012.

36. Hosking, J., et al., *Organisational travel plans for improving health.* Cochrane Database Syst Rev, 2010(3): p. CD005575.

37. Hudson, L.R. and J.E. Pope, *The role of health-risk appraisals in disease management.* Managed Care Interface, 2006. 19(2): p. 43–45.

38. Jensen, J.D., *Can worksite nutritional interventions improve productivity and firm profitability? A literature review.* Perspect Public Health, 2011. 131(4): p. 184–192.

39. Karnon, J., et al., *A review and critique of modelling in prioritising and designing screening programmes.* Health Technol Assess, 2007. 11(52): p. iii-iv, ix-xi, 1–145.

40. Krebs, P., J.O. Prochaska, and J.S. Rossi, *A meta-analysis of computer-tailored interventions for health behavior change.* Prev Med, 2010. 51(3-4): p. 214–221.

41. Kuoppala, J., A. Lamminpaa, and P. Husman, *Work health promotion, job well-being, and sickness absences: a systematic review and meta-analysis.* J Occup Environ Med, 2008. 50(11): p. 1216–1227.

42. Leutzinger, J., et al., *Metabolic syndrome and worksite health promotion.* Am J Health Promot, 2006. 21(1): p. suppl 1–11, iii.

43. MacEachen, E., et al., *Workplace health understandings and processes in small businesses: a systematic review of the qualitative literature.* J Occup Rehabil, 2010. 20(2): p. 180–198.

44. Maes, L., et al., *Effectiveness of workplace interventions in Europe promoting healthy eating: a systematic review.* Eur J Public Health, 2011. Jul 23. [Epub ahead of print].

45. Matson-Koffman, D.M., et al., *A site-specific literature review of policy and environmental interventions that promote physical activity and nutrition for cardiovascular health: what works? [Review] [170 refs].* Am J Health Promot, 2005. 19(3): p. 167–193.

46. Ni Mhurchu, C., L.M. Aston, and S.A. Jebb, *Effects of worksite health promotion interventions on employee diets: a systematic review.* BMC Public Health, 2010. 10: p. 62.

47. Novak, B., et al., *Blue-collar workplaces: a setting for reducing heart health inequalities in New Zealand?* N Z Med J, 2007. 120(1261): p. U2704.

48. Ogilvie, D., et al., *Interventions to promote walking: systematic review.* BMJ, 2007. 334(7605): p. 1204–1207.

49. Pelletier, K.R., *A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VI 2000-2004.* J Occup Environ Med, 2005. 47(10): p. 1051–1058.

50. Pelletier, K.R., *A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VII 2004–2008.* J Occup Environ Med, 2009. 51(7): p. 822–837.

51. Pelletier, K.R., *A review and analysis of the clinical and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: update VIII 2008 to 2010.* J Occup Environ Med, 2011. 53(11): p. 1310–1331.

52. Rothstein, M.A. and H.L. Harrell, *Health risk reduction programs in employer-sponsored health plans: Part I-efficacy.* J Occup Environ Med, 2009. 51(8): p. 943–950.

53. Schultz, A.B., C.Y. Chen, and D.W. Edington, *The cost and impact of health conditions on presenteeism to employers: a review of the literature.* Pharmacoeconomics, 2009. 27(5): p. 365–378.

54. Schultz, A.B. and D.W. Edington, *Employee health and presenteeism: a systematic review.* J Occup Rehabil, 2007. 17(3): p. 547–579.

55. Sherman, B.W. and R.J. Fabius, *Quantifying the value of worksite clinic nonoccupational health care services: a critical analysis and review of the literature.* J Occup Environ Med, 2012. 54(4): p. 394–403.

56. Soler, R.E., et al., *A systematic review of selected interventions for worksite health promotion.The Assessment of Health Risks with Feedback.* Am J Prev Med, 2010. 38(2): p. S237–S262.

57. Sutherland, K., J.B. Christianson, and S. Leatherman, *Impact of targeted financial incentives on personal health behavior: a review of the literature.* Med Care Res Rev, 2008. 65(6 Suppl): p. 36S–78S.

58. Uegaki, K., et al., *Economic evaluations of occupational health interventions from a company's perspective: a systematic review of methods to estimate the cost of health-related productivity loss.* J Occup Rehabil, 2011. 21(1): p. 90–99.

59. US Department of Health and Human Services - Agency for Healthcare Research and Quality (AHRQ) *Health Risk Appraisal - Technology Assesment Report*. 2011.Available at http://www.cms.gov/Medicare/Coverage/DeterminationProcess/downloads//id79ta.pdf Accessed 23 April 2012.

60. van Dongen, J.M., et al., *A systematic review of the cost-effectiveness of worksite physical activity and/or nutrition programs.* Scand J Work Environ Health, 2012.

61. Verweij, L.M., et al., *Meta-analyses of workplace physical activity and dietary behaviour interventions on weight outcomes.* Obes Rev, 2011. 12(6): p. 406–429.

62. Waugh, N., et al., *Screening for type 2 diabetes: literature review and economic modelling.* Health Technol Assess, 2007. 11(17): p. iii-iv, ix-xi, 1–125.

63. Webb, G., et al., *A systematic review of work-place interventions for alcohol-related problems.* Addiction, 2009. 104(3): p. 365–377.

