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Cardiovascular Disease Risk Assessment Data Standard

HISO 10071:2019

Published May 2019

New Zealand Government

MINISTRY OF HEALTH
MANATŪ HAUORA

Contributors

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Thanks and acknowledgements to the contributors to the Ministry of Health's 2018 *Cardiovascular Disease Risk Assessment and Management for Primary Care* publication, which this data standard supports: Assoc Prof Gerry Devlin, Dr Paul Drury, Dr Fraser Hamilton, Dr Ben Hudson, Katie Inker, Prof Rod Jackson, Prof Jim Mann, Dr Helen Rodenburg, Prof Tim Stokes, Dr Jim Vause, Assoc Prof Susan Wells, Prof Michael Williams and Vanessa Young.

Vascular Informatics using Epidemiology and the Web (VIEW) research to develop the equations that underpin the updated approach to cardiovascular risk assessment was funded by grants from the Health Research Council of New Zealand, The Healthier Lives National Science Challenge, and the Heart Foundation of New Zealand.

Citation: Ministry of Health. 2019. *HISO 10071:2019 Cardiovascular Disease Risk Assessment Data Standard*. Wellington: Ministry of Health.

Published in May 2019 by the Ministry of Health
PO Box 5013, Wellington 6140, New Zealand

ISBN 978-1-98-856877-5 (online)
HP 7109

Health Information Standards Organisation (HISO) standards are published by the Ministry of Health for the New Zealand health and disability sector.

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This document is available at health.govt.nz

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1 Introduction

This data standard supports the implementation of CVD risk calculation using the agreed primary prevention equations.

1.1 Background

In 2003, the Health Research Council of New Zealand (HRC) funded the PREDICT cohort study. The study's purpose was to develop new cardiovascular disease (CVD) risk prediction models for the New Zealand population, while simultaneously supporting the implementation of CVD and diabetes guidelines through computerised decision support (Wells et al 2015).

As of December 2017, general practitioners (GPs) and nurses had conducted heart and diabetes checks for over 500,000 patients using the PREDICT web-based platform. With national ethics approval and permission from primary health care providers, unidentifiable data from these checks were sent to the University of Auckland HRC-VIEW research team. Through matching each individual's encrypted National Health Index (NHI) number to national hospitalisation and mortality data sets, the researchers have developed the first of a series of new CVD risk assessment equations tailored to New Zealand populations.

These equations are described in the 2018 Ministry of Health publication *Cardiovascular Disease Risk Assessment and Management for Primary Care* (Ministry of Health 2018).

The four equations are:

- General population
  - PREDICT-CVD version 2018 primary prevention CVD risk equation for women aged 30–74 years
  - PREDICT-CVD version 2018 primary prevention CVD risk equation for men aged 30–74 years
- Diabetes-specific
  - PREDICT-CVD version 2018 primary prevention CVD risk equation for women with diabetes aged 30–74 years
  - PREDICT-CVD version 2018 primary prevention CVD risk equation for men with diabetes aged 30–74 years.

The PREDICT cohort study is an open cohort and will continue to grow. The primary prevention equations will be subject to regular review and will be updated as required. For example, the primary prevention equation for the general population (men and women) has been updated to include body mass index (BMI) in this standard and, as such, differs from the published equation (Pylypchuk et al 2018). In addition,

development of new CVD risk equations is underway specifically for Māori, Pacific and South Asian populations, people aged over 75 years, those with serious mental illness and those who have had a previous CVD event. Accordingly, this data standard will be reviewed and updated as these developments occur.

1.1.1 CVD risk assessment

The goal of a CVD risk assessment that also includes screening for diabetes is to reduce CVD risk for individuals and provide appropriate advice about reducing the risk of developing diabetes. A CVD risk assessment informs people about their risk of future fatal and non-fatal cardiovascular events and strategies to improve their heart health. It also helps identify people with diabetes, to enable them to receive care and learn about helpful lifestyle changes. The overarching principle remains that the intensity of recommended interventions should be proportional to the estimated combined CVD risk.

1.1.2 CVD risk calculation

The risk of an individual having a CVD event in the next five years can be estimated by a statistical model that combines multiple CVD risk factors into one algorithm or equation. When an individual's risk profile is put into the equation, a five-year risk score can be calculated. This calculation has been found to accurately predict future population CVD events in the next five years. As the CVD event rate in New Zealand populations changes over time, it is important for primary health care providers to have the most up-to-date algorithms.

1.1.3 CVD events predicted

The CVD risk calculation predicts the five-year risk of the following fatal and non-fatal CVD events: myocardial infarction, angina, coronary insufficiency, sudden and non-sudden coronary death, stroke (ischaemic or haemorrhagic), transient ischaemic attack, peripheral vascular disease (including claudication) and heart failure.

1.1.4 Exclusions from CVD risk assessment using the primary prevention equations

All past, current and future CVD risk prediction equations are not intended to be used if the patient is pregnant.

Other specific exclusion criteria are:

- being less than 18 years of age

- people with known CVD (angina, myocardial infarction, percutaneous coronary intervention, coronary artery bypass grafting, ischaemic stroke, transient ischaemic attack or peripheral vascular disease
- heart failure diagnosed clinically
- having familial hypercholesterolaemia
- renal failure, defined as having an estimated glomerular filtration rate (eGFR) less than 30 mL/min/1.73 m^2
- a history of renal transplantation or of being on dialysis
- diabetes and overt nephropathy (albumin to creatinine ratio greater than or equal to 30 mg/mmol).

