Australian National University

Review of evidence for the alignment of guidelines on Aboriginal and Torres Strait Islander absolute cardiovascular disease risk

A report prepared for the Australian Government Department of Health

December 2017

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List of acronyms and abbreviations

ACEi	Angiotensin-converting-enzyme inhibitor
ACR	Albumin/creatinine ratio
CARPA	Central Australian Rural Practitioners Association
CHD	Coronary heart disease
CKD	Chronic Kidney Disease
CVD	Cardiovascular disease
eGFR	Estimated glomerular filtration rate
ESSENCE	Essential Service Standards for Equitable National Cardiovascular Care
FRE	Framingham Risk Equation
HDL	High-density lipoprotein
LDL	Low density lipoprotein
MAGIC	Making GRADE the Irresistible Choice
NA	Not applicable
NHMRC	National Health and Medical Research Council of Australia
NICE	National Institute for Health and Care Excellence
NS	Not stated
NVDPA	National Vascular Disease Prevention Alliance
NZ	New Zealand
PCIS	Primary Care Information System
RCT	Randomised Controlled Trial
RACGP	Royal Australian College of General Practitioners
SIGN	Scottish Intercollegiate Guidelines Network
SNAP	Smoking, nutrition, alcohol, physical activity
SPRINT	Systolic Blood Pressure Intervention Trial

KEY MESSAGES

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Policy context

Cardiovascular disease (CVD) is highly preventable. CVD continues to be the largest contributor to mortality within the Aboriginal and Torres Strait Islander population and rates of CVD are disproportionately higher within the Australian Aboriginal and Torres Strait Islander population compared to the non-Indigenous population. Improving uptake of current evidence based solutions such as the absolute risk approach to CVD within the Aboriginal and Torres Strait Islander population is important to address this disparity. Although there are several tools available supporting an absolute CVD risk approach, clinical uptake is limited due to a number of factors including an outdated continued reliance on the 'single risk factor' approach to prevention, diagnosis and treatment of CVD. A major barrier to uptake is inconsistent messages in the current clinical practice guidelines.

Key messages

- There are three main guidelines on the absolute CVD risk approach for Aboriginal and Torres Strait Islander peoples in Australia: The NVDPA Guidelines for the Management of Absolute Cardiovascular Disease Risk; The Central Australian Rural Practitioners Association Standard Treatment Manual; and the RACGP National Guide to a Preventive Health Assessment for Aboriginal and Torres Strait Islander People.
- There is considerable alignment between the existing guidelines, including the need for an absolute risk approach, conditions conferring automatic high risk, use of the Framingham risk equation as the basis of calculating absolute risk, and the need to treat people at a greater than 15% risk of a primary CVD event over the next five years.
- The guidelines diverge materially in relation to four recommendations:
    - the age at which to commence absolute CVD risk assessment;
    - whether or not calculated risk scores should be adjusted upward by 5%;
    - how often CVD risk should be assessed; and
    - treatment targets for blood pressure.
- Available evidence indicates that CVD events and high absolute CVD risk occurs earlier in Aboriginal and Torres Strait Islander peoples, and that prevention of CVD should also start early. The proportion of Aboriginal and Torres Strait Islander peoples at high absolute CVD risk at the ages of 18-34 years broadly corresponds to the proportion at high risk among the general population aged 45-54 years.
- Limited evidence suggests that the current risk scores are likely to underestimate risk in Aboriginal and Torres Strait Islander peoples. Specific data on the extent of underestimation and alternative

validated risk scores in this population are lacking. There is no primary data on adjusting risk scores upwards by 5% in Aboriginal and Torres Strait Islander people.

> Frequency of CVD risk assessment should be based on initial level of risk but the optimal interval for risk reassessment at each level of risk is not clear.

> There is general agreement between the guidelines to lower blood pressure as tolerated but there are inconsistencies in the exact blood pressure target. Evidence suggests that reductions in systolic blood pressure result in proportional reductions in CVD events and all-cause mortality.

> CVD guidelines could be kept up to date by adopting a 'living' guidelines model, but consideration needs to be given to how to identify relevant updated evidence and how to integrate the updates into electronic decision support tools.

Background

The impacts of CVD

Cardiovascular disease (CVD) is the leading cause of death globally and is a major contributor to morbidity. CVD is largely preventable, through effective evidence-based population- and individual-level interventions. There are high rates of premature Aboriginal and Torres Strait Islander CVD in Australia. Hospitalisation rates for ischaemic heart disease between the ages of 25 and 44 are 7-8 times higher among Aboriginal and Torres Strait Islander Australians compared to non-Indigenous Australians and 52% of Aboriginal and Torres Strait Islander CVD hospital admissions are among those aged <55 years, compared to 17% for non-Indigenous Australians.[1] Increased exposure to CVD risk factors, including smoking, diabetes and high blood pressure, rather than ethnicity per se, among these populations are primarily responsible for increased CVD risk.[1]

Evidence based approach to CVD risk assessment

Australian and international guidelines for CVD prevention and treatment recommend assessment and management of CVD risk using an absolute risk approach, that integrates information from multiple risk factors to assess how likely someone is to develop CVD in a given time period.[2-5] The use of multiple risk factors is highly predictive, and this approach is considered cost-effective and minimises under- and over-treatment compared to an approach using single risk factors.[6] In Australia, a person's risk of a primary CVD event (including heart attack and stroke) over the next five years is assessed using risk calculators and charts, combining clinical risk factors and the Framingham Risk Equation (FRE). The 2008 FRE uses information from the main CVD risk factors that can be easily assessed in primary care including age, total cholesterol, high-density lipoprotein (HDL) cholesterol, systolic blood pressure, smoking status and diabetes status.[7] In Australia, people classified as having an absolute risk above 15% in the next five years from the FRE are classified as being at high risk of a primary CVD event. In addition, certain groups can be assumed to be at high risk of cardiovascular events because of a diagnosed clinical condition and a calculation of absolute CVD risk in these people is not considered necessary. This includes those with prior CVD and those with specific clinical risk factors such as moderate or severe chronic kidney disease and diabetes with microalbuminuria.

Aboriginal and Torres Strait Islander absolute CVD risk

Nationally-representative data from the 2012-13 National Aboriginal and Torres Strait Islander Health Measures Survey show that among people aged 35-74 years, 10% had prior CVD and 16% were estimated to be at high absolute risk of a primary CVD event using the NVDPA absolute CVD risk assessment algorithm.[8] Around half of those at high risk of a future CVD event were not receiving lipid-lowering medications (47% for those with prior CVD and 58% for those at high risk of a primary CVD event).[8] In comparison, an estimated 20% of Australians between the ages of 45 and 74 are considered to be at high risk of a future CVD event (this includes 9% with prior CVD and 11% with high risk of a first-time primary event) with over two-thirds not receiving preventative treatments of combined blood pressure- and lipid-lowering medications.[9]

Aboriginal and Torres Strait Islander CVD risk is influenced by social and cultural determinants. Determinants that are specific to Aboriginal and Torres Strait Islander peoples include intergenerational trauma resulting from the effects of colonisation, loss of land and the erosion of cultural and spiritual identity[10] and racism and discrimination.[11] These determinants can directly impact on Aboriginal and Torres Strait Islander peoples' social and emotional wellbeing and contribute to an increase in behavioural and physiological risk factors, such as smoking and body mass index, thereby increasing the risk of CVD.[12-14]

Uptake of the absolute CVD risk assessment and management approach in Australia

In Australia there already exists a range of tools to calculate absolute risk of CVD, including the Australian Cardiovascular Risk Charts and the Australian Absolute Cardiovascular Disease Risk Calculator. There are also many clinical guidelines that relate to the assessment and management of CVD risk, including the National Health and Medical Research Council of Australia (NHMRC)-endorsed National Vascular Disease Prevention Alliance (NVDPA) Guidelines for the Management of Absolute Cardiovascular Disease Risk[5] and the Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual.[15] In the general Australian population, current clinical uptake is below what is considered optimal, with evidence suggesting that around 60% of primary care clinicians regularly perform absolute CVD risk assessment[16] and there is widespread under-treatment according to absolute risk.[9] Levels of uptake of the absolute CVD risk approach among Aboriginal and Torres Strait Islander populations is unknown. One of the potential barriers to improved clinical uptake is

inconsistencies in recommendations in current clinical practice guidelines and, until recently, PBS eligibility criteria for statins.

Aim

The aim of this report was to review current clinical guidelines relevant to Aboriginal and Torres Strait Islander absolute CVD risk assessment and management, identify points of alignment and discordance between the guidelines and review the evidence-base for the guidelines in relation to these points of discordance. Additionally, strategies for keeping clinical guidelines up to date were reviewed. This report was commissioned by the Australian Government Department of Health as part of a program of work aimed at reducing Aboriginal and Torres Strait Islander CVD morbidity and mortality through improving the uptake of an absolute risk approach to CVD assessment and treatment. The review and report were undertaken independently by researchers from: the National Centre for Epidemiology and Population Health, Research School of Population Health, Australian National University; the Academic Unit of General Practice, Medical School, Australian National University; and Rheumatic Heart Disease Australia, Menzies School of Health Research.

Methods

Guideline scoping

We aimed to identify all Australian clinical practice guidelines that made recommendations on absolute CVD risk assessment and management or related to diagnosis/treatment of related chronic conditions (hypertension, diabetes, kidney disease, depression). Since all CVD-related guidelines should include recommendations for Aboriginal and Torres Strait Islander peoples, we did not restrict our search to only those specific to Aboriginal and Torres Strait Islander peoples. In addition, during the scoping process, we included guidelines on related conditions regardless of whether they included recommendations on CVD risk assessment since it can be argued that they should. Guidelines were identified through a combination of database and website searches and stakeholder engagement. Four databases were searched: NHMRC Guidelines and Publications Portal, the NHMRC Australian Clinical Practice website, the Medical Journal of Australia List of Guidelines and Statements and the Royal Australian College of General Practitioners (RACGP) List of Clinical Guidelines.

Search terms: cardiovascular; cardiac; stroke; peripheral vascular disease; Aboriginal; Indigenous; Koori; Murray; Goori; prevention; diabetes; kidney; renal; hypertension; blood pressure; dyslipidemia; metabolic syndrome; mood; mental; depression; antipsychotics.

Inclusion criteria: Guidelines were included in the review if they met the following criteria:

1. Included guidance/recommendations on the assessment of primary CVD risk or related to treatment/management of common co-morbid conditions (diabetes, kidney disease, hypertension, mood disorders); and
2. Were currently being used in clinical practice in Australia as at September 2017.

Exclusion criteria: Guidelines were excluded if they related solely to secondary CVD prevention (since people with prior CVD are automatically considered at high risk and absolute risk scores do not need to be calculated), or specifically to clinical management in children or pregnant women.

Identification of points of discordance

Data extraction: Templates were used to systematically extract data from the relevant guidelines by LF, with secondary review by EP. Data extraction focused on three key components: i) a summary of general information about the guidelines; ii) assessment of absolute CVD risk scores for Aboriginal and Torres Strait Islander peoples, including the recommended approach to calculating risk, age for

commencing assessment and frequency of re-assessment; and iii) management of absolute CVD risk for Aboriginal and Torres Strait Islander peoples, including risk thresholds and treatment recommendations according to risk. Points of concordance and discordance were identified by comparing and identifying similarities and differences between the guidelines in the recommendation of Aboriginal and Torres Strait Islander CVD risk assessment and management.

Evidence review for aligning the guidelines

For each element of discordance identified, we identified the relevant evidence that informed the guidelines. In addition, we undertook a comprehensive search of the literature to identify any further relevant evidence published since the development of the latest guideline. This included a systematic review of literature related to Aboriginal and Torres Strait Islander or Māori absolute CVD risk assessment or management, published since 2012. We included evidence from Indigenous populations in New Zealand as such evidence has been used to inform Australian CVD guidelines in the past. We also conducted forward and backwards citation searches, used the expert knowledge of the research team to identify any missed studies or unpublished evidence, and conducted searches of published abstracts of the 2016 and 2017 Cardiac Society of Australia and New Zealand annual scientific meetings (abstracts prior to this time were not published in a searchable PDF format).The quality of the included studies was assessed using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies from the National Heart, Lung and Blood Institute. Further details of the search strategy are outlined in Appendix A.

Review of approaches for updating clinical guidelines

A systematic literature review was conducted to compare strategies for updating clinical guidelines, with the aim of identifying the most effective ways of keeping guidelines on absolute CVD risk assessment and management up to date. This review was not specific to the Aboriginal health context and was not limited to specific disease types. A previous systematic review, published in 2012, that examined strategies for monitoring and updating clinical practice guidelines was identified.[17] We aimed to update this review by systematically searching the literature published from 2012. Details of the search strategy are outlined in Appendix B.

Findings

Guideline scoping

A total of 228 guidelines[1] were identified using four guideline portals and an additional eight guidelines were identified using the experience and knowledge of the research team. Of the 236 identified guidelines, 14 met the inclusion criteria and were included in this review (see flow chart in Figure 1). An overview of the 14 included guidelines is provided in Table 1. Only one guideline, the NVDPA Guidelines for the Management of Absolute Cardiovascular Disease Risk, was specifically aimed at providing guidance on CVD risk assessment and management, although a further nine guidelines included some guidance on absolute CVD risk. Four guidelines related to health more generally or to comorbid conditions and did not provide recommendations on CVD risk assessment and management. All ten guidelines that provided recommendations on assessing absolute CVD risk also provided specific recommendations for assessing Aboriginal and Torres Strait Islander people. However, only one of these, the RACGP National Guide to a Preventive Health Assessment for Aboriginal and Torres Strait Islander people, was developed specifically and solely for use for Aboriginal and Torres Strait Islander populations.

Overall we identified three main guidelines that provided information on absolute CVD risk assessment and treatment to clinicians and health practitioners: (1) Guidelines for the Management of Absolute Cardiovascular Disease Risk developed by the NVDPA, latest version published in 2012; (2) The CARPA Standard Treatment Manual, latest version published in 2014; and (3) the National Guide to a Preventive Health Assessment for Aboriginal and Torres Strait Islander people developed by the RACGP and the National Aboriginal Community Controlled Health Organisation, latest version published in 2012. All other guidelines that made recommendations on absolute CVD risk assessment and management referred back to the NVDPA guidelines.