64. Aldana, S.G., *Financial impact of health promotion programs: a comprehensive review of the literature.* Am J Health Promot, 2001. 15(5): p. 296–320.

65. Babor, T.F., C.N. Sciamanna, and N.P. Pronk, *Assessing multiple risk behaviors in primary care. Screening issues and related concepts. [Review] [86 refs].* Am J Prev Med, 2004. 27(2 Suppl): p. 42–53.

66. Bankhead, C.R., et al., *The impact of screening on future health-promoting behaviours and health beliefs: a systematic review.* Health Technol Assess, 2003. 7(42): p. 1–92.

67. Loeppke, R., et al., *Health-related workplace productivity measurement: general and migraine-specific recommendations from the ACOEM Expert Panel.* J Occup Environ Med, 2003. 45(4): p. 349–359.

68. Lofland, J.H., L. Pizzi, and K.D. Frick, *A review of health-related workplace productivity loss instruments.* Pharmacoeconomics, 2004. 22(3): p. 165–184.

69. Pelletier, K.R., *A review and analysis of the clinical- and cost-effectiveness studies of comprehensive health promotion and disease management programs at the worksite: 1998-2000 update.* Am J Health Promot, 2001. 16(2): p. 107–116.

70. Petticrew, M.P., et al., *False-negative results in screening programmes: systematic review of impact and implications.* Health Technol Assess, 2000. 4(5): p. 1–120.

71. Riedel, J.E., et al., *The effect of disease prevention and health promotion on workplace productivity: a literature review.* Am J Health Promot, 2001. 15(3): p. 167–191.

72. Shekelle, P., et al., *Health Risk Appraisals and Medicare - Evidence Report and Evidence-Based Recommendations. U.S. Department Of Health And Human Services Health Care Financing Administration.* Baltimore: Centers for Medicare and Medicaid Services. 2003.

73. Araki, I., et al., *Controlled trial of worksite health education through face-to-face counseling vs. e-mail on drinking behavior modification.* J Occup Health, 2006. 48(4): p. 239–245.

74. Armitage, C.J., *Evidence that implementation intentions promote transitions between the stages of change.* J Consult Clin Psychol, 2006. 74(1): p. 141–151.

75. Atlantis, E., et al., *Worksite intervention effects on physical health: a randomized controlled trial.* Health Promot Int, 2006. 21(3): p. 191–200.

76. Backman, D., et al., *Effect of fresh fruit availability at worksites on the fruit and vegetable consumption of low-wage employees.* J Nutr Educ Behav, 2011. 43(4 Suppl 2): p. S113–S121.

77. Bandoni, D.H., F. Sarno, and P.C. Jaime, *Impact of an intervention on the availability and consumption of fruits and vegetables in the workplace.* Public Health Nutr, 2011. 14(6): p. 975–981.

78. Barham, K., et al., *Diabetes prevention and control in the workplace: a pilot project for county employees.* J Public Health Manag Pract, 2011. 17(3): p. 233–241.

79. Beresford, S.A., et al., *Environmental assessment at worksites after a multilevel intervention to promote activity and changes in eating: the PACE project.* J Occup Environ Med, 2010. 52 Suppl 1: p. S22–S28.

80. Bloch, M.J., et al., *Partners in lowering cholesterol: comparison of a multidisciplinary educational program, monetary incentives, or usual care in the treatment of dyslipidemia identified among employees.* J Occup Environ Med, 2006. 48(7): p. 675–681.

81. Block, G., et al., *Development of Alive! (A Lifestyle Intervention Via Email), and its effect on health-related quality of life, presenteeism, and other behavioral outcomes: randomized controlled trial.* J Med Internet Res, 2008. 10(4): p. e43.

82. Brand, R., et al., *Effects of a physical exercise intervention on employees'perceptions quality of life: a randomized controlled trial.* Soz Praventivmed, 2006. 51(1): p. 14–23.

83. Brehm, B.J., et al., *Environmental changes to control obesity: a randomized controlled trial in manufacturing companies.* Am J Health Promot, 2011. 25(5): p. 334–340.

84. Campbell, M.K., et al., *Effects of a tailored health promotion program for female blue-collar workers: health works for women.* Prev Med, 2002. 34(3): p. 313–323.

85. Christensen, J.R., et al., *Diet, physical exercise and cognitive behavioral training as a combined workplace based intervention to reduce body weight and increase physical capacity in health care workers - a randomized controlled trial.* BMC Public Health, 2011. 11: p. 671.

86. Cook, R.F., et al., *A field test of a web-based workplace health promotion program to improve dietary practices, reduce stress, and increase physical activity: a randomized controlled trial.* J Med Internet Res, 2007. 9(2): p. e17.

87. Dekkers, J.C., et al., *Comparative effectiveness of lifestyle interventions on cardiovascular risk factors among a Dutch overweight working population: a randomized controlled trial.* BMC Public Health, 2011. 11(1): p. 49.

88. Dishman, R.K., et al., *Move to Improve: a randomized workplace trial to increase physical activity.* Am J Prev Med, 2009. 36(2): p. 133–141.

89. Doumas, D.M. and E. Hannah, *Preventing high-risk drinking in youth in the workplace: a web-based normative feedback program.* J Subst Abuse Treat, 2008. 34(3): p. 263–271.