If the patient's profile does not meet any of the exclusion criteria listed above or is not otherwise clinically determined as being at very high risk, then a CVD risk calculation can be conducted using the primary prevention equations.

1.1.5 Equations that can be used for patients with diabetes

Either general population or diabetes-specific equations can be used for people with diabetes. However, as the diabetes equation has further diabetes-specific variables included (such as ACR, diabetes medications), it is more accurate and tailored to a patient's diabetes risk profile.

If the full dataset for patients with diabetes is not available, then it is reasonable to calculate the patient's risk score using the general population primary prevention equation.

1.1.6 Patients with type 1 diabetes

The PREDICT diabetes-specific primary prevention score has been developed in a cohort of people with type 2 diabetes (or type unknown). The equations can be used for type 1 diabetes, although this is likely to be an underestimate. Future equations for patients with type 1 diabetes will be developed as the PREDICT cohort accrues larger numbers of people with type 1 diabetes and new scores, as they are developed.

1.2 Purpose and scope of the data standard

The purpose of the data standard is to support the implementation of CVD risk calculation in patient management systems and clinical decision support tools by providing specifics of the primary prevention equations and their use.

The data standard includes:

- a data set specification for the personal health information needed for CVD risk calculation
- the set of variables and coefficients for each primary prevention equation
- requirements for software tools implementing the primary prevention equations and supporting CVD risk assessment.

2 Data set specification

This section provides a data set specification for the input variables required for CVD risk calculation using the primary prevention equations.

The data set covers:

- personal demographics
- prior CVD and other exclusion criteria
- clinical history
- self-reported history
- measured risk factors
- medication.

Data element specifications in this standard conform to the requirements of *ISO/IEC 11179 Information Technology – Metadata Registries (MDR)*.[1]

Definition	A statement that expresses the essential nature of the data element and its differentiation from other elements in the data set.		
Source standards	Established standards or guidelines pertaining to the data element.		
Data type	Alphabetic (A) Date Date/time Numeric (N) Alphanumeric (X) Boolean SNOMED CT identifier	**Representational class**	Code Free text Value Identifier
Field size	Maximum number of characters	**Representational layout**	For example: • X(50) for a 50-character alphanumeric string • NNN for a 3-digit number • NNAAAA for a formatted alphanumeric identifier

[1] See https://standards.iso.org/ittf/PubliclyAvailableStandards/index.html

Data domain	The valid values or codes that are acceptable for the data element. Each coded data element has a specified code set. Code sets use the SNOMED CT clinical terminology standard where possible. Enumerated SNOMED concepts are denoted by preferred term and linked to descriptions in the **SNOMED International browser**. Where there are many member concepts, a reference set is published in the SNOMED NZ Edition, available from the **SNOMED Member Licensing and Distribution Service**. To ensure compatibility between SNOMED concepts and Read Codes, a cross mapping is published in the SNOMED NZ Edition. New Zealand Medicines Terminology (NZMT) is the standard used to identify medicines.
Obligation	Indicates if the data element is mandatory or optional, or whether its appearance is conditional in the context.
Guide for use	Additional guidance to inform the use of the data element.
Verification rules	Quality control mechanisms that preclude invalid values.

2.1 Personal demographics

2.1.1 Age

Age is an important non-modifiable predictor of a CVD event. The primary prevention risk prediction equations were developed from a cohort of people aged 30 to 74 years who were eligible for CVD risk prediction according to the 2003 CVD risk assessment and management guidelines (and subsequent updates) (New Zealand Guidelines Group 2003). A risk calculation outside this age range will be an approximation but potentially useful. Clinical judgement is recommended. For risk calculation purposes, the person's actual age should be input.

Definition	Age in whole years at date of risk calculation		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	18–110		
Obligation	Mandatory		
Guide for use	Either: 1. calculated in the input template by subtracting date of birth from the date of risk calculation and dividing by 365.25 2. populated from the patient's health record 3. entered by self-report. The CVD risk equations were developed for ages 30 to 74 years. Use outside this age range will be an approximation but still potentially useful		
Verification rules	Must be within valid age range		

2.1.2 Biological sex

A person's biological sex is an important predictor of a future CVD event, with men being at higher risk and demonstrating differing weightings of other risk factors within a multivariate risk prediction equation compared with women. Therefore biological sex, rather than sexual identity, is used in CVD risk prediction equations. However, in discussion between the clinician and the patient, a person treated on long-term oestrogens could be considered biologically female; a person on long-term testosterone could be considered biologically male.

Definition	Biological sex for the purpose of risk calculation		
Source standards			
Data type	SNOMED CT identifier	**Representational class**	Code
Field size	18	**Representational layout**	N(18)
Data domain	**Male** **Female**		
Obligation	Mandatory		
Guide for use	Male or female biological risk is determined in discussion between the clinician and the patient CVD risk equations apply according to sex-specific grouping		
Verification rules			

2.1.3 Ethnicity

Ethnicity in this context is for the purpose of CVD risk calculation.

HISO 10001:2017 Ethnicity Data Protocols supports recording up to six ethnicities at level 4 (Ministry of Health 2017). It is assumed that self-reported ethnicity is collected appropriately in primary health care services, using the standard ethnicity question and coded as per Statistics New Zealand (Stats NZ) Ethnicity New Zealand Standard Classification 2005 v2.0.0.

In the development of the CVD risk prediction equations, ethnicities were prioritised and aggregated into five ethnic categories, ordered as: (1) Māori, (2) Pacific, (3) Indian/Other South Asian, (4) Chinese/Other Asian, (5) European/Other.