[1] Throughout the text we refer to a guideline as an individual document which provides clinical guidance and recommendations

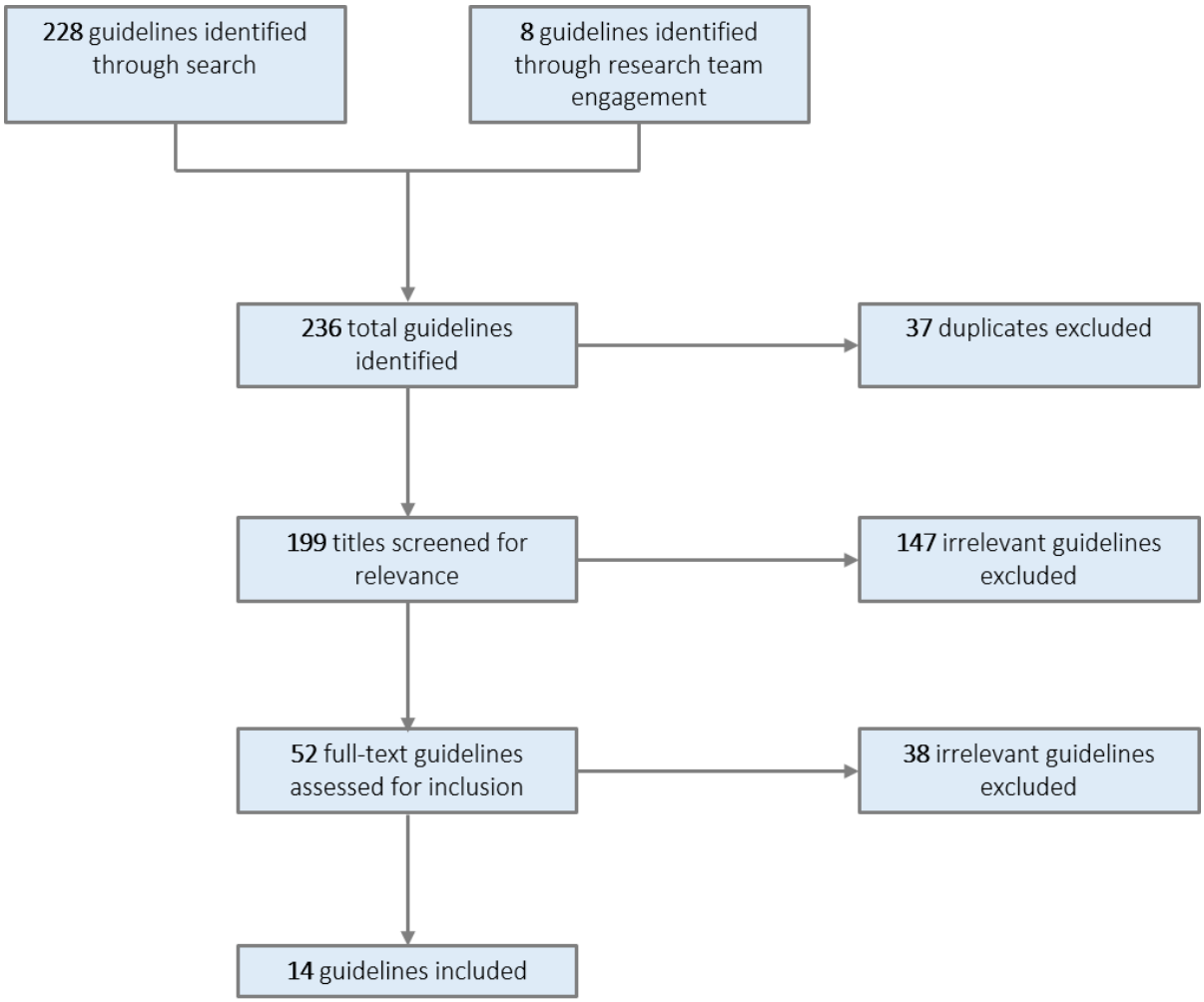


Figure 1: Flow diagram of guidelines included in the review

Table 1: Summary of included guidelines

Guideline (developer)	Intended audience	Period of evidence review & publication date	Absolute CVD risk included?	Recommendations for Aboriginal and Torres Strait Islander peoples included?	Aboriginal and Torres Strait Islander-specific guidelines?
CVD-specific guidelines					
Guidelines for the Management of Absolute Cardiovascular Disease Risk (National Vascular Disease Prevention Alliance [NVDPA])[5]	General practitioners, Aboriginal health workers, other primary care health professionals and physicians.	Search dates for evidence: 2006-June 2010 Published: 2012	Yes	Yes	No
General guidelines					
The Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual (CARPA Inc., Central Australian Aboriginal Congress, Flinders University)[15]	Practitioners working in remote practice in central and northern Australia.	Latest reference: 2011 Published: 2014 (6th Ed.)	Yes	Yes	No
National guide to a preventive health assessment for Aboriginal and Torres Strait Islander people (The Royal Australian College of General Practitioners [RACGP])[18]	All health professionals delivering primary healthcare to Aboriginal and/or Torres Strait Islander people.	Latest reference: 2012 Published: 2012 (2nd Ed.)	Yes	Yes	Yes
Therapeutic guidelines cardiovascular version 6* (Therapeutic Guidelines Limited)[19]	Clinicians	Latest reference: 2012 Published: 2012	Yes	Yes	No
Guidelines for preventive activities in general practice* (RACGP)[20]	Health professionals	Latest reference: 2012 Published: 2016 (9th Ed.)	Yes	Yes	No

Guideline (developer)	Intended audience	Period of evidence review & publication date	Absolute CVD risk included?	Recommendations for Aboriginal and Torres Strait Islander peoples included?	Aboriginal and Torres Strait Islander-specific guidelines?
Chronic Conditions Manual: Prevention and Management of Chronic Conditions in Australia* (Queensland Government, Royal Flying Doctor Service Australia, and Apunipima Cape York Health Council)[21]	Clinicians	Main absolute CVD evidence: 2012 Published: 2015 (1st Ed.)	Yes	Yes	No
Primary Clinical Care Manual (Queensland Health, Royal Flying Doctor Service (Queensland Section))[22]	Registered Nurses, Aboriginal and Torres Strait Islander Health Workers, Midwives, and Paramedics who have authority to practice under a Drug Therapy Protocol in rural hospitals, isolated practice areas, sexual health, or immunisation programs.	Published: 2016 (9th Ed.)	No	N/A	No
Putting prevention into practice: Guidelines for the implementation of prevention in the general practice setting (RACGP)[23]	General practitioners	Published: 2006 (2nd Ed.) Latest reference: 2005	No, although suggests GP could use 'cardiovascular risk calculator'	N/A	N/A
Guidelines on related chronic conditions or risk factors					
Guideline for the diagnosis and management of hypertension in adults – 2016* (The National Heart Foundation of Australia)[24]	Health professionals, particularly those working in primary care and community services.	Search dates for evidence: 2010-2014, with key literature identified up to December 2015 Published: 2016	Yes	Yes	No

Guideline (developer)	Intended audience	Period of evidence review & publication date	Absolute CVD risk included?	Recommendations for Aboriginal and Torres Strait Islander peoples included?	Aboriginal and Torres Strait Islander-specific guidelines?
General practice management of type 2 diabetes* (RACGP and Diabetes Australia)[25]	Health professionals	Latest reference: 2016 Published: 2016	Yes	Yes	No
Chronic Kidney Disease Management in General Practice* (The Australian Kidney Foundation)[26]	General practitioners	Latest reference: 2014 Published: 2015 (3rd Ed.)	Yes	Yes	No
Chronic Kidney Disease Guidelines (Kidney Health Australia – Caring for Australians with Renal Impairment (KHA-CARI))[27]	Clinicians and health care workers	Published: 2013 Latest reference: 2012	No	N/A	N/A
Smoking, nutrition, alcohol, physical activity (SNAP): A population health guide to behavioural risk factors in general practice* (RACGP)[28]	General practitioners and practice staff	Published: 2015 (2nd Ed.)	Yes	Yes	No
Australian guidelines for the treatment of adults with acute stress disorder and posttraumatic stress disorder (Australian Centre for Posttraumatic Mental Health)[29]	Health practitioners, consumers, and policy makers	Published: 2013 Latest reference: 2012	No	N/A	N/A

*Based on NVDPA 2012 guidelines

Points of alignment between guidelines

An overview of recommendations for the assessment and management of CVD absolute risk in the relevant Australian clinical guidelines is provided in Tables C1 and C2 in Appendix C. We identified four commonalities across the guidelines: definitions of clinically-determined high risk groups, recommended risk score, risk thresholds for treatment, and treatment targets for lipids and lifestyle modification.

Clinically-determined high risk

In addition to recommending assessment of absolute CVD risk, most guidelines consistently recommend treatment of people with extremely elevated levels of single risk factors or those with clinical conditions that increase susceptibility to CVD. The reviewed guidelines consistently consider people with the following conditions to be at high risk of absolute CVD without the need to calculate an absolute risk score: diabetes and albuminuria; diabetes and being over the age of 60; chronic kidney disease; systolic blood pressure ≥180 mmHg; and/or total cholesterol ≥7.5 mmol/L. In addition, the NVDPA (and all other guidelines that refer back to these) and the RACGP guidelines consider people to be at high risk if they have a diastolic blood pressure of ≥110 mmHg or a previous diagnosis of hypercholesterolaemia. In all guidelines, people that have had a prior CVD event or Aboriginal and Torres Strait Islander people who are aged >74 years (additionally, in the CARPA guidelines, non-Indigenous people aged 75 years or older) are assumed to have a high risk of CVD and an absolute CVD risk score does not need to be calculated. People with prior CVD are treated according to different sets of guidelines that focus on the management of stroke, heart failure and acute coronary syndrome.[30-32]

Recommended risk score

The guidelines consistently recommend using Australian-specific risk charts or calculators based on the FRE. Almost all guidelines suggest using the online Australian Absolute Cardiovascular Disease Risk Calculator (www.cvdcheck.org.au), developed by the NVDPA, with the exception of the CARPA Standard Treatment Manual which publishes its own charts that have been adapted from those created by the NVDPA and the New Zealand Cardiovascular Risk Charts (2009). The General Practice Management of Type 2 Diabetes guideline also provides information about additional resources including the New Zealand Cardiovascular Risk Charts (2009) and the Heart Foundation New Zealand Know Your Numbers website (www.knowyournumbers.co.nz).

Risk thresholds for treatment

Except for the Chronic Kidney Disease Management in General Practice guideline and the SNAP guideline where risk thresholds for treatment are not explicitly discussed, all guidelines consistently state that treatment should commence when there is more than a 15% risk of a primary CVD event over the next five years. These treatments generally include advice and support for lifestyle changes (e.g. in relation to diet, physical activity and smoking cessation) and commencement of blood-pressure- and lipid-lowering therapy. Although none of the guidelines recommends the immediate routine use of medications in those at moderate risk (10-15% risk of a primary CVD event in the next five years), the NVDPA and the RACGP guidelines recommend lifestyle changes and consideration of blood pressure and lipid-lowering therapy for people where treatment targets are not met after 3-6 months of lifestyle changes or for people who have additional risk factors. Additional risk factors include persistently elevated blood pressure (>160/100 mmHg), a family history of premature CVD, and populations such as Aboriginal and Torres Strait Islander peoples where the FRE is likely to underestimate risk (see below).

Lifestyle and lipid treatment targets

All three main guidelines recommend aiming for health behaviour changes comprising smoking cessation, dietary changes including reducing salt intake (specified target of <4g/day in the RACGP guidelines) and reducing alcohol consumption (specified as a maximum two standard drinks/day in the CARPA and RACGP guidelines). The CARPA and NVDPA, but not the RACGP, guidelines also recommend increasing physical activity (specified target of at least 30 minutes of moderate intensity physical activity on most or all days of the week in the NVDPA guidelines). While the CARPA guidelines recommend monitoring lipids and treating to target, only the NVDPA guideline (and other guidelines that refer back to the NVDPA guidelines) provide specific lipid targets of: <4 mmol/L for total cholesterol, ≥1 mmol/L for high-density lipoprotein, <2 mmol/L for low-density lipoprotein and triglycerides, and <2.5 mmol/L for non-high-density lipoprotein.

Points of discordance between the guidelines

Four key points of discordance were identified between the guidelines:

- age at which screening for CVD risk is recommended to commence for Aboriginal and Torres Strait Islander people;
- whether CVD risk should be automatically adjusted upwards for Aboriginal and Torres Strait Islander people;

- how frequently CVD risk should be re-assessed; and
- the recommended treatment targets for blood pressure.

Age for commencing screening

All guidelines, except the CARPA Standard Treatment Manual, suggest screening should begin at 35 years for Aboriginal and Torres Strait Islander people and 45 years for non-Indigenous people. The CARPA Standard Treatment Manual recommends starting screening at 20 years of age for Aboriginal and Torres Strait Islander peoples and 45 years of age for non-Indigenous people.

Risk adjustments

Although all the guidelines recognise that Aboriginal and Torres Strait Islander peoples are at increased risk of CVD, and that the FRE is likely to underestimate risk in this population, only the CARPA Standard Treatment Manual and the National Heart Foundation hypertension guidelines make a specific recommendation to revise absolute risk prediction for Aboriginal and Torres Strait Islander people upwards by 5%. An additional 5% is also automatically added to absolute CVD risk scores for Aboriginal and Torres Strait Islander people in the CARPA risk calculator that is integrated into the Communicare patient information and recall system and the Northern Territory's Primary Care Information System (PCIS).[2]

Frequency of risk re-assessment

Recommendations on how often people should have their absolute CVD risk re-assessed vary between guidelines. The RACGP Aboriginal and Torres Strait Islander-specific guidelines recommend re-assessment of all Aboriginal and Torres Strait Islander people aged 35-74 annually, while the RACGP Guidelines for Preventive Activities in General Practice recommend re-assessment every 2 years. The CARPA Standard Treatment Manual, the NVDPA guidelines, the Therapeutic Guidelines Cardiovascular version 6, and the General Practice Management of Type 2 Diabetes guidelines recommend re-assessment based on absolute CVD risk status every 2 years for those at low risk (<10%), every 6-12 months for those at moderate risk (10-15%) and according to clinical context for those at high risk (>15%).

[2] The other two major primary care software programs, Medical Director and Best Practice, have the FRE integrated but do not add an additional 5% to calculated CVD risk for Aboriginal and Torres Strait Islander people.

Blood pressure treatment targets

The CARPA, NVDPA and the National Heart Foundation of Australia hypertension guidelines generally agree that lower blood pressure—up to reasonable clinical limits—is better for CVD risk but differ in terms of recommended treatment targets that are recommended. The RACGP guidelines do not explicitly state any blood pressure treatment targets. The CARPA Standard Treatment Manual suggests aiming for blood pressure <130/80 mmHg but explicitly states that medications should not be stopped once targets are reached. The NVDPA guidelines have a slightly higher treatment target of ≤140/90 mmHg except for those with diabetes and albuminuria where a blood pressure target of ≤130/80 mmHg is suggested. It is acknowledged that while treatment targets can be used to monitor treatment effects, more intensive blood pressure lowering is associated with greater reductions in CVD events and this should be assessed against the benefits and harms of treatment in individual patients. The National Heart Foundation of Australia hypertension guideline recommends aiming for systolic blood pressure <140 mmHg in people with uncomplicated hypertension and considering a lower target of <120 mmHg in people with high CVD risk (10-year risk of >20%) with increased monitoring to identify any adverse side-effects.

Evidence review for aligning the guidelines

After reviewing the evidence cited in the current clinical guidelines, one study reported original research examining how well the FRE predicts Aboriginal and Torres Strait Islander CVD risk. No evidence was cited in relation to three of the four main points of discordance between the guidelines: age of commencing screening, risk adjustment, and frequency of risk re-assessment. Multiple sources of primary data were cited in the guidelines in relation to blood pressure targets. We then conducted a systematic literature search of MEDLINE and Scopus for any relevant evidence published since release of the guidelines, identifying 263 papers. Of these, three met our inclusion criteria (see flow chart of study selection in Appendix D). No further relevant studies were located from the forwards and backwards citation searches of references from the included studies or through a search of abstracts of the Cardiac Society of Australia and New Zealand annual scientific meetings. An additional study was found through stakeholder engagement. A summary of the characteristics of the relevant studies is included in Table 2.

Of the five identified relevant studies, two involved Aboriginal peoples from the Northern Territory, one included Aboriginal peoples from Western Australia, one included Aboriginal and Torres Strait Islander peoples from Far North Queensland and one involved Indigenous New Zealand populations.