90. Elliot, D.L., et al., *The PHLAME firefighters' study: feasibility and findings.* Am J Health Behav, 2004. 28(1): p. 13–23.

91. Elliot, D.L., et al., *The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: outcomes of two models of behavior change.* J Occup Environ Med, 2007. 49(2): p. 204-–213.

92. Engbers, L.H., M.N. van Poppel, and W. van Mechelen, *Modest effects of a controlled worksite environmental intervention on cardiovascular risk in office workers.* Prev Med, 2007. 44(4): p. 356–362.

93. Finkelstein, E.A., et al., *A pilot study testing the effect of different levels of financial incentives on weight loss among overweight employees.* J Occup Environ Med, 2007. 49(9): p. 981–989.

94. French, S.A., et al., *Pricing and availability intervention in vending machines at four bus garages.* J Occup Environ Med, 2010. 52 Suppl 1: p. S29–S33.

95. French, S.A., et al., *Worksite environment intervention to prevent obesity among metropolitan transit workers.* Prev Med, 2010. 50(4): p. 180–185.

96. Goetzel, R.Z., et al., *Second-year results of an obesity prevention program at the Dow Chemical Company.* J Occup Environ Med, 2010. 52(3): p. 291–302.

97. Groeneveld, I.F., et al., *Cost-effectiveness and cost-benefit of a lifestyle intervention for workers in the construction industry at risk for cardiovascular disease.* J Occup Environ Med, 2011. 53(6): p. 610–617.

98. Harley, A.E., et al., *Multiple health behavior changes in a cancer prevention intervention for construction workers, 2001-2003.* Prev Chronic Dis, 2010. 7(3): p. A55.

99. Hermansson, U., et al., *Screening and brief intervention for risky alcohol consumption in the workplace: results of a 1-year randomized controlled study.* Alcohol Alcohol, 2010. 45(3): p. 252–257.

100. Hughes, S.L., et al., *Comparison of two health-promotion programs for older workers.* Am J Public Health, 2011. 101(5): p. 883–890.

101. Kant, I., et al., *Structured early consultation with the occupational physician reduces sickness absence among office workers at high risk for long-term sickness absence: a randomized controlled trial.* J Occup Rehabil, 2008. 18(1): p. 79–86.

102. Karlehagen, S. and C.G. Ohlson, *Primary prevention of cardiovascular disease by an occupational health service.* Prev Med, 2003. 37(3): p. 219–225.

103. Kroeze, W., et al., *The efficacy of Web-based and print-delivered computer-tailored interventions to reduce fat intake: results of a randomized, controlled trial.* J Nutr Educ Behav, 2008. 40(4): p. 226–236.

104. Lassen, A.D., et al., *Improving the diet of employees at blue-collar worksites: results from the 'Food at Work' intervention study.* Public Health Nutr, 2011. 14(6): p. 965–974.

105. Linde, J.A., et al., *HealthWorks: results of a multi-component group-randomized worksite environmental intervention trial for weight gain prevention.* Int J Behav Nutr Phys Act, 2012. 9: p. 14.

106. Lowe, M.R., et al., *An intervention study targeting energy and nutrient intake in worksite cafeterias.* Eat Behav, 2010. 11(3): p. 144–151.

107. MacKinnon, D.P., et al., *Long-term effects of a worksite health promotion program for firefighters.* Am J Health Behav, 2010. 34(6): p. 695–706.

108. Makrides, L., et al., *Evaluation of a workplace health program to reduce coronary risk factors.* Clinical Governance: An International Journal, 2008. 13(2): p. 95–105.

109. Maron, D.J., et al., *Health-risk appraisal with or without disease management for worksite cardiovascular risk reduction.* J Cardiovasc Nurs, 2008. 23(6): p. 513–518.

110. Maruyama, C., et al., *Effect of a worksite-based intervention program on metabolic parameters in middle-aged male white-collar workers: a randomized controlled trial.* Prev Med, 2010. 51(1): p. 11–17.

111. Matano, R.A., et al., *A pilot study of an interactive web site in the workplace for reducing alcohol consumption.* J Subst Abuse Treat, 2007. 32(1): p. 71–80.

112. McEachan, R.R., et al., *Testing a workplace physical activity intervention: a cluster randomized controlled trial.* Int J Behav Nutr Phys Act, 2011. 8: p. 29.

113. Merrill, R.M. and S.G. Aldana, *Improving overall health status through the CHIP intervention.* Am J Health Behav, 2009. 33(2): p. 135–146.

114. Merrill, R.M., P. Taylor, and S.G. Aldana, *Coronary Health Improvement Project (CHIP) is associated with improved nutrient intake and decreased depression.* Nutrition, 2008. 24(4): p. 314–321.

115. Morgan, P.J., et al., *The impact of a workplace-based weight loss program on work-related outcomes in overweight male shift workers.* J Occup Environ Med, 2012. 54(2): p. 122–127.

116. Murphy, M.H., et al., *The effect of a worksite based walking programme on cardiovascular risk in previously sedentary civil servants [NCT00284479].* BMC Public Health, 2006. 6: p. 136.

117. Muto, T. and K. Yamauchi, *Evaluation of a multicomponent workplace health promotion program conducted in Japan for improving employees' cardiovascular disease risk factors.* Prev Med, 2001. 33(6): p. 571–577.

