Performance of CVD risk equations for older patients assessed in general practice: a cohort study

Sue Wells, Romana Pylypchuk, Suneela Mehta, Andrew Kerr, Vanessa Selak, Katrina Poppe, Corina Grey, Rod Jackson

ABSTRACT

AIMS: To investigate how well the New Zealand PREDICT-CVD risk equations, derived in people aged 30–74 years and US Pooled Cohort Equations (PCEs) derived in people aged 40–79 years, perform for older people.

METHODS: The PREDICT cohort study automatically recruits participants when clinicians use PREDICT software to conduct a CVD risk assessment. We identified patients aged 70 years and over, without prior CVD, renal disease or heart failure who had been risk assessed between 2004 and 2016. Equation performance was assessed in five-year age bands using calibration graphs and standard discrimination metrics.

RESULTS: 40,161 patients (median 73 years; IQR 71–77) experienced 5,948 CVD events during 185,150 person-years follow-up. PREDICT-CVD equations were well calibrated in 70–74 year olds but underestimated events for women from 75 years and men from 80 years. Discrimination metrics were also poor for these age groups. Recalibrated PCEs overestimated CVD risk in both sexes and had poor discrimination from age 70 years for men and from age 75 years for women.

CONCLUSIONS: While PREDICT-CVD equations performed better than PCEs, neither performed well. Multimorbidity and competing risks are likely to contribute to the poor performance and new CVD risk equations need to include these factors.

Cardiovascular disease (CVD) is the leading cause of potentially preventable global health loss and demand for health and disability services for older people.[1] There is evidence that reducing smoking,[2] blood pressure (BP)[3] and lipids[4] is associated with reduced fatal and non-fatal CVD for adults at any age, and the benefits are largely determined by patients' pre-treatment CVD risk. As older people are more likely than younger people to be at high CVD risk, they are also likely to benefit most from CVD risk-reducing medications.[1] A recent individual person meta-analysis of 28 statin trials found that treatment produced a similar reduction in major vascular events per mmol/L reduction in low-density lipoprotein (LDL) cholesterol *irrespective of age,* although findings were more attenuated for those over 75 years without established CVD.[4] In the case of BP-lowering, the benefits of treatment accrue even among the very old. In a meta-analysis involving only octogenarians from seven clinical trials, BP-lowering medications were associated with lower rates of stroke (34%), heart failure (39%) and major CVD events (22%) than those not receiving treatment.[5] Despite these findings, most CVD risk management guidelines are vague about how to manage older people. In New Zealand, for example, CVD risk assessment and management guidelines recommend a formal quantitative CVD risk assessment for people aged 30–74 years,[6] but once a person turns 75 years of age, risk assessment is 'at the discretion' of

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the clinician. General practitioners (GPs) are given general advice to use clinical judgement taking into account the results of a risk assessment, the likely benefits and risks of treatment and patient preferences.

We have identified an increasing number of New Zealanders aged 75 years and over receiving formal quantitative CVD risk assessments in routine primary care and have generated a cohort of these older people as part of our ongoing PREDICT-CVD risk prediction cohort study.[7] Given the clinical relevance of accurate assessment of CVD risk in older people, we aimed to investigate how well the recently developed PREDICT-CVD equations[8] (derived in people aged 30–74 years), performed in older people. As a comparison, we also assessed the performance of the relatively similar US Pooled Cohort Equations (PCEs),[9] derived in people aged 40–79 years. We hypothesised that these CVD risk equations should perform reasonably well in the subgroup of older patients who GPs considered suitable for routine preventive CVD risk assessment.

Methods

Study population

The PREDICT study has been described in full elsewhere.[7] In brief, patients are automatically recruited to this prospective open cohort study when primary care clinicians undertake standard quantitative CVD risk assessments using the PREDICT web-based decision support programme. Over one-third of GPs use PREDICT software, which is integrated into their electronic patient management systems. An encrypted version of each person's unique national health identifier (National Health Index number, eNHI) is used to anonymously link patients' risk profiles to national and regional health datasets, including all community pharmaceutical dispensing, all community laboratory testing, state-funded hospitalisations and all deaths.[10] Over 98% of New Zealanders have an NHI number,[10] allowing identification and linkage of multiple health contacts, augmentation of risk factor data (prior hospital admissions, pharmaceutical dispensing, laboratory test results) as well as health outcome ascertainment (fatal CVD events in-hospital and out-of-hospital and non-fatal hospital admissions for acute CVD events) during follow-up. Over 95% of CVD hospitalisations occur within our state-funded health services.[11]

For the purposes of this study, eligible patients were those who had a first (baseline) CVD assessment from 31 October 2004 to 30 December 2016 and were aged 70 years or older, unless they met any of the following exclusion criteria: prior history of ischaemic CVD, heart failure, renal disease or missing risk factors needed for CVD risk prediction models. In addition, to emulate the cohort used to develop the PREDICT CVD equations,[8] patients were excluded if their self-identified ethnicity was recorded as Middle Eastern, Latin American, African or recorded as 'other' or 'unknown'. The rationale for this exclusion was that these ethnic groups were too heterogeneous to combine into one category and too few in numbers to disaggregate into meaningful subgroups.

A history of prior CVD was classified according to an International Classification of Diseases, version 10 Australian Modification (ICD-10 AM) for hospitalisations or primary care clinical diagnosis at the time of CVD risk assessment for angina, myocardial infarction (MI), percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG), ischaemic stroke, transient ischaemic attack (TIA), or peripheral vascular disease (PVD). The capture of a patient's history of a hospitalised event used data available from 1 January 1988. (Appendix contains full list of ICD-10 codes) Patients who were dispensed anti-anginal medications on at least three occasions up to five years prior to their baseline visit were also excluded. Renal disease was determined either by an estimated glomerular filtration rate (eGFR) of less than 30ml/min per 1.73m^2, an ICD-10 AM hospitalisation for renal dialysis, prior renal transplantation or a recording of diabetes with nephropathy at the time of CVD risk assessment. Heart failure diagnoses were based on ICD-10 AM hospitalisation code for heart failure or if participants had been dispensed a loop diuretic three or more times in the preceding five years.

Ethnicity classification was based on a nationally agreed prioritisation algorithm when individuals identified with more than one ethnicity[12] in the following order; Māori, Pacific, Indian, Chinese/other Asian and European. Socio-economic status was

assessed using the NZ Deprivation Index (NZDep), a measure assigned to patients according to the deprivation score of their area of residence.[13] For these analyses, NZDep was divided into quintiles from 1 (least deprived) to 5 (most deprived).

Smoking status was defined as either current smoker (including recently quit in the last 12 months) or non-smoker. Diabetes status was classified according to ICD-10 hospitalisation with diabetes and/or dispensing of at least one diabetes medication in the last six months and/or recorded as such by their primary care clinician at the time of CVD risk assessment.

The Charlson comorbidity index is a weighted scoring system that assesses the degree of previously hospitalised comorbidity burden. It is based on 12 conditions that predict one-year survival and has been adapted for use with hospitalisation data using a well-validated ICD-10 coding algorithm.[14] Comorbidities were identified from hospitalisations up to five years prior to the first CVD risk assessment.

The pharmaceutical collection (PHARMS) is a national database of community pharmaceutical dispensing. Reliable identification of dispensing episodes by eNHI has increased over the last decade from 64% in 2004, to 92% in 2006 and over 96% from 2009 onwards.[7] PHARMS was used to identify patients who were dispensed one of the following medications on at least one occasion in the six months prior to the baseline CVD risk assessment: BP-lowering, lipid-lowering and antiplatelet/anticoagulant medications (henceforth termed antithrombotic medications). All these medications are government subsidised. (CVD medications are listed in the Appendix).

Outcomes during follow-up

CVD outcomes for the PREDICT-CVD equations[8] were defined as ICD-10-AM coded hospitalisation or death from ischaemic heart disease, ischaemic or haemorrhagic cerebrovascular events (including TIA), PVD or heart failure. CVD outcomes for the American PCE Equations[9] (termed hard atherosclerotic CVD) are a subset of the former and include fatal or nonfatal MI, fatal or nonfatal stoke, or CHD death (Appendix contains ICD-10-AM codes for both sets of outcomes). Time on study was the time from baseline CVD risk assessment to the first of the following: hospital admission or death related to CVD, death from other causes or end of follow-up.

