Guidelines for the assessment of

Absolute cardiovascular disease risk

Approved by

National Health and Medical Research Council
Australian Government
N H M R C

An initiative of the **National Vascular Disease Prevention Alliance**

Diabetes AUSTRALIA

KIDNEY HEALTH® AUSTRALIA

Heart Foundation™

strokefoundation

National Vascular Disease Prevention Alliance evidence-based practice guidelines for the assessment of **absolute cardiovascular disease risk**

Contents

These guidelines are supported by *Technical report: review of the evidence and evidence-based recommendations for practice* available at www.strokefoundation.com.au, www.kidney.org.au, www.diabetes.com.au and www.heartfoundation.org.au.

Executive summary

These guidelines have been developed for use by general practitioners, Aboriginal health workers, other primary care health professionals and physicians assessing the risk of cardiovascular disease (CVD)[a] in adults without known CVD. It is also intended to provide health system policy makers with the best available evidence on the assessment of absolute CVD risk, as a basis for population health policy.

Multiple causal factors contribute to CVD, most of which are preventable. The numerical probability that an individual will develop CVD within a given period of time (absolute risk) depends more closely on the combination and intensity of risk factors than on the presence of any single risk factor, because the cumulative effects of multiple factors may be synergistic. It is reasonable to expect that a CVD preventive strategy based on estimated absolute risk will be more effective and enable more efficient use of resources, than the traditional clinical management approach based on identifying and correcting individual risk factors through the application of several separate guidelines.

"It is reasonable to expect that a CVD preventive strategy based on estimated absolute risk will be more effective and enable more efficient use of resources, than the traditional clinical management approach based on identifying and correcting individual risk factors through the application of several separate guidelines."

Tools for estimating absolute CVD risk in clinical practice have been developed from data derived from large cohort studies, and are available in electronic and paper-based formats. Those based on the Framingham Risk Equation (derived from the Framingham Heart Study) demonstrate predictive ability that is equal or superior to that of other methods of calculating absolute CVD risk, and are therefore recommended for use in Australian primary care (see **Table 1** opposite).

Special consideration may be necessary to assess CVD risk accurately in Aboriginal and Torres Strait Islander adults, adults with diabetes, adults who are overweight or obese, and those with chronic kidney disease (CKD).

In New Zealand, the current recommendation for cardiovascular risk assessment in Māori is to apply the Framingham Risk Equation and then add 5% to calculated 5-year risk.[1] Preliminary analysis of a large New Zealand cohort study suggests that this approach is appropriate for Māori, Pacific Islanders and people from the Indian subcontinent.[2] Research is needed to determine whether a similar approach might provide more reliable estimates of CVD risk in Australian Aboriginal and Torres Strait Islander communities.

These guidelines do not apply to people with existing CVD, because they are already known to be at high risk of further cardiovascular events.

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[a] The term 'cardiovascular disease' is used in these guidelines to refer collectively to coronary heart disease (CHD), stroke and other vascular disease, including peripheral arterial disease and renovascular disease.

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Table 1. Summary of recommendations*

Recommendation		Grade[†]
I Pages 15 and 21	Absolute cardiovascular risk assessment, using the Framingham Risk Equation to predict risk of a cardiovascular event over the next 5 years, should be performed for all adults aged 45–74 years who are not known to have CVD or to be at increased risk of CVD (see **Recommendation V**).	**B**
II Page 17	In Aboriginal and Torres Strait Islander adults aged 35 years and older who are not known to have CVD or to be at high[‡] risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.[§]	**D**
III Page 18	In adults with diabetes aged 60 years or less who are not known to have CVD or to be at high[‡] risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.[§]	**C**
IV Page 19	In adults who are overweight or obese and who are not known to have CVD or to be at high[‡] risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. The results should be interpreted with the awareness that its predictive value has not been specifically assessed in this population.	**D**
V Pages 20 and 23	Adults with any of the following conditions do not require absolute cardiovascular risk assessment using the Framingham Risk Equation because they are already known to be at increased absolute risk of CVD: i. diabetes and age > 60 years ii. diabetes with microalbuminuria (> 20 mcg/min or urinary albumin:creatinine ratio > 2.5 mg/mmol for males, > 3.5 mg/mmol for females) iii. moderate or severe CKD (persistent proteinuria or estimated glomerular filtration rate (eGFR) < 45 mL/min/1.73 m^2) iv. a previous diagnosis of familial hypercholesterolaemia[ǁ] v. systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg vi. serum total cholesterol > 7.5 mmol/L.	**D**

*   Recommendations I and III are derived from findings of the systematic literature review whenever the body of evidence yielded support for recommendations of at least NHMRC Grade C (see **3.1.3 Evidence-based recommendations** on page 11). Recommendations II, IV and V are clinical consensus statements developed where the systematic literature review process was undertaken, but no evidence was found for or against these recommendations (see **3.2.1 Clinical consensus statements** on page 12).

†   Grades of evidence according to NHMRC classification[3] (see Table 3 on page 13).

‡   Greater than 15% probability of CVD within 5 years.

§   While CVD risk is known to be elevated for the population identified, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

ǁ   Refer to the National Heart Foundation of Australia's information sheet *Familial hypercholesterolaemia: information for doctors.*

Table 2. Summary of practice points*

a Page 6	In adults without known CVD, a comprehensive assessment of cardiovascular risk includes consideration of the below. **Modifiable risk factors** • Smoking status • Blood pressure • Serum lipids • Waist circumference and body mass index • Nutrition • Physical activity level • Alcohol intake[†] **Non-modifiable risk factors** • Age and sex • Family history of premature CVD • Social history including cultural identity, ethnicity, socioeconomic status and mental health **Related conditions** • Diabetes • Kidney function (microalbumin ± urine protein, eGFR) • Familial hypercholesterolaemia • Evidence of atrial fibrillation (history, examination, electrocardiogram)
b Page 23	For adults at high risk of CVD, identifying all cardiovascular risk factors present enables investigation and intensive management by lifestyle interventions (all patients) and pharmacological interventions (where indicated).
c Page 23	A comprehensive assessment of cardiovascular risk involves consideration of socioeconomic deprivation, because it is an independent risk factor for CVD. Absolute risk of CVD calculated using the Framingham Risk Equation is likely to underestimate cardiovascular risk in socioeconomically deprived groups.[§]
d Page 24	In adults with atrial fibrillation (particularly those aged over 65 years), the increased risk[§] of cardiovascular events and all-cause mortality, in addition to thromboembolic disease and stroke, should be taken into account when assessing absolute cardiovascular risk.
e Page 24	The following qualitative risk categories can be used to describe calculated absolute cardiovascular risk: • **'low'** risk corresponds to < 10% probability of CVD within the next 5 years • **'moderate'** risk corresponds to 10–15% risk of CVD within the next 5 years • **'high'** risk corresponds to > 15% risk of CVD within the next 5 years.
f Page 25	Regular review of absolute cardiovascular risk is recommended at intervals according to the initial assessed risk level: • **low** – review every 2 years • **moderate** – review every 6–12 months • **high** – review according to clinical context.

* These practice points were developed to facilitate clinical uptake of these guidelines by GPs and other target users. These were formulated based on expert clinical judgement (see 3.2.1 Clinical consensus statements on page 12 and 3.4 Practice points on page 13).

† Alcohol is a risk factor for elevated blood pressure (which is itself a major independent determinant of risk of atherosclerotic disease), stroke and cardiomyopathy. For a full discussion of this, please see the NHMRC's *Australian guidelines to reduce health risks from drinking alcohol*.

§ While CVD risk is known to be elevated for this population, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

1. Introduction

These guidelines were developed following the 2004 report *The Absolute Risk Project: towards a risk identification tool for coronary heart disease and stroke*[4] commissioned by the Australian Government Department of Health and Ageing (DoHA) in response to the growing burden of CVD in Australia.

The report, which was prepared by the National Vascular Disease Prevention Alliance (NVDPA),[b] identified the need for a systematic review of evidence evaluating absolute CVD risk assessment, to determine best practice and provide guidance for Australian health professionals and policy makers.

In 2005 the NVDPA, funded by the National Heart Foundation of Australia, set up a steering committee to undertake the review and oversee development of guidelines for absolute CVD risk assessment (see **Appendix I. Working group membership and terms of reference** on page 42).

1.1. Purpose and scope of these guidelines

These guidelines are intended to assist Australian primary care health professionals and others to assess CVD risk as accurately as possible, so that they and their patients can make reasonable and well-informed decisions about clinical care to manage CVD risk.

It has been developed in response to the need for an integrated CVD risk assessment approach, to replace separate guidelines for individual risk factors (e.g. raised blood pressure or blood lipid levels), in recognition that an individual's blood pressure or cholesterol level is of limited clinical relevance when considered in isolation from other risk factors.[5]

These guidelines:

- makes recommendations on how to identify adults at increased absolute risk for CVD and those in whom numerical calculation of absolute CVD risk is indicated
- includes recommendations on special considerations in the assessment of absolute CVD risk in the following groups: Aboriginal and Torres Strait Islander adults, adults with diabetes, adults who are overweight or obese, and adults with CKD
- does not apply to people with existing CVD, because they are already known to be at high risk of further CVD events
- is not intended as a guide to the clinical management of CVD risk. However, practice points (see **Table 2** on page 4) based on expert consensus are provided where relevant to the clinical context.

The term 'cardiovascular disease' is used in these guidelines to refer collectively to coronary heart disease (CHD), stroke and other vascular disease including peripheral arterial disease and renovascular disease.

1.2. Who these guidelines are intended for

These guidelines have been developed for use by general practitioners (GPs), Aboriginal health workers and other health professionals assessing CVD risk in primary care. It is also intended to provide health system policy makers with the best available evidence on CVD risk assessment, as a basis for population health policy.

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[b] NVDPA members are Diabetes Australia, Kidney Health Australia, the National Heart Foundation of Australia and the National Stroke Foundation.

2. Background

2.1. Burden of CVD in Australia

Although the rate of deaths due to CVD continues to decline in Australia, CVD is still responsible for more deaths than any other disease group[6,7] and accounts for over one-third of all deaths in Australia.[7] Total CVD burden is expected to increase over the next few decades due to population ageing.[6]

An estimated 1.4 million Australians or 6.9% of the population have a disability associated with CVD.[7] Cardiovascular disease is the most expensive group of conditions in terms of direct health care costs; during the period 2004–2005, it accounted for 11% of total healthcare expenditure in Australia.[7]

2.2. Why assess cardiovascular risk?

Multiple causal factors contribute to CVD. It is estimated that one-quarter of Australians have three or more risk factors.[6] The following modifiable risk factors contribute around 90% of the risk of myocardial infarction observed worldwide: blood lipid abnormalities, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, physical inactivity and inadequate intake of fruits and vegetables.[8]

Given that CVD is largely preventable, Australian and overseas primary care guidelines emphasise comprehensive risk assessment to enable effective management of identified risk factors through lifestyle changes (e.g. weight management, smoking cessation and increasing physical activity) and pharmacological therapy (e.g. anti-platelet agents, blood pressure-lowering agents and lipid-modifying agents).[9–15]

Practice point (a)

In adults without known CVD, a comprehensive assessment of cardiovascular risk includes consideration of the below.

Modifiable risk factors
- Smoking status
- Blood pressure
- Serum lipids
- Waist circumference and body mass index
- Nutrition
- Physical activity level
- Alcohol intake*

Non-modifiable risk factors
- Age and sex
- Family history of premature CVD
- Social history including cultural identity, ethnicity, socioeconomic status and mental health

Related conditions
- Diabetes
- Kidney function (microalbumin ± urine protein, eGFR)
- Familial hypercholesterolaemia
- Evidence of atrial fibrillation (history, examination, electrocardiogram)

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* Alcohol is a risk factor for elevated blood pressure (which is itself a major independent determinant of risk of atherosclerotic disease), stroke and cardiomyopathy. For a full discussion of this, please see the NHMRC's *Australian guidelines to reduce health risks from drinking alcohol*.

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2.3. What is the best way to estimate cardiovascular risk?