118. Naito, M., et al., *Effect of a 4-year workplace-based physical activity intervention program on the blood lipid profiles of participating employees: the high-risk and population strategy for occupational health promotion (HIPOP-OHP) study.* Atherosclerosis, 2008. 197(2): p. 784–790.

119. Nilsson, P.M., E.B. Klasson, and P. Nyberg, *Life-style intervention at the worksite: reduction of cardiovascular risk factors in a randomized study.* Scand J Work Environ Health, 2001. 27(1): p. 57–-62.

120. Nisbeth, O., K. Klausen, and L.B. Andersen, *Effectiveness of counseling over 1 year on changes in lifestyle and coronary heart disease risk factors.* Patient Educ Couns, 2000. 40(2): p. 121–131.

121. Nurminen, E., et al., *Effectiveness of a worksite exercise program with respect to perceived work ability and sick leaves among women with physical work.* Scand J Work Environ Health, 2002. 28(2): p. 85–93.

122. Oenema, A., et al., *Efficacy and use of an internet-delivered computer-tailored lifestyle intervention, targeting saturated fat intake, physical activity and smoking cessation: a randomized controlled trial.* Ann Behav Med, 2008. 35(2): p. 125–135.

123. Okechukwu, C.A., et al., *MassBuilt: effectiveness of an apprenticeship site-based smoking cessation intervention for unionized building trades workers.* Cancer Causes Control, 2009. 20(6): p. 887–894.

124. Osilla, K.C., et al., *Exploring productivity outcomes from a brief intervention for at-risk drinking in an employee assistance program.* Addict Behav, 2010. 35(3): p. 194–200.

125. Papadaki, A. and J.A. Scott, *Follow-up of a web-based tailored intervention promoting the Mediterranean diet in Scotland.* Patient Educ Couns, 2008. 73(2): p. 256–263.

126. Pedersen, M.T., et al., *The effect of worksite physical activity intervention on physical capacity, health, and productivity: a 1-year randomized controlled trial.* J Occup Environ Med, 2009. 51(7): p. 759–770.

127. Plotnikoff, R.C., et al., *The efficacy of stage-matched and standard public health materials for promoting physical activity in the workplace: the Physical Activity Workplace Study (PAWS).* Am J Health Promot, 2007. 21(6): p. 501–509.

128. Plotnikoff, R.C., et al., *Six-month follow-up and participant use and satisfaction of an electronic mail intervention promoting physical activity and nutrition.* Am J Health Promot, 2010. 24(4): p. 255–259.

129. Pressler, A., et al., *An internet-delivered exercise intervention for workplace health promotion in overweight sedentary employees: a randomized trial.* Prev Med, 2010. 51(3-4): p. 234–249.

130. Prochaska, J.O., et al., *Initial efficacy of MI, TTM tailoring and HRI's with multiple behaviors for employee health promotion.* Prev Med, 2008. 46(3): p. 226–231.

131. Proper, K.I., et al., *Effect of individual counseling on physical activity fitness and health: a randomized controlled trial in a workplace setting.* Am J Prev Med, 2003. 24(3): p. 218–226.

132. Purath, J., et al., *A brief intervention to increase physical activity in sedentary working women.* Can J Nurs Res, 2004. 36(1): p. 76–91.

133. Racette, S.B., et al., *Worksite Opportunities for Wellness (WOW): effects on cardiovascular disease risk factors after 1 year.* Prev Med, 2009. 49(2-3): p. 108–114.

134. Rahe, R.H., et al., *A novel stress and coping workplace program reduces illness and healthcare utilization.* Psychosom Med, 2002. 64(2): p. 278–286.

135. Ranby, K.W., et al., *The PHLAME (Promoting Healthy Lifestyles: Alternative Models' Effects) firefighter study: testing mediating mechanisms.* J Occup Health Psychol, 2011. 16(4): p. 501–513.

136. Richmond, R., et al., *Evaluation of a workplace brief intervention for excessive alcohol consumption: the workscreen project.* Prev Med, 2000. 30(1): p. 51–63.

137. Saleh, S.S., et al., *The effectiveness and cost-effectiveness of a rural employer-based wellness program.* J Rural Health, 2010. 26(3): p. 259–265.

138. Sorensen, G., et al., *Promoting behavior change among working-class, multiethnic workers: results of the healthy directions: small business study.* Am J Public Health, 2005. 95(8): p. 1389–1395.

139. Sorensen, G., et al., *Tools for health: the efficacy of a tailored intervention targeted for construction laborers.* Cancer Causes Control, 2007. 18(1): p. 51–59.

140. Sorensen, G., et al., *The influence of social context on changes in fruit and vegetable consumption: results of the healthy directions studies.* Am J Public Health, 2007. 97(7): p. 1216–1227.

141. Sorensen, G., et al., *A comprehensive worksite cancer prevention intervention: behavior change results from a randomized controlled trial (United States).* J Public Health Policy, 2003. 24(1): p. 5–25.

142. Sternfeld, B., et al., *Improving diet and physical activity with ALIVE: a worksite randomized trial.* Am J Prev Med, 2009. 36(6): p. 475–483.