Statistical analysis

The distributions of CVD risk factors, event rates and follow up were investigated for the total population and by five-year age groups; 70–74 years, 75–79 years, 80–84 years and 85 years and over. Calibration was tested separately for PREDICT-CVD[8] and the PCE models[9] by five-year age groups using equation-specific outcomes. The PREDICT-CVD risk models include age, ethnicity, deprivation, diabetes status, history of atrial fibrillation, smoking status, systolic blood pressure (SBP), the ratio of total cholesterol (TC) to high-density lipoprotein (HDL) cholesterol (TC/HDL) and prior dispensing of BP lowering, lipid lowering and antithrombotic medications. The PCEs include age, TC, HDL, smoking and diabetes status, SBP and treated SBP. Calibration was assessed graphically by categorising participants into deciles of predicted five-year CVD risk and plotting mean predicted five-year CVD risk against observed CVD events at five years of follow up, obtained by the Kaplan-Meier method.[15] For PCEs we used recalibrated models where the baseline survival values were estimated by fitting Cox models with the prognostic index from the PCE model (offset term) in the PREDICT-CVD dataset.[16] Discrimination was assessed using Harrell's C statistic and Royston and Sauerbrei's D statistic.[17,18] The proportion of outcome variation explained by PREDICT-CVD and PCEs was assessed using Royston and Sauerbrei's R^2 statistic.[18] All analyses were performed using Stata 15.0 software.[19]

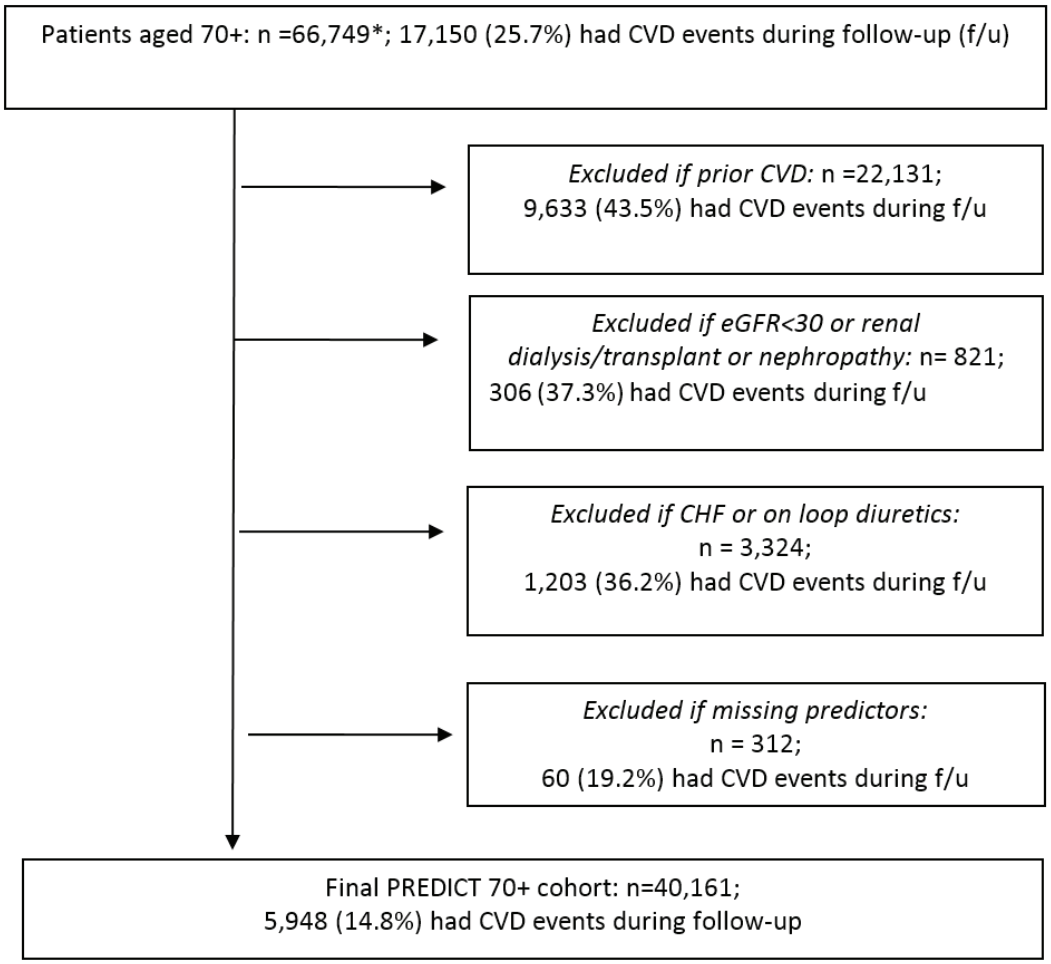
Ethics approval

Approved by the Northern Region Ethics Committee Y in 2003 (AKY/03/12/314) with subsequent annual approval by the National Multi Region Ethics Committee since 2007 (MEC07/19/EXP).

Results

After applying exclusion criteria, 40,161 participants aged 70 years or over had a baseline CVD risk assessment between 31 October 2004 and 30 December 2016 (Figure 1, Table 1).

Figure 1: Study exclusions and incidence of CVD events during follow up.



*Excluded if ethnicity recorded as Middle Eastern, Latin American, African or recorded as 'other' or 'unknown' 'MELAA', 'other' or 'unknown' (in 70+ n=542).

During 185,150 person-years follow-up (mean follow-up time 4.6 years), 5,948 (15%) experienced an incident CVD event of which 1,065 (18%) were fatal. The Appendix describes the number and type of CVD event; mostly due to MI (1,690 events; 28.4%), ischaemic stroke (1,154 events; 19.4%) and heart failure (1,107 events; 18.5%). An additional 3,932 people (10%) died from non-CVD causes. The incidence of CVD and fatal non-CVD events increased markedly with increasing five-year age bands.

The majority of the cohort were women (57%), European (76%) and non-smokers (74%). Just over a third were resident in the two most deprived quintiles. In terms of comorbidity, 6% had a history of atrial fibrillation, 18% had diabetes and 18% had a Charlson comorbidity index of one or more. Overall, 51% of the cohort were on BP-lowering medications, 32% on lipid-lowering and 29% on antithrombotic medications. With increasing age there was an increase in the proportion of women, those of European ethnicity, non-smokers, those dispensed BP-lowering medications and people with atrial fibrillation, diabetes and a comorbidity score of one or more, as well as an increase in mean SBP. Only the mean TC/HDL and proportion dispensed lipid-lowering medications decreased with age.