2.3.1. Single versus multiple risk factors

Individuals tend to develop clusters of risk factors.[16] Assessment of CVD risk on the basis of the combined effect of multiple risk factors is more accurate than the use of individual risk factors, because the cumulative effects of multiple factors may be additive or synergistic.[5,16,17] Because of the ways that risk factors can interact in an individual, moderate reductions in several risk factors may be more effective than a major reduction in one factor.[5] An individual patient is likely to benefit from a personalised management plan that considers the overall effect of all risk factors present.

Individuals at highest overall risk stand to gain the greatest potential benefit from correction or reduction of a single risk factor.[5,18] Treatment decisions based on single risk factors in isolation may result in both over-treatment and under-treatment, i.e. the inappropriate treatment of people unlikely to benefit from treatment due to low absolute CVD risk, and omission of treatment for those at higher absolute risk with the potential to gain greater benefit.[19]

At the population level, interventions targeting those at highest overall cardiovascular risk are likely to achieve the greatest reduction in cardiovascular events.[20] For example, lipid-lowering treatment in people assessed to be at high risk on consideration of all risk factors present will potentially prevent twice as many deaths from CHD in a given population than treating only those with total cholesterol levels above a given arbitrary cut-point.[19,21] Therefore, accurate estimation of cardiovascular risk, especially in people without known CVD, is both fundamental to effective population preventive health programs and a necessary basis for clinical patient care. Since the mid-1990s, major guidelines for the prevention of CVD have moved from an approach based on identifying and correcting individual risk factors through the application of several separate guidelines, to a focus on the individual's overall risk through multiple risk factor assessment.

2.3.2. Relative risk versus absolute risk

The accumulation of data from large cohort studies has enabled the predicted health effects of each single risk factor to be quantified as relative risk. For example, a relative risk of 2 indicates a person with a particular risk factor is twice as likely to develop CVD as a person without that risk factor. Traditionally, doctors have assessed each risk factor separately and made a clinical judgement as to the significance of each in the individual's case, based on relative risks. However, this approach has several limitations.

Assessment of relative risk for single risk factors in isolation does not take into account the potentially synergistic effects of multiple risk factors. Although two individuals may have the same blood pressure or cholesterol levels, the probability of developing CVD within a specified period (absolute risk) may be 20 times higher for one person than the other, due to the effects of other factors such as sex, age, smoking or diabetes.[22,23] Similarly, a patient with low blood pressure or normal cholesterol level but other risk factors may be more likely to develop CVD than another with moderate hypertension only.[5] In addition, interpreting relative risks requires a second piece of information – the underlying population risk. Knowing that a person's risk of a particular outcome is double that of the rest of the population can have substantially different health implications for an individual when the underlying population risk is 1 in 1,000,000 compared with a population risk of 1 in 10.

Knowing a patient's relative risk of CVD arising from each of the risk factors present does not provide adequate information on the clinical significance of correcting a risk factor. Clinical studies measuring the effects of blood pressure and cholesterol reduction have demonstrated that these interventions achieve similar reductions in the relative risk of CVD across a given population. However, the probability of CVD occurring within a specified period varies greatly and depends strongly on the individual's absolute risk.[14]

Absolute risk assessment is recommended in several current Australian guidelines including the National Heart Foundation of Australia's *Guide to management of hypertension for doctors*,[15] the National Heart Foundation of Australia and Cardiac Society of Australian and New Zealand's *Position statement on lipid management – 2005*,[11] and the Royal Australian College of General Practitioners' (RACGP) *Guidelines for preventive activities in general practice* (6th edition).[12] However, until now there have been no comprehensive guidelines on the application of absolute risk assessment in Australian clinical practice.

Definitions[14, 24]

Relative risk: The ratio of the rate of events (e.g. CVD) in the population exposed to a risk factor to the rate among the unexposed population (e.g. the risk of someone developing a CVD event who has a given set of risk factors, compared with the risk in someone of the same age and sex who does not have those risk factors).

Relative risk reduction: The difference in event rates between two groups (e.g. treatment group versus control group), expressed as a proportion of the event rate in the untreated group. Often remains constant whether event rates are high or low within the population.

Absolute risk (global risk, total risk): The numerical probability of an event occurring within a specified period, expressed as a percentage (e.g. 5-year absolute risk of 15% means there is a 15% probability that the individual will experience a cardiovascular event within 5 years).

Absolute risk reduction: The arithmetic difference between event rates in two groups (e.g. the rates of CVD in a lipid-lowering treatment group subtracted from the rate in the untreated group). For any given relative risk reduction, the absolute risk reduction decreases when event rates are low in the given population.

2.4. Potential benefits of routine absolute CVD risk assessment

There is emerging evidence that clinical decisions based on absolute CVD risk may lead to improved management of CVD risk. Access to absolute CVD risk assessments has been shown to increase prescribing of lipid-modifying drugs for high-risk patients with diabetes[23] and lead to both improvement in lipid profiles and significant reductions in the risk of CHD.[25,26] Given that absolute CVD risk assessment provides a more accurate assessment of risk than individual risk factors, it is reasonable to expect that basing management decisions on this assessment will improve outcomes.

Modelling studies provide the most compelling current evidence that absolute CVD risk assessment in general practice is likely to improve CVD outcomes, compared with assessment of single risk factors. When applied to a reference population with known risk factors, a strategy based on targeting those at highest absolute CVD risk is potentially more than twice as effective in reducing death from CHD than treating people with single risk factors (e.g. high total cholesterol level) or attempting to reduce the severity of a single risk factor across the entire population.[21] The strategy of targeting those at high absolute CVD risk also achieves the best balance between preventing deaths and avoiding unnecessary treatment in those at lower risk.[19,20]

Absolute CVD risk assessment helps doctors and patients to make decisions about the priority and intensity that an intervention warrants. The process of assessing absolute CVD risk may stimulate discussion of CVD prevention between patient and doctor,[26] and knowledge of their assessed absolute CVD risk may help to motivate patients to adhere to lifestyle changes or medicine regimens to reduce risk.[9]

Electronic and paper-based tools are available to help doctors estimate a person's absolute risk of CVD. Most absolute CVD risk calculators are based on risk equations derived from large prospective cohort studies and include the following variables: age, sex, blood pressure, cigarette smoking, total cholesterol and high-density lipoprotein (HDL) cholesterol. Absolute CVD risk assessment has been incorporated into Australian, British, European, New Zealand and other guidelines.[1,11,14,15]

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2.5. Absolute CVD risk assessment in specific populations

Special consideration may be necessary to assess absolute CVD risk accurately in the following populations.

- **Aboriginal and Torres Strait Islander adults.** Compared with national rates, Aboriginal and Torres Strait Islander peoples have an exceedingly high age-standardised mortality that has not shown the downward trend seen in the rest of the Australian community over the past 40 years.[6] They are more than twice as likely to die from heart disease, stroke and other cardiovascular diseases than other Australians,[6] and are two to three times more likely to be hospitalised for CHD and heart failure.[6] Aboriginal and Torres Strait Islander peoples also show significantly higher rates of some CVD risk factors including smoking, hypertension, obesity, diabetes, harmful use of alcohol and CKD.[6,7,13]

- **Adults with diabetes mellitus.** A large body of evidence indicates that people with diabetes are at high risk for CVD, particularly in the arteries of the coronary, cerebrovascular and peripheral circulations. CVD is the most common cause of death among people with diabetes. Type 2 diabetes is an independent risk factor for macrovascular disease,[27] while CVD risk factors including hypertension and dyslipidaemia are common comorbidities of diabetes.[27] Despite generally declining rates of death due to CHD in developed countries, which has been attributed to a reduction in cardiovascular risk factors and improvement in the management of heart disease, US data suggest that a much lower reduction has been achieved among people with diabetes than those without diabetes.[28]

- **Adults who are obese or overweight.** Obesity is a strong independent risk factor for cardiovascular events and death due to CHD in Australians.[29,30] The relationship between obesity or overweight and stroke is less clear.[30]

- **Adults with CKD.** People with CKD, manifesting as either reduced glomerular filtration rate (GFR) or the presence of proteinuria, are at increased risk of CVD. Individuals with CKD (GFR 15–60 mL/min per 1.73 m^2) have a 20% higher risk of CVD (myocardial infarction, fatal CHD, stroke and death) than the general population.[31] In patients with CKD requiring dialysis, the risk of death due to CVD is 10–20 times higher than in the general population.[32] Recent studies demonstrate that even early CKD is a significant risk factor for cardiovascular events and death.[31,33,34] People with early CKD are 20 times more likely to die than to require dialysis, and CVD is largely responsible.[35]

- **Adults with a family history of premature CVD.** Family history is an important factor to consider when assessing CVD risk. Compared with the general population, the risk of a coronary event is approximately doubled in individuals with a family history of clinically documented premature CVD (defined as CVD occurring before age 60 in a mother, father or sibling[c]).[36] Similarly, the risk of ischaemic stroke is almost doubled in men with a family history of stroke.[37] (Note that the Framingham Risk Equation does not include family history of CVD because of the methodological difficulties of obtaining accurate data on this factor.)[38]

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[c] Pharmaceutical Benefits Scheme reimbursement criteria for lipid-lowering medicines define family history of CVD as: family history of CHD which has become symptomatic before the age of 55 years in two or more first-degree relatives; family history of CHD which has become symptomatic before the age of 45 years in one or more first-degree relatives.

3. Methodology

These guidelines were developed by a multidisciplinary expert working group in accordance with the National Health and Medical Research Council (NHMRC) standards.[39]

3.1. Systematic review process

Among adults **without known CVD**, the following target populations were identified:

- adults without diabetes
- Aboriginal and Torres Strait Islander adults
- adults with diabetes
- adults who are obese or overweight
- adults with CKD.

Systematic reviews were undertaken to determine:

- which absolute risk assessment method best predicts CVD in the five target populations
- whether absolute risk assessment leads to improvement in CVD outcomes or improved cost-effectiveness.

A broad search strategy was designed to answer all of the clinical questions. Searches were conducted in relevant databases, bibliographies of identified relevant studies, guidelines and websites of relevant peak bodies for evidence published up to April 2006.

The systematic review included only data from studies that compared the predictive abilities of different methods of absolute risk assessment, subject to the inclusion criteria for each separate clinical question (see *Technical report: review of the evidence and evidence-based recommendations for practice*).

Evidence was assessed for quality according to NHMRC criteria.[3]

3.1.1. Predictive ability of absolute CVD risk assessment methods in the target populations

The systematic review was based on the following clinical questions.

1. Which absolute CVD risk assessment method is most predictive of future CVD events in a mixed (male and female) population of adults (aged >18) not known to have CVD or diabetes?[d]

2. Which absolute CVD risk assessment method is most predictive of future CVD events in Aboriginal and Torres Strait Islander adults (aged >18) not known to have CVD?

3. Which absolute CVD risk assessment method is most predictive of future CVD events in a mixed population of adults (aged >18) not known to have CVD and who have diabetes?

4. Which absolute CVD risk assessment method is most predictive of future CVD events in a mixed population of adults (aged >18) not known to have CVD and who are overweight or obese?[e]

5. Which absolute CVD risk assessment method is most predictive of future CVD events in a mixed population of adults (aged >18) with CKD[f] not known to have CVD?

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[d]   For the purposes of these guidelines, diabetes is defined according to World Health Organization and International Diabetes Federation criteria.[40]

[e]   For the purposes of these guidelines, overweight is defined as body mass index (BMI) within the range of 25.0–29.9 kg/m^2 and obesity is defined as BMI ≥ 30 kg/m^2. Waist circumference 94–102 cm (men) or 80–88 cm (women) is associated with increased risk to health. Waist circumference > 102 cm (men) or > 88 cm (women) is associated with substantially increased risk to health.[41] These cut-points are based on data from European populations and may not be appropriate for all ethnocultural groups.

[f]   For the purposes of these guidelines, CKD is defined as GFR < 60 mL/min.

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The reliability of methods for predicting clinical risk can be evaluated according to:

- discrimination (ability to identify those at high risk), usually calculated using the area under the receiver operating characteristic curve (AUC)
- calibration (ability to quantify risk)
- accuracy (degree of concordance between predicted and actual outcomes).

However, very few of the identified studies reported data for calibration or accuracy.

