A unified national cardiovascular disease (CVD) risk generator is required to address equity in the management of CVD risk in clinical practice in New Zealand

Andrew J Kerr, Sue Wells, Allan Moffitt, Mayanna Lund, Jim Kriechbaum, Matire Harwood, Rod Jackson

ABSTRACT

There is a strong body of evidence that supports identifying and managing people according to their risk of a future cardiovascular (CVD) event. Since 2012 the New Zealand public health sector has achieved 90% CVD risk assessment (CVDRA) for each eligible person across New Zealand using a modified version of an overseas risk equation, through incentivising Primary Health Organisation (PHO) performance. In 2018 the New Zealand Ministry of Health endorsed the use of a suite of four new CVDRA equations which were developed using the large NZ Predict cohort (500,000 people). These equations more accurately reflect an individual's CVD risk and incorporate both traditional CVD risk factors, such as smoking and diabetes, but also sociodemographic factors including ethnicity and a deprivation score. The new CVDRA equations are an important tool to address the major inequities in CVD incidence, prevalence and mortality in Aotearoa-New Zealand. However, while the new equations provide more accurate assessment of risk, they are more complicated and therefore more prone to error if not properly validated and systematically implemented. To take advantage of this important opportunity to address equity in heart health we need strategic vision and national leadership. In this paper we make the case that to most safely and cost effectively implement the new equations, the Ministry of Health (MOH) should support a unified national CVD risk generator.

A single, electronic, national CVD risk generator would:

a. ensure national consistency and quality control—a single set of validated and current equations would be available to both clinicians and patients;

b. avoid substantial replication of effort and cost in both developing and validating multiple calculators;

c. enable central collection of the encrypted dataset required to develop more accurate risk assessment equations in population subgroups, both now and in the future, as CVD risk evolves;

d. provide a platform to facilitate systematic and consistent national CVD risk communication and management; and

e. facilitate ease of updating the tool and practice in the future as changes to the algorithm are agreed.

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There are deep and persisting differences in cardiovascular outcomes in New Zealand with people of European ethnicity and those who are wealthier, on average, living much longer and healthier lives than Māori, Pacific people and those who are less well off.[1,2] These inequities could be reduced substantially by better targeted use of cheap and readily available medications, which used in combination, can halve the risk of CVD events within just a few years.[3]

The benefits of cardiovascular preventive medications, including lipid and blood pressure-lowering and antithrombotic drugs, are directly proportional to the level of a person's pre-treatment CVD risk. Also, a person's CVD risk level is determined more by the multivariable interactions of multiple risk predictors, including their ethnicity and deprivation level, than by high levels of single risk factors. New Zealand led the world in introducing CVD risk prediction calculators in the 1990s to help clinicians identify the highest risk patients most likely to benefit from treatment, as well as the lowest risk patients least likely to benefit. As a result, New Zealand general practitioners now prescribe cardiovascular preventive medications more effectively and cost-effectively than their international counterparts.[4]

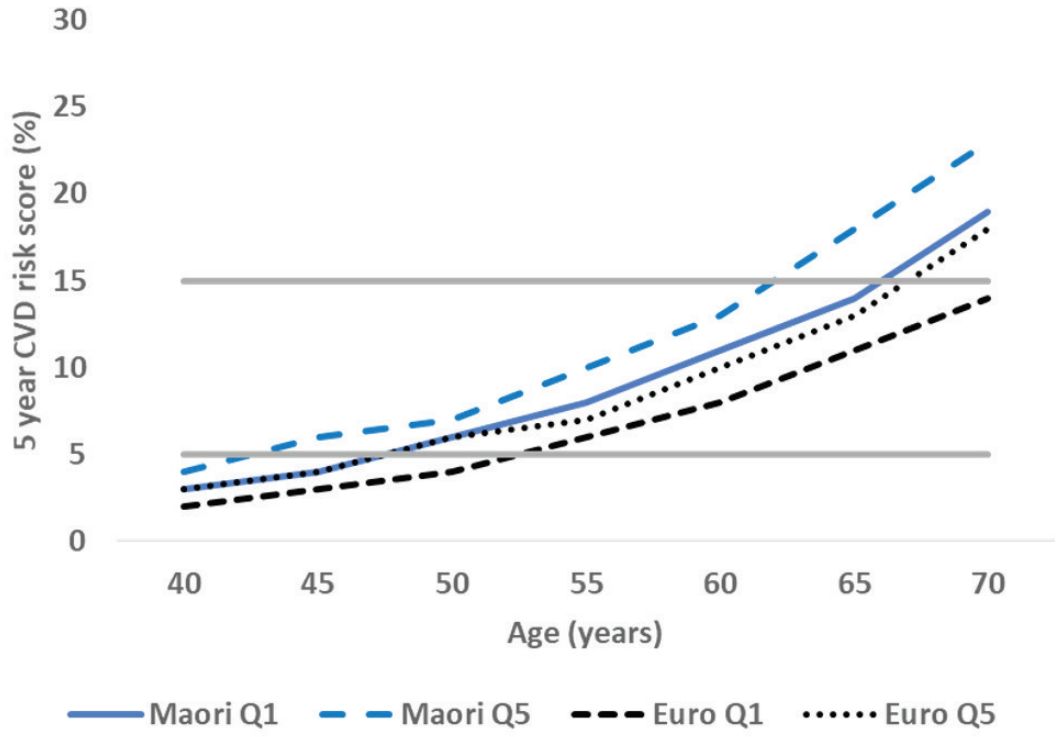
However, at the time they were introduced, the only available CVD risk calculators were derived from a White American population recruited for the Framingham Heart Study. So, while the calculators helped identify high-risk patients based on their standard CVD risk factors, they did not take account of the additional CVD risk that has been observed in a number of ethnic and socioeconomically deprived populations. To help address these inequities in CVD burden, the calculators needed to be modified. Therefore in 2003, national CVD risk assessment and management guidelines recommended that the CVD risk calculated for Māori, Pacific and South Asians using the American equation, should be modified by adding a standard additional increment. This had the desired effect of facilitating earlier treatment in these high CVD risk populations, but was simplistic and its accuracy was unknown because the necessary evidence to more accurately predict risk in different populations was not available.