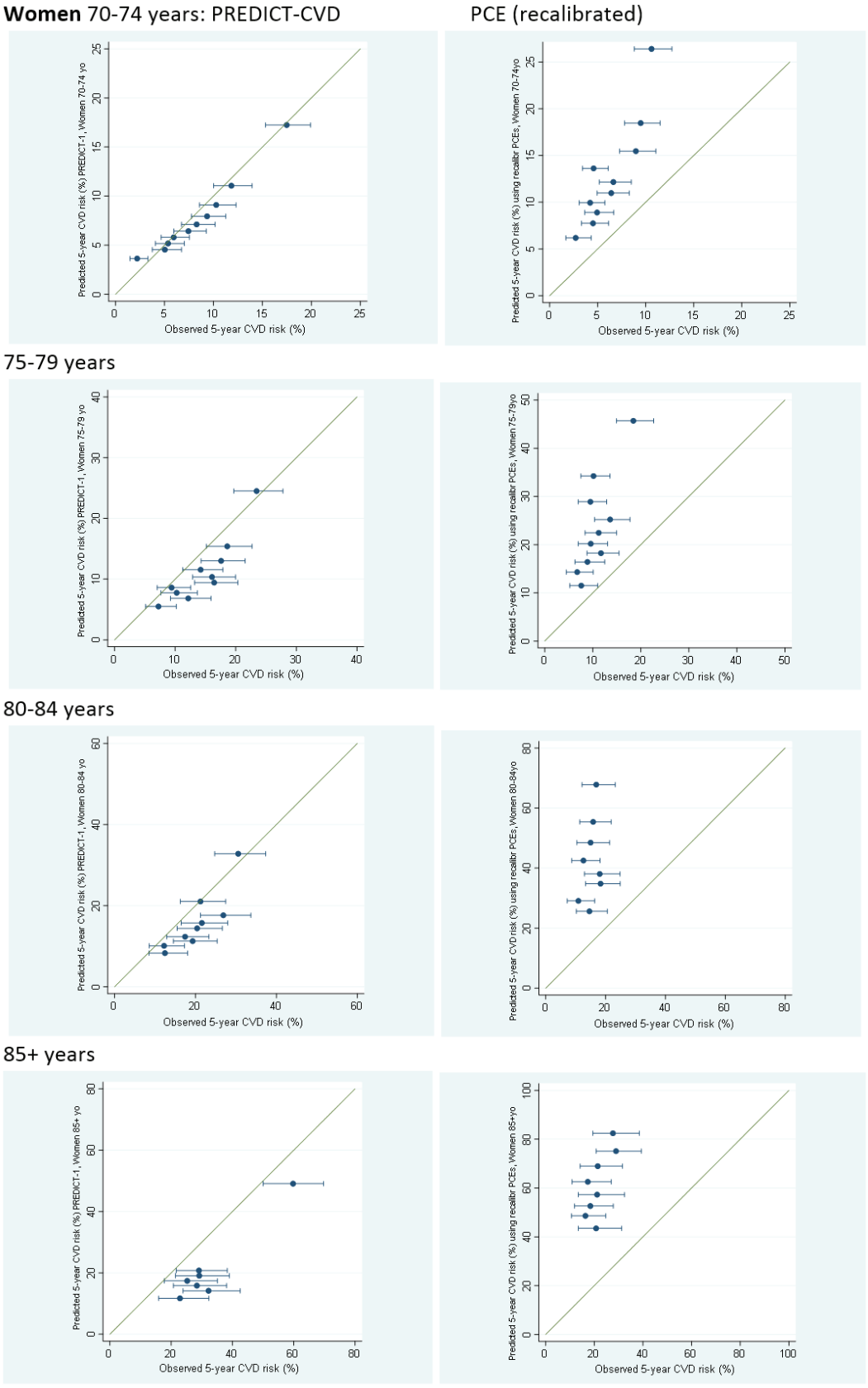
Calibration graphs by decile of predicted risk versus observed five-year CVD event risk for the New Zealand PREDICT-CVD equations and recalibrated PCEs are shown for women (Figure 2) and men (Figure 3) by five-year age groups. In the over 80-year age groups, some deciles could not be plotted according to observed event rate due to insufficient numbers with follow-up at five years.

Table 1: Description of the PREDICT cohort aged 70 years and over.

	Total	70–74 years	75–79 years	80–84 years	85+ years
Median age 73, IQR [71-77], maximum 109 years n (% of cohort) Women	 40,161 22,766 (57%)	 24,795 (62%) 13,630 (55%)	 9,170 (23%) 5,228 (57%)	 4,157 (10%) 2,532 (61%)	 2,039 (5%) 1,376 (68%)
Incident CVD events	5,948 (15%)	2,639 (11%)	1,642 (18%)	1,015 (24%)	652 (32%)
Incidence CVD (per 1,000 per year), median (IQR)	32 (31–33)	23 (22–24)	37 (35–39)	54 (51–58)	85 (78–91)
Non-CVD deaths)	3,932 (10%)	1,517 (6%)	1,036 (11%)	770 (19%)	609 (30%)
Total person-years observed	185,150	114,157	44,599	18,692	7,702
Follow-up time in years; mean (SD), Follow-up time in years; median (IQR)	4.6 (2.3) 4 (3-6)	4.6 (2.2) 4 (3-6)	4.9 (2.3) 5 (3-7)	4.5 (2.3) 4 (3-6)	3.8 (2.2) 4 (2-5)
People with follow-up ≥5 years	15,954	9,506	4,124	1,741	583
Self-identified ethnicity					
European	30,685 (76%)	18,634 (75%)	6,918 (75%)	3,378 (81%)	1,755 (86%)
NZ Māori	1,923 (5%)	1,322 (5%)	434 (5%)	124 (3%)	43 (2%)
Pacific	2,384 (6%)	1,460 (6%)	598 (7%)	253 (6%)	73 (4%)
Indian	1,453 (4%)	993 (4%)	314 (3%)	110 (3%)	36 (2%)
Chinese/other Asian	3,716 (9%)	2,386 (10%)	906 (10%)	292 (7%)	132 (7%)
NZ Deprivation quintile					
1 (least deprived)	9,741 (24%)	6,225 (25%)	2,113 (23%)	947 (23%)	456 (22%)
2	8,638 (22%)	5,472 (22%)	1,974 (22%)	827 (20%)	365 (18%)
3	7,962 (20%)	4,965 (20%)	1,768 (19%)	803 (19%)	426 (21%)
4	7,403 (18%)	4,383 (18%)	1,761 (19%)	835 (20%)	424 (21%
5 (most deprived)	6,417 (16%)	3,750 (15%)	1,554 (17%)	745 (18%)	368 (18%)
Smoking					
Never smoker	29,706 (74%)	18,062 (73%)	6,862 (75%)	3,152 (76%)	1,630 (80%)
Ex-smoker	8,352 (21%)	5,206 (21%)	1,901 (21%)	876 (21%)	369 (18%)
Current smoker	2,103 (5%)	1,527 (6%)	407 (4%)	129 (3%)	40 (2%)
Family history of premature CVD	2,919 (7%)	1,940 (8%)	681 (7%)	209 (5%)	89 (4%)
History of atrial fibrillation	2,197 (6%)	1,048 (4%)	570 (6%)	364 (9%)	215 (11%)
Diabetes	7,382 (18%)	3,625 (15%)	2,165 (24%)	1,085 (26%)	507 (25%)
Charlson comorbidity index					
0	33,094 (82%)	21,168 (85%)	7,406 (81%)	3,128 (75%)	1,392 (68%)
1	1,903 (5%)	1,057 (4%)	458 (5%)	264 (6%)	124 (6%)
2	3,932 (10%)	1,965 (8%)	992 (11%)	584 (14%)	391 (19%)
3+	1,232 (3%)	605 (2%)	314 (3%)	181 (4%)	132 (7%)
Systolic blood pressure, mmHg; mean (SD)	137 (16)	136 (15)	137 (15)	138 (16)	139 (17)
TC/HDL*; mean (SD)	3.7 (1.0)	3.7 (1.0)	3.6 (1.0)	3.5 (1.0)	3.4 (1.0)
Medications at index assessment					
On blood pressure lowering medications	20,505 (51%)	11,372 (46%)	5,219 (57)	2,635 (63%)	1,279 (63%)
On lipid lowering medications	12,663 (32%)	7,479 (30%)	3,279 (36%)	1,394 (34%)	511 (25%)
On antithrombotic medications	11,540 (29%)	6,170 (25%)	3,060 (33%)	1,557 (38%)	753 (37%)