For risk calculation purposes, it is recommended that putting ethnicity data into the template follow the same rule. That is, if a person self-identifies as being Chinese, European and Māori, then they should be inputted as Māori to the risk calculator. The only exception to this rule is if people self-identify as being both Fijian and Indian. From an epidemiological perspective when developing the equations, these individuals most closely resemble the risk profile of Indian and should be input as such.

Definition	Prioritised ethnic category		
Source standards	HISO 10001:2017 Ethnicity Data Protocols Stats NZ Ethnicity New Zealand Standard Classification 2005		
Data type	Numeric	**Representational class**	Code
Field size	5	**Representational layout**	NNNNN
Data domain	Māori – 21111, level 2 code 21 Pacific – Level 2 codes 35, 36, 34, 33, 32, 31, 37, 30 Indian/Other South Asian – Level 2 code 43 (including Fijian Indian 43112), Sri Lankan (441, 44100), Sinhalese (44111), Sri Lankan Tamil (44112), Sri Lankan nec (44199), Afghani (44411), Bangladeshi (44412), Nepalese (44413), Pakistani (44414), Tibetan (44415) Chinese/Other Asian – Level 2 code 41, 42, 44 (if not included in the Indian/Other South Asian category), 40 European and Other – Level 2 codes 52, 53, 51, 61, 12, 10, 11, 91, 95, 97, 99		
Obligation	Mandatory		
Guide for use	Ethnicity should be recorded at level 4 in the patient's health record Apply the prioritisation rules to determine the ethnic category and use the most specific code to record it Level 2 and 3 codes encompass the level 4 codes they prefix		
Verification rules			

2.1.4 Deprivation index

The New Zealand Deprivation Index (NZDep) score is a measure for assessing socioeconomic status and is a significant predictor of CVD risk, independent of other risk factors.

NZDep is a measure assigned to a patient's area of residence. The score is based on nine variables from the Census, reflecting eight dimensions of relative deprivation of census tracts (Salmond et al 2007). NZDep is updated with each Census (eg, 2006, 2013, 2018), so the index closest to the CVD risk calculation should be used if available. For CVD risk calculation, input NZDep according to quintile of deprivation (from 1 least deprived to 5 most deprived).

Definition	NZDep score expressed as quintile of deprivation		
Source standards	**NZDep**		
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	1–5		
Obligation	Mandatory		
Guide for use	NZDep score is derived each census (eg, 2006, 2013, 2018). Use the NZDep closest to the date of CVD risk calculation If NZDep score is unknown, use the NZiDep index of socioeconomic deprivation for individuals (Salmond et al 2006). This eight-question survey can provide quintile of deprivation for putting into the risk calculator		

Verification rules	

2.2 Prior CVD and other exclusion criteria

2.2.1 Prior CVD

Prior CVD is defined as having had one or more of the following conditions or procedures. These are all related to atherosclerotic arterial disease of the heart, brain and peripheral vessels:

- angina
- myocardial infarction
- percutaneous coronary intervention
- coronary artery bypass grafting
- ischaemic stroke
- transient ischaemic attack
- peripheral vascular disease (clinical diagnosis or procedure).

If a prior CVD condition or procedure is present, then individuals are excluded from CVD risk assessment using the primary prevention equations. However, these conditions and procedures are included in the table below as they need to be explicitly reported at the time of CVD risk assessment and will be variables within future secondary prevention equations.

Condition or procedure	Definition
Angina	History of stable or unstable angina
Myocardial infarction	Previous heart attack or acute coronary syndrome, including both non-ST elevation myocardial infarction (non-STEMI) and ST elevation myocardial infarction (STEMI)
Percutaneous coronary intervention	Previous percutaneous coronary intervention, including coronary angioplasty and stenting
Coronary artery bypass grafting	Previous coronary artery bypass grafting procedure
Ischaemic stroke	Previous ischaemic stroke with neurological signs and symptoms lasting more than 24 hours
Transient ischaemic attack (TIA)	Previous history of TIA – signs and symptoms typical of a stroke but with full recovery in less than 24 hours

Peripheral vascular disease: • **Peripheral ischaemia** • **History of peripheral vascular disease procedure** • **Aneurysm of artery of trunk** • **Aneurysm of peripheral artery** • **Carotid artery stenosis** • **Intermittent claudication** • **Pain at rest due to peripheral vascular disease**	Atherosclerotic peripheral vascular disease of any peripheral arteries (eg, to legs and feet), including renal, carotid and vertebral arteries. Diagnosis could be based on: • clinical signs and symptoms, such as intermittent claudication • diminished foot pulses or carotid bruits • radiological evidence or atherosclerotic arterial disease or prior surgical procedures • abdominal aortic aneurysm • carotid stenosis or asymptomatic carotid disease (including plaque identified on carotid ultrasound)

A reference set listing the above conditions and procedures will be published in the SNOMED NZ Edition.

2.2.2 Other exclusion criteria

There are four more conditions or findings that meet exclusion criteria for CVD risk calculation via primary prevention equations (both general population and diabetes-specific equations). These disorders are associated with CVD event risks similar to those with prior CVD and need to be explicitly reported at the time of CVD risk assessment.