143. Taimela, S., et al., *Effectiveness of a targeted occupational health intervention in workers with high risk of sickness absence: baseline characteristics and adherence as effect modifying factors in a randomized controlled trial.* J Occup Rehabil, 2010. 20(1): p. 14–20.

144. Taimela, S., et al., *An occupational health intervention programme for workers at high risk for sickness absence. Cost effectiveness analysis based on a randomised controlled trial.* Occup Environ Med, 2008. 65(4): p. 242–248.

145. Taimela, S., et al., *The effectiveness of two occupational health intervention programmes in reducing sickness absence among employees at risk. Two randomised controlled trials.* Occup Environ Med, 2008. 65(4): p. 236–241.

146. Terry, P.E., et al., *The ACTIVATE study: results from a group-randomized controlled trial comparing a traditional worksite health promotion program with an activated consumer program.* Am J Health Promot, 2011. 26(2): p. Nov-Dec.

147. Thieszen, C.L., et al., *The Coronary Health Improvement Project (CHIP) for lowering weight and improving psychosocial health.* Psychol Rep, 2011. 109(1): p. 338–352.

148. van Wier, M.F., et al., *Phone and e-mail counseling are effective for weight management in an overweight working population: a randomized controlled trial.* BMC Public Health, 2009. 9: p. 6.

149. van Wier, M.F., et al., *Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees.* J Occup Environ Med, 2011. 53(6): p. 680–686.

150. Vermeer, W.M., et al., *Small portion sizes in worksite cafeterias: do they help consumers to reduce their food intake?* Int J Obes (Lond), 2011. 35(9): p. 1200–1207.

151. Wolf, A.M., et al., *Impact of lifestyle intervention on lost productivity and disability: improving control with activity and nutrition.* J Occup Environ Med, 2009. 51(2): p. 139–145.

152. Mills, P.R., et al., *Impact of a health promotion program on employee health risks and work productivity.* Am J Health Promot, 2007. 22(1): p. 45–53.

153. De Bourdeaudhuij, I., et al., *Evaluation of an interactive computer-tailored nutrition intervention in a real-life setting.* Ann Behav Med, 2007. 33(1): p. 39–48.

154. Moy, F., A.A. Sallam, and M. Wong, *The results of a worksite health promotion programme in Kuala Lumpur, Malaysia.* Health Promot Int, 2006. 21(4): p. 301–310.

155. Serxner, S., et al., *The impact of a worksite health promotion program on short-term disability usage.* J Occup Environ Med, 2001. 43(1): p. 25–29.

156. Gold, D.B., D.R. Anderson, and S.A. Serxner, *Impact of a telephone-based intervention on the reduction of health risks.* Am J Health Promot, 2000. 15(2): p. 97–106.

157. Angotti, C.M., et al., *Combined dietary and exercise intervention for control of serum cholesterol in the workplace.* Am J Health Promot, 2000. 15(1): p. 9–16.

158. Bergstrom, G., et al., *A comprehensive workplace intervention and its outcome with regard to lifestyle, health and sick leave: the AHA study.* Work, 2008. 31(2): p. 167–180.

159. Byrne, D.W., et al., *Seven-year trends in employee health habits from a comprehensive workplace health promotion program at Vanderbilt University.* J Occup Environ Med, 2011. 53(12): p. 1372–1381.

160. Carls, G.S., et al., *The impact of weight gain or loss on health care costs for employees at the Johnson & Johnson Family of Companies.* J Occup Environ Med, 2011. 53(1): p. 8–16.

161. Colkesen, E.B., et al., *Effects on cardiovascular disease risk of a web-based health risk assessment with tailored health advice: a follow-up study. Vasc Health Risk Manag, 2011. 7: p. 67–74.*

162. DeJoy, D.M., et al., *Combining environmental and individual weight management interventions in a work setting: results from the Dow chemical study.* J Occup Environ Med, 2011. 53(3): p. 245–252.

163. Faghri, P.D., et al., *The role of tailored consultation following health-risk appraisals in employees' health behavior.* J Occup Environ Med, 2008. 50(12): p. 1378–1385.

164. Goetzel, R.Z., et al., *The long-term impact of Johnson & Johnson's Health & Wellness Program on employee health risks.* J Occup Environ Med, 2002. 44(5): p. 417–424.

165. Herman, C.W., et al., *Effectiveness of an incentive-based online physical activity intervention on employee health status.* J Occup Environ Med, 2006. 48(9): p. 889–895.

166. Lin, Y.C., et al., *Worksite health screening programs for predicting the development of Metabolic Syndrome in middle-aged employees: a five-year follow-up study.* BMC Public Health, 2010. 10(747).

167. Loeppke, R., D.W. Edington, and S. Bég, *Impact of the prevention plan on employee health risk reduction.* Popul Health Manag, 2010. 13(5): p. 275-–284.

168. Long, D.A. and P. Sheehan, *A case study of population health improvement at a Midwest regional hospital employer.* Popul Health Manag, 2010. 13(3): p. 163–173.

169. Merrill, R.M., et al., *The impact of worksite wellness in a small business setting.* J Occup Environ Med, 2011. 53(2): p. 127–131.

170. Merrill, R.M., D.E. Bowden, and S.G. Aldana, *Factors associated with attrition and success in a worksite wellness telephonic health coaching program.* Educ Health (Abingdon), 2010. 23(3): p. 385.