All studies were found to be of fair or good quality. Approximately equal numbers of men and women were included in each of the studies. Two studies assessed coronary heart disease rates per 1,000 person years,[33, 34] one assessed ten-year absolute CVD risk[35] and two assessed both five- and ten-year absolute CVD risk.[36, 37]

Two studies assessed how well the FRE performed for Aboriginal peoples from remote Northern Territory[34] and urban Western Australia (Table 3).[33] Both studies found that the FRE underestimated Aboriginal CVD risk; observed rates of coronary heart disease were estimated at 11-13 cases per 1,000 person years and were approximately 2.5 times higher than the predicted rates. The FRE particularly underestimated CVD risk in younger women (under the age of 35) in remote communities where the observed rates were 30 times higher than those predicted.[34]

Since there is evidence that the FRE underestimates risk in Aboriginal people, the CARPA Standard Treatment Manual and associated electronic decision support tools and the National Heart Foundation of Australia hypertension guideline adjust risk automatically upwards by 5% for Aboriginal and Torres Strait Islander people. This is based on similar recommendations for the Indigenous population and other at-risk populations (those with a family history of premature CVD and those with diabetes who also have microalbuminuria or who have had diabetes for 10 or more years or who have HbA1c consistently 8%) in the New Zealand Cardiovascular Guidelines Handbook.[4] Calibration (how well predicted rates match the observed rates) of this New Zealand adjusted score was compared to that for the unadjusted FRE in a sample of 21,000 Māori, Pacific and Indian people (Table 3).[37] In these populations that are exposed to high levels of risk factors, the FRE underestimated five-year CVD risk by 1.1-2.2% in people with low risk and overestimated risk by 2.4-4.1% in people with high predicted risk. The New Zealand adjusted score overestimated risk in the Māori, Pacific and Indian participants by around 1-5% in people at low risk and 7-9% in people with predicted high risk. This suggests that the automatic upward adjustment of the FRE by 5% may over-correct the underestimation in some high risk populations and the authors suggest that population-specific risk scores are needed.[37]

Work on developing population-specific risk scores for Aboriginal and Torres Strait Islander peoples is starting in Australia. Two related studies by Adegbija and colleagues (both published in 2015, listed as a single entry in Tables 2 and 3) aimed to predict absolute CVD risk using a simplified risk score consisting of age and waist circumference. Age and waist circumference were associated with absolute CVD risk but common performance measures, including calibration and discrimination (how well the score discriminates between people with and without CVD), were not reported. They found that the

established waist circumference cut-offs of 88cm for women and 102cm for men overestimated and underestimated CVD risk, respectively.[35] Among the Aboriginal population they estimated a waist circumference of 91.5cm for men and 92.5cm for women was associated with a similar absolute CVD risk as having a body mass index in the overweight range.[38] Hua and colleagues (2017) used Aboriginal and Torres Strait Islander data from 1,448 people in 26 communities in Far North Queensland to recalibrate the FRE. The recalibrated score had improved the ability to discriminate between those with and without CVD and was better calibrated than the FRE alone.[36] However, their approach did not take into account people at clinically-determined high risk, even though the vast majority of Aboriginal and Torres Strait Islander peoples classified as being at high absolute risk are so categorised because of clinical factors, especially diabetes and chronic kidney disease.[8] At this stage the recalibrated score has also not been validated in a different Australian Aboriginal and Torres Strait Islander population, which is essential before a recalibrated risk score can be recommended for use in practice.

Table 2: Characteristics of included studies examining absolute cardiovascular disease risk assessment in Aboriginal and Torres Strait Islander people or Indigenous New Zealand populations

Author	Objective	Study design	Study setting and target pop	Sample size	Sex (%)	Age range	CVD definition
Studies cited in current clinical guidelines (published prior to 2010)							
Wang et al., 2005[34]	Assess whether the FRE predicts risk in Aboriginal people	Prospective cohort study	Aboriginal people in remote Northern Territory region	687	Men (52) and women (48)	20-74 years	Predicted coronary heart disease (CHD) (myocardial infarction, death from CHD, angina pectoris and coronary insufficiency) rates per 1000 person years
Relevant studies identified through expert collaboration							
Bradshaw et al., 2009[33]	Assess whether the FRE predicts risk in urban Aboriginal people	Cohort study	Aboriginal people in Perth, Western Australia	891	Men (45) and women (55)	18-80	Predicted CHD event (ischaemic heart disease, coronary revascularisation, cardiac-related death) rates per 1000 person years
Studies identified through a systematic literature search (2010-2017)							
Adegbija et al., 2015[35, 38]	Prediction of cardiovascular disease risk using waist circumference in Aboriginal and Torres Strait Islander people	Prospective cohort study	Aboriginal people in a remote community in the Northern Territory	920	Men (51) and women (49)	18-76 years	10-year absolute CVD risk
Hua et al., 2017[36]	Validation of the 1991, 2008 and recalibrated FRE CVD models	Cohort study	26 remote Aboriginal and Torres Strait Islander communities in Far North Queensland who undertook Well Person's Health Check cohort	1448	Men (48) and women (52)	30-74 years	5- and 10-year CVD risk. CVD defined as CHD (including myocardial infarction, angina pectoris and coronary insufficiency), CHD death, stroke, congestive heart failure and peripheral vascular disease

Author	Objective	Study design	Study setting and target pop	Sample size	Sex (%)	Age range	CVD definition
Riddell et al., 2010[37]	Assess the calibration of the FRE and New Zealand adjusted FRE	Prospective cohort study	European and Māori, Pacific and Indian participants in New Zealand	21,026 Māori, Pacific, and Indian	Not specified but there were 55% men and 45% women in the overall population (including non-Indigenous people).	30-74 years	5-year CVD risk. CVD defined as ischaemic heart disease, stroke or transient ischaemic attack, peripheral vascular disease, percutaneous coronary intervention and/or coronary artery bypass graft

Table 3: Details of CVD absolute risk assessment and findings of included studies relating in Aboriginal and Torres Strait Islander people or Indigenous New Zealand populations

Study	Age of screening commencement	Factors defining clinically determined high risk	Risk score and adjustments	Findings	Quality rating (good, fair poor)
Studies cited in current clinical guidelines (published prior to 2010)					
Wang et al., 2005	20	Not specified	FRE	Observed CHD rates were 2.5 times the FRE predicted rates (11 CVD cases per 1000 person-years vs. predicted 4.4 per 1000 person-years). Underestimation was particularly high in women, especially younger women, with the observed rates of CVD (3.3 cases per 1000 person-years) being around 30 times higher in Aboriginal women under the age of 35 than those predicted by the FRE (predicted 0.1 per 1000 person-years).	Fair
Relevant studies identified through expert collaboration (published prior to 2010)					
Bradshaw et al., 2009	18	Recorded diagnosis of CHD, reported diabetes, hypertension and obesity	FRE	Observed CHD rates were comparable to those seen in Wang et al. (2005), 12.6 CHD cases per 1000 person-years. Comparable trends were seen in all age categories (though higher rates seen in middle age categories [35-44 and 45-54] in the urban populations).	Fair
Studies identified through a systematic literature search (2010-2017)					

Study	Age of screening commencement	Factors defining clinically determined high risk	Risk score and adjustments	Findings	Quality rating (good, fair poor)
Adegbija et al., 2015	18	Not specified	Waist circumference and age were the only two predictors used	Absolute CVD risk increased with increasing age and waist circumference. The established waist circumference cut-offs of 88cm in women and 102cm in men overestimated CVD risk in women and underestimate it in men suggesting different cut-points are needed for Aboriginal populations. Another paper by this group suggests waist circumference cut-offs of 91.5cm in men and 92.5cm for women have similar absolute CVD risks as having a body mass index in the overweight range.	Good
Hua et al, 2017	35	Not specified	FRE 1991 & 2008.	FRE significantly underestimated the CVD risk by 1/3. The 1991 model showed good discrimination ability but poor calibration. After recalibration the 2008 model corrected the underestimation and improved calibration for 5-yr risk prediction. A 5-year absolute CVD risk chart for the Aboriginal and Torres Strait Islander people was generated, based on a recalibration of the 2008 FRE. The recalibrated risk score showed a slightly improved risk discrimination compared to the uncalibrated FRE and improved calibration. External validation has not yet been done.	Fair
Riddell et al., 2010	30	Not specified. People with diabetes plus nephropathy or a diagnosed genetic lipid disorder were excluded.	FRE and a New Zealand adjusted FRE which includes adding 5% to the predicted risk for people of Māori, Pacific or Indian subcontinent ethnicity or with other risk factors	The FRE underestimated CVD risk by 1.1-2.2% in people with low risk and overestimated risk by 2.4-4.1% in people with high predicted risk. The NZ adjusted FRE overestimated risk in the Māori, Pacific and Indian participants by around 1–5% in people at low risk and 7–9% in people with predicted high risk.	Fair

Review of approaches for updating clinical guidelines

Current approach for updating CVD clinical guidelines in Australia

The NVDPA guidelines, last published in 2012, use a comprehensive but resource-intensive approach to guideline development and updating which involves a combination of literature searches and reviewing of the evidence, formulation of recommendations, and public consultation.[5] To formulate the recommendations, an expert consensus-based approach is used whereby several members of the expert working group use the information from the literature review to draft recommendations. These are sent to the whole expert working group for feedback until a consensus agreement of >75% is achieved (this required two circulation rounds for the last update of the NVDPA guideline in 2012). This process can take several years to complete which means that some aspects of the guidelines are likely to be out of date by the time they are published. Furthermore, the resources required mean that updating is conducted infrequently. In an effort to ensure more up to date clinical guidelines, other approaches such as the creation of 'living' guidelines are being explored. For example, the Cancer Council of Australia is replacing printed versions of guidelines with an online wiki platform where continuously updated guidelines are published (http://wiki.cancer.org.au/australia/Guidelines). The sections below provide an overview of the current evidence for approaches to evaluating if clinical guidelines are out of date, different literature search strategies for updating guidelines, and approaches for ensuring guidelines are kept up to date. Evidence has been drawn from previous systematic reviews of this topic,[17, 39, 40] supplemented by an updated search of the literature from 2012 onwards. We identified a total of 10 relevant studies in addition to those captured in the previous systematic reviews (see flow chart of study selection in Appendix E), with summaries of the evidence provided in Tables F1-F2 in Appendix F.

Approaches to evaluating if guidelines are out of date

Different tools have been developed to assist with deciding whether guidelines need updating. Examples include flow-charts to help guide the development group through the process of determining the type and scope of an update (Appendix G)[39] and questionnaires as part of a two-stage document assessment and review approach.[41] In the first stage of this document assessment and review approach a clinical expert and methodologist assess the guidelines using a six-item questionnaire which classifies guidelines into endorse, defer, review or archive (Appendix H).[41] A four-item questionnaire is then used for guidelines that are to be reviewed to help determine the impact of any new evidence and any actions to be taken (Appendix I). However, this document assessment and review approach is time consuming (median time of 167 days) so although it may help guide decisions about when to update

guidelines, it is unlikely that this would shorten or make less onerous the process of updating guidelines.

Literature search strategies for updating guidelines

There are two main approaches that are used for finding relevant literature to update clinical guidelines. Restrictive searches use specific search terms to focus the updated literature review to certain topics, while exhaustive searches aim to canvass all the relevant literature. An exhaustive search is the gold standard strategy for updating guidelines,[17] but this approach is generally more burdensome, costly and time consuming compared to restrictive searches.[17, 42] Restrictive searches are potentially more effective than exhaustive searches and take significantly less time to perform, but may fail to identify studies that could potentially trigger an update.[43-45] A possible area for future research would be to assess the use of a combined approach whereby a restrictive search strategy in addition to input from experts is used to identify key references for recommendations that are already based on good evidence, and an exhaustive search strategy in addition to input from experts is used to identify evidence for recommendations based on little or weak evidence. A scoring algorithm has also been developed to select the most relevant evidence for guidelines.[46] Relevant articles are retrieved using a literature search and then filtered using a set of criteria. An algebraic model is then used to score the evidence based on its relevance. Validation of this process using 40 random guidelines indicated that 90% of relevant articles were found.[46]

Strategies for keeping guidelines up to date

Generally the process for updating guidelines is poorly described in guideline handbooks.[47] In many circumstances, partially updating guidelines can be more appropriate than updating the whole clinical guideline.[39] Full updates are resource intensive, with the costs and effort comparable to those required for the initial development.[39] Partial (or 'selective') updates can provide updates in a timeframe that suits the fast-paced developments in health care. However, deciding which parts or recommendations in the guideline need updating can be difficult and subjective.[39, 45] Input from stakeholders and experts can reduce subjectivity[47] but this may slow down the updating process if feedback is not timely or if a consensus is not reached.[41, 43] A common approach to updating guidelines is to re-evaluate guidelines within a specified timeframe. For Australian CVD-related guidelines this is typically occurs every five years in practice, but most handbooks and studies suggest re-evaluating guidelines more frequently at around every two to three years.[40, 45]

A novel approach that has emerged is the idea of 'living' guidelines that are regularly or continuously updated. Living guidelines are developed using similar methodology as is used for partial updates but updates are made on a continuous rolling basis. The Scottish Intercollegiate Guidelines Network (SIGN) manual for guideline development (SIGN 50) suggests that living guidelines are updated annually or biannually but with timing that depends on how fast new evidence emerges.[48] The specific parts of the guidelines to be updated will depend on what new evidence has been identified. For example, this methodology is used to keep the British Guideline on the Management of Asthma up to date, with draft updates presented at the British Thoracic Society biannual meetings and draft updates published on both the SIGN and British Thoracic Society websites for comment for a fixed period of time. A similar approach could be used to keep the main NVDPA guidelines up to date, with draft updates presented to an advisory committee of health care experts and with the most up to date guidelines published on relevant websites (such as the Heart Foundation webpage) or a custom-built wiki platform.

Tools to support the development and dissemination of updated and living guidelines are becoming available. For example, an online software application, called MAGICapp (Making GRADE the Irresistible Choice, available at: http://magicproject.org/) can support the creation of electronic guidelines and publication on the web and on smartphones and tablets and the creation of decision aids and integration with electronic medical records. When guidelines are modified or updated these end-user outputs will be automatically updated to reflect the guideline changes.[49] The use of electronic tools and publication platforms, such as the Cancer Council of Australia wiki platform, may facilitate guideline updates while maintaining methodological rigor and transparency.[47] The MAGICapp is currently used to support development of several international and national guidelines including the NHMRC Guidelines for the Prevention and Control of Infection in Healthcare.

Discussion

Summary of key findings

We identified three main guidelines that guide Aboriginal and Torres Strait Islander absolute CVD risk assessment and management in Australia: the NVDPA Guidelines for the Management of Absolute Cardiovascular Disease Risk; the CARPA Standard Treatment Manual; and the RACGP National Guide to a Preventive Health Assessment for Aboriginal and Torres Strait Islander People. All other guidelines that make recommendations on absolute CVD risk primarily relate back to the guidance of the NVDPA guideline. Focusing on alignment of the three main clinical guidelines is therefore likely to ensure consistency among the guidelines going forward. This review of the evidence is timely as the NVDPA guidelines were due to be updated in 2017 and the RACGP guidelines were in the process of being updated at the time of writing this report.

Reassuringly, in areas where there is strong empirical evidence (such as clinically determined high risk, risk scores and lipid treatment targets), recommendations were generally consistent across the clinical guidelines. The guidelines diverged with respect to recommendations that were mostly based on consensus-based expert opinion. The four main points of discordance identified included the age at which to commence absolute CVD risk assessment, additional risk adjustments for people identifying as Aboriginal or Torres Strait Islander, how often CVD risk should be assessed, and exact treatment targets for blood pressure. At the time of development of most of these guidelines there was little empirical evidence to inform the first three of these points. In the section below ('Evidence for aligning the guidelines') we outline the current evidence for each of main points of discordance between the guidelines.