Condition or findings	Definition
Heart failure	Clinical diagnosis of heart failure
Familial hypercholesterolaemia	Raised levels of total cholesterol and low-density lipoprotein (LDL) cholesterol consistent with autosomal dominant inheritance. This requires a specialist diagnosis and is associated with family tracing
Renal failure • **Chronic kidney disease stage 4** • **Chronic kidney disease stage 5** (disorder) • **Chronic kidney disease stage 5 with transplant** • **Chronic kidney disease stage 5 on dialysis**	A history of renal transplantation, chronic renal dialysis or having an estimated glomerular filtration rate (eGFR) <30 mL/min/1.73 m^2
Overt diabetic nephropathy	Having diabetes and an urinary albumin to creatinine ratio (ACR)≥30 mg/mmol

A SNOMED reference set listing the above conditions will be published in the SNOMED NZ Edition.

2.3 Clinical history

A history of atrial fibrillation, diabetes and duration of diabetes, and family history of premature ischaemic CVD are input variables to the CVD primary prevention equations.

2.3.1 Atrial fibrillation

Atrial fibrillation (AF) is a common abnormal heart rhythm that increases the risk of stroke. AF is clinically diagnosed after electrocardiogram (ECG) confirmation. It is characterised by an irregularly irregular heart beat and may occur on and off (paroxysmal atrial fibrillation), or it may continue indefinitely (persistent or permanent atrial fibrillation). AF may be a new finding or a long-term disorder.

Definition	ECG-confirmed atrial fibrillation		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No 1 = Yes, **ECG confirmed atrial fibrillation**		
Obligation	Mandatory		
Guide for use	Clinical diagnosis after ECG confirmation		
Verification rules			

2.3.2 Diabetes

Diabetes is a chronic disease that occurs when the pancreas is not able to produce enough insulin or when the body cannot effectively use the insulin it makes. This leads to hyperglycaemia (raised glucose level in the blood), which over the long term can damage organs and tissues. It is an independent predictor of cardiovascular events.

Definition	Diagnosed with type 1 diabetes, type 2 diabetes or type unknown		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No diabetes 1 = **Diabetes mellitus type 1** 2 = **Diabetes mellitus type 2** 3 = **Diabetes type unknown**		
Obligation	Mandatory		
Guide for use	Clinical diagnosis		
Verification rules			

2.3.3 Duration of diabetes

The longer the time a person has diabetes, the greater the risk of vascular disease. Duration of diabetes is included in the diabetes-specific primary prevention models.

Definition	Length of time in completed years a patient has had a diagnosis of diabetes		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	0–100		
Obligation	Mandatory		
Guide for use	Self-reported or clinical diagnosis Calculate by subtracting the year of electronic submission from the year of diagnosis of diabetes This represents completed years since diagnosis and could also be estimated by a clinician and patient if the year of diagnosis is unknown		
Verification rules			

2.4 Self-reported history

2.4.1 Family history of premature ischaemic CVD

A family history of premature ischaemic CVD in a parent or sibling is associated with an increased risk of a CVD event and included as a predictor in the primary prevention equations.

Note change in age definition from previous CVD risk assessment and management guidelines.

Definition	Having a first-degree relative (parent or sibling) who was hospitalised or died from a heart attack or stroke before the age of 50 years		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = **No family history of cardiovascular disease in first degree relative less than 50 years of age** 1 = **Family history of cardiovascular disease in first degree relative less than 50 years of age**		
Obligation	Mandatory		
Guide for use	Self-reported		

Verification rules	

2.4.2 Smoking

This variable records smoking status and refers primarily to cigarette smoking. The previous equation used in the New Zealand CVD guidelines was derived from the Framingham Heart study and included people who had recently quit smoking within the previous 12 months as having an equivalent risk as current smokers. The new primary prevention equations have demonstrated that all ex-smokers (less than or greater than 12 months) have an equivalent risk after adjusting for other risk factors.

Definition	Cigarette smoking status		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = **Never smoked tobacco** 1 = **Ex-smoker** 1 = **Ex-smoker for less than one year** 2 = **Smoker**		
Obligation	Mandatory		
Guide for use	Self-reported		
Verification rules			

2.5 Measured risk factors

2.5.1 Blood pressure

Blood pressure (BP) is typically recorded as having systolic and diastolic measurements in mmHg. The ideal BP for most individuals is likely to be below 120 mmHg systolic and 75 mmHg diastolic. Above this level, the risk of a CVD event increases continuously with increasing BP.

Definition	Systolic BP – the average of two seated measurements in mmHg taken on two separate occasions (at least 10 minutes apart)		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	40 ≤ value ≤ 310		
Obligation	Mandatory		

Guide for use	Clinical measurement from a sphygmomanometer Although both systolic and diastolic BP are collected, only systolic BP is presently used in the CVD risk equations BP measurements should be recorded with a date in the patient's health record
Verification rules	Systolic BP must be greater than diastolic BP

Definition	Diastolic BP – the average of two seated measurements in mmHg taken on two separate occasions (at least 10 minutes apart)		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	20 ≤ diastolic BP ≤ 200		
Obligation	Mandatory		
Guide for use	Clinical measurement from a sphygmomanometer Although both systolic and diastolic BP are collected, only systolic BP is presently used in the CVD risk equations BP measurements should be recorded with a date in the patient's health record		
Verification rules	Systolic BP must be greater than diastolic BP		

2.5.2 Weight

Weight in kilograms is used in conjunction with height in metres to calculate a body mass index (BMI).

Definition	Body weight in kilograms		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	30 ≤ value ≤ 350		
Obligation	Mandatory		
Guide for use	Measured in a clinical setting For calculating BMI		
Verification rules			

2.5.3 Height

Weight in kilograms is used in conjunction with height in metres to calculate a body mass index (BMI).