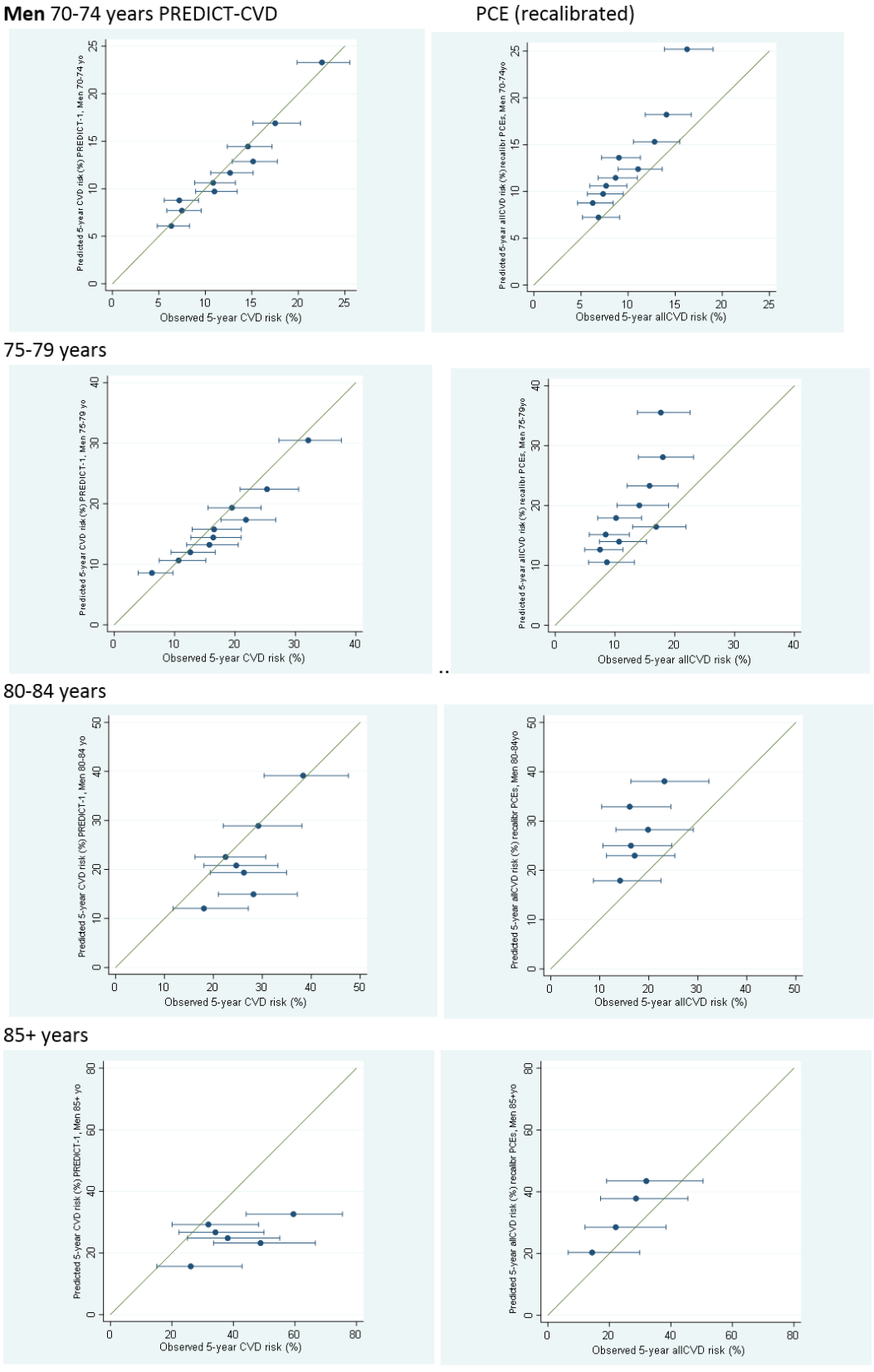
*IQR: interquartile range; SD: standard deviation; CVD: cardiovascular disease; NZ: New Zealand; TC/HDL: Total Cholesterol to HDL Cholesterol ratio.

Figure 2: Calibration plots by decile of predicted risk and observed CVD event risk at five years according to PREDICT-CVD, PCE and recalibrated PCE for women by age group.



A diagonal line with intercept of 0 and slope of 1 represents perfect calibration. Plotted risk deciles below the diagonal represent an underestimate of predicted risk, above the diagonal, an overestimate.

Figure 3: Calibration graphs by decile of predicted risk and observed CVD event risk at five years according PREDICT-CVD, PCE and recalibrated PCE for men by age group.



A diagonal line with intercept of 0 and slope of 1 represents perfect calibration. Plotted risk deciles below the diagonal represent an underestimate of predicted risk, above the diagonal, an overestimate.

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Table 2: Performance metrics of PREDICT-CVD models, by sex and age group.

	Women				Men			
	70–74 years	75–79 years	80–84 years	85+ years	70–74 years	75–79 years	80–84 years	85+ years
Harrell's C	0.638 (0.621, 0.655)	0.586 (0.565, 0.606)	0.577 (0.551, 0.602)	0.582 (0.553, 0.612)	0.617 (0.601, 0.633)	0.624 (0.603, 0.645)	0.557 (0.528, 0.587)	0.530 (0.489, 0.572)
D statistic	0.781 (0.689, 0.873)	0.483 (0.371, 0.595)	0.410 (0.277, 0.543)	0.512 (0.353, 0.671)	0.615 (0.529, 0.701)	0.638 (0.522, 0.754)	0.307 (0.150, 0.464)	0.226 (0.010, 0.442)
R^2	13% (9%, 16 %)	5% (3%, 8%)	4% (2%, 7%)	6% (3%, 10%)	8% (6%, 10%)	9% (6%, 13%)	2% (0%, 4%)	1% (0%, 4%)

For women, PREDICT-CVD was well calibrated for those aged 70–74 years but underestimated CVD risk for women aged 75–84 years with the exception of those in the highest deciles of risk. Among those aged 85 years and over, underestimation of risk was also observed as well as suggesting poor discrimination by decile of risk (ie, risk deciles clustered over a similar observed five-year event rate). In contrast, the recalibrated PCEs overestimated CVD risk across all age groups. For those over 80 years, while predicted risk deciles were well separated, they were also stacked above the same observed event rate, indicating poor discrimination as well as poor calibration.

For men, PREDICT-CVD was reasonably well calibrated for those aged 70–79 years but underestimated CVD risk for men aged 80–84 years with the exception of those in the three highest deciles of risk, and underestimated CVD risk for all aged 85 years and over as well as showing poor discrimination. The PCEs overestimated CVD risk across all age groups from 70–84 years. However, in the 85+ age group, in the deciles with sufficient participants at five years of follow-up, overestimation with the recalibrated PCEs was less marked than at younger age groups.

Tables 2 and 3 summarise the discrimination metrics by age group and sex for PREDICT-CVD and PCEs. The discrimination and overall performance were generally poor for both equations in people over age 75 years.

Discussion

This study investigated the performance of contemporary CVD risk prediction equations in a cohort of 40,161 ambulatory people aged 70 years and over who had a heart health check, while visiting their GP. Over a third of the cohort were aged over 74 years. While both the calibration and discrimination performance of the equations varied, in general they performed increasingly poorly in people over 75 years of age, particularly the PCEs.

This is the first study comparing the performance of contemporary CVD risk equations in a cohort of older people whose GPs had decided to risk assess them in a routine practice setting. Previous studies have been based on either total general practice population samples,[20] population-based health surveys[21] or combined cohort studies populations.[9,22] Our study

Table 3: Performance metrics of PCE models, by sex and age group.

	Women				Men			
	70–74 years	75–79 years	80–84 years	85+ years	70–74 years	75–79 years	80–84 years	85+ years
Harrell's C	0.611 (0.590, 0.631)	0.568 (0.541, 0.594)	0.536 (0.504, 0.567)	0.565 (0.525, 0.605)	0.593 (0.573, 0.612)	0.590 (0.563, 0.617)	0.551 (0.513, 0.588)	0.554 (0.503, 0.605)
D statistic	0.615 (0.505, 0.725)	0.367 (0.228, 0.506)	0.272 (0.103, 0.441)	0.386 (0.176, 0.596)	0.468 (0.358, 0.558)	0.444 (0.301, 0.587)	0.337 (0.141, 0.533)	0.371 (0.099, 0.643)
R^2	8% (6%, 12%)	3% (1%, 7%)	2% (0%, 5%)	3% (1%, 8%)	5% (2%, 7%)	4% (2%, 8%)	3% (1%, 6%)	3% (1%, 9%)

reported comorbidity and non-CVD deaths across our total cohort and in five-year age bands. While some comorbidities have been reported in previous evaluations of some equations,[20] none have reported how these factors, that are likely to influence the accuracy of risk assessment in the elderly, change with increasing age. Furthermore, previous evaluations of equation performance in older people have used wide age bands, which can mask significant differences by age, given the diminishing numbers of people in increasingly older age bands.[20,22]

There are other CVD risk prediction equations recommended for use in older patients. These include QRISK3 developed by UK researchers for people aged 25–84 years;[20] Systematic COronary Risk Evaluation in older people (SCORE O.P.) developed by European researchers for people aged 65–80 years;[22] and the Canadian CVD Population Risk Tool (CVDPoRT) for ages 20–105.[21] The QRISK3 model includes over 20 predictor variables,[20] many of which we were unable to incorporate given our more limited CVD profile data. Similarly, the Canadian CVDPoRT equation, derived from large population health surveys includes many lifestyle factors also not captured in our primary care-derived dataset.[21] We considered assessing the performance of SCORE O.P. equations, derived in people aged 65–80 years, but it only predicts CVD mortality and many patients are also concerned about the impact of non-fatal major CVD events. Moreover, diabetes is not included as a predictor, yet a quarter of the PREDICT cohort over 75 years had diabetes.