In addition to aligning the guidelines so that consistent clinical messages are provided, it is important to consider the most appropriate ways of keeping the guidelines up to date in the future. This is particularly important as more empirical evidence to guide Aboriginal and Torres Strait Islander CVD risk assessment and management becomes available (see 'Future directions' below). Up to half of all clinical guidelines become out of date within six years,[50] and given how long the updating process can take, recommendations in some guidelines may be out of date by the time of publishing. A promising strategy is the idea of living guidelines which involve continuously updating sections of guidelines as new evidence becomes available. Similar to new measures by the Cancer Council of Australia, the most up to date version of CVD absolute risk assessment and management guidelines, as well as draft updates for comment, could be published and accessed via an online wiki platform rather than

published as hard-copies. Such an approach can be less resource intensive and ensure guidelines are updated and disseminated to users as new evidence becomes available. However, consideration needs to be given as to how this would be done in practice and who would be responsible for decision-making, as well as when guideline recommendations should be integrated into clinical decision support software, as is done for the CARPA guidelines. Tools such as MAGICapp may be useful to support reflecting guideline updates in clinical software.

Evidence for aligning the guidelines

Age for commencing screening

All the guidelines, except for the CARPA Standard Treatment Manual, recommend Aboriginal and Torres Strait Islander CVD risk assessment should commence at age 35. The CARPA Standard Treatment Manual recommends an earlier starting age of 20 years. Although the current version of the RACGP guideline also recommends commencing screening, using clinically-determined high risk categories and the FRE, from the age of 35 years, the newest version of this guideline (currently being updated) will recommend commencing screening from the age of 30 years instead. Although not specifically a guideline, the Essential Service Standards for Equitable National Cardiovascular Care (ESSENCE) recommends that Aboriginal and Torres Strait Islander people aged 15 years and over should be offered a cardiovascular risk assessment using a validated absolute risk algorithm at least once every year.[51]

At the population-level, Aboriginal and Torres Strait Islander CVD risk occurs earlier in life compared to non-Indigenous Australians. Nationally representative data from the 2012-13 Australian Aboriginal and Torres Strait Islander Health Survey found that 9% of Aboriginal and Torres Strait Islander people aged 18-34 had self-reported CVD, double that reported by non-Indigenous Australians, and 52% of Aboriginal and Torres Strait Islander CVD hospitalisations occur among those aged <55 years compared to 17% for non-Indigenous Australians.[1] Using data from the 2012-13 National Aboriginal and Torres Strait Islander Health Measures Survey, an estimated 1.1% of 18-24 year olds and 4.7% of 25-34 year old Aboriginal and Torres Strait Islander people were at high absolute primary risk of CVD.[8] It should be noted that 4.0% of the general population aged 45-54 is at high primary CVD risk.[8] This evidence suggests high CVD risk occurs earlier in life for Aboriginal and Torres Strait Islander people than is targeted in most of the current guidelines, and Aboriginal and Torres Strait Islander people between the ages of 18 and 34 experience an equivalent level of risk to the general population aged 45-54 years. However, it is not clear at what age risk assessment should commence within this interval of 18-34 years. The FRE is only validated for use in people aged 30-74,[52] and since age is the main driver of

predicted CVD risk using the FRE, short-term five- and ten-year absolute risk scores tend to underestimate risk in younger people who do not have clinically-determined high risk, even if they have several other CVD risk factors. Although there is some evidence that the FRE underestimates CVD risk in Aboriginal and Torres Strait Islander people, there is no direct evidence about whether, and to what extent, the NVDPA algorithm which includes both clinically-determined high risk categories and absolute risk estimated from the FRE underestimates risk in this population. Based on unpublished data from the 2012-13 National Aboriginal and Torres Strait Islander Health Measures Survey, over 75% of those who were at high CVD risk were identified based on clinically-determined high risk categories, using the NVDPA algorithm; the proportion was even higher at younger ages.[8] Hence, identification and management of those with diabetes and chronic kidney disease is an important component of improving CVD health.

Risk adjustments

Risk scores are better at predicting risk when the population they are applied to is similar to the population used to derive the risk score or if the risk score has been recalibrated for use in the relevant population. Currently, no Aboriginal and Torres Strait Islander risk scores have been developed and validated, although research is progressing in this area. Available validated risk scores, such as the FRE, tend to underestimate risk in Indigenous populations, including Aboriginal and Torres Strait Islander peoples and Māori people in New Zealand.[33, 34, 37] The FRE was developed using data from a cohort of people from Framingham, Massachusetts in the US, originally set-up in the 1940s,[53] whose profile of risk factors and CVD events rates differ greatly from those observed in Aboriginal and Torres Strait Islander communities.

The New Zealand Cardiovascular Guidelines Handbook currently recommends adding 5% to the calculated risk for Māori and Pacific peoples and people from the Indian subcontinent.[4] Based on the New Zealand recommendations, a similar risk adjustment is used in the CARPA Standard Treatment Manual and is available in risk calculators within Communicare and PCIS software where the CARPA guideline recommendations are followed. The decision to adjust risk scores by adding 5% to scores for New Zealand Indigenous and other at-risk populations was based on expert opinion by the NZGG (New Zealand Guidelines Group) Guidelines development team, building on evidence that these people are exposed to greater levels of CVD risk factors and are at higher risk of CVD events. More recent work from New Zealand suggests that this 5% risk adjustment can lead to overestimating CVD risk in Māori, Pacific, and people of Indian origin in New Zealand.[37] While this might be preferable to underestimating

risk, no studies have been conducted to assess the validity of adjusting CVD risk scores upwards by 5% in Aboriginal and Torres Strait Islander people. There is a clear need for risk scores to be developed or recalibrated specifically for Indigenous populations. Work in this area has commenced in Australia with attempts at recalibrating the FRE for Aboriginal and Torres Strait Islander peoples.[36] However, the impacts of this study are limited as clinically-determined high risk was not taken into account, the recalibrated equation has not been externally validated, and it is not clear whether a single recalibrated score can be applied across different Aboriginal and Torres Strait Islander populations across Australia. Further inroads are likely in the future (see more information in 'Future directions' below).

Frequency of risk re-assessment

There was variation between the guidelines in recommendations for how often CVD risk should be re-assessed. Recommendations varied from set intervals (such as every two years) to risk-specific intervals, and none of the guidelines provided suggestions specific for Aboriginal and Torres Strait Islander people. These differences are not confined to Australian guidelines, with variations seen across international CVD risk assessment and management guidelines.[3, 31, 54] This is likely due to the paucity of evidence on optimal intervals for risk assessment, with recommendations being developed using consensus-based expert opinion rather than published literature. Australian non-Indigenous evidence shows there is large variation in how often general practitioners think CVD risk should be re-assessed.[55] After reviewing hypothetical patient case files, re-assessment within six months was recommended for most (71%) patients, which is a much shorter time-frame than that recommended by most guidelines. This study suggests that among the general Australian population general practitioners were not aware of or did not follow recommended time intervals for risk re-assessment. However, the study provides no evidence on how often risk should be re-measured.

We were only able to find one study that quantitatively assessed how often CVD risk should be re-assessed.[56] Published in 2013, after development of most of the current guidelines, the study used data from longitudinal cohort studies in Japan and the US to assess the probability that participants with low-moderate risk would cross the treatment threshold (in this case >20% risk of CVD over a ten-year time frame) at specific times. The results suggest that people with a baseline risk of <10% over 10 years do not need to be re-assessed for a further 8-10 years, those with a 10-<15% risk may need risk re-assessment somewhere between 3-8 years, and those with a 15-<20% may need to be re-assessed within one year. The results of this study suggest that recommendations for risk re-assessment should be based on initial level of risk (as is outlined in the NVDPA and CARPA guidelines) but further research

is needed to specify the optimal re-assessment intervals for Australian (Aboriginal and Torres Strait Islander and non-Indigenous) risk thresholds.

Blood pressure treatment targets

The guidelines generally provided a consistent message that lower blood pressure—within reasonable clinical limits—was better for improved CVD outcomes, but there were differences in the exact blood pressure targets recommended, likely due to the difference in timing of previous guideline updates. This point of discordance was not specific to Aboriginal and Torres Strait Islander people, and was instead a general point of difference between the guidelines. In contrast to the other three points of discordance, there is strong empirical evidence to inform recommendations on blood pressure targets. Earlier evidence from clinical trials found no difference in CVD events between people with type 2 diabetes treated to a target of <120 mmHg and <140 mmHg.[57] This earlier evidence informed guidelines published in 2012 or prior, such as the NVDPA guidelines which recommend a systolic blood pressure target of <140 mmHg. More recent evidence suggests that greater reductions in CVD events can be achieved with lower blood pressure targets. The Systolic Blood Pressure Intervention Trial (SPRINT) allocated 9,361 people at high risk of CVD (ten year risk of ≥20%) to treatment targets of <120 mmHg or <140 mmHg.[58] Those treated to the lower systolic blood pressure target of <120 mmHg had fewer CVD events and lower risk of all-cause mortality over a 3-year period, although they also experienced a greater number of adverse events. A systematic review and meta-analysis published in 2016, included over 600,000 participants contributing data to SPRINT and to 122 other clinical trials, found a 20% reduction in the risk of CVD events and a 13% reduction in all-cause mortality for every 10 mmHg reduction in systolic blood pressure.[59] The review found that results were consistent across different levels of initial blood pressure, even in those with systolic blood pressure of <130 mmHg, and in people with and without prior CVD.[59] Overall the evidence suggests that there is a proportional relationship between lower systolic blood pressure and improvements in CVD outcomes. There is strong evidence to support targeting of systolic blood pressure to <130 mmHg although lower is generally better and exact treatment targets should be decided on an individual basis depending on the clinical context and consideration of the benefits vs. harms. This evidence informed the development of the 2016 National Heart Foundation of Australia hypertension guideline which recommends a general target of systolic blood pressure <140 mmHg and a lower target of <120 mmHg in those at high absolute CVD if considered safe on an individual basis.

Future directions

Although we found little direct empirical evidence using data from Aboriginal and Torres Strait Islander populations in our evidence review, the importance of providing specific recommendations for Aboriginal and Torres Strait Islander peoples should be acknowledged. All Australian guidelines that made recommendations on absolute CVD risk assessment also provided specific recommendations for assessing and managing Aboriginal and Torres Strait Islander CVD risks. In addition to the clinical guidelines reviewed in this report, several other resources for improving Aboriginal and Torres Strait Islander cardiovascular health are available. ESSENCE outlines the essential services and care that should be accessible to Aboriginal and Torres Strait Islander people to prevent and manage CVD.[51] In order to reduce the disparities in Aboriginal and Torres Strait Islander CVD morbidity and mortality, the ESSENCE standards focus on targeting the social determinants of health, improving access to affordable nutrition, and affirming the central role of primary health care for cardiovascular assessment and treatment. Each of the ESSENCE standards are grouped against ten targets for policy development and health system reform, rated by feasibility, and have an expected timeframe for implementation. The Better Cardiac Care measures for Aboriginal and Torres Strait Islander people is an Australian Government initiative set-up by the Australian Health Ministers' Advisory Council in 2014. The aim is to reduce cardiovascular morbidity and mortality by improving access to health services and management of CVD risk factors and treatment. The initiative outlines five priority areas for action, including early CVD risk assessment and management to improve primary prevention. While neither ESSENCE nor Better Cardiac Care provide clinical guidance, they set-out system-wide improvements that are needed to improve cardiac health and prevent Aboriginal and Torres Strait Islander CVD mortality and morbidity. These resources should be taken into account when updating and aligning recommendations in clinical guidelines.

More empirical evidence is needed to inform Australian clinical guidelines and provide consistent messages regarding Aboriginal and Torres Strait Islander absolute CVD risk. The Cardiovascular Risk in Indigenous People study will involve the collation of data from six existing Australian cohorts from Northern Territory, Queensland and Western Australia, with data from an estimated 6,000 Aboriginal and Torres Strait Islander people. The aim of the study is to investigate the relationship between non-traditional risk factors, such as abdominal obesity and metabolic disorders, and CVD outcomes, and to assess the accuracy of current CVD risk scores, and develop and improve CVD risk scores. There are limitations to this dataset including small sample sizes for validation, historical data and inconsistencies in data recording, limiting the transferability of these results. The Better Indigenous Risk stratification for Cardiac Health study aims to enroll 1,000 Aboriginal and Torres Strait Islander people from remote

and urban areas of Australia and 1,000 non-Indigenous participants.[60] Information on traditional CVD risk factors will be collected in addition to data on emerging and novel risk factors including sleep quality, lipid profiles and pre-clinical CVD markers. Data collected in the study will be used to examine the association between these novel risk factors and Aboriginal and Torres Strait Islander CVD outcomes to improve CVD absolute risk assessment. It should be noted that it will take a considerable time for this study to produce results and the numbers will be too small on their own to be useful for recalibrating Aboriginal and Torres Strait Islander CVD risk scores.

While these studies will provide valuable data sources for improving CVD risk assessment and management in Aboriginal and Torres Strait Islander peoples, including investigating CVD risk prediction, the extent to which the data will be able to resolve many of the outstanding issues is unclear, including validation of recalibrated risk scores and examining how early in life and how often CVD risk assessment should be done. This is because the number of events, even in the combined data, is relatively small.

A framework is needed to provide large-scale data to allow regular and ongoing re-calibration and refinement of risk prediction, along the lines of those implemented internationally. In New Zealand, the PREDICT-CVD cohort includes electronic general practice data captured through integrated decision support software, with annual linkage to anonymised routine datasets including medication dispensing, pathology results, hospitalisations and deaths.[61] The PREDICT-CVD data have been used to examine the levels of CVD risk factors and test the performance of the FRE in Māori, Pacific and Indian populations.[61] Plans to link electronic general practice records in the Northern Territory with hospital and death data may provide an opportunity to obtain the large-scale, continuously recorded data needed for similar research in Australia.[62] The MedicineInsight dataset which contains Australian general practice data from almost 4 million patients (~73,000 Aboriginal and Torres Strait Islander patients), could provide an additional valuable data source for improving Australian absolute CVD risk prediction (Aboriginal and Torres Strait Islander and non-Indigenous) but is not currently routinely linked with hospital and deaths data needed to identify CVD events.[63] Infrastructure is needed to allow recommendations in clinical guidelines to be updated regularly as direct evidence from Aboriginal and Torres Strait Islander peoples becomes available.