Definition	Body height in metres

Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	N.NN
Data domain	1.00 ≤ value ≤ 2.30		
Obligation	Mandatory		
Guide for use	Measured in a clinical setting For calculating BMI		
Verification rules			

2.5.4 Body mass index

An individual's body mass index (BMI) is calculated by weight in kilograms divided by height in metres squared (kg/m^2). BMI is associated with CVD event risk independently of the presence of diabetes, blood pressure and lipid levels. BMI has been included in general population and diabetes primary prevention equations either as a categorical variable or continuous variable.

The categorical variable is defined as follows.

Definition	Categorical variable based on a measure in kg/m^2 derived from weight in kilograms and height in metres		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NN.N
Data domain	For general population primary prevention equations, BMI is a categorical variable: 0 = 18.5 ≤ value < 25.0 1 = value <18.5 2 = 25.0 ≤ value < 30.0 3 = 30.0 ≤ value < 35.0 4 = 35.0 ≤ value < 40.0 5 = 40.0 ≤ value 6 = unknown		
Obligation	Mandatory		
Guide for use	Derived from calculation in kg/m^2 from height and weight measurements BMI is used as a categorical variable in the general population primary prevention equation and allows for BMI status to be missing or unknown		
Verification rules			

The continuous variable is defined as follows.

Definition	A measure in kg/m^2 derived from weight in kilograms and height in metres		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NN.N
Data domain	BMI is a continuous variable for diabetes-specific primary prevention equations		
Obligation	Mandatory		
Guide for use	Calculated in kg/m^2 from height and weight measurements BMI is used as a continuous measure in the diabetes-specific primary prevention equations		
Verification rules			

2.5.5 Total cholesterol

A single non-fasting total cholesterol (TC) and high-density lipoprotein cholesterol (HDL) test is required to calculate a TC/HDL ratio in the primary prevention equations.

Definition	A single non-fasting total cholesterol measurement in mmol/L		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	4	**Representational layout**	NNN.N
Data domain	1.0 ≤ value ≤ 103.6		
Obligation	Mandatory		
Guide for use	Laboratory test result with NZPOCS code For calculation of TC/HDL		
Verification rules			

2.5.6 High-density lipoprotein cholesterol

A single non-fasting total cholesterol (TC) and high-density lipoprotein cholesterol (HDL) is required to calculate a TC/HDL ratio in the primary prevention equations.

Definition	Use a single non-fasting HDL cholesterol measurement in mmol/L		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NN.N
Data domain	1.0 ≤ value ≤ 51.8		

Obligation	Mandatory
Guide for use	Laboratory test result with NZPOCS code For calculation of TC/HDL
Verification rules	

2.5.7 Non fasting total cholesterol to high-density lipoprotein cholesterol ratio

For CVD risk prediction, the non-fasting total cholesterol to high-density lipoprotein cholesterol ratio (TC/HDL) is a better predictor of CVD event risk than any of the other lipid fractions.

Definition	Single non-fasting total cholesterol to high-density lipoprotein cholesterol (TC:HDL-C) ratio		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	4	**Representational layout**	NN.NN
Data domain	1.08 ≤ value ≤ 30.1		
Obligation	Mandatory		
Guide for use	Calculate from laboratory test results for total cholesterol and high-density lipoprotein cholesterol		
Verification rules			

2.5.8 Serum creatinine

Serum creatinine is a laboratory test for kidney function. It is used in the CKD-Epi Study equation to derive an estimated glomerular filtration rate (eGFR).

Definition	Laboratory test result for serum creatinine measured in umol/L		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	4	**Representational layout**	NNNN
Data domain	20 ≤ value < 5000		
Obligation	Mandatory		
Guide for use	Laboratory test result with NZPOCS code Used to calculate the eGFR using the CKD-Epi Study equation		
Verification rules			

2.5.9 Estimated glomerular filtration rate

The estimated glomerular filtration rate (eGFR) is a measure of kidney function with normal levels being above 90 mL/min/1.73 m^2. If the eGFR is consistently less than 30 mL/min/1.73 m^2, then the individual has chronic kidney disease stage 4 or 5 (or chronic renal failure). At this level, they are estimated to have the CVD risk of someone with prior CVD and are excluded from having a risk score calculated using primary prevention equations.

Definition	eGFR in units of mL/min/1.73 m^2 derived using a validated equation		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	3	**Representational layout**	NNN
Data domain	Based on age and serum creatinine valid ranges		
Obligation	Mandatory		
Guide for use	Laboratory test result for serum creatinine identified by NZPOCS code CKD-Epi Study equation denoted by the formula: $141 * \min\left(\frac{Scr}{k}, 1\right)^{\alpha} * \max\left(\frac{Scr}{k}, 1\right)^{-1.209} * 0.993^{age} * 1.018\ [if\ female]$ • Scr is serum creatinine in mg/dl (use 0.0113 as unit conversion from u/mol) • κ is 0.7 for females and 0.9 for males • α is -0.329 for females and -0.411 for males • min indicates the minimum of Scr/κ or 1 • max indicates the maximum of Scr/κ or 1 Note: Ethnicity coefficient for African American is not applied for New Zealand If eGFR < 30 mL/min/1.73 m^2, then the patient is excluded from CVD risk calculation using the primary prevention equations.		
Verification rules			

2.5.10 HbA_{1c}

HbA_{1c} is a measure of glycated haemoglobin and is used for screening for diabetes or monitoring glycaemic control for people with diabetes.