For each study that evaluated and reported the predictive ability of the assessment method, data were extracted to calculate:

- AUC for each population studied
- sensitivity and specificity
- whether the assessment method overestimated or underestimated CVD risk.

Confidence intervals were determined, where available.

The AUC measure takes into account both the ability of the risk assessment method to correctly identify 'true' cases of CVD that occur within the specified follow-up period (sensitivity) and its ability to correctly rule out non-cases (specificity). Current CVD risk assessment methods calculate risk as the probability of a CVD event occurring within a specified period, expressed as a percentage. The AUC represents the probability that, of any pair of individuals randomly selected from the cases (the set of those who developed CVD within the specified period) and from the non-cases (the set of those who did not develop CVD), the recorded baseline risk score for the case will be higher than that of the non-case.

An ideal absolute CVD risk assessment method would consistently predict all cases and eliminate all non-cases (i.e. AUC = 1). Since no method can be expected to achieve this, the AUC is used to identify the optimal balance between false-positive and false-negative tests (over- and under-prediction of CVD within the specified time period).

Recommendations were made on the basis of results from studies that compared the predictive ability of different methods of absolute CVD risk assessment.

Results of non-comparative studies that investigated the predictive ability of individual absolute CVD risk assessment methods were also reported, to provide further information.

3.1.2. Effectiveness and cost-effectiveness of absolute CVD risk assessment

A systematic review was undertaken to answer the following clinical questions.

1. Does absolute CVD risk assessment lead to improvement in CVD outcomes?

2. Is absolute CVD risk assessment cost-effective?

From the wider body of evidence retrieved using the broad search strategy, studies were identified that:

- compared absolute CVD risk assessment methods
- reported clinical outcomes in individuals in whom absolute CVD risk assessment was undertaken
- reported resource costs for each intervention, including direct and indirect costs.

The systematic review methodology, including statistical analyses, is detailed in *Technical report: review of the evidence and evidence-based recommendations for practice.*

In addition, following completion of the systematic review, the Consensus Statement Development Group considered modelling studies that investigated implications of absolute CVD risk assessment for clinical outcomes and health system costs (see 3.2 Consensus statements development process on page 12).

3.1.3. Evidence-based recommendations

Recommendations were formulated based on the findings of the systematic literature review whenever the body of evidence yielded support for recommendations of at least NHMRC grade C (defined as 'Body of evidence provides some support for recommendation(s) but care should be taken in its application'; see Table 3 on page 13).[3]

Clinical questions were referred to the Consensus Statement Development Group if the systematic review yielded insufficient evidence to make a recommendation of grade C or better.

3.2. Consensus statements development process

3.2.1. Clinical consensus statements

The working group considered that guidance should be provided on each of the clinical questions to facilitate clinical uptake of these guidelines by GPs and other target users. Therefore, where the systematic review identified insufficient evidence to answer a clinical question, a consensus statement was formulated based on available evidence and on expert clinical judgement.

The consensus statements development process involved the following steps.

1. The National Vascular Disease Prevention Alliance selected experts and key opinion leaders (including GPs, cardiologists, endocrinologists, neurologists, nephrologists and health economists) to form a Consensus Statement Development Group.

2. The Consensus Statement Development Group identified key clinical issues to be addressed:

   (i) clinical issues relevant to absolute CVD risk assessment in the population groups unanswered by the systematic review:

   • Aboriginal and Torres Strait Islander adults

   • adults who are overweight or obese

   • adults with CKD.

   (ii) further clinical issues on which GPs would require guidance when applying the evidence-based recommendations in practice:

   • the age range for application of absolute CVD risk assessment

   • clinical markers and other indicators of high absolute risk, which would make calculation of numerical absolute risk unnecessary.

3. Each clinical issue was assigned to a Consensus Statement Development Group member with the appropriate expertise, who reviewed literature published up to August 2007, including any relevant evidence outside the systematic review inclusion criteria.

4. A consensus development conference of all Consensus Statement Development Group members was convened, during which the following tasks were undertaken:

   (i) clinical experts presented the findings of the literature searches and proposed a draft statement on each clinical issue

   (ii) the group discussed the merits of the evidence and considered changes to the proposed statements in consideration of current health system policy and practice contexts

   (iii) consensus was reached on each statement.

5. The draft consensus statements were circulated to the Consensus Statement Development Group to ensure that all experts concurred.

3.2.2. Clinical and cost implications of absolute CVD risk assessment

The Consensus Statement Development Group identified additional published studies relevant to the discussion of clinical and cost implications of absolute CVD risk assessment, which were outside the inclusion criteria for the systematic review. These included several modelling studies that investigated potential effectiveness and cost-effectiveness of various population-based CVD prevention strategies.

Modelling studies are useful for assessing the benefits of prevention interventions, because it may not always be feasible to undertake large clinical trials or wait until sufficient health outcomes have occurred in the populations of interest. Modelling studies assist in answering 'What if?' questions. However, modelling studies have several significant limitations. The data used in such models are derived from a variety of sources and therefore may be subject to a range of potential biases and uncertainty. Sophisticated statistical techniques are often used to assess the range of uncertainty in a given data set and to improve the reliability of the results.

The modelling studies are considered in this report because of their relevance to the incorporation of absolute CVD risk assessment protocols into the health system, but they did not form the basis of formal recommendations.

3.3. Levels of evidence for evidence-based recommendations and consensus statements

Each recommendation was graded according to NHMRC classification (see Table 3 below and *Technical report: review of the evidence and evidence-based recommendations for practice*).

Table 3. NHMRC grades of recommendation[3]

Grade of recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution

3.4. Practice points

Practice points (see Table 2 on page 4) were developed concurrently with the consensus recommendations, where the Executive Working Group and Consensus Statement Development Group identified additional clinical issues relevant to absolute CVD risk assessment. Issues included the following:

- factors to be considered when performing a comprehensive assessment of CVD risk in adults without known CVD
- the intervals at which absolute CVD risk assessment should be repeated in individuals
- the management of individual risk factors in Aboriginal and Torres Strait Islander adults
- the contribution of atrial fibrillation to absolute CVD risk
- the contribution of social deprivation to absolute CVD risk
- the importance of identifying individuals at high CVD risk so that risk can be managed through lifestyle and pharmacological interventions.

Each clinical issue was assigned to a Consensus Statement Development Group member with the appropriate expertise, who drafted a practice point based on clinical expertise and published literature, including any relevant evidence outside the systematic review inclusion criteria.

The practice points do not represent evidence-based recommendations and are included only to link the recommendations on absolute CVD risk assessment to the context of clinical practice.

4. Findings and recommendations

For each clinical question, the following summary sets out:

(i) the main findings of the systematic review

(ii) other considerations documented by the Consensus Statement Development Group

(iii) the Executive Working Group's final recommendations. Detailed findings of the systematic review are reported in *Technical report: review of the evidence and evidence-based recommendations for practice.*

4.1. Predictive ability of absolute CVD risk assessment methods in adults without known CVD or diabetes

4.1.1. Findings of the systematic review

Ten high-quality studies compared the predictive ability of different absolute CVD risk assessment methods.

All of the eight studies that compared the Framingham Risk Equation with other methods found that it has a higher or equivalent predictive ability.

Three studies of varying quality compared the ability of absolute CVD risk assessment methods to classify individuals into risk categories.

Fifteen studies of varying quality reported predictive ability of individual absolute CVD risk assessment methods.

Ten high-quality (level II) prospective cohort studies were identified that compared the predictive ability of different absolute CVD risk assessment methods in a single cohort of adults without known CVD or diabetes.[42–51] These studies were conducted in cohorts in the UK, France, Ireland, Italy, USA and New Zealand, and involved comparisons between a score derived from the Framingham Risk Equation and the New Zealand risk chart, the Prospective Cardiovascular Münster Study risk score, the Italian Heart Project risk score and the European Study of Cardiology risk score.

The predictive ability of the Framingham Risk Equation was generally similar to that of comparator risk scores over 5 or 10 years in the populations tested. All of the eight studies that compared the Framingham Risk Equation with other methods found that it had higher or equivalent predictive ability.[42–44,47–51]

The Framingham Risk Equation and the Prospective Cardiovascular Münster Study risk score overestimated absolute CVD risk in several European populations.[42–44]

The Framingham Risk Equation underestimated CVD events among low-risk adults in a US population.[49] In the same population, both the Framingham Risk Equation and the European Study of Cardiology risk score overestimated CVD events in higher risk groups.

The Framingham Risk Equation predicted absolute CVD risk more accurately among UK and US populations than a method based on the presence or absence of the metabolic syndrome (defined as three or more metabolic abnormalities based on modified National Cholesterol Education Program Adult Treatment Panel III criteria) over follow-up periods of 7–8 years,[50] 10–11 years[47] or 20 years.[51] The combination of both methods did not improve predictive ability compared with the Framingham Risk Equation alone.[47,50,51]

A comparative study in a US cohort also found that the Computer Risk Model (an electronic instrument based on the Framingham Risk Equation) had a greater predictive ability than the Canadian Consensus Conference on Cholesterol risk score, the First National Cholesterol Education Program risk score or the Second National Cholesterol Education Program risk score.[46]

Two high-quality (level II) studies[52,53] compared the ability of absolute CVD risk assessment methods to classify populations into risk categories over 10-year follow-up in US and Belgian populations. The Framingham Risk Equation and the First National Health and Nutrition Examination Survey (NHANES I) cohort risk score each accurately predicted the relative distribution of observed CVD events across calculated risk quintiles when applied to a US sample other than the cohort from which the scores were derived.[53] The Framingham Risk Equation accurately predicted the relative distribution of observed CVD events across calculated risk quartiles among men in two Belgian cohorts, but did not accurately discriminate between the two lowest risk quartiles among women aged 50–74 years in one of these cohorts.[52]

Guidelines for the assessment of **Absolute** cardiovascular disease **risk**

The predictive ability of the Global Coronary risk score in discriminating between risk strata was similar to that of the Framingham Risk Equation when applied to one of the reference cohorts.[52] Another low-quality (level III-2) study found that the Framingham Risk Equation, the Northern Sweden Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases (MONICA) study risk equation, and risk stratification according to World Health Organization/International Hypertension Society 1999 Hypertension guidelines showed similar predictive ability with respect to the relative number of CVD events between risk strata in a Swedish population over follow-up of 1–14 years.[54]

Further evidence, including findings from non-comparative studies designed to evaluate a single risk score in a particular cohort, suggests that the 10-year predictive ability of the Framingham Risk Equation is similar to that of the NHANES I risk score in the US population and the Global Coronary risk score in the Belgian population.

Fifteen studies of varying quality were identified that validated the absolute risk predictive ability of the Framingham Risk Equation (14 studies) or the Oriental risk score (one study) in various geographical populations of adults without known CVD or diabetes. These included 10 high-quality (level II) studies conducted in Australia, New Zealand, the UK, USA, Europe, the Middle East, the Caribbean, China and other Asian countries.[48,55–63] In these studies, over follow-up intervals of between 4.4 and 8 years, the Framingham Risk Equation:

- showed a high predictive ability in the following populations: elderly Australian men and women in a regional town,[61] black American men and women,[58] white American men and women,[58] Scottish men with elevated low-density lipoprotein (LDL) cholesterol levels,[62] New Zealand men and women,[48] and white UK men and women when the annual risk of CHD exceeded 1.5%[59]

- overestimated absolute CVD risk in the following populations: Japanese American men, Hispanic American men and Native American women in the US,[58] French,[59] Swedes,[59] Italians,[59] German men,[55] UK middle-aged men,[56] Chinese men and women,[60,63] and populations with low observed rates of CHD mortality[59]

- underestimated absolute CVD risk in the following populations: socioeconomically deprived middle-aged UK men and women[57] and populations with high observed rates of CHD mortality.[59]

4.1.2. Conclusions of the systematic review

The Framingham Risk Equation is the most thoroughly tested method of assessing absolute CVD risk in adults not known to have either diabetes or existing CVD. In comparative studies, it has shown equivalent or higher predictive ability than other absolute CVD risk assessment methods in non-diabetic cohorts. The Framingham Risk Equation has been validated in various non-diabetic adult populations, but may over- or underestimate risk in some populations.

4.1.3. Other considerations

The rationale for upper and lower age cut-points is described in 5.1. In which age groups should absolute CVD risk assessment be undertaken? (see page 21).