It has previously been reported that CVD risk prediction equations developed and validated in younger age cohorts may not perform well when applied to populations aged 75 and older due to competing risks.[23] Most equations do not incorporate the effect of other comorbid conditions or polypharmacy on CVD risk and competing risks of death from cancer or dementia. These competing risk events (non-CVD death events, which preclude an individual from experiencing a CVD event) become increasingly important with age. Indeed 10% of our study cohort died from non-CVD causes. For older age cohorts, where mortality rates are comparatively high, equations that treat non-CVD events as competing risks are likely to be needed to achieve more accurate risk prediction.[23]

The major strength of this study is also its major limitation. Participants were those older people, who, in the clinical judgement of primary care clinicians, were suitable for a routine preventive CVD risk assessment. While 90% of all New Zealanders aged 30–74 years have had a CVD risk assessment,[24] many of the older people in our cohort have been risk assessed largely at the discretion of their primary care provider. Therefore they are not representative of all older people in the study region, because risk assessment would not be clinically appropriate for many of those not included (eg, those with dementia or requiring palliative care). We estimated that 50% of people aged 75–79 years, 30% aged 80–84 years and 25% of those aged 85 years and over, who did not have prior CVD, were included in our study. A further limitation is the use of the Charlson comorbidity index, modified to the extent that only 9 of the 12 comorbidities could be present in the study cohort (heart failure, stroke, renal disease being excluded). While the index has been validated in a New Zealand population, it suffers from including a very limited range of hospitalised-only long-term conditions and therefore underestimates the true multimorbidity burden in primary care. Indeed the prevalence of multimorbidity in the 65–84 year age group has been found to be as much as 65% in Scottish general practices.[25] This is particularly relevant as most CVD risk prediction equations, and CVD risk management guidelines, tend to take a narrow disease-focused approach.[26]

This paper poses a series of clinical implications to current CVD risk prediction practice. Many older people are still engaged in the workforce and physically active. In the current Ministry of Health CVD guidance,[6] healthy people over 75 years with few comorbidities and an estimated life expectancy of more than five years, CVD risk assessment using the PREDICT equations are recommended as well as discussing the same management options as for people under 75 years of age. However, although CVD risk factors have similar effects in those under and over 75 years,[22,27] risk assessment and management is more complex for older age groups as health status, physical and

cognitive functioning varies greatly.[28] The risk of other long-term conditions increases with age[25] and this in turn is associated with polypharmacy and complicated medication regimens.[29,30] In this context, the risks and benefits of CVD risk-reducing interventions is accompanied by less certainty. Some treatment-related risks will increase, such as bleeding with aspirin, requiring clinicians to vary their advice.[30] Furthermore, general health and functioning such as frailty, cognitive impairment, quality of life and personal preferences need to be taken into account. Older people may be more concerned about the risk of stroke than MI, as stroke may result in mental and physical disability and loss of independence, so single CVD outcomes (eg, stroke), as well as composite CVD outcomes, may be useful to guide discussions. The emerging guidance on how best to manage multimorbidity might offer a way forward here, with its focus on realistic treatment goals shared between clinician and patient and the need to recognise preference sensitive decisions (eg, medication that may benefit one condition but may make another worse).[31–33]

From this study of presumed healthy older people being risk assessed in general practice, we have found that the performance of the CVD equations derived mainly in people under age 75 years need to be improved to support clinical decision-making for people aged 75 years and over. We recommend that CVD equations used in people over 75 years incorporate factors such as multimorbidity and competing risks with additional risk-benefit tools taking into account physical and cognitive functioning and patient preferences.

Appendix

Number and type of incident CVD events in the PREDICT-1° patients, 70+ years old men and women

Outcome type	Total	Non-fatal events, n	Fatal events, n	Proportion of all CVD events, %
Myocardial infarction	1,690	1244	446	28.4
Unstable angina	165	161	4	2.8
Other coronary heart disease	522	478	44	8.8
Congestive heart failure	1,107	1053	54	18.5
Ischaemic stroke	1,154	908	246	19.4
Haemorrhagic stroke	241	145	96	4.1
Transient ischemic attack	558	552	6	9.4
Other cerebrovascular disease	16	16	0	0.3
Peripheral vascular disease	386	326	60	6.5
Other CVD-related deaths	109	NA	109	1.8
All CVD events[a]	5,948	4,883	1,065	100

[a]If a patient had more than one type of CVD event, only the first was counted.

Medications available in New Zealand according to the CVD treatment categories of interest

	Class of blood pressure-lowering drugs*					
	ACE inhibitor	**ARB**	**Beta blocker**	**CCB**	**Other**	**Thiazide**
Medication name	Benazepril Captopril Cilazapril Enalapril Lisinopril Perindopril Quinapril Trandolapril	Candesartan Losartan	Acebutolol Alprenolol Atenolol Bisoprolol Carvedilol Celiprolol Labetalol Metoprolol Nadolol Oxprenolol Pindolol Propranolol Sotalol Timolol	Amlodipine Diltiazem Felodipine Isradipine Nifedipine Verapamil	Amiloride Clonidine Clopamide Hydralazine Methyldopa Triamterene	Bendrofluazide Chlorthalidone Chlorothiazide Cyclopenthiazide Hydrochlorothiazide Indapamide Methyclothiazide

*Alpha blockers, loop diuretics (bumetanide, frusemide), metolazone and spironolactone excluded as primary indication not usually to reduce blood pressure.

	Class of lipid-lowering drugs	
	Statin	**Other lipid lowering treatment**
Medication name	Atorvastatin Fluvastatin Pravastatin Simvastatin	Acipimox Bezafibrate Cholestyramine Clofibrate Colestipol Ezetimibe Ezetimibe with simvastatin Gemfibrozil Nicotinic acid

	Class of antithrombotic drugs	
	Antiplatelets	**Anticoagulants**
Medication name	Aspirin Clopidogrel Dipyridamole Prasugrel Ticagrelor Ticlopidine	Dabigatran Phenindione Rivaroxaban Warfarin

International Classification of Disease-10-Australian Modification (ICD-10-AM) codes for the PREDICT-1° CVD events outcome, from hospital discharge and mortality records

Outcome type	ICD-10-AM codes
Haemorrhagic stroke	I600 - I616, I618 - I619
Congestive heart failure	I110, I130, I132, I50, I500, I501, I509
Coronary heart disease	I200, I201, I208 – I209, I210 - I214, I219 - I222, I228 - I236, I238, I240, I248, I249, I253-I256, I460, I469
Cerebral vascular disease	I630 - I636, I638 - I639, I64 , G450 - G453, G458 - G459, G460 - G468, I660 - I664, I668 - I670, I672
Peripheral vascular disease	E1050 - E1052, E1150 - E1152, E1350 - E1352, E1451 - E1452, I650 - I653, I658 - I659, I7021-I7024, I7100 - I7103, I711, I713, I715, I718, I739 - I745, I748 - I749
Other ischaemic CVD-related deaths	E1053, E1059, E1153, E1159, E1353, E1359, E1453, E1459, I250, I2510-I2513, I258, I259, I461, I672, I690, I691, I693, I694, I698, I700, I701, I7020, I708, I709, I714, I716

International Classification of Disease-10-Australian Modification (ICD-10-AM) codes for the PCEs hard atherosclerotic CVD outcome,* from hospital discharge and mortality records.

Outcome type	ICD-10-AM codes
Myocardial infarction	I210, I211 - I214, I219 - I221, I228, I229
Other coronary heart disease	I201, I208, I209, I230, I231, I232, I233, I234, I235, I236, I238, I240, I248, I249, I252, I253, I254, I255, I256, I460, I469,
Ischaemic stroke	I630 - I636, I638, I639, I64
Haemorrhagic stroke	I600 - I616, I618, I619

*Both fatal and nonfatal events with myocardial infarction and stroke codes were included but only fatal events with 'Other coronary heart disease' codes.