References

1. Australian Institute of Health and Welfare. Cardiovascular disease, diabetes and chronic kidney disease— Australian facts: Aboriginal and Torres Strait Islander people (no. 5. Cat. no. CDK 5). Canberra: AIHW, 2015.
2. National Institute for Health and Care Excellence. Clinical guideline CG181: Lipid modification: cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease. National Institute for Health and Care Excellence., 2014.
3. Goff DC, Jr., Lloyd-Jones DM, Bennett G, Coady S, D'Agostino RB, Gibbons R, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014 Jun 24;129(25 Suppl 2):S49-73. PubMed PMID: 24222018. Epub 2013/11/14. eng.
4. Ministry of Health. Cardiovascular disease risk assessment: New Zealand primary care handbook 2012 (updated 2013). 2013.
5. National Vascular Disease Prevention Alliance. Guidelines for the management of absolute cardiovascular disease risk. 2012.
6. Cobiac LJ, Magnus A, Barendregt JJ, Carter R, Vos T. Improving the cost-effectiveness of cardiovascular disease prevention in Australia: a modelling study. BMC Public Health. 2012 Jun 01;12:398. PubMed PMID: 22657090. Pubmed Central PMCID: Pmc3560211. Epub 2012/06/05. eng.
7. D'Agostino RB, Sr., Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. Circulation. 2008 Feb 12;117(6):743-53. PubMed PMID: 18212285. Epub 2008/01/24. eng.
8. Calabria BK, R.J., Lovett, R.W., Fernando, P., Martin, T., Malamoo, L., Welsh, J. and Banks, E. . Absolute cardiovascular disease risk and use of lipid-lowering therapy among Aboriginal and Torres Strait Islander people: evidence to optimise prevention. Med J Aust. Under review.
9. Banks E, Crouch SR, Korda RJ, Stavreski B, Page K, Thurber KA, et al. Absolute risk of cardiovascular disease events, and blood pressure- and lipid-lowering therapy in Australia. Med J Aust. 2016 May 02;204(8):320. PubMed PMID: 27125809. Epub 2016/04/30. eng.
10. Steering Committee for the Review of Government Service Provision. Overcoming Indigenous Disadvantage: Key Indicators 2016. Canberra: Productivity Commission; 2016.
11. Awofeso N. Racism: a major impediment to optimal Indigenous health and health care in Australia. Australian Indigenous Health Bulletin. 2011;11(3):1-14.
12. Gray C, Brown A, Thomson N. Review of cardiovascular health among Indigenous Australians: Australian Indigenous Health*InfoNet*; 2012 [cited 2017 18th December]. Available from: http://www.healthinfonet.ecu.edu.au/chronic-conditions/cvd/reviews/heart_review.
13. Harper S, Lynch J, Smith GD. Social determinants and the decline of Cardiovascular disease: understanding the links. Annu Rev Public Health. 2011;32:39-69.
14. Kreatsoulas C, Anand SS. The impact of social determinants on cardiovascular disease. Can J Cardiol. 2010;26(Suppl C):8C-13C.
15. Central Australian Rural Practitioners Association Inc. CARPA Standard Treatment Manual. 6th Edition ed. Alice Springs, Australia: Centre for Remote Health; 2014.
16. Heeley EL, Peiris DP, Patel AA, Cass A, Weekes A, Morgan C, et al. Cardiovascular risk perception and evidence--practice gaps in Australian general practice (the AusHEART study). Med J Aust. 2010 Mar 01;192(5):254-9. PubMed PMID: 20201758. Epub 2010/03/06. eng.
17. Martinez Garcia L, Arevalo-Rodriguez I, Sola I, Haynes RB, Vandvik PO, Alonso-Coello P. Strategies for monitoring and updating clinical practice guidelines: a systematic review. Implement Sci. 2012 Nov 19;7:109. PubMed PMID: 23164220. Pubmed Central PMCID: Pmc3520818. Epub 2012/11/21. eng.
18. NACCHO/RACGP. National guide to a preventive health assessment for Aboriginal and Torres Strait Islander people. 2nd edn. South Melbourne: The RACGP; 2012.
19. Therapeutic Guidelines. Therapeutic Guidelines Cardiovascular Version 62012.

20. The Royal Australian College of General Practitioners. Guidelines for preventive activities in general practice. 9th Edn. East Melbourne, Vic: RACGP; 2016.
21. Queensland Health Royal Flying Doctor Service Australia (Queensland Section) and Apunipima Cape York Health Council. Chronic conditions manual : Prevention and management of chronic conditions in Australia. 1st ed. Cairns: The Rural and Remote Clinical Support Unit, Torres and Cape Hospital and Health Service; 2015.
22. Queensland Health Royal Flying Doctor Service Australia (Queensland Section) and Apunipima Cape York Health Council. Primary Clinical Care Manual 9th edition. Cairns: The Rural and Remote Clinical Support Unit, Torres and Cape Hospital and Health Service; 2016.
23. The Royal Australian College of General Practitioners. Guidelines for the implementation fo prevention in the general practice setting (2nd edition). South Melbourne, Victoria: RACGP; 2006.
24. Gabb GM, Mangoni A, Anderson CS, Cowley D, Dowden JS, Golledge J, et al. Guideline for the diagnosis and management of hypertension in adults-2016. Med J Aust. 2016;205(2):85-7.
25. The Royal Australian College of General Practitioners. General practice management of type 2 diabetes: 2016–18. East Melbourne, Vic: RACGP; 2016.
26. The Australian Kidney Foundation. Chronic Kidney Disease (CKD) management in general practice. 3rd ed2015.
27. Pilmore H, Dogra G, Roberts M, Lambers Heerspink HJ, Ninomiya T, Huxley R, et al. Cardiovascular disease in patients with chronic kidney disease. Nephrology. 2014;19(1):3-10.
28. The Royal Australian College of General Practitioners. Smoking, nutrition, alcohol, physical activity (SNAP): A population health guide to behavioural risk factors in general practice, 2nd edn. Melbourne: The Royal Australian College of General Practitioners; 2015.
29. Phoenix Australia- Centre for Posstraumatic Mental Health. Australian Guidelines for the Treatment of Acute Stress Disorder and Posttraumatic Stress Disorder. Melbourne, Victoria: Phoenix Australia; 2013.
30. Chew DP, Scott IA, Cullen L, French JK, Briffa TG, Tideman PA, et al. National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand: Australian Clinical Guidelines for the Management of Acute Coronary Syndromes 2016. Heart Lung Circ.25(9):895-951.
31. National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand (Chronic Heart Failure Guidelines Expert Writing Panel). Guidelines for the prevention, detection and management of chronic heart failure in Australia. 2011.
32. National Stroke Foundation. Clinical Guidelines for Stroke Management. Melbourne, Australia: 2010.
33. Bradshaw PJ, Alfonso HS, Finn JC, Owen J, Thompson PL. Coronary heart disease events in Aboriginal Australians: incidence in an urban population. Med J Aust. 2009 May 18;190(10):583-6. PubMed PMID: 19450210. Epub 2009/05/20. eng.
34. Wang Z, Hoy WE. Is the Framingham coronary heart disease absolute risk function applicable to Aboriginal people? Med J Aust. 2005 Jan 17;182(2):66-9. PubMed PMID: 15651963. Epub 2005/01/18. eng.
35. Adegbija O, Hoy W, Wang Z. Prediction of cardiovascular disease risk using waist circumference among Aboriginals in a remote Australian community. BMC Public Health. 2015 Jan 31;15:57. PubMed PMID: 25636174. Pubmed Central PMCID: Pmc4318125. Epub 2015/02/01. eng.
36. Hua X, McDermott R, Lung T, Wenitong M, Tran-Duy A, Li M, et al. Validation and recalibration of the Framingham cardiovascular disease risk models in an Australian Indigenous cohort. Eur J Prev Cardiol. 2017 Oct;24(15):1660-9. PubMed PMID: 28749178. Epub 2017/07/28. eng.
37. Riddell T, Wells S, Jackson R, Lee AW, Crengle S, Bramley D, et al. Performance of Framingham cardiovascular risk scores by ethnic groups in New Zealand: PREDICT CVD-10. N Z Med J. 2010;123(1309):50-61.
38. Adegbija O, Hoy WE, Wang Z. Waist circumference values equivalent to body mass index points for predicting absolute cardiovascular disease risks among adults in an Aboriginal community: A prospective cohort study. BMJ Open. 2015;5(11).

39. Becker M, Neugebauer EAM, Eikermann M. Partial updating of clinical practice guidelines often makes more sense than full updating: A systematic review on methods and the development of an updating procedure. J Clin Epidemiol. 2014;67(1):33-45.
40. Vernooij RWM, Sanabria AJ, Solà I, Alonso-Coello P, Martínez García L. Guidance for updating clinical practice guidelines: A systematic review of methodological handbooks. Implement Sci. 2014;9(1).
41. Agbassi C, Messersmith H, McNair S, Brouwers M. Priority-based initiative for updating existing evidence-based clinical practice guidelines: The results of two iterations. J Clin Epidemiol. 2014;67(12):1335-42.
42. Eccles M, Rousseau N, Freemantle N. Updating evidence-based clinical guidelines. J Health Serv Res Policy. 2002 Apr;7(2):98-103. PubMed PMID: 11934374. Epub 2002/04/06. eng.
43. Gartlehner G, West SL, Lohr KN, Kahwati L, Johnson JG, Harris RP, et al. Assessing the need to update prevention guidelines: A comparison of two methods. Int J Qual Health Care. 2004;16(5):399-406.
44. Martínez García L, Sanabria AJ, Araya I, Lawson J, Solà I, Vernooij RWM, et al. Efficiency of pragmatic search strategies to update clinical guidelines recommendations. BMC Med Res Methodol. 2015;15(1).
45. Shekelle P, Woolf S, Grimshaw JM, Schünemann HJ, Eccles MP. Developing clinical practice guidelines: reviewing, reporting, and publishing guidelines; updating guidelines; and the emerging issues of enhancing guideline implementability and accounting for comorbid conditions in guideline development. Implement Sci. 2012;7(1).
46. Iruetaguena A, Garcia Adeva JJ, Pikatza JM, Segundo U, Buenestado D, Barrena R. Automatic retrieval of current evidence to support update of bibliography in clinical guidelines. Expert Syst Appl. 2013;40(6):2081-91.
47. Uhlig K, Berns JS, Carville S, Chan W, Cheung M, Guyatt GH, et al. Recommendations for kidney disease guideline updating: A report by the KDIGO Methods Committee. Kidney International. 2016;89(4):753-60.
48. Scottish Intercollegiate Guidelines Network (SIGN). SIGN 50: a guideline developer's handbook. Edinburgh:: 2015.
49. Vandvik PO, Brandt L, Alonso-Coello P, Treweek S, Akl EA, Kristiansen A, et al. Creating clinical practice guidelines we can trust, use, and share a new era is imminent. Chest. 2013;144(2):381-9.
50. Gurgel RK. Updating Clinical Practice Guidelines: How Do We Stay Current? Otolaryngol Head Neck Surg. 2015 Oct;153(4):488-90. PubMed PMID: 25754181. Epub 2015/03/11. eng.
51. Brown A, O'Shea RL, Mott K, McBride KF, Lawson T, Jennings GL. Essential service standards for equitable national cardiovascular care for Aboriginal and Torres Strait Islander people. Heart Lung Circ. 2015 Feb;24(2):126-41. PubMed PMID: 25459487. Epub 2014/12/03. eng.
52. D'Agostino RB, Sr., Grundy S, Sullivan LM, Wilson P. Validation of the Framingham coronary heart disease prediction scores: results of a multiple ethnic groups investigation. Jama. 2001 Jul 11;286(2):180-7. PubMed PMID: 11448281. Epub 2001/07/13. eng.
53. Dawber TR, Meadors GF, Moore FE. Epidemiological Approaches to Heart Disease: The Framingham Study. Am J Public Health Nations Health. 1951;41(3):279-86. PubMed PMID: PMC1525365.
54. National Institute for Health and Care Excellence. Lipid modification: Cardiovascular risk assessment and the modification of blood lipids for the primary and secondary prevention of cardiovascular disease (clinical guideline CG181). 2014.
55. McKinn S, Bonner C, Jansen J, Teixeira-Pinto A, So M, Irwig L, et al. Factors influencing general practitioners' decisions about cardiovascular disease risk reassessment: findings from experimental and interview studies. BMC Fam Pract. 2016 Aug 05;17:107. PubMed PMID: 27495325. Pubmed Central PMCID: Pmc4974805. Epub 2016/08/09. eng.

56. Bell KJ, Hayen A, Irwig L, Takahashi O, Ohde S, Glasziou P. When to remeasure cardiovascular risk in untreated people at low and intermediate risk: observational study. Bmj. 2013 Apr 03;346:f1895. PubMed PMID: 23553971. Epub 2013/04/05. eng.
57. Cushman WC, Evans GW, Byington RP, Goff DC, Jr., Grimm RH, Jr., Cutler JA, et al. Effects of intensive blood-pressure control in type 2 diabetes mellitus. N Engl J Med. 2010 Apr 29;362(17):1575-85. PubMed PMID: 20228401. Pubmed Central PMCID: Pmc4123215. Epub 2010/03/17. eng.
58. Wright JT, Jr., Williamson JD, Whelton PK, Snyder JK, Sink KM, Rocco MV, et al. A Randomized Trial of Intensive versus Standard Blood-Pressure Control. N Engl J Med. 2015 Nov 26;373(22):2103-16. PubMed PMID: 26551272. Pubmed Central PMCID: Pmc4689591. Epub 2015/11/10. eng.
59. Ettehad D, Emdin CA, Kiran A, Anderson SG, Callender T, Emberson J, et al. Blood pressure lowering for prevention of cardiovascular disease and death: a systematic review and meta-analysis. Lancet. 2016 Mar 5;387(10022):957-67. PubMed PMID: 26724178. Epub 2016/01/03. eng.
60. Rémond MGW, Stewart S, Carrington MJ, Marwick TH, Kingwell BA, Meikle P, et al. Better Indigenous Risk stratification for Cardiac Health study (BIRCH) protocol: rationale and design of a cross-sectional and prospective cohort study to identify novel cardiovascular risk indicators in Aboriginal Australian and Torres Strait Islander adults. BMC Cardiovasc Disord. 2017;17:228. PubMed PMID: PMC5569545.
61. Wells S, Riddell T, Kerr A, Pylypchuk R, Chelimo C, Marshall R, et al. Cohort Profile: The PREDICT Cardiovascular Disease Cohort in New Zealand Primary Care (PREDICT-CVD 19). Int J Epidemiol. 2017 Feb 1;46(1):22. PubMed PMID: 26686841. Epub 2015/12/22. eng.
62. Burgess CP, Sinclair G, Ramjan M, Coffey PJ, Connors CM, Katekar LV. Strengthening cardiovascular disease prevention in remote indigenous communities in Australia's Northern Territory. Heart Lung Circ. 2015 May;24(5):450-7. PubMed PMID: 25541229. Epub 2014/12/30. eng.
63. NPS MedicineWise. Using MedicineInsight data 2017 [cited 2017 19 Dec]. Available from: https://www.nps.org.au/medicine-insight/using-medicineinsight-data#about-medicineinsight.
64. Shekelle PG, Ortiz E, Rhodes S, Morton SC, Eccles MP, Grimshaw JM, et al. Validity of the Agency for Healthcare Research and Quality Clinical Practice Guidelines: How Quickly Do Guidelines Become Outdated? Jama. 2001;286(12):1461-7.
65. Bosquet L, Guillo S, Gory-Delabaere G, Fervers B, COSOR. Technological and scientific literature monitoring for updating clinical practice guidelines: example with use of PET scanning in patients with cancer. Improving Outcomes Through Health Technology Assessment. 19th Annual Meeting of the International Society of Technology Assessment in Health Care; Alberta, Canada, Canmore2003. p. 272.
66. Nunes V, Shaw E, editors. When to update guidelines: A pragmatic approach. 6th Guidelines International Network Conference; 2009; Lisbon.
67. Newton S, Merlin T, Forbes D, Phelps A, Creamer M, Hiller J. Challenges in updating evidence-based clinical practice guidelines. Third Annual Meeting Health Technology Assessment International; Adelaide, Australia2006. p. 141.
68. Parmelli E, Papini D, Moja L, Bandieri E, Belfiglio M, Ciccone G, et al. Updating clinical recommendations for breast, colorectal and lung cancer treatments: An opportunity to improve methodology and clinical relevance. Ann Oncol. 2011;22(1):188-94.
69. Johnston ME, Brouwers MC, Browman GP. Keeping cancer guidelines current: results of a comprehensive prospective literature monitoring strategy for twenty clinical practice guidelines. Int J Technol Assess Health Care. 2003;19(4):646-55.
70. Dhaliwal R, Cahill N, Lemieux M, Heyland DK. The Canadian Critical Care Nutrition Guidelines in 2013: An Update on Current Recommendations and Implementation Strategies. Nutr Clin Pract. 2014;29(1):29-43.
71. Zamborlini V, Hu Q, Huang Z, da Silveira M, Pruski C, ten Teije A, et al. Knowledge-driven paper retrieval to support updating of clinical guidelines: A use case on PubMed. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)2017. p. 71-89.