Groups who can be assumed to be at increased CVD risk are listed in 5.2. For which groups can increased risk of cardiovascular events be assumed without calculating absolute CVD risk using a risk equation? (see page 21).

Recommendation I	Grade B
Absolute cardiovascular risk assessment, using the Framingham Risk Equation to predict risk of a cardiovascular event over the next 5 years, should be performed for all adults aged 45–74 years who are not known to have CVD or to be at increased risk of CVD (see **Recommendation V** on pages 20 and 23).	

4.2. Predictive ability of absolute CVD risk assessment methods in Aboriginal and Torres Strait Islander adults without known CVD

4.2.1. Findings of the systematic review

One high-quality study in a sample of Aboriginal and Torres Strait Islander adults examined the predictive ability of absolute CVD risk assessment methods.

The Framingham Risk Equation substantially underestimated absolute CVD risk in this population.

The systematic review identified only one high-quality (level II) study evaluating the predictive ability of an absolute CVD risk assessment method in adult Aboriginal and Torres Strait Islander adults not known to have CVD. In this remote Northern Territory Aboriginal community, the Framingham Risk Equation markedly underestimated absolute CVD risk in a small sample of men and women aged 20–74 years.[64]

The total observed number of CHD events was 2.5 times the number predicted by the Framingham Risk Equation. The observed incidence was approximately four times the predicted incidence among people aged under 35 years, three times the predicted incidence among individuals aged 35–44 years and approximately twice the predicted incidence in people aged over 45 years. In younger women, the observed CHD rate was 30 times the predicted rate.[64]

4.2.2. Conclusions of the systematic review

A recommendation as to the most appropriate absolute CVD risk assessment method in Aboriginal and Torres Strait Islander adults cannot be made on the basis of available level II evidence.

4.2.3. Other considerations

The high CVD risk documented in some remote Aboriginal communities may not be fully explained by the prevalence of traditional risk factors.[65] Several possible explanations have been suggested.[65]

- The presence of traditional risk factors may contribute to overall risk differently from the patterns observed in reference populations (e.g. the US Framingham Heart Study population). Aboriginal people might experience more rapid disease progression compared with Europeans who have the same risk factors. The cardiovascular 'protective' effect of female sex may not exist among Aboriginal women.[66]

- Additional factors (e.g. high levels of C-reactive protein suggesting inflammation,[67,68] high rates of CKD, central obesity,[69] low birth weight), may contribute to increased CVD risk in Aboriginal peoples.

- Socioeconomic deprivation, associated with lack of preventive treatment and poor nutrition, may contribute to rapid progression of CVD in Aboriginal and Torres Strait Islander people.[6,7]

Although the Framingham Risk Equation has been shown to underestimate CVD risk in one remote Tiwi Islands community,[65] this finding may not apply to other geographically and ethnoculturally distinct Aboriginal and Torres Strait Islander communities throughout the Torres Strait, Northern Queensland, Central Australia, the Kimberley and urban communities. Further research is needed to determine the degree of heterogeneity of risk between sub-populations. It should also be noted that the study undertaken in the Tiwi cohort assessed symptomatic CHD and not a wider composite CVD outcome measure.

The lack of evidence supporting the Framingham Risk Equation in this population should not be regarded as a barrier to a global risk assessment approach. The *National guide to a preventive health assessment in Aboriginal and Torres Strait Islander peoples*[13] recommends that, if current absolute CVD risk assessment tables are used in Aboriginal and Torres Strait Islander adults, the estimate requires upward adjustment, particularly in women, in whom the tables for men may be more accurate. The guide also recommends that absolute CVD risk assessment should commence at a younger age than for the general population, in view of the higher age-standardised mortality seen among Aboriginal and Torres Strait Islander peoples.[6]

In New Zealand, the current recommendation for cardiovascular risk assessment in Māori is to apply the Framingham Risk Equation and then add 5% to the calculated 5-year risk.[1] Preliminary analysis of a large New Zealand cohort study suggests that this approach is appropriate for Māori, Pacific Islanders and people from the Indian subcontinent.[2] Research is needed to determine whether a similar approach might provide more reliable estimates of CVD risk in Australian Aboriginal and Torres Strait Islander communities.

Recommendation II	Grade D

In Aboriginal and Torres Strait Islander adults aged 35 years and older who are not known to have CVD or to be at high* risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation.

Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.†

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* Greater than 15% probability of CVD within 5 years.

† While CVD risk is known to be elevated for this population, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

4.3. Predictive ability of absolute CVD risk assessment methods in adults with diabetes but without known CVD

4.3.1. Findings of the systematic review

Two high-quality studies compared the predictive ability of different absolute CVD risk assessment methods in populations with type 2 diabetes.

The Framingham Risk Equation and the UK Prospective Diabetes Study (UKPDS) risk score showed similar 10-year predictive ability in populations of men and women with type 2 diabetes. Both methods underestimated absolute CVD risk.

The incorporation of non-traditional risk factors into absolute CVD risk assessment may improve predictive ability, but such methods have not yet been fully developed for clinical use.

Two high-quality (level II) studies were identified that each compared two methods of absolute CVD risk assessment. The Framingham Risk Equation was compared with the UKPDS risk score in patients participating in a small (n = 428) UK general practice-based follow-up study conducted among men and women with diabetes aged 30–64 years.[70] For the entire cohort, no statistically significant difference in predictive ability was found between the two methods. However, AUC for 10-year risk was numerically higher for the Framingham Risk Equation than the UKPDS risk score both for men and women when data were analysed separately. The clinical implications of this finding are not clear.

A US study in 1237 men and women with diabetes aged 45–64 years compared the predictive ability of traditional risk factors (e.g. age, race, total cholesterol, HDL cholesterol, systolic blood pressure) with the predictive ability of a combination of traditional and non-traditional factors (e.g. BMI, waist-to-hip ratio, serum lipoprotein(a), serum albumin, serum creatinine, white blood cell count, fibrinogen, factor VIII, physical activity, dietary lipid, left ventricular hypertrophy, carotid intima-media thickness). The score based on a combination of traditional and non-traditional factors was a better predictor of 10-year absolute CVD risk than traditional factors alone, both in men and women.[45]

4.3.2. Conclusions of the systematic review

In adults with type 2 diabetes not known to have CVD, it is reasonable to use the Framingham Risk Equation to assess absolute CVD risk over 5 or 10 years, with an awareness that it is likely to underestimate absolute CVD risk.

4.3.3. Other considerations

Other recent cohort studies have reported that the Framingham Risk Equation underestimated risk in patients with diabetes,[71,72] consistent with the findings of those included in the systematic review.

Based on these findings, some investigators argue for the development of diabetes-specific CVD risk calculators.[71] However, other investigators have concluded that the development of separate risk prediction models for patients with diabetes does not improve predictive ability and that the presence of diabetes alone should not be assumed to indicate a common level of high risk.[73] Some investigators have proposed the use of the Framingham Risk Equation with the addition of a constant calibration factor for diabetes.[72]

Overall, current evidence supports the use of the Framingham Risk Equation in the general population of adults with diabetes.[72,74] In people with diabetes aged over 60 years, a high risk of CVD events (> 15% probability of a cardiovascular event within 5 years) can reasonably be assumed. Numerical calculation of absolute CVD risk is not necessary in this group (see 5.2. For which groups can increased risk of cardiovascular events be assumed without calculating absolute CVD risk using a risk equation? on page 21).

Recommendation III	Grade C

In adults with diabetes aged 60 years or less who are not known to have CVD or to be at high* risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation.

Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.[†]

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* Greater than 15% probability of CVD within 5 years.

[†] While CVD risk is known to be elevated for this population, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

4.4. Predictive ability of absolute CVD risk assessment methods in adults without known CVD who are overweight or obese

4.4.1. Findings of the systematic review

> No studies were identified that specifically evaluated the predictive ability of absolute CVD risk assessment in adults who are overweight or obese, without known CVD.

4.4.2. Other considerations

International data demonstrate a strong relationship between overweight and obesity and CVD risk.[75] Australian data are limited. Investigators in a recent multivariate analysis concluded that obesity (in this study, best measured by waist-to-hip ratio) is a dominant and independent predictive variable for CVD events and CVD deaths in Australian men and women.[29]

The most widely recognised indicator of overweight and obesity is BMI, measured as weight divided by height squared (kg/m^2). Several authors have recently proposed that CVD risk correlates better with other metrics that better quantify abdominal (visceral) obesity, such as waist circumference or waist-to-hip ratio.[76,77] Current NHMRC *Clinical practice guidelines for the management of overweight and obesity in adults* recommend that waist circumference should be measured in combination with either BMI or weight, for those patients who wish to be measured.[78] Definitions and targets based on data from European populations may not be appropriate for all ethnocultural groups.

The Framingham Risk Equation does not include measures of obesity. In recognition of the association between weight and CVD risk, routine measurement of waist circumference or waist-to-hip ratio (with or without BMI) may be valuable in clinical CVD risk assessment, in addition to other assessed factors that are included in the Framingham Risk Equation.

Given the secular trend towards markedly higher rates of overweight and obesity in the populations of developed countries since the Framingham observations were made, the Framingham Risk Equation may underestimate CVD by failing to consider the effect of obesity or overweight status (particularly central adiposity) on CVD risk. However, in the absence of evidence for the predictive ability of an absolute CVD risk assessment method in adults who are overweight or obese, it is reasonable to use the Framingham Risk Equation in this group.

Recommendation IV	Grade D

In adults who are overweight or obese and who are not known to have CVD or to be at high* risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation.

The results should be interpreted with the awareness that its predictive value has not been specifically assessed in this population.

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* Greater than 15% probability of CVD within 5 years.

4.5. Predictive ability of absolute CVD risk assessment methods in adults with CKD but without known CVD

4.5.1. Findings of the systematic review

Only one study assessing the predictive ability of an absolute CVD risk assessment method in this population was identified. The study design was of low quality (level III-2), with a high risk of bias and a small sample size (n = 96).[79]

The study, which assessed rates of myocardial infarction in French men and women with stages 2–4 CKD (mean age 65 years) over 7.4 years follow-up,[79] reported high specificity (89%) but low sensitivity (24%) as a predictor of myocardial infarction using 20% risk as the cut-point. The authors concluded that the Framingham risk score was a poor predictor of CHD risk in people with stage 2–4 CKD.

4.5.2. Conclusions of the systematic review

Recommendations as to the most appropriate absolute CVD risk assessment method for people with CKD cannot be made on the available evidence.

4.5.3. Other considerations

Absolute CVD risk assessment based on the Framingham Risk Equation is not suitable in this population, because traditional risk factors have been shown to underestimate CVD events in patients with CKD.

Clinical studies indicate that people with moderate or severe CKD – defined as persistent proteinuria or eGFR < 45 mL/min/1.73 m^2 – have a significantly increased risk of developing CVD. This effect is independent of the presence of diabetes or pre-existing CVD.

The definition of moderate or severe CKD on which this recommendation is based represents a threshold midway between stage 1 and stage 5 CKD as defined by the National Kidney Foundation Kidney Disease Outcomes Quality Initiative.[80] While all stages of CKD indicate increased CVD risk relative to people without CKD, an inverse correlation between eGFR and CVD risk has been consistently observed. A patient with eGFR < 45 mL/min/1.73m^2 has markedly increased risk of CVD compared with a patient with eGFR 45–60 mL/min/1.73 m^2.[34] Proteinuria (most commonly defined in population studies as a dipstick reading of 1+ or greater), is similarly associated with increased CVD risk, and risk increases with proteinuria level.[34,81]

Investigators in one US epidemiological study concluded that stage 3 CKD represents a significantly lesser risk of CVD than prior CHD.[82] However, the majority of eGFR recorded in that study fell within the range of 45–60 mL/min/1.73 m^2, and therefore outside the criteria proposed in the present recommendation. Data from all other studies assessing CKD as an independent risk factor for CVD support the recommendation that moderate or severe CKD should be considered a marker of increased CVD risk. Less than 4% of Australian adults have moderate or severe CKD.