Definition	Non-fasting laboratory test measuring glycated haemoglobin in mmol/mol		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	4	**Representational layout**	NNNN
Data domain	20 < value < 5000		
Obligation	Mandatory		
Guide for use	Laboratory test result identified by NZPOCS code		
Verification rules			

2.5.11 Urinary albumin to creatinine ratio (for people with diabetes)

The 2018 CVD consensus statement recommends collecting a urinary albumin to creatinine ratio (ACR), also known as urinary microalbumin, at least annually for all people with diagnosed diabetes. This test helps identify kidney disease that can occur as a complication of diabetes. If a person has an ACR consistently above 30mg/mmol, they are diagnosed as having overt diabetic nephropathy or macroalbuminuria. At this level, they will have the CVD risk of someone with prior CVD and are excluded from having a risk score calculated using primary prevention equations.

Definition	Urinary ACR laboratory test measurement in mg/mmol		
Source standards	NZPOCS		
Data type	Numeric	**Representational class**	Value
Field size	5	**Representational layout**	NNNN.N
Data domain	0.1 < value < 5650.0		
Obligation	Mandatory		
Guide for use	Laboratory test result with NZPOCS code Test result needed for diabetes primary prevention equations only If ACR ≥ 30 then it is excluded for all primary prevention equations (general population and diabetes specific equations)		
Verification rules			

2.6 Medications

Medications in the patient's health record should be represented using the New Zealand Medicines Terminology (NZMT).

A mapping between SNOMED CT and NZMT medicinal products is published in the SNOMED NZ Edition to enable interoperability and clinical decision support. The list of medicines and substances under each of the following headings will be published as a reference set in the SNOMED NZ Edition.

2.6.1 Lipid-lowering medication

Being on any lipid-lowering medication, if prescribed in the six months before a CVD risk assessment, is included as a variable in the CVD risk equations.

Definition	On lipid-lowering medication The patient has been prescribed one or more medications that lower lipids (statins or other medications) in the previous six months
Source standards	

Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No 1 = Yes		
Obligation	Mandatory		
Guide for use	Clinical criteria based on long-term medications		
Verification rules			

Lipid-lowering medications (as at publication date)

As new statins or other lipid-lowering medications are approved, they will be added to this list.

Sub-category	Product/substance
Statin	pravastatin simvastatin atorvastatin fluvastatin ezetimibe + simvastatin
Other lipid-lowering drugs	acipimox bezafibrate cholestyramine clofibrate colestipol hydrochloride ezetimibe ezetimibe + simvastatin gemfibrozil nicotinic acid

2.6.2 Blood pressure lowering medication

Being on a blood pressure lowering medication, if prescribed in the six months before a CVD risk assessment, is included as a variable in the CVD risk equations.

Definition	On blood pressure lowering medication The patient has been prescribed one or more medications that lower blood pressure – eg, angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blocker (ARB), beta blockers, calcium channel blockers, thiazides and other BP-lowering medications – in the previous six months		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N

Data domain	0 = No 1 = Yes
Obligation	Mandatory
Guide for use	Clinical criteria based on long-term medications
Verification rules	

Blood pressure lowering medications (as at publication date)

As new blood pressure lowering medications are approved, they will be added to the list.

Sub-category	Product/substance
ACE inhibitor	captopril, perindopril, lisinopril, benazepril, quinapril, cilazapril, enalapril maleate, trandolapril, quinapril + hydrochlorothiazide, captopril + hydrochlorothiazide, lisinopril + hydrochlorothiazide, enalapril maleate + hydrochlorothiazide, cilazapril + hydrochlorothiazide
Angiotensin II receptor blocker	losartan with hydrochlorothiazide, candesartan cilexetil, losartan potassium, losartan + hydrochlorothiazide, losartan potassium + hydrochlorothiazide, losartan
Beta-blocker	carvedilol, celiprolol, timolol (not eye drops), sotalol, propranolol, pindolol, oxprenolol, nadolol, metoprolol tartrate, metoprolol succinate, labetalol, atenolol, alprenolol, acebutolol, acebutolol + hydrochlorothiazide, pindolol + clopamide, atenolol + chlorthalidone, bisoprolol fumarate
Calcium channel blocker	amlodipine, diltiazem hydrochloride, felodipine, isradipine, nifedipine, verapamil hydrochloride, verapamil hydrochloride
Thiazide	acebutolol + hydrochlorothiazide, amiloride hydrochloride + hydrochlorothiazide, atenolol + chlorthalidone, bendroflumethiazide (bendrofluazide), captopril + hydrochlorothiazide, chlorothiazide, chlortalidone (Chlorthalidone), cilazapril + hydrochlorothiazide, cyclopenthiazide, enalapril maleate + hydrochlorothiazide, indapamide, lisinopril + hydrochlorothiazide, losartan, losartan potassium + hydrochlorothiazide, losartan + hydrochlorothiazide, losartan + hydrochlorothiazide, methyclothiazide, methyldopa + hydrochlorothiazide, quinapril + hydrochlorothiazide, triamterene + hydrochlorothiazide
Other blood pressure lowering drugs	amiloride hydrochloride, amiloride hydrochloride + furosemide, amiloride hydrochloride + hydrochlorothiazide, clonidine, clonidine hydrochloride, hydralazine hydrochloride, methyldopa, methyldopa + hydrochlorothiazide, pindolol + clopamide, triamterene + hydrochlorothiazide

2.6.3 Antithrombotic medication

Being on an antithrombotic medication, if prescribed in the six months before a CVD risk assessment, is included in the CVD risk equations.