171. Neville, B.H., R.M. Merrill, and K.L. Kumpfer, *Longitudinal outcomes of a comprehensive, incentivized worksite wellness program.* Eval Health Prof, 2011. 34(1): p. 103–123.

172. Pescatello, L.S., et al., *The cardiovascular health impact of an incentive worksite health promotion program.* Am J Health Promot, 2001. 16(1): p. 16–20.

173. Robroek, S.J., et al., *Demographic, behavioral, and psychosocial correlates of using the website component of a worksite physical activity and healthy nutrition promotion program: a longitudinal study.* J Med Internet Res, 2010. 12(3): p. e44.

174. Robroek, S.J., D.E. Lindeboom, and A. Burdorf, *Initial and sustained participation in an internet-delivered long-term worksite health promotion program on physical activity and nutrition.* J Med Internet Res, 2012. 14(2): p. e43.

175. Serxner, S., A. Alberti, and S. Weinberger, *Medical cost savings for participants and nonparticipants in health risk assessments, lifestyle management, disease management, depression management, and nurseline in a large financial services corporation.* Am J Health Promot, 2012. 26(4): p. 245–252.

176. Tarride, J., et al., *Partnership in employee health. A workplace health program for British Columbia Public Service Agency (Canada).* Work, 2011. 40(4): p. 459–471.

177. Yen, L., et al., *Changes in health risks among the participants in the United Auto Workers - General Motors lifesteps health promotion program.* Am J Health Promot, 2001. 16(1): p. 7–15.

178. Scoggins, J.F., et al., *Short-term and long-term weight management results of a large employer-sponsored wellness program.* J Occup Environ Med, 2011. 53(11): p. 1215–1220.

179. Byers, T.E., et al., *Speaking with one voice on worksite wellness: the American Cancer Society, the American Diabetes Association, and the American Heart Association.* Am J Health Promot, 2011. 26(1): p. eiii-ev.

180. Colkesen, E.B., et al., *Participation in a workplace web-based health risk assessment program.* Occup Med (Lond), 2011. 61(8): p. 586–589.

181. Government of Victoria Department of Health, *Workplace health promotion: case studies for creating a supportive environment for health*. 2011. Available at http://www.health.vic.gov.au/prevention/ Accessed 23 April 2012.

182. Government of Victoria Department of Health, *Promoting a healthy workplace*. 2011. Available at http://docs.health.vic.gov.au/docs/doc/91BEED1B3BD4D7E5CA25792E00785EDF/$FILE/Promoting%20a%20healthy%20workplace.pdf. Accessed 23 April 2012.

183. Merrill, R.M., et al., *Evaluation of a best-practice worksite wellness program in a small-employer setting using selected well-being indices.* J Occup Environ Med, 2011. 53(4): p. 448–454.

184. O'Donnell, M.P., *Commentaries on "Workplace health promotion will become irrelevant in national policy if we do not learn to speak with one voice".* Am J Health Promot, 2011. 26(1): p. ei–eii.

185. Ovbiosa-Akinbosoye, O.E. and D.A. Long, *Factors associated with long-term weight loss and weight maintenance: analysis of a comprehensive workplace wellness program.* J Occup Environ Med, 2011. 53(11): p. 1236–1242.

186. Prochaska, J.O., et al., *The well-being assessment for productivity: a well-being approach to presenteeism.* J Occup Environ Med, 2011. 53(7): p. 735–742.

187. Pronk, N.P., et al., *The association between health assessment-derived summary health scores and health care costs.* J Occup Environ Med, 2011. 53(8): p. 872-878.

188. Pyenson, B.S., et al., *An actuarial analysis shows that offering lung cancer screening as an insurance benefit would save lives at relatively low cost.* Health Aff (Millwood), 2012. 31(4): p. 770–779.

189. Rajda, J., D.J. Vreeman, and H.G. Wei, *Semantic interoperability of Health Risk Assessments.* AMIA Annu Symp Proc, 2011. 2011: p. 1134–1143.

190. Wald, N.J., M. Simmonds, and J.K. Morris, *Screening for future cardiovascular disease using age alone compared with multiple risk factors and age.* PLoS ONE [Electronic Resource], 2011. 6(5).

191. Bachler, J., *Health risk appraisal: how sharp is this tool in shaping employee behavior?* Find brief, 2009. 12(8): p. 1–3.

192. Carnethon, M., et al. *Worksite wellness programs for cardiovascular disease prevention: a policy statement from the American Heart Association*. Circulation, 2009. 120, 1725–1741.

193. Dettloff, R.W. and J.A. Morse, *Demonstration of community pharmacy and managed care organization collaboration on cardiovascular disease risk factor identification using health risk appraisal.* J Am Pharm Assoc (2003), 2009. 49(2): p. 220–222.

194. Gaetano, D.E., et al., *Health surveillance for rural volunteer firefighters and emergency medical services personnel.* AAOHN J, 2007. 55(2): p. 57–63.

195. Goetzel, R.Z., et al., *Development of a community-wide cardiovascular risk reduction assessment tool for small rural employers in upstate New York.* Prev Chronic Dis, 2009. 6(2): p. A65.

196. Goetzel, R.Z., et al., *Emerging trends in health and productivity management.* Am J Health Promot, 2007. 22(1): p. 1–7.

