CVD risk calculators: the New Zealand experience

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Over 40 years ago Framingham Heart Study investigators developed multivariable cardiovascular disease (CVD) risk prediction equations that identified high-risk patients much more accurately than traditional classifications based on blood pressure or blood cholesterol levels alone. As the benefits of CVD risk-reducing interventions are proportional to pre-treatment risk, treating patients assessed as high CVD risk using multivariable prediction equations is also more effective than treating patients based on high levels of single risk factors.

In the 1990s New Zealand developed the world's first national CVD risk factor management guidelines based on multivariable predicted risk and recommended using 1991 Framingham Heart Study prediction equations to inform treatment decisions. By 2003 all individual CVD risk factor-based guidelines had been combined in one national CVD risk management guideline, which recommended that blood pressure-lowering and lipid-lowering drugs be offered to people with a predicted 5-year CVD risk of 15% or higher, using a modified Framingham equation.

At the time, no local cohort studies were available to validate the Framingham equations. So in 2003, we developed PREDICT, a computerised decision support system that helped general practitioners implement the national guidelines while simultaneously generating a cohort study to investigate whether the Framingham equation was applicable to the ethnically and socioeconomically diverse 21st century New Zealand population.

Over the next 15 years we collected the CVD risk profiles of over 500,000 New Zealanders using the PREDICT tool. The study period coincided with the introduction of a Ministry of Health-funded national primary care CVD risk assessment target, which resulted in approximately 90% of eligible New Zealand adults completing a CVD risk assessment. We have linked the individual patient CVD risk profile data collected in PREDICT to national hospitalisations and deaths using the encrypted National Health Identifier (NHI) and have recently completed the development of new CVD risk predictions.

These new equations include several new significant predictors over and above the standard Framingham predictors, notably ethnicity and the NZ Deprivation Index. We have demonstrated that the previously used Framingham equation is now poorly calibrated in the contemporary New Zealand primary care population, overestimating risk by more than 50%. However, despite the addition of several important new predictors that were each present in 10-20% of the study population, the discrimination performance of the new equations, as measured by standard discrimination statistics is only modestly better than Framingham.

This study highlights the importance of assessing the calibration of internationally developed risk prediction equations in the local populations where they are applied. It has also highlighted the inherent weakness of standard equation discrimination statistics, which are global statistics, that are very insensitive to the addition of new predictors representing important high-risk sub-populations. New criteria will need to be developed to decide whether additional predictors should be added to existing equations.

In February 2018, the New Zealand Ministry of Health released updated CVD risk management guidelines, recommending that general practitioners now use the new PREDICT-derived CVD risk equations. The threshold for considering drug treatment has also been lowered to 5% over 5 years. This change was made because of the lower risk predicted by the new equations, the very low cost of most CVD preventive medications today and increasing evidence that blood pressure-lowering and lipid-lowering medications have minimal significant side effects. We are currently developing a family of CVD risk prediction equations relevant to multiple patient groups and we also plan to update equations on a regular basis. It has been proposed that these equations will be maintained in one central national risk engine that can be linked to all electronic patient management systems. Not only would this provide one national standard set of equations but if the data entered into the equations is stored, it can be used for updating equations and for auditing practice.