The new PREDICT-CVD equations

Now, after 15 years of research funded largely by the Health Research Council and National Heart Foundation, new CVD risk prediction equations, based on over 400,000 New Zealand primary care patients from the PREDICT study are available. The **PREDICT-CVD 1⁰** primary prevention equations for men and women and the **PREDICT-CVD diabetes** equations for men and women with diabetes were made available in 2018.[5] The **PREDICT-CVD 1⁰** equations have been endorsed by a recent Ministry of Health Advisory Committee on CVD risk assessment and management to replace the modified US calculators that have been used since 2003.[6] Taking advantage of a larger patient cohort and more follow-up time updated versions of **PREDICT-CVD 1⁰** equations which include body mass index (BMI) as a variable are now available. In addition, research funded by the National Science Challenge will produce three further population specific primary prevention equations - for Māori, Pacific and Indian. There are also new equations being developed for patients with serious mental illness, a group who are at both increased risk of cardiovascular disease, and less likely to have appropriate cardiac care.[7] A secondary prevention equation to estimate CVD risk in patients with known CVD is available and is being updated to provide five-year CVD risk estimates. Furthermore, CVD risk in the population changes over time and equations need to be updated regularly to reflect this.

The new equations specifically address health equity by including separate predictors for all major ethnic groups represented in New Zealand and also include predictors for socioeconomic deprivation, using the national socioeconomic deprivation score (NZDep). They are considerably more accurate than the previous equations in identifying patient groups at highest (and lowest) CVD risk. Māori women, for example have a 50% higher risk than European women, all other risk factors being equal, and there is a similar difference in risk between the most socioeconomically deprived and least deprived 20% of New Zealanders.

Figure 1: The impact of both ethnicity and socioeconomic status on the risk of CVD and the implications for the equity of CVD risk management.



In Figure 1 we illustrate the impact of ethnicity and socioeconomic status on the age-related CVD risk trajectory using an example with four men—two Māori and two European—when all the other standard risk factors are identical. For illustrative purposes they all have the same blood pressure (BP 140/90mmHg), total cholesterol to high density lipoprotein ratio (TC/HDL 4.6) and are smokers, have a BMI of 30 but have not as yet developed diabetes. Using the new **PREDICT-CVD 1**[9] equation, the European patient living in a neighbourhood of least deprivation (Q1) has the lowest risk trajectory, and would be nearly 55 years old before he reaches the 5% 5y CVD risk threshold at which more intensive management, including medication, would be considered clinically appropriate. In contrast, the Māori patient living in Q5 would be considered for more intensive management 10 years earlier, because he reaches the 5% 5y CVD risk threshold when he is 44 years old. Furthermore, the Māori/Q5 man also crosses the 15% threshold at which medication is strongly recommend 10 years earlier than the European/Q1 man.

The new New Zealand equations also demonstrate that the previously used American equation now substantially overestimates risk, particularly among European and Chinese populations and those in the least socioeconomically deprived groups. Therefore, the new calculators will facilitate a reduction in overtreatment of those at lowest risk and of the overtreatment of those at lowest risk.