ICD 10 codes included in the definition of prior CVD

CODE	DESCRIPTION FULL
G460	Middle cerebral artery syndrome (I66.0+)
G461	Anterior cerebral artery syndrome (I66.1+)
G462	Posterior cerebral artery syndrome (I66.2+)
G463	Brain stem stroke syndrome (I60-I67+)
G464	Cerebellar stroke syndrome (I60-I67+)
G465	Cerebellar stroke syndrome (I60-I67+)
G466	Pure sensory lacunar syndrome (I60-I67+)
G467	Other lacunar syndromes (I60-I67+)
G468	Other vascular syndromes of brain in cerebrovascular diseases (I60-I67+)
I651	Occlusion and stenosis of basilar artery
I660	Occlusion and stenosis of middle cerebral artery

I661	Occlusion and stenosis of anterior cerebral artery
I662	Occlusion and stenosis of posterior cerebral artery
I663	Occlusion and stenosis of cerebellar arteries
I664	Occlusion and stenosis of multiple and bilateral cerebral arteries
I668	Occlusion and stenosis of other cerebral artery
I669	Occlusion and stenosis of unspecified cerebral artery
I670	Dissection of cerebral arteries, nonruptured
I672	Cerebral atherosclerosis
I698	Sequelae of other and unspecified cerebrovascular diseases
G450	Vertebro-basilar artery syndrome
G451	Carotid artery syndrome (hemispheric)
G452	Multiple and bilateral precerebral artery syndromes
G453	Amaurosis fugax
G458	Other transient cerebral ischaemic attacks and related syndromes
G459	Transient cerebral ischaemic attack, unspecified
I630	Cerebral infarction due to thrombosis of precerebral arteries
I631	Cerebral infarction due to embolism of precerebral arteries
I632	Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries
I633	Cerebral infarction due to thrombosis of cerebral arteries
I634	Cerebral infarction due to embolism of cerebral arteries
I635	Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries
I636	Cerebral infarction due to cerebral venous thrombosis, nonpyogenic
I638	Other cerebral infarction
I639	Cerebral infarction, unspecified
I64	Stroke, not specified as haemorrhage or infarction
I693	Sequelae of cerebral infarction
I694	Sequelae of stroke, not specified as haemorrhage or infarction
I600	Subarachnoid haemorrhage from carotid siphon and bifurcation
I601	Subarachnoid haemorrhage from middle cerebral artery
I602	Subarachnoid haemorrhage from anterior communicating artery
I603	Subarachnoid haemorrhage from posterior communicating artery
I604	Subarachnoid haemorrhage from basilar artery
I605	Subarachnoid haemorrhage from vertebral artery
I606	Subarachnoid haemorrhage from other intracranial arteries
I607	Subarachnoid haemorrhage from intracranial artery, unspecified
I608	Other subarachnoid haemorrhage
I609	Subarachnoid haemorrhage, unspecified

I610	Intracerebral haemorrhage in hemisphere, subcortical
I611	Intracerebral haemorrhage in hemisphere, cortical
I612	Intracerebral haemorrhage in hemisphere, unspecified
I613	Intracerebral haemorrhage in brain stem
I614	Intracerebral haemorrhage in cerebellum
I615	Intracerebral haemorrhage, intraventricular
I616	Intracerebral haemorrhage, multiple localized
I618	Other intracerebral haemorrhage
I619	Intracerebral haemorrhage, unspecified
I690	Sequelae of subarachnoid haemorrhage
I691	Sequelae of intracerebral haemorrhage
3270000	Carotid bypass using vein
3270001	Carotid-carotid bypass using vein
3270002	Carotid-subclavian bypass using vein
3270003	Carotid-vertebral bypass using vein
3270004	Aorto-subclavian-carotid bypass using vein
3270005	Carotid bypass using synthetic material
3270006	Carotid-carotid bypass using synthetic material
3270007	Carotid-vertebral bypass using synthetic material
3270008	Carotid-subclavian bypass using synthetic material
3270009	Aorto-carotid bypass using synthetic material
3270010	Aorto-carotid-brachial bypass using synthetic material
3270011	Aorto-subclavian-carotid bypass using synthetic material
3270300	Resection of carotid artery with re-anastomosis
3270800	Aorto-femoral bypass using synthetic material
3270801	Aorto-femoro-femoral bypass using synthetic material
3270802	Aorto-iliac bypass using synthetic material
3270803	Aorto-ilio-femoral bypass using synthetic material
3271200	Ilio-femoral bypass using vein
3271201	Ilio-femoral bypass using synthetic material
3271500	Subclavian-femoral bypass using synthetic material
3271501	Subclavian-femoro-femoral bypass using synthetic material
3271502	Axillo-femoral bypass using synthetic material
3271503	Axillo-femoro-femoral bypass using synthetic material
3271800	Ilio-femoral crossover bypass
3271801	Femoro-femoral crossover bypass
3273000	Mesenteric bypass using vein, single vessel

3273001	Mesenteric bypass using synthetic material, single vessel
3273300	Mesenteric bypass using vein, multiple vessels
3273301	Mesenteric bypass using synthetic material, multiple vessels
3273600	Other procedures on inferior mesenteric artery
3273900	Femoral artery bypass using vein, above knee
3274200	Femoral artery bypass using vein, below knee
3274500	Femoral artery bypass using vein, to tibio-peroneal trunk, tibial or peroneal artery
3274800	Femoral artery bypass using vein, within 5cm of ankle
3275100	Femoral artery bypass using synthetic material, above knee
3275101	Femoral artery bypass using synthetic material, below knee
3275102	Femoral artery bypass using synthetic material, to tibio-peroneal trunk, tibial or peroneal artery
3275103	Femoral artery bypass using synthetic material, within 5 cm of ankle
3275400	Femoro-femoral bypass using composite graft
3275401	Femoro-popliteal bypass using composite graft
3275402	Femoral to tibial or peroneal artery bypass using composite graft
3275700	Femoral artery sequential bypass using vein
3275701	Femoral artery sequential bypass using synthetic material
3276300	Other arterial bypass using vein
3276301	Other arterial bypass graft using synthetic material
3276302	Subclavian-vertebral bypass using vein
3276303	Subclavian-axillary bypass using vein
3276305	Aorto-coeliac bypass using vein
3276306	Aorto-femoro-popliteal bypass using vein
3276307	Ilio-iliac bypass using vein
3276308	Popliteal-tibial bypass using vein
3276309	Aorto-subclavian bypass using synthetic material
3276310	Subclavian-subclavian bypass using synthetic material
3276311	Subclavian-vertebral bypass using synthetic material
3276312	Subclavian-axillary bypass using synthetic material
3276313	Axillo-axillary bypass using synthetic material
3276314	Axillo-brachial bypass using synthetic material
3276316	Aorto-coeliac bypass using synthetic material
3276317	Aorto-femoro-popliteal bypass using synthetic material
3276318	Ilio-iliac bypass using synthetic material
3276319	Popliteal-tibial bypass using synthetic material
3305000	Replacement of popliteal aneurysm using vein

3305500	Replacement of popliteal aneurysm using synthetic graft
3307500	Repair of aneurysm in neck
3308000	Repair of intra-abdominal aneurysm
3310000	Replacement of carotid artery aneurysm with graft
3311200	Replacement of suprarenal abdominal aorta aneurysm with graft
3311500	Replacement of infrarenal abdominal aortic aneurysm with tube graft
3311800	Replacement of infrarenal abdominal aortic aneurysm with bifurcation graft to iliac arteries
3312100	Replacement of infrarenal abdominal aortic aneursym with bifurcation graft to femoral arteries
3312400	Replacement of iliac artery aneurysm with graft, unilateral
3312700	Replacement of iliac artery aneurysm with graft, bilateral
3313000	Excision and repair of visceral artery aneurysm with direct anastomosis
3315100	Replacement of ruptured suprarenal abdominal aortic aneurysm with graft
3315400	Replacement of ruptured infrarenal abdominal aortic aneurysm with tube graft
3315700	Replacement of ruptured infrarenal aortic aneurysm with bifurcation graft to iliac arteries
3316000	Replacement of ruptured infrarenal abdominal aortic aneurysm with bifurcation graft to femoral arteries
3316300	Replacement of ruptured iliac artery aneurysm with graft
3317200	Replacement of other major artery aneurysm with graft
3317800	Repair of ruptured aneurysm in neck
3318100	Repair of ruptured intra-abdominal aneurysm
3350000	Carotid endarterectomy
3350600	Innominate endarterectomy
3350601	Subclavian endarterectomy
3350900	Aorta endarterectomy
3351200	Aorto-iliac endarterectomy
3351500	Aorto-femoral endarterectomy
3351501	Ilio-femoral endarterectomy, bilateral
3351800	Iliac endarterectomy
3352100	Ilio-femoral endarterectomy, unilateral
3352400	Renal endarterectomy, unilateral
3352700	Renal endarterectomy, bilateral
3353000	Coeliac endarterectomy
3353001	Superior mesenteric endarterectomy
3353300	Coeliac and superior mesenteric endarterectomy
3353600	Inferior mesenteric endarterectomy