Recommendation V (iii)	Grade D
The presence of moderate or severe CKD (persistent proteinuria or eGFR rate < 45 mL/min/1.73 m^2) indicates increased cardiovascular risk status. (See 5.2. For which groups can increased risk of cardiovascular events be assumed without calculating absolute CVD risk using a risk equation? on page 21.)	

5. Related clinical considerations

5.1. In which age groups should absolute CVD risk assessment be undertaken?

> The clinical relevance of absolute CVD risk assessment using the Framingham Risk Equation is greatest for middle-aged individuals. Therefore, absolute CVD risk assessment is recommended for all adults aged 45–74 years who are not already known to be at increased risk.

These guidelines recommend assessment of absolute CVD risk in those aged 45 years and older because many of the risk factors included in the Framingham Risk Equation (e.g. high blood pressure, high total cholesterol) become more prevalent with increasing age. A recent analysis of chronic disease and associated risk factors in Australia found that the proportion of people with five or more risk factors for chronic disease (including CVD) was highest in the 45–64 and 65–84 years age groups.[83]

The lower age limit of 45 is consistent with current Australian policy initiatives, such as the '45-year-old health check' (Medical Benefits Scheme item number 717, also known as the Well Person's Health Check). This program encourages preventive health checks for people between the ages of 45 and 49 years who are at risk of developing chronic disease, as part of the Australian Government's Australian Better Health Initiative. The lower age limit of 45 years is also aligned with existing clinical recommendations in Australia, such as the RACGP *Guidelines for preventive activities in general practice*, which recommends assessment of lipid levels from 45 years.

The upper age limit of 74 years has been proposed because this was the upper age for the original Framingham Heart Study cohort. Clinical judgement, instead of a numerical risk score, should be used when assessing CVD risk in people 75 years and older, because the majority fall into the high-risk category (>15%) when assessed by the Framingham Risk Equation.

Recommendation I	Grade B

Absolute cardiovascular risk assessment, using the Framingham Risk Equation to predict risk of a cardiovascular event over the next 5 years, should be performed for all adults aged 45–74 years who are not known to have CVD or to be at increased risk of CVD (see **Recommendation V** on pages 20 and 23).

5.2. For which groups can increased risk of cardiovascular events be assumed without calculating absolute CVD risk using a risk equation?

> Based on available published evidence and clinical consensus, significantly increased risk for cardiovascular events can be assumed in individuals with any of the following:
>
> - diabetes and age > 60 years
>
> - diabetes with microalbuminuria (> 20 mcg/min or urinary albumin:creatinine ratio > 2.5 mg/mmol for males, > 3.5 mg/mmol for females)
>
> - moderate or severe CKD (persistent proteinuria or eGFR < 45 mL/min/1.73m^2)
>
> - a previous diagnosis of familial hypercholesterolaemia*
>
> - systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg
>
> - serum total cholesterol > 7.5 mmol/L.
>
> _____
>
> * Refer to the National Heart Foundation of Australia's information sheet *Familial hypercholesterolaemia: information for doctors*.

5.2.1. Diabetes and age > 60 years

In clinical practice it is both reasonable and expedient to make the assumption that all patients aged over 60 years with diabetes are at high CVD risk, given that numerical calculation of absolute CVD risk is unlikely to affect clinical management decisions significantly because intensive management of risk factors is generally indicated in this group. (For instance, blood pressure-lowering drugs are indicated and cholesterol-lowering drugs are likely to be prescribed regardless of numerical risk, consistent with Pharmaceutical Benefits Scheme (PBS) reimbursement criteria.)

5.2.2. Diabetes with microalbuminuria

The presence of microalbuminuria approximately doubles CVD risk.[84–87] In clinical practice it is both reasonable and expedient to make the assumption that all adults with diabetes and microalbuminuria are at high CVD risk. Numerical calculation of absolute CVD risk is unlikely to affect clinical management decisions significantly, given that intensive management of risk factors is generally indicated in this group. Blood pressure-lowering drugs are indicated and cholesterol-lowering drugs are likely to be prescribed regardless of numerical risk, consistent with PBS reimbursement criteria.

5.2.3. Moderate or severe CKD

Clinical studies indicate that people with moderate or severe CKD (defined as persistent proteinuria or eGFR < 45 mL/min/1.73 m^2) have an increased risk of developing CVD. This effect is independent of the presence of diabetes or pre-existing CVD (see **4.5. Predictive ability of absolute CVD risk assessment methods in adults with CKD but without known CVD** on page 20).

5.2.4. Familial hypercholesterolaemia

Familial hypercholesterolaemia (a genetic disorder resulting in impaired cellular uptake of plasma LDL cholesterol) is strongly associated with premature CHD. It has been estimated to carry an eight-fold increase in the relative risk of death due to CHD among young and middle-aged adults, compared with the general population.[88] However, this relative risk has approximately halved following the widespread use of HMG-CoA reductase inhibitors (statins) since the early 1990s.[88]

Most national and international guidelines for cardiovascular risk management recommend that individuals with familial hypercholesterolaemia should be considered to be at high risk for CVD and receive treatment to reduce risk.[1,14,89]

Other less common inherited lipid disorders are associated with various levels of CVD risk. Severe hypertriglyceridaemia levels may be associated with pancreatitis and an increase in the long-term risk of CVD. In individuals with moderately elevated triglyceride levels or isolated low HDL cholesterol levels, absolute CVD risk depends on other factors including family history of premature CHD.[90]

Accordingly, doctors should assess CVD risk as high in all patients with familial hypercholesterolaemia, but assess risk on an individual basis in those with other inherited lipid disorders.

5.2.5. Systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg

Extreme levels of risk factors are associated with high absolute CVD risk, regardless of other factors. Adults with severe hypertension should be assessed as having high risk for CVD.[91] Absolute CVD risk status remains high in this group after antihypertensive therapy.

5.2.6. Serum total cholesterol > 7.5 mmol/L

The Framingham Heart Study included few people with total cholesterol levels of 7.5 mmol/L or higher. Therefore, the Framingham Risk Equation has not been validated in this group. Markedly elevated total cholesterol levels are commonly associated with familial hypercholesterolaemia, which is known to carry a high risk of CVD (see **5.2.4 Familial hypercholesterolaemia** on the left).

Consistent with other national and international guidelines, it is reasonable to assume that markedly elevated total cholesterol indicates high CVD risk.[1,92] The cut-point of 7.5 mmol/L was selected to match PBS reimbursement criteria for cholesterol-lowering drugs.

Recommendation V	Grade D

Adults with any of the following conditions do not require absolute cardiovascular risk assessment using the Framingham Risk Equation because they are already known to be at increased absolute risk of CVD:

i.   diabetes and age > 60 years

ii. diabetes with microalbuminuria (> 20 mcg/min or urinary albumin:creatinine ratio > 2.5 mg/mmol for males, > 3.5 mg/mmol for females)

iii. moderate or severe CKD (persistent proteinuria or eGFR < 45 mL/min/1.73 m^2)

iv. a previous diagnosis of familial hypercholesterolaemia*

v.   systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg

vi. serum total cholesterol > 7.5 mmol/L.

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*   Refer to the National Heart Foundation of Australia's information sheet *Familial hypercholesterolaemia: information for doctors*.

Practice point (b)

For adults at high risk of CVD, identifying all cardiovascular risk factors present enables investigation and intensive management by lifestyle interventions (all patients) and pharmacological interventions (where indicated).

5.3. Should socioeconomic status be considered in CVD risk assessment?

Measures of socioeconomic status are not included in the Framingham Risk Equation, but are included in some more recent absolute CVD risk assessment methods. Socioeconomic deprivation should be considered in addition to calculated risk, because it is an independent risk factor for CVD.

Few data are available to quantify the effect of socioeconomic status on absolute CVD risk. Data from a study conducted in Scotland indicate that the Framingham Risk Equation underestimated absolute CVD risk in socioeconomically deprived groups.[57,93] No Australian studies have directly addressed this issue.

However, socioeconomic deprivation has been associated with adverse cardiovascular outcomes in Australian adults (where socioeconomic disadvantage is measured according to the Index of Relative Socioeconomic Disadvantage, which takes into account social and economic characteristics of the geographical area such as low income, low educational attainment, high levels of public sector housing, high unemployment and jobs in relatively unskilled occupations).[6,7]

There is emerging evidence that the incorporation of social deprivation scores into absolute CVD risk assessment tools improves their predictive value.[93,94] However, this approach has been tested only in specific populations and has not been validated in the Australian population. In the absence of a numerical formula for incorporating social deprivation into risk assessments for Australian adults, it is recommended that a subjective assessment of the effect of social status should be taken into account when assessing CVD risk.

Practice point (c)

A comprehensive assessment of cardiovascular risk involves consideration of socioeconomic deprivation, because it is an independent risk factor for CVD. Absolute risk of CVD calculated using the Framingham Risk Equation is likely to underestimate cardiovascular risk in socioeconomically deprived groups.*

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*   While CVD risk is known to be elevated for this population, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

5.4. How does the presence of atrial fibrillation affect absolute CVD risk?

Atrial fibrillation is an important marker (regardless of causality), not only of thromboembolic disease and stroke, but also of incident all-cause mortality, cardiovascular death, heart failure and possibly coronary events.[95,96]

The rate of thromboembolic disease and stroke varies among people with atrial fibrillation not receiving warfarin, averaging approximately 4–5% per year.[97,98] Stroke risk increases with increasing age, previous transient ischaemic attack or stroke, hypertension, diabetes, impaired left ventricular function and a large left atrium. People with atrial fibrillation aged 65 or older are at high risk for stroke.

The presence of atrial fibrillation should prompt a thorough investigation for other CVD risk factors.

Practice point (d)

In adults with atrial fibrillation (particularly those aged over 65 years), the increased risk* of cardiovascular events and all-cause mortality, in addition to thromboembolic disease and stroke, should be taken into account when assessing absolute cardiovascular risk.

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* While CVD risk is known to be elevated for this population, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

5.5. Which absolute risk cut-points correspond to low, moderate and high risk?

When speaking to patients it is useful to use adjectives that express risk as well as to explain numerical probability. Descriptors of risk categories are arbitrary. Definitions of 'high' risk vary between various national and international guidelines. The utility of other clinical measures and tools in reclassifying patients with moderate risk is currently under investigation (see 7. Recommendations for research on page 28).

For the Australian context, the Consensus Statement Development Group reached the consensus shown in Practice point (e).

Practice point (e)

The following qualitative risk categories can be used to describe calculated absolute cardiovascular risk.

Qualitative descriptor	Calculated probability of a cardiovascular event within 5 years (Framingham Risk Equation)
Low	< 10%
Moderate	10–15%
High	> 15%

5.6. At what intervals should absolute CVD risk assessment be repeated?

Current Australian guidelines recommend different reassessment intervals for each of the component risk factors considered in the Framingham Risk Equation,[11,12,15] but there are no current recommendations specifically for reviewing absolute CVD risk in individuals without CVD.

Intervals for review of absolute CVD risk were determined after consideration of the recommendations of established preventive guidelines for general practice and of the likelihood that an individual's risk status will change over time.

5.6.1. Monitoring change in risk status following initial assessment

Reassessment of absolute CVD risk status should be undertaken when there is a reasonable expectation that it will affect clinical management decisions. In those at low risk, absolute CVD risk should be assessed approximately every 2 years (concurrent with reassessment of blood pressure) or if individual risk factor status deteriorates.[g]

In a person assessed to be at moderate absolute CVD risk (10–15% probability of a cardiovascular event within 5 years), closer monitoring of risk is needed because risk level may become high in response to worsening status of one or more risk factors.

In a person assessed to be at high absolute CVD risk, risk status is unlikely to be revised downward in the short term, although occasionally it may be reduced following reversal of modifiable risk factors (e.g. permanent smoking cessation). Reassessment of risk status will depend on the individual's clinical profile and the purpose of risk assessment (e.g. to encourage continued adherence to a treatment plan, or to inform the decision to commence additional treatment).

The following intervals are intended only as a guide. Appropriate intervals at which an individual's absolute CVD risk should be reviewed will depend on clinical judgement.