The development of these new equations, which are unique internationally, was only possible because of the combined efforts of a number of PHOs, university researchers and research funders, along with substantial support from the Ministry of Health and other healthcare organisations. In addition, without access to the high-quality electronic routine national health databases covering drug dispensing, hospitalisations and deaths that can be linked by New Zealand's National Health Index (NHI) number, the research required to develop these equations would have been prohibitively expensive.

The Ministry of Health, several DHBs, PHOs, the Health Research Council of New Zealand and the National Heart Foundation supported the establishment of the PREDICT study in 2002, but, the game-changer came in 2012 when the Ministry instituted the national 'more heart and diabetes checks'

target. The goal was to complete formal CVD risk assessments on at least 90% of all eligible New Zealanders and the Ministry provided funding that enabled PHOs to help primary care practitioners to achieve this goal by 2016.[8]

Making the CVD risk equations nationally available—what is needed?

To take advantage of this important opportunity to address equity in heart health we need strategic vision and national leadership.

CVDRA is being used to help make individual treatment decision for patients and is a great opportunity to improve equity for our patients. It is therefore critical that the risk estimate calculated is accurate otherwise there is a risk of inappropriate treatment decisions, and even harm to patients. In New Zealand, CVDRA in primary care is delivered using electronic decision support systems integrated with the patient management systems. To deliver accurate risk assessment is dependent on several steps. These include:

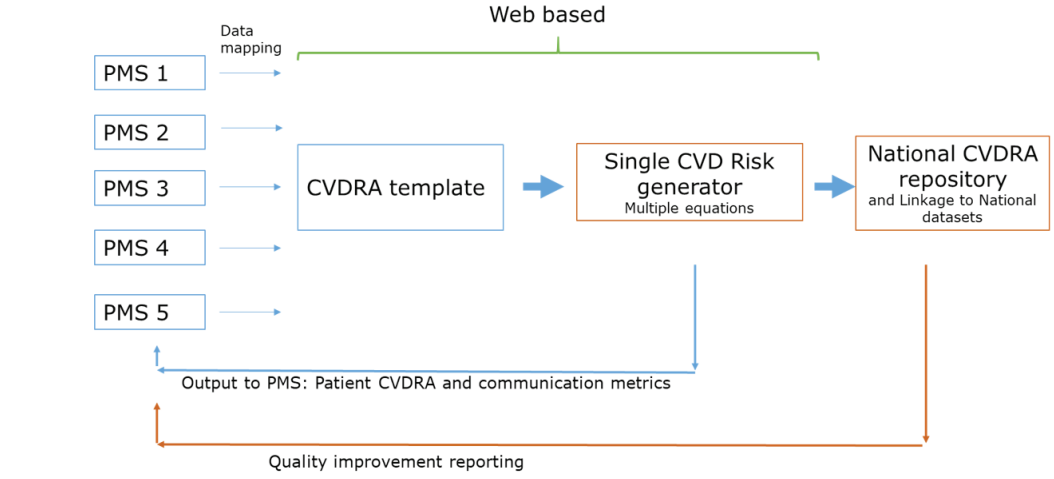
1. the accuracy of initial data entry in the PMS
2. the mapping of risk data to the risk calculator
3. the programming and output of the risk calculator
4. good governance of the data dictionary, PMS implementation and risk generator content

To support national implementation the Ministry of Health (MOH) have commissioned a CVD Consensus Data Dictionary to describe the data elements required for input to the calculator, standardise their definitions and consider the metadata requirements for a risk calculator.

This is a key first step, but the next important decision is whether to have a single national risk generator or to have the multiple PMS software vendors develop their own. Currently we are aware of at least five software vendors who are developing their own risk calculators based on the 2017 published equation. While the new equations provide more accurate assessment of risk, they are more complicated and therefore more likely to be prone to error if not properly validated, and systematically implemented and tested within PMSs. In addition, 15 years of research have led to development of a suite of more tailored personalised equations so the complexity of validation, implementation and testing is magnified. Furthermore, the Consensus statement also recommended that CVD risk be paired with visual CVD risk communication tools (such as Heart Age and CVD risk trajectory) and risk-benefit tools for initiating management. To address equity of health outcomes, these health literacy tools are vital and a consistent national approach is needed.

We propose an alternative approach using a single, freely available, web-based National Risk Generator.

Figure 2: Proposed Schema for Implementation of a Single National CVD risk generator.



CVDRA Data items defined according to National CVDRA Data dictionary
PMS = GP Practice management system, CVDRA = cardiovascular disease risk assessment

All CVD risk data items should be defined according to the CVD Consensus Data Dictionary (PMS = GP Practice management system, CVDRA = cardiovascular disease risk assessment).