72. Zhu H, Ni Y, Cai P, Cao F, editors. Automatic information extraction for computerized clinical guideline. Studies in Health Technology and Informatics; 2013.
73. Bittl JA, He Y. Bayesian Analysis: A Practical Approach to Interpret Clinical Trials and Create Clinical Practice Guidelines. Circulation. 2017;10(8).

Appendix A: Search strategy for the systematic review on the assessment of absolute CVD risk and treatment in Aboriginal and Torres Strait Islander people and Indigenous New Zealand populations

We searched MEDLINE and Scopus (PROPSERO registration number: CRD42017079181), with searches were restricted to English language and to articles published since 2012 (date of the latest guideline). Search terms for each database are provided below. Titles and abstracts were screened to identify relevant publications. Full texts were then identified for the relevant publications and two researchers (EP and SP) independently assessed the publications against the selection criteria. Additional publications were identified through stakeholder engagement. Data were systematically extracted from the publications using data extraction templates.

Inclusion criteria:

- Related to assessing absolute CVD risk assessment and/or approaches for treating high absolute risk in Aboriginal and/or Torres Strait Islander people or Indigenous people in New Zealand.
- Included participants without existing CVD, or participants with and without prior CVD but where the results were presented separately for these groups.
- Included primary data

Exclusion criteria:

- Studies that only included pregnant women or children (<18 years old),
- Studies that detailed the development or testing of electronic decision support tools
- Studies that only reported on population profiles of CVD absolute risk.

The quality of the included studies was assessed independently by two reviewers (LO and SP), with discrepancies resolved by discussion and by adjudication of a third reviewer (EP), using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies from National Heart, Lung and Blood Institute.

MEDLINE search terms:

1. Cardiovascular OR "Heart disease" OR CVD OR "Coronary heart disease" OR CHD OR "cardiovascular system" OR "Cardiovascular Diseases"[Mesh] OR "cardiovascular

system"[MeSH Terms] OR Stroke OR “Cerebrovascular disease*” OR “Myocardial infarction” OR MI OR “Ischaemic heart disease “ OR IHD

2. "risk prediction*" OR "risk model*" OR "risk score*" OR "risk assessment*" OR "Models, Cardiovascular"[Mesh]
3. “Early Medical Intervention” [MeSH] OR risk management [MeSH] OR “primary prevention” OR "Primary Prevention"[MeSH] OR “Preventive Health Services” [MeSH] OR "Cardiovascular Diseases/prevention and control"[MeSH Terms] OR "Coronary Disease/prevention and control"[MeSH]
4. Indigenous OR Aboriginal OR “Torres Strait Islander” OR Maori
5. Australia OR “New Zealand”
6. 1 AND (2 OR 3) AND 4 AND 5

Scopus search terms:

1. TITLE-ABS-KEY (cardiovascular OR "Heart disease" OR cvd OR "Coronary heart disease" OR chd OR "cardiovascular system" OR "Cardiovascular Disease*" OR "cardiovascular system" OR stroke OR "Cerebrovascular disease*" OR "Myocardial infarction" OR mi) OR TITLE-ABS-KEY ("Ischaemic heart disease" OR ihd)
2. (TITLE-ABS-KEY ("risk prediction" OR "risk model*" OR "risk score*" OR "risk assessment*" OR "Models, Cardiovascular") OR TITLE-ABS-KEY (“early medical intervention” OR “risk management” OR “primary prevention” OR “preventive Health Services” OR "Cardiovascular Diseases/prevention and control” OR "Coronary Disease/prevention and control”))AND TITLE-ABS-KEY (Indigenous OR Aboriginal OR " Torres Strait Islander" OR Maori) AND TITLE-ABS-KEY (Australia OR “New Zealand”)) AND PUBYEAR > 2010
3. 1 AND 2

Appendix B: Search strategy for approaches to updating clinical guidelines

MEDLINE, Scopus and the Cochrane Library were searched for studies published in English since 01 July 2012 (date of last systematic review on this topic). Search terms for each database are provided below. We used the same selection criteria as was used in the systematic review published in 2012.[17]

Inclusion criteria:

- Evaluated one or more methods of updating (with or without monitoring) evidence-based clinical guidelines or recommendations, without restriction by health topic.
- Assessed strategies for evaluating if clinical guidelines are out of date; for updating clinical guidelines; or for continuous monitoring and updating of clinical guidelines.

Exclusion criteria:

- Methodological handbooks and clinical guidelines updates.

Titles and abstracts were screened to identify relevant publications. Full texts were then identified for the relevant publications and two researchers (AD and KM) independently assessed the publications against the selection criteria. Data extraction templates were used to systematically extract data from the relevant guidelines.

MEDLINE search terms:

1. Clinical practice guideline*[tw]
2. Clinical guideline*[tiab]
3. Guideline*[ti]
4. Updat*[tw]
5. Up to date[tw]
6. (#1 OR #2) OR #3
7. #5 OR #6
8. #4 AND #7

Cochrane Library search terms:

1. Clinical practice guideline*':ti, ab, kw
2. Clinical guideline*
3. Guideline*:ti
4. (#1 OR #2 OR #3)

5. Update*
6. Up to date
7. (#5 OR #6)
8. (#4 AND #7)

Scopus search terms:

1. (TITLE-ABS-KEY (‘clinical practice guideline*’ OR “Clinical guideline*”) AND TITLE (guideline*) AND TITLE-ABS-KEY (updat* OR “up to date”)) AND PUBYEAR > 2011 AND PUBYEAR <2018

Appendix C: Data extracted from Australian clinical guidelines on absolute CVD risk assessment and management

The tables below contain information extracted from Australian clinical guidelines that include recommendations on absolute CVD risk assessment and management. Table 1 contains information related to recommendations on how absolute CVD risk should be assessed, including the age at which screening for CVD risk should start, clinical risk factors that indicate a person should be automatically considered to be at high risk of CVD regardless of their calculated absolute risk score, and how frequently people are recommended to have their absolute CVD risk assessed. Table 2 comprises information on recommendations related to management of absolute CVD risk, including the thresholds for commencing treatment, what treatments are recommended for those at moderate or high absolute risk of CVD, and treatment targets.

Table C1: Summary of absolute CVD risk assessment as recommended relevant Australian clinical guidelines

Guideline	Age-range for screening	Factors defining clinically determined high risk	Risk score and calculation tools	Risk adjustments	Frequency of recommended re-assessment
CVD-specific guidelines					
NVDPA Guidelines for the Management of Absolute Cardiovascular Disease Risk[5]	Non-Indigenous Australians: 45-74 Aboriginal and Torres Strait Islander people: 35-74	• Diabetes and age >60 years • Diabetes with microalbuminuria • Moderate or severe chronic kidney disease (CKD) • Familial hypercholesterolaemia • Systolic ≥180 mmHg or diastolic ≥110mmHg • Serum total cholesterol >7.5 mmol/L • Aboriginal or Torres Strait Islander people aged more than 74 years	Australian absolute CVD risk calculator and charts www.cvdcheck.org.au, based on the FRE	None explicitly recommended Consider treating Aboriginal and Torres Strait Islander people as high risk if they are moderate absolute risk	• Low (<10%): every 2 years • Moderate (10-15%): every 6-12 months • High (>15%): according to clinical context
General guidelines					
The CARPA Standard	Non-Indigenous Australians: 45-74	Has one or more of the following: • Diabetes AND kidney disease (urine Albumin/creatinine ratio	Calculated using a colour- coded risk matrix adapted from the NVDPA guidelines and the New	Add 5% to calculated risk for Aboriginal and	• Low (<10%): every 2 years with Adult Health Check

Guideline	Age-range for screening	Factors defining clinically determined high risk	Risk score and calculation tools	Risk adjustments	Frequency of recommended re-assessment
Treatment Manual[15]	Aboriginal and Torres Strait Islander people: 20-74	(ACR) >2.4 for males, >3.4 for females) • Diabetes AND age over 60 years • CKD (Estimated glomerular filtration rate (eGFR) less than 45) • Persistent systolic ≥180mmHg *OR* diastolic >110mmHg *OR* total cholesterol ≥7.5mmol/L • 75 years or older	Zealand (NZ) Cardiovascular Risk Charts. Specific charts are provided for Aboriginal and Torres Strait Islander people.	Torres Strait Islander people	• Moderate (10-15%): every year • High (>15%): continue to consider high-risk and treat to target. Do not stop medications when targets reached.
RACGP National guide to a preventive health assessment for Aboriginal and Torres Strait Islander people[18]	35-74 years, general health screening recommended to commence from age 12	Same as the NVDPA guidelines	FRE	None explicitly recommended	Annually as part of annual health assessment. For those being treated with lifestyle interventions, review every two years in those at low risk and according to clinical context for those at moderate or high risk. Those being treated with preventative medications should be re-assessed according to clinical context.
Therapeutic guidelines cardiovascular version 6[19]	Aboriginal and Torres Strait Islander people: 35 years and over non-Indigenous: 45 years and over	As per NVDPA guidelines	Australian absolute CVD risk calculator and charts www.cvdcheck.org.au, based on the FRE		• Low (<10%): Reassess absolute CVD risk every 2 years • Moderate (10-15%): Reassess absolute CVD risk every 6-12 months
Guidelines for preventive	Aboriginal and Torres Strait Islander people	As per NVDPA guidelines	Australian absolute CVD risk calculator and charts		Every two years

Guideline	Age-range for screening	Factors defining clinically determined high risk	Risk score and calculation tools	Risk adjustments	Frequency of recommended re-assessment
activities in general practice[20]	Australians: 35 years and over non-Indigenous: 45 years and over		www.cvdcheck.org.au, based on the FRE		
Chronic Conditions Manual: Prevention and Management of Chronic Conditions in Australia[21]	Aboriginal and Torres Strait Islander people: 35 years and over non-Indigenous: 45 years and over	As per NVDPA guidelines	Australian cardiovascular risk charts from the National Stroke Foundation	For Aboriginal and/or Torres Strait Islander people, consider managing as though at a higher risk level	Discussed in the context of hypertensive patients. • Low (<10%): Review absolute risk in 6-12 months • Moderate (10-15%): Review absolute risk in 3-6 months Patients with pre-diabetes: Assessed every 12 months
Guidelines on related chronic conditions or risk factors					
Guideline for the diagnosis and management of hypertension in adults – 2016[24]	Aboriginal and Torres Strait Islander people: 35 years and over non-Indigenous: 45 years and over Without a known history of CVD or other co-morbidities	As per NVDPA guidelines	Australian absolute CVD risk calculator and charts www.cvdcheck.org.au, based on the FRE	Add 5% to the calculated risk score for Aboriginal and Torres Strait Islander people	No specific advice for reassessment of absolute CVD risk. If diagnosed with hypertension and: • At high absolute CVD risk (>15%): reviewed according to clinical context • At moderate absolute CVD risk (10-15%) and systolic 130-139 mmHg or diastolic 85-90 mmHg: blood pressure should be reviewed at 6 months • At low absolute CVD risk (<10%) and systolic 140-

Guideline	Age-range for screening	Factors defining clinically determined high risk	Risk score and calculation tools	Risk adjustments	Frequency of recommended re-assessment
					159 mmHg: blood pressure should be reviewed after 2 months of lifestyle advice
General practice management of type 2 diabetes[25]	Not specifically stated	As per NVDPA guidelines	The guidelines recommend calculating risk level using an evidence based tool: • NVDPA charts, www.cvdcheck.org.au • NZ Cardiovascular Risk charts, www.health.govt.nz/publications • Heart Foundation NZ, www.knowyournumbers.co.nz		• Low (<10%): Review absolute risk every two years • Moderate (10-15%): Review absolute risk every 6-12 months • High (>15%): Review absolute risk according to clinical context
Chronic Kidney Disease Management in General Practice[26]	Aboriginal and Torres Strait Islander people: 35 years and over non-Indigenous: 45 years and over Without existing CVD or other clinically determined high risk factors	As per NVDPA guidelines	Australian absolute CVD risk calculator and charts www.cvdcheck.org.au, based on the FRE		Not discussed

Guideline	Age-range for screening	Factors defining clinically determined high risk	Risk score and calculation tools	Risk adjustments	Frequency of recommended re-assessment
Smoking, nutrition, alcohol, physical activity (SNAP): A population health guide to behavioural risk factors in general practice[28]	Not discussed. As per NVDPA 2012 Guidelines.	As per NVDPA guidelines	• www.cvdcheck.org.au, based on the FRE • Australian cardiovascular risk charts from the Australian Heart Foundation		Not discussed. As per NVDPA 2012 Guidelines.