197. Goris, A., T. Washington, and B. Ainsworth, *The effect of a health risk assessment, personal coaching, and lifestyle intervention program on increasing physical activity behavior of inactive employees within a randomized controlled trial.* Obesity, 2009. 17: p. S269–S269.

198. Horgan, J.M., A. Blenkinsopp, and R.J. McManus, *Evaluation of a cardiovascular disease opportunistic risk assessment pilot ('Heart MOT' service) in community pharmacies.* J Public Health, 2010. 32(1): p. 110–116.

199. Kelly, J.T., *Evaluating employee health risks due to hypertension and obesity: self-testing workplace health stations.* Postgrad Med, 2009. 121(1): p. 152–158.

200. Krass, I., et al., *Pharmacy diabetes care program: analysis of two screening methods for undiagnosed type 2 diabetes in Australian community pharmacy.* Diabetes Res Clin Pract, 2007. 75(3): p. 339–347.

201. Liu, Y., et al., *Identifying patients at risk of cardiovascular disease: a pharmacist-managed screening event for union workers and their dependents.* J Am Pharm Assoc (2003), 2009. 49(4): p. 549–553.

202. McLellan, R.K., et al., *Impact of workplace sociocultural attributes on participation in health assessments.* J Occup Environ Med, 2009. 51(7): p. 797–803.

203. Phillips, J.F., *Using an ounce of prevention: does it reduce health care expenditures and reap pounds of profits? A study of the financial impact of wellness and health risk screening programs.* J Health Care Finance, 2009. 36(2): p. 1–12.

204. PricewaterhouseCoopers *Workplace Wellness in Australia*. 2010. Available at http://www.pwc.com.au/industry/healthcare/assets/Workplace-Wellness-Sep10.pdf. Accessed 24 May 2012.

205. Rothstein, M.A. and H.L. Harrell, *Health risk reduction programs in employer-sponsored health plans: Part II-law and ethics.* J Occup Environ Med, 2009. 51(8): p. 951–957.

206. Rula, E.Y. and A. Hobgood, *The impact of health risk awareness on employee risk levels.* Am J Health Behav, 2010. 34(5): p. 532–543.

207. Aoun, S. and L. Johnson, *Men's health promotion by general practitioners in a workplace setting.* Aust J Rural Health, 2002. 10(6): p. 268–272.

208. Barzvi, A.L., *Convergent validation of self-reported and biometric indicators of employee health.* Diss Abstr Int B, 2003. 64(6-B): p. 2905.

209. Cole, D.C., et al., *Quality of working life indicators in Canadian health care organizations: a tool for healthy, health care workplaces?* Occup Med (Lond), 2005. 55(1): p. 54–59.

210. Gracey, M., et al., *An Aboriginal-driven program to prevent, control and manage nutrition-related "lifestyle" diseases including diabetes.* Asia Pac J Clin Nutr, 2006. 15(2): p. 178–188.

211. Halpin, H.A., et al., *The routine use of health risk appraisals: Results from a national study of physician organizations.* Am J Health Promot, 2005. 20(1): p. 34–38.

212. Hourihan, F., I. Krass, and T. Chen, *Rural community pharmacy: a feasible site for a health promotion and screening service for cardiovascular risk factors.* Aust J Rural Health, 2003. 11(1): p. 28–35.

213. Kashima, S.R., *Transitioning from a pen-and-paper health risk appraisal to an online health risk appraisal at a petroleum company.* Health Promot Pract, 2006. 7(4): p. 450–458.

214. Kessler, R.C., et al., *Using the World Health Organization Health and Work Performance Questionnaire (HPQ) to evaluate the indirect workplace costs of illness.* J Occup Environ Med, 2004. 46(6 Suppl): p. S23–S37.

215. Kessler, R.C., et al., *The World Health Organization Health and Work Performance Questionnaire (HPQ).* J Occup Environ Med, 2003. 45(2): p. 156–174.

216. Koopman, C., et al., *Stanford presenteeism scale: health status and employee productivity.* J Occup Environ Med, 2002. 44(1): p. 14–20.

217. Marschke, L.M., et al., *Cardiovascular health status and health risk assessment method of preference among worksite employees.* J Prim Prev, 2006. 27(1): p. 67–79.

218. Musich, S., et al., *A case study of 10-year health risk appraisal participation patterns in a comprehensive health promotion program.* Am J Health Promot, 2001. 15(4): p. 237–240.

219. Musich, S., et al., *Excess healthcare costs associated with excess health risks in diseased and non-diseased Health Risk Appraisal participants.* Disease Management and Health Outcomes, 2002. 10(4): p. 251–-258.

220. Ozminkowski, R.J., R.Z. Goetzel, and S.R. Long, *A validity analysis of the Work Productivity Short Inventory (WPSI) instrument measuring employee health and productivity.* J Occup Environ Med, 2003. 45(11): p. 1183–1195.

221. Ozminkowski, R.J., et al., *Estimating risk reduction required to break even in a health promotion program.* Am J Health Promot, 2004. 18(4): p. 316–325.

222. Ozminkowski, R.J., et al., *The savings gained from participation in health promotion programs for Medicare beneficiaries.* J Occup Environ Med, 2006. 48(11): p. 1125–1132.