A common, single, web-based data entry template would be presented, auto-populate data from the PMS and be completed for each patient. The risk generator would receive data from the template, access the appropriate equation for that patient and then present the risk, with a visual risk communication display as well as the risk/benefit of management. The risk score could be saved in the PMS linked directly to which equation was used. The risk generator would contain all the equations, but also an algorithm for choosing the most appropriate one to use for each patient, eg, which primary prevention equation for patients with diabetes, ethnic specific equation, severe mental illness equation, etc. Information technology (IT) such as an application programming interface (API) is one option that could be utilised. It would also be able to be accessed via a standalone web-based template on a website for the public, cardiologists in public or private services, laboratories, pharmacies, occupational health clinics and even overseas (eg, Pacific countries).

Accurate CVDRA positively impacts three of the Ministry of Health's medium-term priorities. The proposed schema would allow primary care physicians to have accurate information available as a starting point to discuss the best options for risk reduction with patients. It increases equity of care by preventing under-treatment of groups at elevated cardiovascular risk because of ethnicity or socioeconomic deprivation. The schema would also ensure that a new risk equation for people with severe mental illness could be applied nationally when developed so this at risk group would benefit without delay.

Beyond the CVD Risk Generator

A web-based CVD risk tool also makes a National CVD Database possible. If established according to best practice clinical, ethnic and consumer governance and data stewardship, it could provide valid, consistent, robust clinical data and form a comprehensive national CVD and diabetes database. While the new equations took over 15 years of research to complete, the infrastructure required to rapidly update them and to develop more accurate and more individualised equations is now largely in place across the country, because electronic CVD risk calculators are now used in almost every PHO. If all PHOs now joined one centralised electronic CVD risk system, it would be possible to develop new equations for specified high-risk sub-populations within just a few years. This national database would support existing clinical performance indicators and identify in real time equity gaps in CVD health outcomes across the whole population.

Competing interests:
Dr Jackson and Dr Kerr report grants from HRC during the conduct of the study. Dr Wells reports grants from HRC and The Stevenson Foundation during the conduct of the study. Dr Harwood reports grants from HRC and National Science Challenge—Healthier Lives during the conduct of the study.

Author information:
Andrew Kerr, Cardiologist, Middlemore Hospital, Auckland, Adjunct Associate Professor Department of Medicine, University of Auckland and Member of the New Zealand National Cardiac Network; Sue Wells, Associate Professor, Department of Epidemiology and Biostatistics, University of Auckland, Auckland; Allan Moffitt, General Practitioner and Clinical Director, ProCare Networks Ltd, Auckland; Mayanna Lund, Cardiologist Middlemore Hospital, Auckland and Chair of the New Zealand Division of the Cardiac Society of Australia and New Zealand; Jim Kreichbaum, General Practitioner and Primary Care Clinical Director Auckland District Health Board, Auckland; Matire Harwood, Associate Professor, Te Kupenga Hauora Māori, University of Auckland and Clinical Lead National Hauora Coalition PHO; Rod Jackson, Professor, Department of Epidemiology and Biostatistics, University of Auckland, Auckland.

Corresponding author:
Associate Professor Andrew Kerr, c/o Department of Cardiology, Middlemore Hospital, Otahuhu, Auckland 93311.
a.kerr@auckland.ac.nz

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REFERENCES:

1. Chan WC, Wright C, Riddell T, et al. Ethnic and socio-economic disparities in the prevalence of cardiovascular disease in New Zealand. New Zealand Medical Journal. 2008; 121:3341.
2. Statistics New Zealand. Life expectancy. Edition. Wellington: Statistics New Zealand, cited October 2015].Available from: http://www.stats.govt.nz/browse_for_stats/health/life_expectancy.aspx
3. Wald NJ, Law MR. A strategy to reduce cardiovascular disease by more than 80%. British Medical Journal. 2003; 326:1419.
4. Schilling C, Knight J, Mortimer D, et al. Australian general practitioners initiate statin therapy primarily on the basis of lipid levels; New Zealand general practitioners use absolute risk. Health Policy. 2017; 121:1233–9.
5. Pylypchuk R, Wells S, Kerr A, et al. Cardiovascular disease risk prediction equations in 400 000 primary care patients in New Zealand: a derivation and validation study. Lancet. 2018; 391:1897–907.
6. Ministry of Health. Cardiovascular Disease Risk Assessment and Management for Primary Care. Wellington: Ministry of Health, 2018.
7. De Hert M, Correll CU, Bobes J, et al. Physical illness in patients with severe mental disorders. I. Prevalence, impact of medications and disparities in health care. World Psychiatry. 2011; 10:52–77.
8. Allen and Clarke. More Heart and Diabetes Checks Evaluation. Wellington: Ministry of Health, 2016.