3353900	Endarterectomy of extremities
3354200	Extended endarterectomy of deep femoral artery
3354800	Patch graft of artery using vein
3354801	Patch graft of artery using synthetic material
3354802	Patch graft of vein using vein
3354803	Patch graft of vein using synthetic material
3355100	Procurement of vein from limb for patch graft
3355400	Endarterectomy in conjunction with arterial bypass to prepare site for anastomosis
3530000	Percutaneous transluminal balloon angioplasty of 1 peripheral artery or vein of 1 limb
3530301	Percutaneous transluminal balloon angioplasty of aortic visceral branches
3530304	Percutaneous transluminal balloon angioplasty of 2 or more peripheral arteries or veins of 1 limb
3530306	Percutaneous transluminal balloon angioplasty
3530307	Open transluminal balloon angioplasty
3530600	Percutaneous insertion of 1 stent into single peripheral artery or vein of 1 limb
3530601	Percutaneous insertion of 2 or more stents into single peripheral artery or vein of 1 limb
3530602	Percutaneous insertion of 2 or more stents into multiple peripheral arteries or veins of 1 limb
3530700	Percutaneous transluminal angioplasty of single carotid artery, single stent
3530701	Percutaneous transluminal angioplasty of single carotid artery, multiple stents
3530900	Percutaneous insertion of 1 stent into single visceral artery or vein
3530901	Percutaneous insertion of 2 or more stents into single visceral artery or vein
3530902	Percutaneous insertion of 2 or more stents into multiple visceral arteries or veins
3530906	Percutaneous transluminal balloon angioplasty with stenting, single stent
3530907	Percutaneous transluminal balloon angioplasty with stenting, multiple stents
3530908	Open transluminal balloon angioplasty with stenting, single stent
3530909	Open transluminal balloon angioplasty with stenting, multiple stents
3531200	Percutaneous peripheral artery atherectomy
3531201	Open peripheral artery atherectomy
3531500	Percutaneous peripheral laser angioplasty
3531501	Open peripheral laser angioplasty
9021100	Subclavian-vertebral bypass using vein
9021101	Subclavian-axillary bypass using vein
9021102	Spleno-renal bypass using vein
9021103	Aorto-coeliac bypass using vein
9021104	Aorto-femoro-popliteal bypass using vein
9021105	Ilio-iliac bypass using vein

9021106	Popliteal-tibial bypass using vein
9021200	Aorto-subclavian bypass using synthetic material
9021201	Subclavian-subclavian bypass using synthetic material
9021202	Subclavian-vertebral bypass using synthetic material
9021203	Subclavian-axillary bypass using synthetic material
9021204	Axillo-axillary bypass using synthetic material
9021205	Axillo-brachial bypass using synthetic material
9021206	Spleno-renal bypass using synthetic material
9021207	Aorto-coeliac bypass using synthetic material
9021208	Aorto-femoro-popliteal bypass using synthetic material
9021209	Ilio-iliac bypass using synthetic material
9021210	Popliteal-tibeal bypass using synthetic material
9022900	Other endarterectomy
9023000	Embolectomy or thrombectomy of other artery
9023100	Replacement of occluded non-infected prosthetic bypass graft from trunk
Z958	Presence of other cardiac and vascular implants and grafts
Z959	Presence of cardiac and vascular implant and graft, unspecified
E1050	Insulin-dependent diabetes mellitus with peripheral circulatory complications, not stated as uncontrolled
E1051	Insulin-dependent diabetes mellitus with peripheral circulatory complications, stated as uncontrolled
E1052	Type 1 diabetes mellitus with peripheral angiopathy, with gangrene
E1150	Non-insulin-dependent diabetes mellitus with peripheral circulatory complications, not stated as uncontrolled
E1151	Non-insulin-dependent diabetes mellitus with peripheral circulatory complications, stated as uncontrolled
E1152	Type 2 diabetes mellitus with peripheral angiopathy, with gangrene
E1350	Other specified diabetes mellitus with peripheral circulatory complications, not stated as uncontrolled
E1351	Other specified diabetes mellitus with peripheral circulatory complications, stated as uncontrolled
E1352	Other specified diabetes mellitus with peripheral angiopathy, with gangrene
E1451	Unspecified diabetes mellitus with peripheral circulatory complications, stated as uncontrolled
E1452	Unspecified diabetes mellitus with peripheral angiopathy, with gangrene
I650	Occlusion and stenosis of vertebral artery
I652	Occlusion and stenosis of carotid artery
I653	Occlusion and stenosis of multiple and bilateral precerebral arteries

I658	Occlusion and stenosis of other precerebral artery
I659	Occlusion and stenosis of unspecified precerebral artery
I700	Atherosclerosis of aorta
I701	Atherosclerosis of renal artery
I7020	Atherosclerosis of arteries of extremities, unspecified
I7021	Atherosclerosis of arteries of extremities with intermittent claudication
I7022	Atherosclerosis of arteries of extremities with rest pain
I7023	Atherosclerosis of arteries of extremities with ulceration
I7024	Atherosclerosis of arteries of extremities with gangrene
I708	Atherosclerosis of other arteries
I709	Generalized and unspecified atherosclerosis
I7100	Dissection of aorta, unspecified site
I7101	Dissection of thoracic aorta
I7102	Dissection of abdominal aorta
I7103	Dissection of thoracoabdominal aorta
I711	Thoracic aortic aneurysm, ruptured
I713	Abdominal aortic aneurysm, ruptured
I714	Abdominal aortic aneurysm, without mention of rupture
I715	Thoracoabdominal aortic aneurysm, ruptured
I716	Thoracoabdominal aortic aneurysm, without mention of rupture
I718	Aortic aneurysm of unspecified site, ruptured
I739	Peripheral vascular disease, unspecified
I740	Embolism and thrombosis of abdominal aorta
I741	Embolism and thrombosis of other and unspecified parts of aorta
I742	Embolism and thrombosis of arteries of upper extremities
I743	Embolism and thrombosis of arteries of lower extremities
I744	Embolism and thrombosis of arteries of extremities, unspecified
I745	Embolism and thrombosis of iliac artery
I748	Embolism and thrombosis of other arteries
I749	Embolism and thrombosis of unspecified artery
3530401	Open transluminal balloon angioplasty of 1 coronary artery
3530501	Open transluminal balloon angioplasty of 2 or more coronary arteries
3531003	Open insertion of 1 transluminal stent into single coronary artery
3531004	Open insertion of 2 or more transluminal stents into single coronary artery
3531005	Open insertion of 2 or more transluminal stents into multiple coronary arteries
3845619	Other intrathoracic procedures on arteries of heart without cardiopulmonary bypass