The variable is split into the two sub-categories antiplatelet agents and anticoagulants. As further risk equations are likely to be developed for i) atrial fibrillation and ii) bleeding risk from antiplatelet agents, these sub-categories should be collected separately.

Definition	On antithrombotic medication The patient has been prescribed either an antiplatelet or an anticoagulant in the previous six months		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No 1 = Yes		
Obligation	Mandatory		
Guide for use	Clinical criteria based on long-term medications Combination of antiplatelet or anticoagulant medication used in CVD risk prediction equations		
Verification rules			

Antiplatelet agents

Definition	On antiplatelet medication The patient has been prescribed one or more medications that are used as antiplatelet agents (eg, aspirin, clopidogrel) in the previous six months		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No 1 = Yes		
Obligation	Mandatory		
Guide for use	Clinical criteria based on long-term medications		
Verification rules			

Antiplatelet medications (as at publication date)

As new antiplatelet medications are approved, they will be added to this list.

Sub-category	Product/substance
Aspirin	aspirin
Clopidogrel	clopidogrel
Ticagrelor	ticagrelor

Other antiplatelet	dipyridamole (1) prasugrel ticlopidine hydrochloride

Anticoagulant agents

Definition	On anticoagulant medication The patient has been prescribed one or more medications that are used as anticoagulant agents (eg, warfarin, dabigatran) in the previous six months		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N
Data domain	0 = No 1 = Yes		
Obligation	Mandatory		
Guide for use	Clinical criteria based on long-term medications		
Verification rules			

Anticoagulant medications (as at publication date)

As new anticoagulant medications are approved they will be added to this list.

Sub-category	Product/substance
Warfarin	warfarin sodium
Other anticoagulants	phenindione dabigatran rivaroxaban apixaban

2.6.4 Diabetes medications

Being on any of the following types of medication used for glycaemic control for diabetes is an input to the diabetes-specific primary prevention equations.

Definition	Medications used to support glycaemic control in people with diabetes		
Source standards			
Data type	Numeric	**Representational class**	Value
Field size	1	**Representational layout**	N

Data domain	0 = None 1 = Metformin 2 = Other oral hypoglycaemic medications 3 = Insulin
Obligation	Mandatory
Guide for use	Clinical criteria based on long-term medications
Verification rules	

Diabetes medications (as at publication date)

As new diabetes medications are approved, they will be added to this list.

Sub-category	Product/substance
Insulin	insulin lispro insulin neutral insulin isophane insulin zinc suspension insulin aspart insulin glargine glucagon hydrochloride
Metformin	metformin hydrochloride
Other oral-hypoglycaemic agents	sulfonylurea thiazolidinedione rosiglitazone pioglitazone tolbutamide tolazamide glipizide gliclazide glibenclamide acarbose sitagliptin saxagliptin vildagliptin exenatide dapagliflozin

3 Primary prevention equations

The tables in this section provide the coefficients for each of the four PREDICT CVD v.2018 primary prevention equations.

The equations are:

- PREDICT CVD v.2018 primary prevention equation for women (30–74 years)
- PREDICT CVD v.2018 primary prevention equation for men (30–74 years)
- PREDICT CVD v.2018 primary prevention equation for women with diabetes (30–74 years)
- PREDICT CVD v.2018 primary prevention equation for men with diabetes (30–74 years).

Using the correct equation, the five-year CVD risk is calculated as a percentage:

$$(1\text{-Baseline survival function}^{\exp(\text{sum of (coefficients * variables)})}) * 100$$

Each equation has a defined set of input variables and coefficients. Some variables have a mean for centring and certain inputs involve other specified calculations. The *ln* function is the natural logarithm.

There is a statistical confidence interval around each estimated risk. Given this imprecision, it is appropriate to round up or down the calculated score to the nearest whole number. For example, if the CVD risk is calculated as 14.641%, the rounded risk score to quote is 15%.

All calculated CVD risk scores must be saved in the patient's health record, noting the equation used. The rationale for this is so that new CVD risk scores are clearly distinguishable from previous Framingham scores and from each other.

Each of the equations will be denoted by a new SNOMED concept created for this purpose in the SNOMED NZ Edition. The above names for the equations will be used as the preferred terms for the concepts, and each risk score should be recorded with the correct SNOMED CT identifier.

3.1 PREDICT CVD v.2018 primary prevention equation for women (30–74 years)

Variable	Coefficient	Mean for centring
Age (centred)	0.0734393	56.05801
Māori	0.4164622	
Pacific	0.2268597	
Indian/Other South Asian	0.2086713	
Chinese/Asian	-0.2680559	
NZDep quintile (centred)	0.0957229	2.994877
Ex-smoker	0.1444243	
Current smoker	0.6768396	
Family history of premature CVD	0.0645588	
Atrial fibrillation	0.9293084	
Diabetes	0.4967444	
Systolic BP(centred)	0.0176523	128.6736
TC/HDL (centred)	0.1361335	3.715383
BMI:		
0. Normal (18.5–24.9)		
1. Underweight (<18.5)	0.6277962	
2. Overweight (25.0–29.9)	0.0018215	
3. Obesity class 1 (30.0–34.9)	-0.0169324	
4. Obesity class 2 (35.0–39.9)	0.0343351	
5. Obesity class 3 (40.0+)	0.3196519	
6. BMI unknown	0.0213595	
On BP-lowering medication	0.3487781	
On lipid-lowering medication	-0.0568366	
On either antiplatelet or anticoagulant medications	0.1393368	
Age (centred) x diabetes	-0.0189779	
Age (centred) x systolic BP (centred)	-0.000471	
On BP-lowering medication x systolic BP (centred)	-0.0054002	
Baseline survival function (women) at five years	0.9845026	