Table C2: Summary of the management of absolute CVD risk as recommended relevant Australian clinical guidelines

Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
CVD-specific guidelines					
NVDPA Guidelines for the Management of Absolute Cardiovascular Disease Risk[5]	Generally if absolute risk of having a CVD is >15% over the next 5 years	Diabetes, CKD	Lifestyle: appropriate, specific advice and support regarding diet and physical activity; appropriate advice, support and pharmacotherapy for smoking cessation. Medications: not routinely recommended. Consider blood pressure lowering and/or lipid lowering if 3-6 months of lifestyle intervention does not reduce risk or if one or more applies: • Blood pressure persistently ≥160/100 mmHg, • Family history of premature CVD • Specific population where FRE underestimates risk (e.g. Aboriginal and Torres Strait Islander peoples). Withdrawal of therapy could be considered for people who make profound lifestyle changes	Lifestyle: frequent and sustained specific advice and support regarding diet and physical activity; appropriate advice, support and pharmacotherapy for smoking cessation; advice given simultaneously with blood pressure and lipid lowering drug treatment Medications: Treat simultaneously with lipid lowering and blood pressure lowering unless contraindicated or clinically inappropriate; Aspirin not routinely recommended; consider withdrawal of therapy for people who make profound lifestyle changes.	Blood pressure: ≤140/90 mmHg in general or people with CKD; ≤130/80 mmHg in all people with diabetes; ≤130/80 mmHg in people with albuminuria. Lipids: Total cholesterol <4.0 mmol/L; HDL-C ≥1.0 mmol/L; LDL-C <2.0 mmol/L; Non HDL-C <2.5 mmol/L; triglycerides <2.0 mmol/L. Lifestyle: smoking cessation; consume diet rich in vegetables and fruit, low in salt and saturated and trans fats; at least 30 mins moderate intensity physical activity on most or preferably all days of the week; limit alcohol intake to follow Australian guidelines.
General guidelines					

Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
The CARPA Standard Treatment Manual[15]	More than 15% chance of heart attack or stroke in the next 5 years			Address the following risk factors: • Smoking • Overweight/obesity • Alcohol • Physical activity • High blood pressure • Diabetes • Abnormal blood fats • Kidney disease • Depression	• Smoking cessation • Overweight/obesity: less saturated fats, salts; more physical activity; ≤94cm waist for males, ≤80cm waist for females • Limit alcohol intake to ≤2 standard drinks/day • High blood pressure <130/80; ACEi recommended • Diabetes: aim for HbA1c 53mmol/mol (≤7%); oral medicines for glucose control, often need insulin as well • Abnormal blood fats: monitor levels; treat to target; statin recommended • Kidney disease: monitor eGFR and urine ACR; target blood pressure <130/80; ACEi recommended • Depression: identify and treat • Aspirin recommended if CVD or diabetes
RACGP National guide to a	Pharmacotherapy recommended for	• Obesity	Lifestyle risk reduction advice for the following	Lifestyle risk reduction advice same as moderate risk.	• Smoking cessation • Healthy diet

Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
preventive health assessment for Aboriginal and Torres Strait Islander people[18]	• Low risk (<10%) with blood pressure persistently ≥160/100 mmHg • Moderate risk (10-15%) after review and unless contraindicated • High risk (>15%) unless contraindicated	• Family history of CVD before age 55 years in a mother, father, or sibling • Presence of albuminuria • Atrial fibrillation • Impaired fasting glucose intolerance • Socioeconomic hardship • Depression or other psychosocial stress • Excessive alcohol intake	• Physical activity • Weight loss • Smoking cessation • Reduce salt to <4g/day • Diet rich in fruit and vegetables, whole grain cereals, nuts and seeds, legumes, fish, lean meat, poultry, low fat dairy products and limiting saturated and trans fat intake • Limit alcohol intake to ≤2 standard drinks/day Pharmacotherapy • Review individual risk factor profile and recommend commencing a blood pressure lowering medication and/or lipid lowering medication unless contraindicated	Pharmacotherapy • Recommend commencing both a blood pressure lowering medication and lipid lowering medication regardless of risk factor levels unless contraindicated • Aspirin is not routinely recommended	• Reduce salt to >4g/day • Limit alcohol intake to ≤2 standard drinks/day
Therapeutic guidelines cardiovascular version 6[19]	• Moderate risk (10-15%) if 3 to 6 months of behavioural risk modification does not reduce risk; blood pressure persistently ≥160/100 mmHg;	• Blood pressure persistently ≥160/100 mmHg • Family history of premature CVD • Specific population where FRE underestimates risk	Lifestyle: appropriate, specific advice and support regarding diet and physical activity; appropriate advice, support and pharmacotherapy for smoking cessation. Medications: not routinely recommended. Consider	• Frequent and sustained specific advice and support regarding diet and physical activity • Same smoking cessation advice as moderate risk • Treat simultaneously with blood pressure-lowering and lipid-modifying	None given.

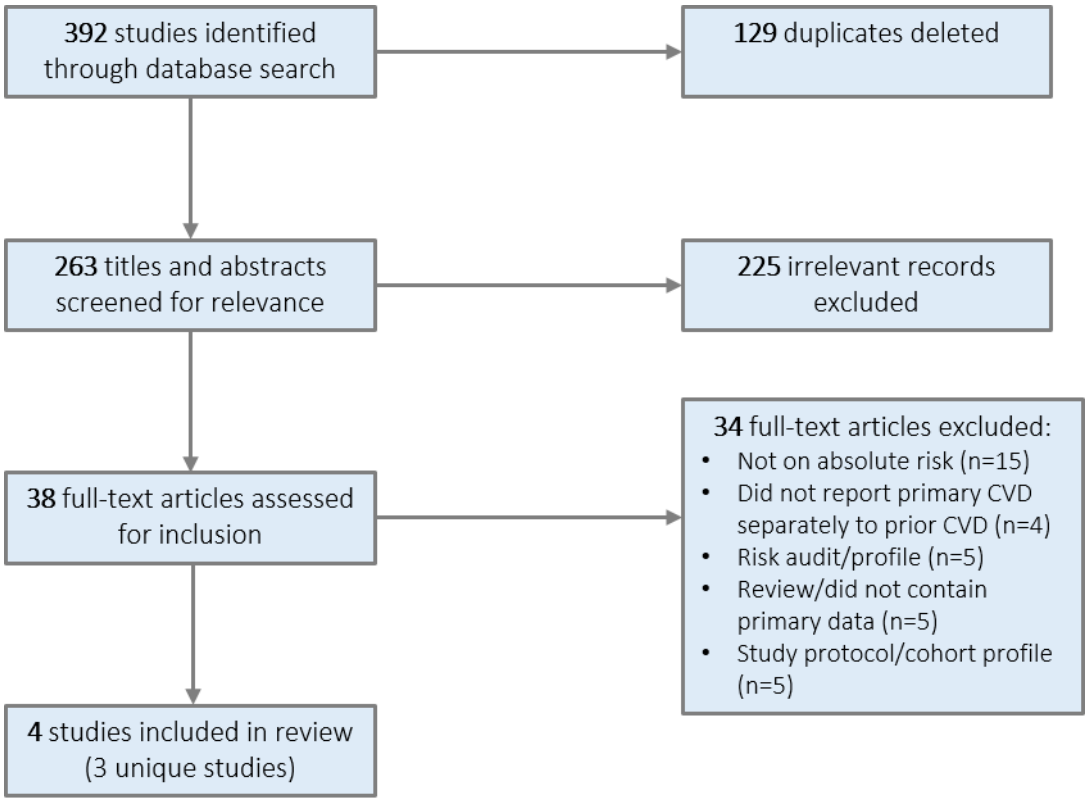
Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
	family history of premature CVD; specific population where FRE underestimates risk • High risk (>15%)		blood pressure lowering and/or lipid lowering if 3-6 months of lifestyle intervention does not reduce risk or if one or more applies: • Blood pressure persistently ≥160/100 mmHg, • Family history of premature CVD • Specific population where FRE underestimates risk (e.g. Aboriginal and Torres Strait Islander people). • Withdrawal of therapy could be considered for people who make profound lifestyle changes	therapy unless contraindicated or clinically inappropriate • Aspirin not routinely recommended	
Guidelines for preventive activities in general practice[20]	• Low risk (<10%) if blood pressure persistently over 160/100 mmHg • Moderate risk (10-15%): if systolic is 140-159 mmHg or diastolic is 90-99 mmHg; blood pressure persistently over		• Provide lifestyle advice • Consider pharmacotherapy if systolic 140-159 mmHg or diastolic 90-99 mmHg. If systolic 130-139 mmHg or diastolic 85-89mmHg, review blood pressure in six months • Offer pharmacotherapy simultaneously with	• Provide intensive lifestyle advice • Commence pharmacotherapy (simultaneously with lipid therapy unless contraindicated) • Ask questions about symptoms of transient ischaemic attacks	• Blood pressure ≤140/90 mmHg in adults without CVD, or lower (systolic <120 mmHg) in some individuals who tolerate more intensive treatment and those with CKD • Blood pressure ≤130/80 mmHg in people with diabetes or

Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
	160/100 mmHg; family history of premature CVD; specific population where FRE underestimates risk • High risk (>15%)		lifestyle intervention if blood pressure persistently ≥160/100 mmHg or if family history of premature CVD or specific population where FRE underestimates risk	• If atrial fibrillation, determine cause and treat according to cardiovascular and thromboembolic risk	microalbuminuria or macroalbuminuria
Chronic Conditions Manual: Prevention and Management of Chronic Conditions in Australia[21]	Discussed in the context of hypertension • Low risk (<10%): if systolic ≥ 150 mmHg or diastolic ≥90 mmHg • Moderate risk (10-15%): if systolic ≥ 140 mmHg or diastolic ≥90 mmHg • High risk (>15%)	• Depression • Socioeconomic deprivation • Diabetes • Aboriginal or Torres Strait Islander people	• Lifestyle modification • Manage blood pressure • Manage associated conditions and reassess absolute CVD regularly • Start drug treatment if systolic ≥ 140 mmHg or diastolic ≥90 mmHg	In addition to treatments for moderate risk, start drug treatment immediately	Treatment targets in the context of other conditions only discussed
Guidelines on related chronic conditions or risk factors					
Guideline for the diagnosis and management of hypertension in adults – 2016[24]	• Low risk (<10%) if blood pressure persistently ≥160/100 mmHg • Moderate risk (10-15%): if persistent blood pressure ≥140		• Provide lifestyle advice • For patients with blood pressure persistently ≥160/10 mmHg; persistent blood pressure ≥140 mmHg systolic and/or ≥90 mmHg diastolic; family history of	• Provide lifestyle advice • Start immediate drug treatment	• In selected high cardiovascular risk populations where a more intense treatment can be considered, aiming to a target of <120 mmHg systolic can

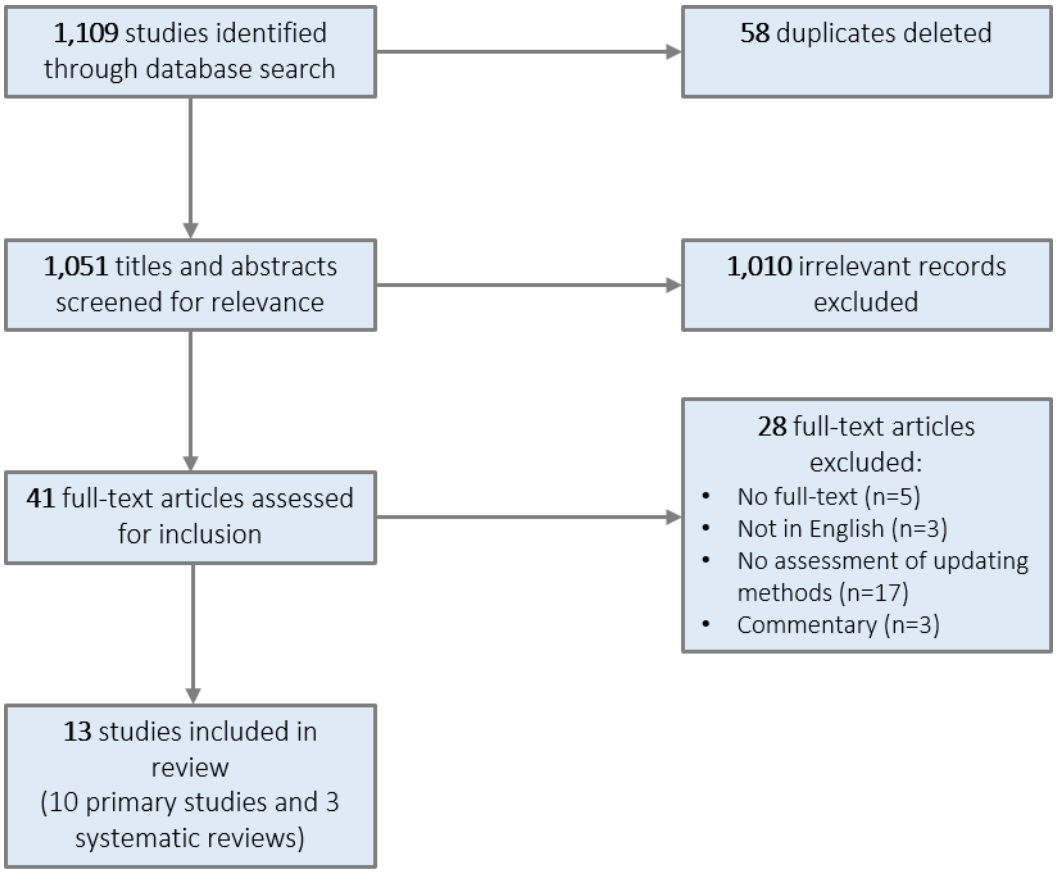
Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
	mmHg systolic and/or ≥90 mmHg diastolic; blood pressure persistently ≥160/100 mmHg; family history of CVD; or Aboriginal or Torres Strait Islander people • High risk (>15%)		premature CVD; or Aboriginal or Torres Strait Islander people, antihypertensive therapy should be started • Aspirin not recommended for CVD prevention in patients with hypertension at low-moderate risk		improve cardiovascular outcomes
General practice management of type 2 diabetes[25]	• Low risk (<10%) if blood pressure persistently >160/100 mmHg • Moderate risk (10-15%): if 3-6 months of lifestyle intervention does not reduce risk; blood pressure persistently >160/100 mmHg; family history of premature CVD; or specific population where FRE underestimates risk		<u>Lifestyle:</u> appropriate, specific advice and support regarding diet and physical activity; appropriate advice, support and pharmacotherapy for smoking cessation. <u>Medications:</u> not routinely recommended. Consider blood pressure lowering and/or lipid lowering if 3-6 months of lifestyle intervention does not reduce risk or if one or more applies: • Blood pressure persistently ≥160/100 mmHg, • Family history of premature CVD	• Frequent and sustained specific advice and support regarding diet and physical activity • Same smoking cessation advice as moderate risk • Treat simultaneously with lipid-lowering and blood pressure-lowering drug treatment unless contraindicated or clinically inappropriate • Aspirin is not routinely recommended • Consider withdrawal of therapy for people who make profound lifestyle changes	Moderate risk: • Total cholesterol <4.0 mmol/L • High density lipoprotein cholesterol ≥1.0 mmol/L • Low density lipoprotein cholesterol <2.0 mmol/L • NonHDL-C <2.5 mmol/L • Triglicerides <2.0 mmol/L • Smoking cessation • Consume diet rich in vegetables and fruit, low in salt and saturated and trans fats • At least 30 min physical activity on most or preferably every day of the week • Limit alcohol intake

Guideline	Risk thresholds for commencing treatment	Other conditions not already defined that may impact on treatment decisions	Treatments recommended for those at moderate risk	Treatments recommended for those at high risk	Treatment targets
	• High risk (>15%)		• Specific population where FRE underestimates risk (e.g. Aboriginal and Torres Strait Islander peoples). • Withdrawal of therapy could be considered for people who make profound lifestyle changes		High risk: • ≤140/90 mmHg in general or people with CKD • ≤130/80 mmHg in all people with diabetes • ≤130/80 mmHg if microalbuminuria or macroalbuminuria
Chronic Kidney Disease Management in General Practice[26]	Guidelines recommend pharmacological management strategies (if indicated) based on the patient's risk level and clinical judgement (e.g. high risk require more intensive intervention and follow up)		• Basic lifestyle advice • Pharmacotherapy not discussed by absolute CVD risk categories	• Basic lifestyle advice • Pharmacotherapy if blood pressure is above target level (≥140/90 mmHG). Pharmacotherapy is not discussed by absolute CVD risk categories	Treatment targets in the context of CKD only discussed
Smoking, nutrition, alcohol, physical activity (SNAP): A population health guide to behavioural risk factors in general practice[28]	Not discussed. As per NVDPA 2012 Guidelines.		Not discussed. As per NVDPA 2012 Guidelines.	Not discussed. As per NVDPA 2012 Guidelines.	Not discussed. As per NVDPA 2012 Guidelines.

Appendix D: Flow chart showing selection of studies for the evidence review for aligning the guidelines



Appendix E: Flow chart showing selection of studies for the review of approaches for updating clinical guidelines



Appendix F: Data extracted from studies included in the review of approaches for updating clinical guidelines

The two tables below contain information extracted from the studies identified in the literature search of approaches for updating clinical guidelines.