3850500	Open coronary endarterectomy
3850700	Left ventricular aneurysmectomy
3850700	Left ventricular aneurysmectomy
3850800	Left ventricular aneurysmectomy with patch graft
3850900	Repair of ventricular septal rupture
3849700	Coronary artery bypass, using 1 saphenous vein graft
3849701	Coronary artery bypass, using 2 saphenous vein grafts
3849702	Coronary artery bypass, using 3 saphenous vein grafts
3849703	Coronary artery bypass, using 4 or more saphenous vein grafts
3849704	Coronary artery bypass, using 1 other venous graft
3849705	Coronary artery bypass, using 2 other venous grafts
3849706	Coronary artery bypass, using 3 other venous grafts
3849707	Coronary artery bypass, using 4 or more venous grafts
3850000	Coronary artery bypass, using 1 LIMA graft
3850001	Coronary artery bypass, using 1 RIMA graft
3850002	Coronary artery bypass, using 1 radial artery graft
3850003	Coronary artery bypass, using 1 epigastric artery graft
3850004	Coronary artery bypass, using 1 other arterial graft
3850300	Coronary artery bypass, using 2 LIMA grafts
3850301	Coronary artery bypass, using 2 RIMA grafts
3850302	Coronary artery bypass, using 2 radial artery grafts
3850303	Coronary artery bypass, using 2 epigastric artery grafts
3850304	Coronary artery bypass, using 2 or more other arterial grafts
3850500	Open coronary endarterectomy
3863700	Re-operation for reconstruction of occluded coronary artery
9020100	Coronary artery bypass, using 1 other material graft, not elsewhere classified
9020101	Coronary artery bypass, using 2 other material grafts, not elsewhere classified
9020102	Coronary artery bypass, using 3 other material grafts, not elsewhere classified
9020103	Coronary artery bypass, using 4 or more other material grafts, not elsewhere classified
Z951	Presence of aortocoronary bypass graft
3530400	Percutaneous transluminal balloon angioplasty of 1 coronary artery
3530500	Percutaneous transluminal balloon angioplasty of 2 or more coronary arteries
3531000	Percutaneous insertion of 1 transluminal stent into single coronary artery
3531001	Percutaneous insertion of 2 or more transluminal stents into single coronary artery
3531002	Percutaneous insertion of 2 or more transluminal stents into multiple coronary arteries
3830000	Percutaneous transluminal balloon angioplasty of 1 coronary artery

3830600	Percutaneous insertion of 1 transluminal stent into single coronary artery
3830601	Percutaneous insertion of >= 2 transluminal stents into single coronary artery
3830602	Percutaneous insertion of >= 2 transluminal stents into multiple coronary arteries
3830900	Percutaneous transluminal coronary rotational atherectomy [PTCRA], 1 artery
3831200	Percutaneous transluminal coronary rotational atherectomy [PTCRA], 1 artery with insertion 1 stent
3831201	Percutaneous transluminal coronary rotational atherectomy [PTCRA], 1 artery w insertion >= 2 stents
3831500	Percutaneous transluminal coronary rotational atherectomy [PTCRA], multiple arteries
3831800	Percutaneous transluminal coronary rotational atherectomy [PTCRA], multi arteries w insert 1 stent
9021800	Percutaneous transluminal coronary angioplasty with aspiration thrombectomy, 1 artery
9021801	Percutaneous transluminal coronary angioplasty with aspiration thrombectomy, multiple arteries
I110	Hypertensive heart disease with heart failure
I130	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure
I132	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure
I200	Unstable angina
I201	Angina pectoris with documented spasm
I208	Other forms of angina pectoris
I209	Angina pectoris, unspecified
I210	Acute transmural myocardial infarction of anterior wall
I211	Acute transmural myocardial infarction of inferior wall
I212	Acute transmural myocardial infarction of other sites
I213	Acute transmural myocardial infarction of unspecified site
I214	Acute subendocardial myocardial infarction
I219	Acute myocardial infarction, unspecified
I220	Subsequent myocardial infarction of anterior wall
I221	Subsequent myocardial infarction of inferior wall
I222	Subsequent non-ST elevation (NSTEMI) myocardial infarction
I228	Subsequent myocardial infarction of other sites
I229	Subsequent myocardial infarction of unspecified site
I230	Haemopericardium as current complication following acute myocardial infarction
I231	Atrial septal defect as current complication following acute myocardial infarction
I232	Ventricular septal defect as current complication following acute myocardial infarction
I233	Rupture of cardiac wall without haemopericardium as current complication following acute myocardial infarction

I234	Rupture of chordae tendineae as current complication following acute myocardial infarction
I235	Rupture of papillary muscle as current complication following acute myocardial infarction
I236	Thrombosis of atrium, auricular appendage, and ventricle as current complications following acute myocardial infarction
I238	Other current complications following acute myocardial infarction
I240	Coronary thrombosis not resulting in myocardial infarction
I248	Other forms of acute ischaemic heart disease
I249	Acute ischaemic heart disease, unspecified
I250	Atherosclerotic cardiovascular disease, so described
I2510	Atherosclerotic heart disease, of unspecified vessel
I2511	Atherosclerotic heart disease, of native coronary artery
I2512	Atherosclerotic heart disease, of autologous bypass graft
I2513	Atherosclerotic heart disease, of nonautologous biological bypass graft
I252	Old myocardial infarction
I253	Aneurysm of heart
I254	Coronary artery aneurysm
I255	Ischaemic cardiomyopathy
I256	Silent myocardial ischaemia
I258	Other forms of chronic ischaemic heart disease
I259	Chronic ischaemic heart disease, unspecified
I460	Cardiac arrest with successful resuscitation
I469	Cardiac arrest, unspecified
I50	Heart failure
I500	congestive heart failure
I501	Left ventricular failure
I509	Heart failure unspecified
Z955	Presence of coronary angioplasty implant and graft

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Author information:
Sue Wells, School of Population Health, University of Auckland, Auckland;
Romana Pylypchuk, School of Population Health, University of Auckland, Auckland;
Suneela Mehta, School of Population Health, University of Auckland, Auckland;
Andrew Kerr, Cardiology Department, Middlemore Hospital, Auckland;
Vanessa Selak, School of Population Health, University of Auckland, Auckland;
Katrina Poppe, Department of Medicine, University of Auckland, Auckland;
Corina Grey, School of Population Health, University of Auckland, Auckland;
Rod Jackson, School of Population Health, University of Auckland, Auckland.

Corresponding author:
A/P Sue Wells, School of Population Health, University of Auckland, Private Bag 92019 Auckland Mail Centre, Auckland 1142.
s.wells@auckland.ac.nz

URL:
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Social consequences of assisted dying: a case study

Rhona Winnington, Roderick MacLeod

This paper discusses the potential effects of assisted dying (AD) legislation beyond the relief of individual suffering. AD is when an individual chooses that they wish to die and either self-medicate to end their life under clinical supervision, or clinicians administer the medication for them. This paper focuses on potential family/whānau and community consequences should we introduce such legislation into New Zealand culture, highlighting that family members whose loved one has had an assisted death are feeling obligated to also consider dying in this way as their health fails. Furthermore, we highlight that even when AD is a legal option, all those involved in the assisted death remain secretive about what has occurred due to a fear of being judged by others. Finally, we offer insight into a concerning potential side-effect of AD legislation; that is that when individuals are exposed to someone considering an assisted death, they too will also consider using this legislation. This participant describes the effect of AD legislation as being infectious.

Demographics of New Zealand women with vulval lichen sclerosus: is specialist care equitable?

Harriet S Cheng, Coco Kerckhoffs, Nicky Perkins, Lois Eva

Vulval lichen sclerosus is an autoimmune skin condition which can cause inflammation, scarring and increased risk of cancer in genital skin. Around 1% of women are affected. This study examined cases of lichen sclerosus seen by dermatology, gynaecology and sexual health at Auckland District Health Board. We found most women seen were of New Zealand European ethnicity and compared with Census data for our region, European women were over-represented. Māori, Pacific and Asian women were under-represented. Causes for this inequitable ethnic representation may include sociocultural beliefs, variations in access to care or ethnic differences in the prevalence of lichen sclerosus. Further study is required to deepen our understanding and allow work to reduce inequity.

Performance of CVD risk equations for older patients assessed in general practice: a cohort study

Sue Wells, Romana Pylypchuk, Suneela Mehta, Andrew Kerr, Vanessa Selak, Katrina Poppe, Corina Grey, Rod Jackson

Cardiovascular disease (CVD) is the leading cause of preventable health loss for older people, many of whom are still engaged in the workforce and physically active. The current Ministry of Health CVD guidelines recommend that GPs consider doing a routine heart check using New Zealand CVD risk equations for healthy people over 75 years and discuss the same management options as for people under 75 years of age. However, risk assessment and management is more complex for older age groups as health status varies greatly. The risk of other long-term conditions increases with age and this in turn is associated with complicated medication regimens. As a first step, we investigated how well current CVD risk equations (developed for people 30–74 years) performed for over 40,000 older people for whom GPs considered suitable for routine preventive CVD risk assessment. We found current CVD risk equations underestimated five-year CVD hospitalisations or deaths for women from 75 years and men from 80 years.