223. Ozminkowski, R.J., et al., *Long-term impact of Johnson & Johnson's Health & Wellness Program on health care utilization and expenditures.* J Occup Environ Med, 2002. 44(1): p. 21–29.

224. Serxner, S.A., et al., *The relationship between health promotion program participation and medical costs: A dose response.* J Occup Environ Med, 2003. 45(11): p. 1196–1200.

225. Simpson, J.M., et al., *The Australian national workplace health project: design and baseline findings.* Prev Med, 2000. 31(3): p. 249–260.

226. Turpin, R.S., et al., *Reliability and validity of the Stanford Presenteeism Scale.* J Occup Environ Med, 2004. 46(11): p. 1123–1133.

227. Wang, P.S., et al., *Effects of efforts to increase response rates on a workplace chronic condition screening survey.* Med care, 2002. 40(9): p. 752–760.

228. Kaufman, H.W., F.R. Williams, and M.A. Odeh, *Value of laboratory tests in employer-sponsored health risk assessments for newly identifying health conditions: Analysis of 52,270 participants.* PLoS ONE, 2011. 6(12): e28201.

229. Freak-Poli, R.L., et al., *Participant characteristics associated with greater reductions in waist circumference during a four-month, pedometer-based, workplace health program.* BMC Public Health, 2011. 11: p. 824.

230. Freak-Poli, R., et al., *Impact of a pedometer-based workplace health program on cardiovascular and diabetes risk profile.* Prev Med, 2011. 53(3): p. 162–171.

231. Freak-Poli, R., R. Wolfe, and A. Peeters, *Risk of cardiovascular disease and diabetes in a working population with sedentary occupations.* J Occup Environ Med, 2010. 52(11): p. 1132–1137.

232. Musich, S., et al., *The association of two productivity measures with health risks and medical conditions in an Australian employee population.* Am J Health Promot, 2006. 20(5): p. 353–363.

233. Taitel, M.S., et al., *Incentives and other factors associated with employee participation in health risk assessments.* J Occup Environ Med, 2008. 50(8): p. 863–872.

234. Nkansah, N., et al., *Effect of outpatient pharmacists' non-dispensing roles on patient outcomes and prescribing patterns.* Cochrane Database Syst Rev, 2010(7): p. CD000336.

235. Wibowo, Y., et al., *Analysis of enhanced pharmacy services in rural community pharmacies in Western Australia.* Rural Remote Health, 2010. 10(3): p. 1400.

236. Boyle, T.C., J. Coffey, and T. Palmer, *Men's health initiative risk assessment study: effect of community pharmacy-based screening.* J Am Pharm Assoc (2003), 2004. 44(5): p. 569–577.

237. Dobbins Ta, S.J.M.O.B., *Who comes to a workplace health risk assessment?* Int J Behav Med, 1998. 5: p. 323–334.

238. Robroek, S.J., et al., *Determinants of participation in worksite health promotion programmes: a systematic review.* Int J Behav Nutr Phys Act, 2009. 6: p. 26.

239. Mathew, T.H., et al., *Screening for chronic kidney disease in Australia: a pilot study in the community and workplace.* Kidney Int Suppl, 2010. 116(16).

240. Merrill, R.M., et al., *Effectiveness of a workplace wellness program for maintaining health and promoting healthy behaviors.* J Occup Environ Med, 2011. 53(7): p. 782–787.

241. Merrill, R.M., et al., *Lowering employee health care costs through the Healthy Lifestyle Incentive Program.* J Public Health Manag Pract, 2011. 17(3): p. 225–232.

242. Wellsource Inc. *Personal Wellness Profile. Clackamas, Wellsource, Inc.* 2011. Available at http//:www.wellsource.com Accessed 23 April 2012.

243. Poole, K., K. Kumpfer, and M. Pett, *The impact of an incentive-based worksite health promotion program on modifiable health risk factors.* Am J Health Promot, 2001. 16(1): p. 21–26, ii.

244. Seaverson, E.L., et al., *The role of incentive design, incentive value, communications strategy, and worksite culture on health risk assessment participation.* Am J Health Promot, 2009. 23(5): p. 343–352.

245. Goetzel, R.Z., et al., *Promising practices in employer health and productivity management efforts: findings from a benchmarking study.* J Occup Environ Med, 2007. 49(2): p. 111–130.

246. National Health and Medical Research Council *NHMRC levels of evidence and grades for recommendations for developers of guidelines*. 2009. Available at www.nhmrc.gov.au.

247. Merlin, T., A. Weston, and R. Tooher, *Extending an evidence hierarchy to include topics other than treatment: revising the Australian 'levels of evidence'.* BMC Med Res Methodol, 2009. 9: p. 34.

248. National Health and Medical Research Council, *How to review the evidence: systematic identification and review of the scientific literature. Canberra: National Health and Medical Research Council.* 2000.

249. Briss, P.A., et al., *Developing and using the Guide to Community Preventive Services: lessons learned about evidence-based public health.* Annu Rev Public Health, 2004. 25: p. 281–302.

250. Briss, P.A., et al., *Developing an evidence-based Guide to Community Preventive Services: methods. The Task Force on Community Preventive Services.* Am J Prev Med, 2000. 18(1 Suppl): p. 35–43.