Table F1: Overview of included studies

Study	Study Type	Objective	Sample	Health Topic	Country
Articles identified in 2012 systematic review by Martinez Garcia et al.					
Shekelle et al. 2001[64]	Prospective, not comparison study	Evaluate if clinical guidelines out of date	17 clinical guidelines	Several	USA
Bosquet et al. 2003[65]	Prospective, not comparison study	Evaluate if clinical guidelines out of date	1 clinical guideline	PET scanning in cancer	France
Gartlehner et al. 2004[43]	Prospective, comparison study	Evaluate if clinical guidelines out of date	6 topics	Prevention topics	USA
Nunes et al. 2009[66]	Prospective, not comparison study	Evaluate if clinical guidelines out of date	1 clinical guideline	Obesity	UK
Eccles et al. 2002[42]	Prospective, comparison study (development vs updating)	Compare updating process	2 clinical guidelines	Angina and asthma in adults	UK
Newton et al. 2006[67]	Prospective, not comparison study	Updating and adapting clinical guideline	1 clinical guideline	Posttraumatic Stress Disorder	Australia
Parmelli et al. 2011[68]	Prospective, comparison study (development vs updating)	Updating	15 recommendations	Anticancer drug for breast, colorectal and lung cancer	Italy

Study	Study Type	Objective	Sample	Health Topic	Country
Johnston et al. 2003[69]	Prospective, not comparison study	Continuous monitoring and updating strategy ('living' guidelines)	20 clinical guidelines	Cancer	Canada
Articles identified by systematic review					
Dhaliwal et al. 2014[70]	Prospective, not comparison study	Updating clinical guidelines	68 RCTs	Critical care nutrition	Canada
Shekelle et al. 2012[45]	Methodology Review	Guideline development methods	NA	Various	USA
Martinez Garcia et al. 2015[44]	Prospective, comparison study	Evaluate strategies to update clinical guidelines	4 clinical guidelines	Various	Spain
Vernooij et al. 2014[40]	Systematic review	Identify guidance for updating clinical guidelines	35 handbooks	NA	Spain
Zamborlini et al. 2017[71]	Prospective, comparison study	Strategies for detecting evidence for updating clinical guidelines	11 conclusions	Breast cancer	Netherlands
Becker et al. 2014[39]	Systematic review	Updating clinical guidelines	7 articles, 47 manuals	Various	Germany
Agbassi et al. 2014[41]	Methodology Review	Describe and validate strategy for updating clinical guidelines	2011: 109 documents, 2012: 88 documents	NS	Canada
Uhlig et al. 2016[47]	Review	Updating clinical guidelines	NA	Kidney disease	USA
Articles detailing methodological and software tools					

Study	Study Type	Objective	Sample	Health Topic	Country
Zhu et al. 2013[72]	Methodological	Automatic extraction of information from clinical guidelines	177 recommendations	NS	China
Bittl et al. 2017[73]	Statistical methods	Evaluate Bayesian analysis for updating of clinical guidelines	3 clinical examples	Diabetes and coronary artery disease	USA
Vandvik et al. 2013[49]	Methodological	Address problems in development, dissemination, and updating of trustworthy clinical practice guidelines	NA	NA	Norway
Iruetaguena et al. 2013[46]	Methodological	Updating bibliography references using algebraic scoring method	40 clinical guidelines	Several topics	Spain

Table F2: Stages of the strategies

Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Articles identified in 2012 systematic review by Martinez Garcia et al.					
Shekelle et al. 2001[64]	Validity of clinical guidelines based on search and survey with clinical experts	Restricted search 5 key medical journals and key specialty journals. Reviews, editorials, commentaries. Additional search in NGC and web sites of clinical guidelines publishing organizations. Surveyed experts by mail	2.9% (208 articles reviewed from 7.150 articles initially identified)	76.5% of the guidelines needed updating	NS
Bosquet et al. 2003[65]	Search and consultation with original working group	Exhaustive search MEDLINE, EMBASE, SBU & APM web sites	45.2% (118 references submitted to the working group from 261 references initially identified)	NA	NS
Gartlehner et al. 2004[43]	Comparative search strategies	Modified Shekelle et al 2001 & Exhaustive search MEDLINE, The Cochrane Library Reviews, meta-analysis, RCTs. Surveys to national or international experts	Modified Shekelle: 2.6% (36 eligible studies from 1,382 citations initially identified), Exhaustive: 1.2% (45 eligible studies from 3,687 initially identified)	NA	NS

Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Nunes et al. 2009[66]	Search and review of new clinical guidelines	Restricted search Guidelines	28% (seven guidelines reviewed from 25 guidelines initially identified)	No recommendations needed to be updated	NS. Less time required to perform update than perform an exhaustive search
Eccles et al. 2002[42]	Comparison of development and updating process	Exhaustive search MEDLINE, EMBASE, The Cochrane Library	1.0% for each guideline	Recommendations remained unchanged.	NS. Cited as time consuming
Newton et al. 2006[67]	Compare updating method with original development process, adapt to local context	Exhaustive search NS	0.2% (43 studies included from 19,423 citations initially identified)	Integrating a qualitative and quantitative data on the prior review and developing recommendations	9 months to update 11 research questions and develop 7 new questions
Parmelli et al. 2011[68]	Compare updating method with original development process	Exhaustive search MEDLINE, EMBASE, central and databases for conference (ASCO) SRs, meta-analysis, RCTs	3.5% (24 papers included from 686 records initially screened)	6/15 recommendations updated. Classified strength of recommendation in 4 levels: strong positive, weak positive, weak negative and strong negative. Voted by experts in meeting	8 months

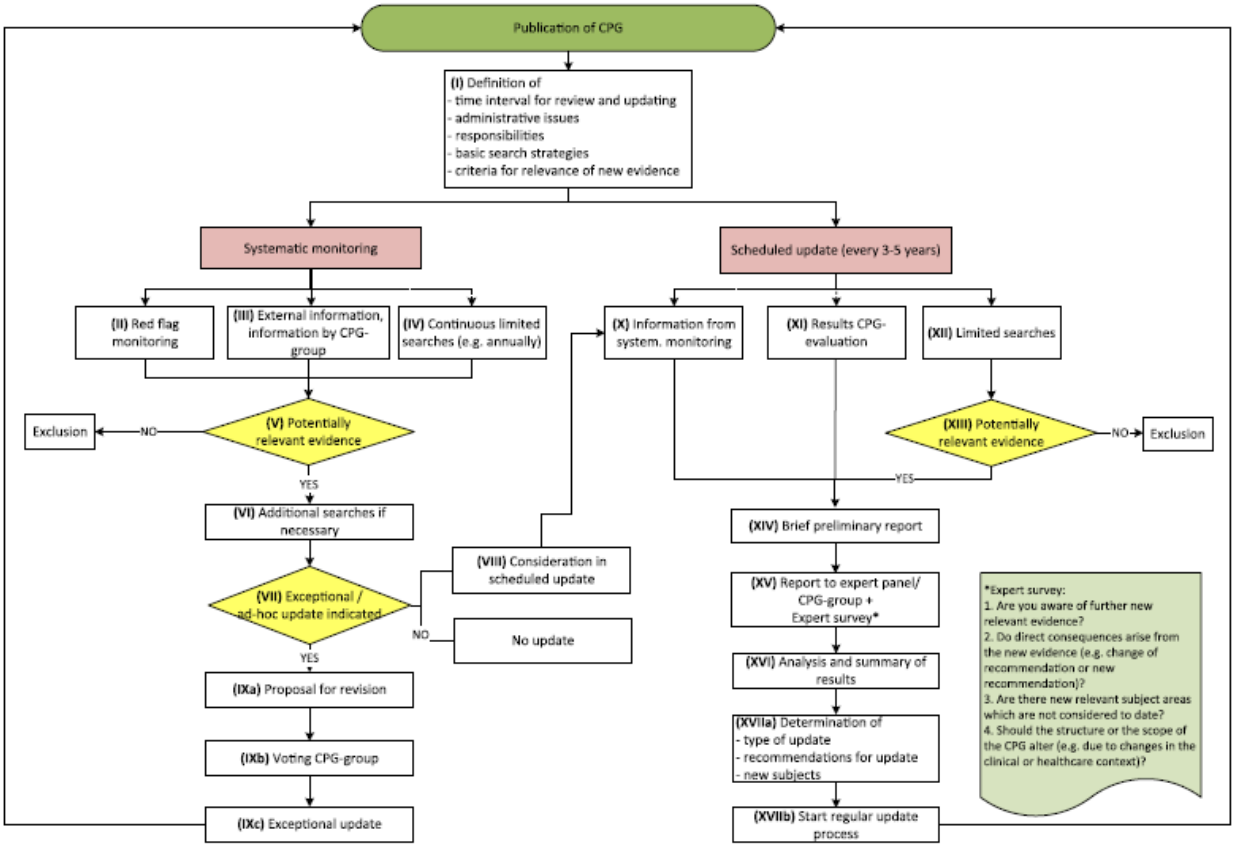
Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Johnston et al. 2003[69]	Monitoring strategy	Exhaustive search MEDLINE (monthly), CancerList (monthly), HealthStar (monthly), The Cochrane Library (quarterly) Guidelines, SRs, RCTs Additional search in key journals and proceedings meeting, Notifications by DSG members	23.75% (19 citations with impact on recommends from 80 citations initially identified)	Clinical recommendations were changed in in 30% of the guidelines	NS
Articles identified by systematic review					
Dhaliwal et al. 2014[70]	Review of updated 2013 clinical guidelines which are based on RCTs	NS	68 new RCTs identified since the 2009 clinical guidelines	10 new sections or clinical topics. Of the old clinical topics, 3 recommendations were upgraded, 4 were downgraded, and 27 remained the same	NS
Shekelle et al. 2012[45]	Discussion about developing guidelines	NS	NA	NA	NA

Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Martinez Garcia et al. 2015[44]	Comparative search strategies	Exhaustive and restrictive PubMed Clinical Queries for MEDLINE, PLUS (McMaster Premium Literature Service) database.	69 references identified by exhaustive strategy/18 (or 26.1%) references identified by PLUS strategy / 4486 references initially retrieved	Exhaustive strategy: 25 recommendations/ Restrictive strategy: 18 and 17/ PLUS strategy: 10 recommendations (40%)	Restrictive search: 174hr/ PLUS search: 28hr
Vernooij et al. 2014[40]	Updating guidance provided by clinical guidelines handbooks	Exhaustive MEDLINE, Guidelines international network, US National Guidelines Clearinghouse, institutions that use handbooks in previous international survey	35 handbooks (initially 1,992 records identified)	NA	NS
Zamborlini et al. 2017[71]	Knowledge model (Transition-based Medical Recommendation model) for detecting new evidence	NS	Average of 32.6% recall, 1145.18 papers, using semantic distance. Increasing to average 80.9% recall, 885.45 papers, using the knowledge model	NA	NS. High human-intervention cost
Becker et al. 2014[39]	Evaluate when and how to update guidelines; develop procedure for updating	Exhaustive MEDLINE, Embase, the Cochrane Methodology Register	7 full-text reports, 47 manuals; developed systematic monitoring system and schedule updating process	NA	NS

Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Agbassi et al. 2014[41]	Use of document assessment and review (DAR) strategy	NS	2011: 109 documents assessed/ 2012: 88 documents assessed	2011 assessment: 15 urgent and high-priority reviews (52%) resulted in an endorsement, eight (28%) rewritten to correct or update the recommendations, six (21%) archived with no further action. 2012: 88 total documents assessed; 15 (17%) archived, 32 (36%) deferred, 3 (3%) considered special cases, 38 (43%) prioritized for review	median time 167 days (range, 18-358 days)
Uhlig et al. 2016[47]	Review of updating methods	NS	NA	Recommends that KDIGO move to dynamic updating (i.e 'living guidelines')	NS
Articles detailing methodological and software tools					
Zhu et al. 2013[72]	Rule-based information extraction system	NS	Rule based method on test data set achieves 71.75% f-measure for patient state annotation and 81.96% f-measure for action annotation	NS	NS
Bittl et al. 2017[73]	Bayesian analysis	NS	Validated by 3 examples	NS	NS
Vandvik et al. 2013[49]	Online software app (MAGICapp)	NS	NS	NS	NS

Author & year	Update method/tool	Evidence search strategy	Search/tool performance	Changes to guidelines	Resource use (time)
Iruetaguena et al. 2013[46]	Scoring algorithm	Restricted National Guideline Clearinghouse, Entrez Utilities Web Services, MEDLINE	Method had a 91.9% finding average, increasing to 95.4% if focused on RCTs.	None	NS

Appendix G: Flow-chart for determining the type and scope of a guideline update[39]



Appendix H: Six-item document assessment tool[41]

Ontario
Cancer Care Ontario
Action Cancer Ontario

Document Assessment Tool

Number and title of document	
Current Report Date	
Last Literature Search Date	
Date Assessed	
Research coordinator	
Outcome (*for internal use*)	

Instructions. For each document, please respond YES or NO to all the questions below. Provide an explanation of each answer as necessary.

1. Is the document still relevant (clinically or to the cancer care system as a whole in some way)?	
2. Should full assessment and review of this document be deferred until next year? *Consider YES if:* ➢ *The document is less than three years old, and there is no reason to doubt the recommendations* ➢ *The document is between three and five years old, and a justification can be provided as to why the recommendations can be considered trustworthy for another year*	
3. Do the questions and search criteria as they are in the document address current needs, such that an updated literature search would be useful and identify relevant evidence? *Consider NO if:* ➢ *The standard of care has shifted significantly since the last version of the document, such that the questions only address the topic in part* ➢ *There are new, significant options (for treatment, diagnosis, etc.) available that are not covered by the current questions, such that new questions would need to be added to the document*	

➢ *In general, if you believe that for the document to still be useful it will have to substantially be rewritten* ➢ *The document has been repeatedly deferred, and is now older than five years*	
4. Does the document have an impact on access to care (that is, are decisions about access or payment for care made by the Ministry, CCO, or other organizations based on the recommendations in this document)? *Consider YES if:* ➢ *Ministry funding decisions have been, are, or will be made on the basis of this document* ➢ *An indication for a chemotherapy regimen was funded, or rejected, based on the document* ➢ *Case by case review or out of country requests are known to be decided based on the document* ➢ *Funding for some screening, diagnostic, staging or treatment procedure was or is determined*	
5. Is there known evidence that has been published since this document's last literature search (see above) that would result in significant changes to the recommendations?	
6. Should this document be taken off the website while it awaits full review, or can it be left there with an "IN REVIEW" watermark? *Consider YES if:* ➢ *If followed, even in error, the recommendations have the potential to cause harm to patients.*	
Please list any additional factors that should be considered in prioritizing this document for review:	

Appendix I: Four-item document review tool[41]

Ontario
Cancer Care Ontario
Action Cancer Ontario

PEBC Document Review Tool

Number and title of document under review	
Current Report Date	
Clinical Expert	
Research Coordinator	
Date Assessed	
Approval Date and Review Outcome (once completed)	

Original Question(s):

Target Population:

Study Section Criteria:

Search Details:

Brief Summary/Discussion of New Evidence:

Clinical Expert Interest Declaration:

Instructions. Instructions. For each document, please respond YES or NO to all the questions below. Provide an explanation of each answer as necessary.	
1. Does any of the newly identified evidence, on initial review, contradict the current recommendations, such that the current recommendations may cause harm or lead to unnecessary or improper treatment if followed?	
2. On initial review, a. Does the newly identified evidence support the existing recommendations?	

b. Do the current recommendations cover all relevant subjects addressed by the evidence, such that no new recommendations are necessary?	
3. Is there a good reason (e.g., new stronger evidence will be published soon, changes to current recommendations are trivial or address very limited situations) to postpone updating the guideline? Answer Yes or No, and explain if necessary:	
4. Do the PEBC and the DSG/GDG responsible for this document have the resources available to write a full update of this document within the next year?	

Review Outcome	
DSG/GDG Approval Date	
DSG/GDG Commentary	