Practice point (f)

Regular review of absolute cardiovascular risk is recommended at intervals according to the initial assessed risk level:

Low < 10% risk of cardiovascular event within 5 years	Review every 2 years
Moderate 10–15% risk of cardiovascular event within 5 years	Review every 6–12 months
High > 15% risk of cardiovascular event within 5 years	Review according to clinical context

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[g]   Individual risk factors should be reassessed at intervals recommended in the *Guidelines for preventive activities in general practice (6th edition)*.[12]

6. Effectiveness, cost-effectiveness and economic implications of absolute CVD risk assessment

6.1. Findings of the systematic review

No studies directly assessed whether absolute CVD risk assessment leads to improved clinical outcomes compared with usual assessment, or compared clinical outcomes in individuals in whom absolute CVD risk was assessed using different methods.

No studies directly assessed the cost-effectiveness of absolute CVD risk assessment versus usual assessment, or assessed the cost-effectiveness of absolute CVD risk assessment by one method versus another method.

No studies directly comparing different absolute CVD risk assessment methods in clinical care reported costs of assessment, cost of interventions or individual health outcomes.

6.2. Conclusions of the systematic review

There is no direct empirical evidence as to whether absolute CVD risk assessment leads to improved CVD outcomes, or which risk assessment method is most effective in achieving improved CVD outcomes. While a few studies of varying quality have reported effects on treatment, predicted risk or risk factor levels as a result of risk assessment,[25,99,100] none have reported CVD outcomes.

No conclusion can be made as to the cost-effectiveness of one absolute CVD risk assessment tool over another in any of the identified populations, based on the evidence identified by the systematic review.

6.3. Other considerations

6.3.1. Implications of absolute CVD risk assessment for clinical outcomes

The best available evidence for the potential effects of absolute risk assessment methods on CVD rates comes from modelling studies, which use statistical constructs to simulate resource (cost) inputs and health outcomes within populations under a variety of scenarios. The findings of selected modelling studies are included here as a basis for considering the economic implications

of clinical CVD risk assessment, but do not represent a comprehensive review of the effectiveness or cost-effectiveness of absolute risk assessment. It should be noted that the study populations of modelling studies do not match the target populations of these guidelines and did not necessarily exclude people with pre-existing CVD.

A recent study comparing several national and international guidelines for the use of statin treatment to prevent CHD, applied each to a Canadian reference population to examine its potential effectiveness (deaths due to CHD avoided) and efficiency (unnecessary treatment avoided).[19] The absolute risk assessment charts used in all guidelines were based on the Framingham Risk Equation (Canadian, Australian, New Zealand, US, Joint British Societies), except for the European societies guidelines, which used data from the Systematic Coronary Risk Evaluation study. Modelling demonstrated that a strategy of treating people at high absolute risk was potentially more than twice as effective in reducing death from CHD as the strategy of treating people with high total cholesterol concentrations.[21] Although this study was designed primarily to compare different intervention cut-points, rather than to discriminate between different absolute risk assessment methods, its findings may be relevant to the broader implications of absolute CVD risk assessment in the Australian setting.

The findings from modelling studies suggest that:[19,21,101]

- clinical guidelines for CVD risk reduction are likely to be most efficient and effective when based on absolute risk assessment, rather than testing for single risk factors (e.g. high blood pressure or high cholesterol) in isolation

- improvements in population health are likely to be maximised when medical interventions are targeted to groups at high absolute risk and when interventions that achieve high relative risk reduction are deployed; however, some strategies that are not based on absolute risk (e.g. population-wide reduction of salt in processed foods) may also be effective in reducing CVD

- strategies that aim to reduce the prevalence of single risk factors are generally likely to be relatively ineffective at the population level, because they inevitably direct the bulk of interventions to the low-risk segments of the population.

6.3.2. Cost implications

Factors that must be considered when assessing cost-effectiveness include:

- risk threshold for intervention
- direct and indirect resource costs for risk assessment and interventions, including costs associated with clinical events
- effectiveness (proportion of events prevented by the intervention)
- uptake of guidelines by primary care doctors.

In the absence of evidence from studies directly measuring the cost-effectiveness of CVD prevention strategies based on different methods of absolute risk assessment, the best currently available information on cost-effectiveness is obtained from modelling studies and inferred from effectiveness data.

The most cost-effective risk management approach will result in the optimal balance between effectiveness (e.g. maximising the number of CVD events avoided) and efficiency (making the best use of resources for the health benefits obtained, e.g. by targeting only selected segments of the population). It should be noted that cost-effective interventions may be cost saving or cost incurring. Interventions that incur additional costs, compared with usual care, may still be considered cost-effective when the additional health benefit is justified by health policy.

Accurate prediction of CVD risk is crucial to enable optimal intervention cut-points to be set for a given population. However, it is difficult to make comparisons between the cost-effectiveness of different methods of applying risk assessment to clinical intervention, because available studies differ with respect to several variables, including absolute CVD risk thresholds for interventions, methods of absolute CVD risk assessment, clinical outcomes measured and clinical interventions to manage risk. Costs of health resources will also vary between health systems (including national and regional jurisdictions).

A recent modelling study found that the direct costs of implementing national guidelines were 4–6 times lower for New Zealand guidelines than for Australian, US, UK or Canadian guidelines.[20] Assessment costs were partly minimised by screening only age groups in which case-finding was most likely.

The New Zealand guidelines were also more cost-effective than Australian, US, UK or Canadian guidelines. However, all the guidelines showed similar cost-efficiency when applied to individuals aged over 65 years, because cost per cardiovascular event prevented was markedly lower in those aged 65–74 years than in younger age groups.[20]

Modelling studies suggest that the most cost-effective population strategies for preventing CVD are those which apply all the following principles:[5,20,21,101–104]

- intervention thresholds are based on absolute CVD risk assessment rather than targeting a particular risk factor (e.g. high blood pressure or high cholesterol) in isolation
- medical interventions are targeted to the highest-risk segment of the population based on absolute risk assessment
- effective low-cost pharmaceutical treatments (e.g. aspirin) are used.

Some non-medical CVD prevention strategies that target the entire population are also likely to be highly cost-effective. These include mass education on risk reduction, or reducing dietary salt intake through the food industry.[101]

Therefore, it is reasonable to expect that improved cost-effectiveness will result from implementation of these guidelines' recommendations for routine absolute risk assessment using the most accurate tools currently available – provided that optimal intervention trigger cut-points are set and effective interventions recommended. An evaluation of the cost-effectiveness of applying these recommendations for absolute CVD risk assessment in Australian primary care is beyond the scope of these guidelines and further evidence would be required before a modelling study could be undertaken.

7. Recommendations for research

7.1. Limitations of the Framingham Risk Equation

The Framingham Risk Equation has been validated in various populations,[58] but has been reported to overestimate risk in populations with low CHD-related mortality and underestimate risk in populations with high mortality, including sub-populations such as socioeconomically deprived groups,[105] some ethnocultural groups including Aboriginal and Torres Strait Islander peoples,[64,89] and people with comorbid medical conditions.[89] Limitations of the Framingham Risk Equation include failure to incorporate some significant risk factors (e.g. obesity, physical inactivity, family history of CVD, socioeconomic status, psychosocial factors) and insufficient consideration of the effects of advanced age.[106,89]

Investigations are underway to identify other clinical parameters and assessment tools that might be used to reclassify risk in those with moderate risk. There is some controversy regarding the potential role of such measures. Current research is also investigating better methods of assessing the incremental value of these measures compared with standard prediction tools.[107,108]

Further research is required to develop models that better predict CVD risk in all relevant sub-populations. With the emergence of newer approaches involving multiple biomarkers,[109,110] research is needed to assess the predictive reliability of new risk equations that incorporate these and their application to specific target groups. Further research addressing recalibration and adjustment of the Framingham Risk Equation in Aboriginal and Torres Strait Islander populations, along with evaluation of additional or non-traditional risk markers, should be a national priority.

At present, despite the limitations of the Framingham Risk Equation, its use in routine CVD risk assessment is likely to result in more accurate risk assessment than the use of individual risk factors.

7.2. Design of prognostic studies

The research literature examining absolute CVD risk assessment is limited by a number of common methodological weaknesses, such as inclusion of people with CVD at baseline, inadequate lengths of follow-up and small sample sizes. Future prospective studies should be designed to avoid these methodological flaws.

7.3. Target sub-populations

There is a need for studies evaluating the predictive value of absolute risk assessment in the following groups and validating any proposed assessment methods:

- people with diabetes
- people with CKD
- people who are overweight or obese (including the best measure of adiposity and the interaction between obesity and other risk factors, including ethnocultural factors)
- various ethnocultural subgroups in Australia
- Aboriginal and Torres Strait Islander peoples
- socioeconomically deprived groups
- people with mental illness.

7.4. Effectiveness and cost-effectiveness

Currently there is no direct evidence to determine whether absolute CVD risk assessment improves CVD outcomes or reduces health care costs, and only tentative evidence that it improves some risk factors for CVD. Further, the validity of currently available absolute CVD risk assessment methods in an Australian population has only been investigated in a small number of studies. Well-designed effectiveness studies and cost-effectiveness studies are needed.

More research is needed on the effect of absolute CVD risk assessment on the delivery of interventions that lower risk, including investigation of the optimal age for beginning such assessments in men and women.

7.5. Tools

There is a need for new practical CVD risk assessment tools based on risk equations purpose-designed for the Australian population and its sub-populations, including Aboriginal and Torres Strait Islander peoples. Such tools must be validated in the target groups identified and adaptable to the range of practice styles in Australian primary care.

Interpreting the significance of a given calculated risk level will depend on the individual's life expectancy.

7.6. Communication of risk information to individuals

The most effective method by which to explain absolute risk to people and communicate an individual's risk remains uncertain (see 8.2.4. Self-management support and the community on page 32).

8. Implementation

These guidelines represent a critical first step in promoting the routine assessment of absolute CVD risk as a basis for CVD prevention in Australia. Next, we must consider how we can best support and facilitate uptake of the absolute risk approach in the Australian primary health care sector.

We now have the opportunity to develop a comprehensive and coherent preventive approach by integrating existing separate management guidelines into a single preventive approach based on absolute risk CVD assessment. Such integrated guidance will help health professionals identify people at risk of CVD more effectively, so that they may be offered appropriate, proven preventive interventions.

Development of an implementation strategy for these guidelines (see **Figure 1** below) must consider:

- which implementation strategies are likely to be most effective, based on local and international evidence
- policy and program opportunities to support uptake of these guidelines
- the provision of adequate resources and sufficient capacity to translate the recommendations into practice.

An implementation plan will be developed in the 12 months following publication of these guidelines. The scope of the implementation strategies will be dependent on the availability of adequate resources to support its uptake.

Figure 1. Key factors that determine an appropriate implementation strategy

8.1. Effectiveness of implementation strategies

8.1.1. Implementation of absolute CVD risk assessment

Routine assessment of absolute CVD risk requires health professionals to perform a calculation involving several numerical data representing an individual's status for various risk factors. To facilitate this task, a range of electronic and paper-based tools will also be needed.

Other countries have demonstrated that it is feasible to incorporate the use of absolute CVD risk assessment into routine primary care practice.[100,111] Many versions of the Framingham Risk Equation have been developed. These vary in format and according to whether continuous or categorical variables are used. (For detailed descriptions of absolute risk equations included in these guidelines, see *Technical report: review of the evidence and evidence-based recommendations for practice*). The New Zealand risk chart, which is derived from the Framingham Risk Equation, can be readily adapted for use in Australian general practice.

An effective implementation strategy will also involve the task of integrating multiple treatment guidelines and providing clear, consistent recommendations for clinical decisions based on absolute CVD risk assessment. To achieve this, an integrated strategy for preventive cardiovascular care is needed, supported by health system policy and funding.

Primary care health professionals will require education and support, including appropriate practice resources, to incorporate the recommended actions into practice protocols.

8.1.2. Barriers to uptake of absolute CVD risk assessment tools

Absolute risk assessment tools have been available for more than a decade, yet their utility and uptake have been variable. In Australia, there appears to be a low level of understanding and use of these tools by GPs.[112]

Several overseas studies have explored barriers to the use of absolute CVD risk assessment tools. Concerns that the tool may oversimplify risk and that use of the tool may lead to over-treatment were the barriers most commonly reported by Swiss general physicians in a recent survey.[113]

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A better understanding of local barriers for primary care uptake of these tools and strategies that have been shown to overcome these are needed to inform educational and implementation strategies.