3.2 PREDICT CVD v.2018 primary prevention equation for men (30–74 years)

Variable	Coefficient	Mean for centring
Age (centred)	0.0669484	51.59444
Māori	0.3166164	
Pacific	0.2217931	
Indian/Other South Asian	0.3666816	
Chinese/Asian	-0.4131973	
NZDep quintile (centred)	0.0631146	2.975732
Ex-smoker	0.0748648	
Current smoker	0.5317607	
Family history of premature CVD	0.1275721	
Atrial fibrillation	0.6250334	
Diabetes	0.4107586	
Systolic BP(centred)	0.0179827	128.8637
TC/HDL (centred)	0.1296756	4.385853
BMI:		
0. Normal (18.5–24.9)		
1. Underweight (< 18.5)	0.5488212	
2. Overweight (25.0–29.9)	-0.033177	
3. Obesity class 1 (30.0–34.9)	-0.0025986	
4. Obesity class 2 (35.0–39.9)	0.1202739	
5. Obesity class 3 (40.0+)	0.3799261	
6. BMI unknown	-0.073928	
On BP-lowering medication	0.2847596	
On lipid-lowering medication	-0.0256429	
On either antiplatelet or anticoagulant medications	0.0701999	
Age (centred) x diabetes	-0.0124356	
Age (centred) x systolic BP (centred)	-0.0004931	
On BP-lowering medication x systolic BP (centred)	-0.0049226	
Baseline survival function (men) at five years	0.9712501	

3.3 PREDICT CVD v.2018 primary prevention equation for women with diabetes (30–74 years)

Variable	Coefficient	Mean for centring
Age (centred)	0.0424465	53.598009
Māori	0.0770441	
Pacific	-0.2533	
Indian/Other South Asian	0.138371	
Chinese/Asian	-0.3611259	
NZDep quintile (centred)	0.0699105	3.657006
Current smoker	0.4391752	
Family history of premature CVD	0.1063846	
Atrial fibrillation	0.7864886	
Systolic BP(centred)	0.0127053	131.380365
TC/HDL (centred)	0.1139678	3.970698
BMI (centred)	0.0073966	33.515572
Years since diagnosis of type 2 diabetes (centred)	0.0163962	5.406364
eGFR (centred)	-0.0090784	89.558866
ACR (centred, log transformed and scaled)	0.1842885	ln(X)+4.314302355 where X=(ACR +0.00999999977648 26) /1000
HbA1c (centred)	0.0076733	63.618622
On oral hypoglycaemic medication	0.1248604	
On insulin	0.3535548	
On BP-lowering medication	0.0988141	
On lipid-lowering medication	-0.1595083	
On either antiplatelet or anticoagulant medications	0.0605766	
Baseline survival function (women) at five years	0.945571	

3.4 PREDICT CVD v.2018 primary prevention equation for men with diabetes (30–74 years)

Variable	Coefficient	Mean for centring
Age (centred)	0.0472422	53.738152
Māori	-0.0553093	
Pacific	-0.210811	
Indian/Other South Asian	0.1522338	
Chinese/Asian	-0.3852922	
NZDep quintile (centred)	0.0413719	3.410281
Current smoker	0.3509447	
Family history of premature CVD	0.2093793	
Atrial fibrillation	0.5284553	
Systolic BP (centred)	0.0054797	131.662168
TC/HDL (centred)	0.0805627	4.330372
BMI (centred)	0.0117137	31.338254
Years since diagnosis of type 2 diabetes (centred)	0.0162351	5.183025
eGFR (centred)	-0.0025889	88.788314
ACR (centred, log transformed and scaled)	0.1815067	ln(X)+4.275179 where X=(ACR +0.0099999997764826) /1000
HbA1c (centred)	0.0074805	63.889441
On oral hypoglycaemic medication	0.0051476	
On insulin	0.1846547	
On BP-lowering medication	0.1532122	
On lipid-lowering medication	-0.0344494	
On either antiplatelet or anticoagulant medications	0.0474684	
Baseline survival function (men) at five years	0.9121175	

4 Requirements for software tools

Patient communication and joint clinical and patient decision-making are critical components of the CVD risk assessment and management process. A primary care practitioner needs to be able to communicate risk effectively to the patient and should also recognise that decision support tools for different levels of health literacy are useful adjuncts to help patients understand risk.

Software tools implementing the equations and supporting communication and health literacy should be able to:

- calculate and present the individual's estimated five-year CVD risk, heart age and risk trajectory
- show the effect of a range of interventions, including:
  - lifestyle changes such as smoking cessation, increasing physical activity, dietary change and reducing alcohol
  - medications such as statins, antihypertensive medicines and aspirin
- present estimated five-year CVD risk with and without intervention as a graphic (for example, as side-by-side displays of absolute risk, each showing 100 faces or figures and the percentage at risk).

These software tools should also be very usable, interoperable and secure:

- Tools interoperate with patient management systems and patient portals.
- Tools automatically populate from the patient's health record and save risk results back into the record.
- The patient can use these tools to access their risk assessment online.
- The clinician can print a copy of a patient's risk assessment and management advice.
- Tools are easily adaptable to new and modified risk equations.
- Tools are secure and protect patient privacy.

5 References

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