8.1.3. General evidence of effectiveness

The literature on effectiveness of guideline dissemination and implementation has yielded conflicting findings. Earlier reviews suggested that the most successful strategies involved multifaceted activities directed at different levels in the health system. However, these approaches tended to be resource-intensive and were often difficult to implement. Most reports provided poor descriptions of single and multifaceted strategies and lacked specific details of delivery methods.

Collectively, these strategies achieved only modest to moderate improvements in care. Across all study comparisons, multifaceted interventions did not appear to be more effective than single interventions. Interventions directed towards health professionals (reminders, educational outreach, educational materials and audit plus feedback) were all shown to have modest effects, whereas patient-directed interventions appeared to result in moderate improvements in clinical care.[114]

8.2. Policy and program opportunities

The Chronic Care Model proposed by Wagner et al[115] and endorsed by the World Health Organization[116] provides a framework for considering how the opportunities presented by primary care policy and programs might best be exploited in planning an implementation strategy for absolute CVD risk assessment. The Chronic Care Model identifies the following as key elements of a health care system that promotes high-quality care for people with chronic diseases:

- health system – includes coordination of care between levels and components of the system and incentives for health professionals to provide quality care
- delivery system design – includes defining team members' roles and tasks and ensuring regular follow-up
- decision support – includes incorporation of evidence-based guidelines into routine clinical practices and the integration of specialist care into primary care

- clinical information systems – organisation of clinical data for patients and the population so as to facilitate effectiveness and efficiency of care (includes reminder systems and case-finding)
- self-management support – involves preparing people with chronic disease to manage their own health care
- the community – incorporating community-based resources into health care.

8.2.1. Health system

The adoption of an absolute CVD risk approach in the front line of Australia's health system will serve to deliver evidence-based care to those at high risk with the potential for the most benefit. Treatment decisions based on predetermined thresholds allow for consistency, transparency and the potential for clinical audits as part of a quality-improvement framework for primary care. The systematic implementation of these guidelines need to be considered in any review of general practice and/or the development of any new national primary health care strategy. Health system implications arising in relation to the implementation of these guidelines will need to be considered by a range of stakeholders, including the Commonwealth Department of Health and Ageing, Medicare Australia, primary care groups and member organisations of the NVDPA. Planning for implementation may require a period of several years.

Implementation of these guidelines may consider the integration of the recommendations into existing models for funding patient care, including payments for services provided by health professionals and for prescription medicines.

Absolute CVD risk assessment could build upon, and be integrated into, existing initiatives such as:

- the Well Person's Health Check
- enhanced Primary Care Program (e.g. inclusion of absolute CVD risk assessment into Management Plans and Team Care Arrangements Care Plans)
- chronic disease programs such as the Practice Incentive and Service Incentive Programs payments for patients with diabetes

- the CHD and diabetes components of the Australian Primary Care Collaboratives Program
- referral to allied health providers, especially to dietitians and exercise physiologists and diabetes educators for those at higher risk (e.g. Allied Health Group Services under Medicare for patients with type 2 diabetes).

It may also be appropriate to incorporate absolute CVD risk assessment into PBS reimbursement criteria for medicines used in the prevention of CVD.

8.2.2. Delivery system design

Tasks necessary for absolute CVD risk assessment can be efficiently incorporated into the roles of practice nurses and allied health professionals, e.g. through the Well Person's Health Check or Team Care Arrangements Care Plans.

Various front-line health professionals other than the primary care doctor can also participate in identifying patients at high risk.

8.2.3. Clinical information systems

For effective implementation of absolute CVD risk assessment in primary care, information systems must be organised to facilitate the following:

- identification of patients who require absolute CVD risk assessment
- automatic transfer of patient data from the main medical record to the electronic risk calculator, so that data need only be entered once
- recording estimated risk
- prompting the doctor to manage risk appropriately
- plotting progress of patient risk factor changes over time.

Clinical information systems currently in use in general practice do not routinely capture all the data items required for absolute risk assessment in a form that could be readily transferred to a risk calculator and linked directly to management prompts and/or digital templates for generating referral letters. The requisite software needs to be developed in collaboration with the software industry, in the same way that physical activity prescription and Lifescripts have been developed in Australia.

Concurrently, there is a need to develop mechanisms by which members of the community who have a family history of premature CVD are appropriately identified and offered preventive care. European data suggest that only 11% of siblings and 6% of offspring of people with a positive family history are currently assessed for coronary risk factors.[117]

8.2.4. Self-management support and the community

To ensure optimal uptake of services relating to absolute CVD risk assessment, supporting resources to inform the community about the recommendations in these guidelines will need to be developed alongside clinical tools.

Implementation of these guidelines might also be supported by the development of a risk assessment tool for use by consumers, which would estimate potential benefits of specific lifestyle changes (e.g. weight loss or smoking cessation). Such a tool would not only help people to make healthy lifestyle choices, it could also encourage those at higher risk to seek specific advice from their doctors. Supporting resources should also include self-management tools to assist people to manage risk appropriately, once they have identified their risk level.

The Commonwealth and state governments have supported the development of self-management training though the Sharing Health Care initiative. This initiative might be broadened to include consumer training in the absolute risk approach, which will allow them to make better-informed decisions about the management of lifestyle and physiological risk factors.

Implementation strategies targeting the community can be informed by work already undertaken by the NVDPA to investigate consumer preferences for the communication of cardiovascular risk.[118]

8.3. Resources and capacity

An implementation plan incorporating these factors will be developed in the 12 months following publication of these guidelines. Initial and ongoing funding for implementation will be important.

The Commonwealth Government funded the preparation of a 2004 report by the NVDPA entitled *The Absolute Risk Project: towards a risk identification tool for coronary heart disease and stroke*. That report included the findings of qualitative research undertaken with GPs and consumers to identify their preferred modes of communication (including format of guidelines and means of expressing CVD risk) and made recommendations based on these findings.

The Absolute CVD Risk Implementation Working Group was convened by the DoHA to advise on the implementation of an absolute risk approach to the assessment and management of CVD in Australian practice. It includes representatives of key stakeholder groups including the RACGP and Australian General Practice Network (AGPN).

Although individual organisations such as the National Heart Foundation of Australia and peak medical bodies have developed recommendations for the implementation of absolute CVD risk assessment (some have even produced resources to support the implementation of absolute CVD risk assessment as recommended in their own guidelines), these initiatives remain fragmented and isolated. To succeed, implementation of these recommendations in Australian primary care must:

- be properly resourced
- involve a means of effectively integrating the various existing guidelines into a new single guideline for the management of CVD based on an absolute risk assessment approach
- ensure consistency of recommendations between guidelines within and between organisations.

8.4. Recommendations for implementation

1. Any future review of general practice and/or the development of any new national primary health care strategy will benefit from considering the implementation of these absolute CVD risk assessment guidelines.

2. The NVDPA will seek the support of key stakeholders in formulating the full implementation plan for these absolute CVD risk guidelines, including supportive health policy, the political will to achieve better preventive care and adequate resources for the development of an effective implementation plan.

   This process should be informed by the report *The Absolute Risk Project: towards a risk identification tool for coronary heart disease and stroke* and should involve key stakeholders, including relevant DoHA divisions (Primary and Ambulatory Care, Population Health, Medical Benefits Scheme and PBS) and representatives of professional, educational and practice support bodies including the AGPN, Australian College of Rural and Remote Medicine, Australian Practice Nurses Association, National Aboriginal Controlled Community Health Organisation, National Prescribing Service, NVDPA and the RACGP.

3. Implementation of these absolute CVD risk guidelines should be based on best-practice chronic disease management principles, including a systematic approach and appropriate incentives and supports for health professionals, and should be adapted to local contexts.

4. The absolute CVD risk assessment approach can be integrated into all chronic disease management and funding initiatives that encourage GPs to practise quality preventive health care through an evidence-based approach to the detection and management of chronic disease. This applies to both new and existing initiatives, including:

   - the Australian Primary Care Collaboratives Program
   - the Well Person's Health Check
   - utilisation of appropriate Medicare (Chronic Disease Management) items
   - an expanded role for practice nurses.

9. Recommendations for updating these guidelines

Guidelines should be reviewed, and revised if necessary, at least every 5 years. Review should be more frequent in areas where clinical practice or research is known to be changing rapidly.

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Appendices

Appendix I. Working group membership and terms of reference

A Steering Committee of the NVDPA was responsible for providing high level advisory input to the development of these guidelines, in accordance with NHMRC Standards and Procedures for Externally Developed Guidelines. The Steering Committee reported to the full committee of the NVDPA.

The responsibilities of the Steering Committee included the following.

1. Overseeing operational aspects of the contract with Monash Institute of Health Services Research (MIHSR) to conduct the systematic review and develop these guidelines. This included providing feedback and input to the draft guidelines developed by MIHSR and reviewing and making recommendations regarding feedback gained through the public consultation process.

2. Review of relevant existing guidelines.

3. Advising on a plan for communication, dissemination and implementation.

4. Developing recommendations for periodically updating these guidelines.

5. Reporting regularly to the full committee of the NVDPA.

Each steering committee member completed a form declaring any potential conflict of interest relevant to participation in this project.

An Executive Working Group of the Steering Committee was responsible for day-to-day supervision of this project. Responsibilities included identifying, reviewing and classifying relevant literature in collaboration with MIHSR and providing regular advice and support to the MIHSR team.

A Consensus Statement Development Group was appointed to guide the development of consensus recommendations for clinical questions for which the systematic review identified insufficient data on which to base evidence-based recommendations.

NVDPA Executive Working Group

Co-Chairs

Professor Stephen Colagiuri (NVDPA representative)
Diabetologist (Diabetes Australia) and Professor of Metabolic Health, University of Sydney

Professor Andrew Tonkin
Cardiologist (Austin Health) and Head of the Cardiovascular Research Unit, Department of Epidemiology and Preventive Medicine, Monash University (formerly National Heart Foundation of Australia)

Other members

Professor Mark Harris
General Practitioner, Centre for Primary Health Care and Equity, University of NSW and RACGP

Dr Tom Briffa
Research Fellow, Allied Health, University of Western Australia and past Executive Officer, National Heart Foundation of Australia

Dr Nancy Huang
National Manager Clinical Programs, National Heart Foundation of Australia

Ms Karen Carey-Hazell
Consumer Representative

Ms Leva Azadi
Executive Officer, National Heart Foundation of Australia (May 2008–)

Ms Jill Waddell
Executive Officer, National Heart Foundation of Australia (Dec 2006–June 2008)

Steering Committee

Dr Erin Lalor (NVDPA Chair)
Chief Executive Officer, National Stroke Foundation

Associate Professor Tim Mathew (past NVDPA Chair)
Nephrologist (National Medical Director, Kidney Health Australia)

Professor Chris Bladin
Neurologist (National Stroke Foundation)

Guidelines for the assessment of **Absolute** cardiovascular disease **risk**

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Mr Richard McCluskey
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Appendix II. Process report

Methodology

The methodology and search strategies for these absolute CVD risk guidelines have been previously reported. For an outline of the methods see 3. **Methodology** on page 10. For greater detail see the report by the MIHSR: *Technical report: review of the evidence and evidence-based recommendations for practice.*

Development process

The Absolute CVD Risk Guidelines Project proceeded from the Absolute Risk Project previously conducted by the NVDPA.[4] The guidelines development process was led by a steering committee of the NVDPA, with funding and project management support from the National Heart Foundation of Australia. An Executive Working Group was formed to oversee its development. In April 2005, funding was obtained from the Heart Foundation National Board to undertake this task. In May 2006, the NHMRC formally agreed to accept these guidelines into its work plan for 2006.

Research phase

The MIHSR was contracted to develop the guideline according to NHMRC standards and procedures. A final draft from MIHSR (*Technical report: review of the evidence and evidence-based recommendations for practice*) was circulated to the Executive Working Group members on 20 December 2006.

Writing phase

The systematic review undertaken by the MIHSR was unable to answer some clinical questions. Therefore, in March 2007, a consensus development workshop was held with a range of experts to address these questions. Following this process, a medical writer was contracted in July 2007 to develop brief clinical practice guidelines based on the systematic review and technical report. The Executive Working Group signed off on the draft guidelines in February 2008 and formal approval was obtained from the NVDPA in March 2008.

Public consultation

Public consultation was conducted between 17 April and 21 May 2008, during which the draft guidelines were made available on the National Heart Foundation of Australia website. Notification was posted in

The Australian national newspaper, and a range of stakeholders, committees, working groups and interested people were invited by both the NVDPA and the National Heart Foundation of Australia to provide submissions.

Overall, seven submissions were received as part of the public consultation feedback process. Submissions were received from:

Assoc Prof David Sullivan
Royal Prince Alfred Hospital

Ms Annette Byron
Dietitians Association of Australia

Dr Sophie Couzos
National Aboriginal Community Controlled Health Organisation

Prof Mark Nelson
University of Tasmania

Assoc Prof Anushka Patel and Dr David Peiris
The George Institute

Prof Garry Jennings and Prof Anthony Dart
Baker IDI Heart and Diabetes Institute

CARI (Caring for Australasians with Renal Impairment)

Finalising the guidelines

Comments received from the public consultation process were considered individually and passed on to relevant experts to further inform their inclusion in the guidelines. The Executive Working Group met on 23 July 2008 to finalise outstanding issues from the public consultation submissions. Based on all the feedback, the guidelines were revised accordingly. The final draft of the guidelines was sent to the NHMRC for review on Monday 28 July 2008.

Prior to endorsement by the NHMRC, the guidelines underwent an independent review process conducted by the NHMRC. The guidelines were further refined in response to the reviewer's recommendations.

The final guidelines were submitted to the NHMRC for endorsement on 20 November 2008.

Endorsement from the NHMRC was received in January 2009.

Guidelines for the assessment of **Absolute** cardiovascular disease **risk**

Glossary and abbreviations

Glossary of terms

Abdominal obesity: the condition of carrying excess body fat predominantly around the waist (as opposed to carrying excess fat mainly around the hips).

Absolute risk (global risk, total risk): the numerical probability of an event occurring within a specified period, usually expressed as a percentage.

Anti-platelet agents: medicines that reduce the risk of abnormal blood clotting (e.g. aspirin, clopidogrel).

Atrial fibrillation: one of a number of disorders commonly referred to as 'arrhythmias', in which the heart does not beat with a normal rhythm. Atrial fibrillation is caused by a disturbance of the heart's electrical system. The problem starts in the upper chambers of the heart (the atria) and causes these chambers to quiver (or 'fibrillate'), rather than beat normally. This can mean that the heart is not pumping efficiently.

Blood lipids: fatty substances naturally occurring in the blood (cholesterol and triglycerides).

Blood pressure: the pressure of the blood against the inner walls of the arteries as it is pumped around the body by the heart. Blood pressure varies from moment to moment and is affected by factors such as body position, breathing, emotional state, physical activity and sleep.

Body mass index (BMI): a calculated number used to identify and measure underweight, overweight or obesity, calculated from a person's height and weight. BMI = weight (in kg) divided by height (in m) squared.

Cardiovascular disease (CVD): group term for all medical conditions affecting the heart or blood vessels (e.g. coronary heart disease, stroke, peripheral arterial disease, some types of kidney disease).

Cholesterol: see blood lipids.

Chronic heart failure: a condition in which the heart does not pump blood effectively, typically resulting in breathlessness and fatigue.

Chronic kidney disease (CKD): long-term inability of the kidney/s to function normally, most commonly caused by diabetes, inflammation of the kidneys or high blood pressure.

Cohort studies: a type of medical research in which a selected group of people is studied over time, often over a period of several years.

Coronary heart disease (CHD): a disease in which arteries that surround the heart and supply blood to the heart muscle become partly blocked.

Diabetes mellitus (diabetes): a long-term disease that affects the way body cells take up and use glucose (sugar) from the blood, resulting in abnormally high levels of glucose in the blood.

Familial hypercholesterolaemia: an inherited condition in which removal of cholesterol from the blood is reduced, causing high blood cholesterol levels and early heart disease in some families.

Framingham Risk Equation: a statistical method of predicting an individual's likelihood of developing CVD within the next 5 or 10 years, based on risk factors such as age, sex and blood pressure.

Hypertension: raised blood pressure.

Myocardial infarction (heart attack): temporary loss of blood supply to the heart muscle, typically caused by a blood clot that suddenly blocks a narrowed artery. This can result in heart muscle damage.

Peripheral arterial disease: disease affecting the arteries other than those of the heart or brain.

Relative risk: a measure of the difference in likelihood of experiencing an event between those who are exposed to a particular risk factor or treatment and those who are not.

Renovascular disease: cardiovascular disease affecting the blood vessels supplying the kidney.

Stroke: a medical condition that occurs when the supply of blood to the brain is suddenly disrupted (e.g. due to blockage of an artery by a blood clot, or because the artery breaks or bursts).

Abbreviations

AUC	Area under the receiver operating characteristic curve
AGPN	Australian General Practice Network
BMI	Body mass index
CHD	Coronary heart disease
CKD	Chronic kidney disease
CVD	Cardiovascular disease
DoHA	Department of Health and Ageing
eGFR	Estimated glomerular filtration rate
GFR	Glomerular filtration rate
GP	General practitioner
HDL	High-density lipoprotein
LDL	Low-density lipoprotein
MIHSR	Monash Institute of Health Services Research
MONICA	Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases
NHANES I	First National Health and Nutrition Examination Survey (US)
NHMRC	National Health and Medical Research Council
NVDPA	National Vascular Disease Prevention Alliance
PBS	Pharmaceutical Benefits Scheme
RACGP	Royal Australian College of General Practitioners
UKPDS	United Kingdom Prospective Diabetes Study

Guidelines for the assessment of **Absolute** cardiovascular disease **risk**

Tables and figures

Table 1. Summary of recommendations*

Recommendation		Grade†
I	Absolute cardiovascular risk assessment, using the Framingham Risk Equation to predict risk of a cardiovascular event over the next 5 years, should be performed for all adults aged 45–74 years who are not known to have CVD or to be at increased risk of CVD (see **Recommendation V**).	**B**
II	In Aboriginal and Torres Strait Islander adults aged 35 years and older who are not known to have CVD or to be at high‡ risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.§	**D**
III	In adults with diabetes aged 60 years or less who are not known to have CVD or to be at high‡ risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. Although the Framingham Risk Equation might underestimate risk in this population, available evidence suggests that this approach will provide an estimate of minimum cardiovascular risk.§	**C**
IV	In adults who are overweight or obese and who are not known to have CVD or to be at high‡ risk, absolute cardiovascular risk over the next 5 years should be calculated using the Framingham Risk Equation. The results should be interpreted with the awareness that its predictive value has not been specifically assessed in this population.	**D**
V	Adults with any of the following conditions do not require absolute cardiovascular risk assessment using the Framingham Risk Equation because they are already known to be at increased absolute risk of CVD: i. diabetes and age > 60 years ii. diabetes with microalbuminuria (> 20 mcg/min or urinary albumin:creatinine ratio > 2.5 mg/mmol for males, > 3.5 mg/mmol for females) iii. moderate or severe CKD (persistent proteinuria or eGFR < 45 mL/min/1.73 m²) iv. a previous diagnosis of familial hypercholesterolaemiaǁ v. systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg vi. serum total cholesterol > 7.5 mmol/L.	**D**

* Recommendations I and III are derived from findings of the systematic literature review whenever the body of evidence yielded support for recommendations of at least NHMRC Grade C (see **3.1.3 Evidence-based recommendations** on page 11). Recommendations II, IV and V are clinical consensus statements developed where the systematic literature review process was undertaken, but no evidence was found for or against these recommendations (see **3.2.1 Clinical consensus statements** on page 12).

† Grades of evidence according to NHMRC classification[3] (see Table 3 on page 13).

‡ Greater than 15% probability of CVD within 5 years.

§ While CVD risk is known to be elevated for the population identified, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

ǁ Refer to the National Heart Foundation of Australia's information sheet *Familial hypercholesterolaemia: information for doctors.*

Table 2. Summary of practice points*

a	In adults without known CVD, a comprehensive assessment of cardiovascular risk includes consideration of the below.

Modifiable risk factors	**Non-modifiable risk factors**	**Related conditions**
• Smoking status	• Age and sex	• Diabetes
• Blood pressure	• Family history of premature CVD	• Kidney function (microalbumin ± urine protein, eGFR)
• Serum lipids	• Social history including cultural identity, ethnicity, socioeconomic status and mental health	• Familial hypercholesterolaemia
• Waist circumference and body mass index		• Evidence of atrial fibrillation (history, examination, electrocardiogram)
• Nutrition		
• Physical activity level		
• Alcohol intake[†]		

b	For adults at high risk of CVD, identifying all cardiovascular risk factors present enables investigation and intensive management by lifestyle interventions (all patients) and pharmacological interventions (where indicated).
c	A comprehensive assessment of cardiovascular risk involves consideration of socioeconomic deprivation, because it is an independent risk factor for CVD. Absolute risk of CVD calculated using the Framingham Risk Equation is likely to underestimate cardiovascular risk in socioeconomically deprived groups.[‡]
d	In adults with atrial fibrillation (particularly those aged over 65 years), the increased risk[‡] of cardiovascular events and all-cause mortality, in addition to thromboembolic disease and stroke, should be taken into account when assessing absolute cardiovascular risk.
e	The following qualitative risk categories can be used to describe calculated absolute cardiovascular risk: • **'low'** risk corresponds to < 10% probability of CVD within the next 5 years • **'moderate'** risk corresponds to 10–15% risk of CVD within the next 5 years • **'high'** risk corresponds to > 15% risk of CVD within the next 5 years.
f	Regular review of absolute cardiovascular risk is recommended at intervals according to initial assessed risk level: • **low** – review every 2 years • **moderate** – review every 6–12 months • **high** – review according to clinical context.

* These practice points were developed to facilitate clinical uptake of these guidelines by GPs and other target users. These were formulated based on expert clinical judgement (see 3.2.1 Clinical consensus statements on page 12 and 3.4 Practice points on page 13).

† Alcohol is a risk factor for elevated blood pressure (which is itself a major independent determinant of risk of atherosclerotic disease), stroke and cardiomyopathy. For a full discussion of this, please see the NHMRC's *Australian guidelines to reduce health risks from drinking alcohol*.

‡ While CVD risk is known to be elevated for the population identified, it is not possible to quantify the degree of additional CVD risk in an individual. Clinical judgement is necessary when assessing an individual's overall CVD risk.

Table 3. NHMRC grades of recommendation[3]

Grade of recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution

Figure 1. Key factors that determine an appropriate implementation strategy
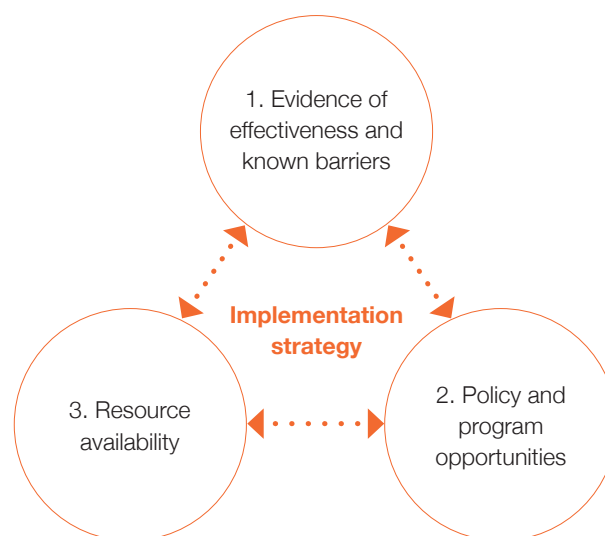
Approved by

The NVDPA is a group of four leading and well-known Australian charities: Kidney Health Australia, Diabetes Australia, the National Heart Foundation of Australia and the National Stroke Foundation. It was established in 2000 and aims to reduce cardiovascular disease in Australia. Links to these guidelines can be found on NVDPA member websites: www.strokefoundation.com.au, www.kidney.org.au, www.diabetesaustralia.com.au and www.heartfoundation.org.au.