Advancing Risk Prediction for Cardiovascular Disease: the AHA PREVENT Equations

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The assessment of absolute cardiovascular risk is essential in guiding the primary prevention of cardiovascular disease (CVD). In 2023, the American Heart Association (AHA) developed the sex-specific equations for Predicting Risk of CVD EVENTs (PREVENT) to reflect the contemporary burden and patterns of CVD risk (https://professional.heart.org/en/guidelines-and-statements/prevent-calculator).[1,2]

The recognition of the complex interplay of obesity, diabetes, and kidney disease, which was recently defined by the AHA as cardiovascular-kidney-metabolic syndrome, was the impetus for developing the PREVENT equations.[3] Unlike the Pooled Cohort Equations that predict risk only for atherosclerotic cardiovascular disease (ASCVD),[4] the PREVENT equations estimate the risk for total CVD, which includes heart failure and ASCVD. The PREVENT equations also have separate models for predicting ASCVD or heart failure alone. They have several advantages, including broader generalizability, longer-term risk estimates, and more comprehensive inclusion of factors related to cardiovascular-kidney-metabolic syndrome.

The PREVENT equations were derived from a large, diverse, contemporary sample (1992-2022) that included observational cohorts and electronic health record data. Because of this and the broad inclusivity in the data sets used, the PREVENT equations are more accurate at predicting CVD among diverse populations than the Pooled Cohort Equations, which were based exclusively on observational cohort data from White and Black adults.

The PREVENT equations demonstrated excellent discrimination (overall accuracy) and calibration (how well observed outcomes matched predicted outcomes) in the external validation sample of more than 3 million adults. Although self-identified race was not included as a predictor in the PREVENT models, discrimination and calibration were excellent in each racial and ethnic group studied; this reflects that the larger, more diverse data sets used are representative of the overall US population. The derivation of the PREVENT equations was not limited to any racial or ethnic group. This is different from the derivation sample for the Pooled Cohort Equations, which serves as the basis for ASCVD calculators that include race (eg, White, African American). However, the accuracy of the PREVENT equations for individual Asian or Hispanic subgroups has not been tested, and this should be a priority in the future because of the known heterogeneity of CVD (eg, observed higher risk for CVD among South Asian people).[5]

Quantifying short- and long-term CVD risk is particularly relevant for younger adults; the PREVENT equations estimate CVD risk at 10 years (short term) and 30 years (long term). Because age is a major driver of CVD risk, young adults are at low risk in the short term. However, nearly one-half of adults who have a low risk over the next 10 years are still at high risk of having CVD in the next 30 years, which would be missed with short-term risk estimation alone.[6] The 2019 American College of Cardiology/AHA primary prevention guidelines recommend estimating 30-year ASCVD risk for adults 20 to 59 years of age.[7] The PREVENT equations allow for estimating 10-year and 30-year risk beginning at 30 years of age, a decade before the Pooled Cohort Equations, allowing for earlier and more comprehensive risk estimation in the clinician-patient discussion.

There is flexibility with the PREVENT equations because they offer a base model and enhanced models that can be personalized for each patient with optional predictors. The PREVENT base model includes kidney function with estimated glomerular filtration rate per the 2021 Chronic Kidney Disease Epidemiology Collaboration equation (which does not include race) and statin use. The inclusion of kidney function reflects the growing burden of chronic kidney disease, an independent risk factor for CVD. Given the significant increase in statin use, the inclusion of patients who take statins and those who do not broadens the PREVENT equations' generalizability and use. In contrast, because the intent of the Pooled Cohort Equations was to specifically guide initiation of statin therapy, the derivation sample included only individuals not taking statin therapy.

The enhanced PREVENT equations include additional risk factors for personalizing risk (ie, urine albumin-creatinine ratio, A1C, and patient zip code for incorporating social deprivation index as a marker for area-level social determinants of health). The nearly universal availability of patients' residential zip codes

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in electronic health records should enable broad application of the PREVENT model with the social deprivation index and better account for the influence of neighborhood-level social determinants on CVD risk.

The PREVENT equations represent several major advances in accurate and comprehensive risk prediction for CVD. They include predictors and outcomes relevant to the contemporary US population with a high cardiovascular-kidney-metabolic syndrome burden. The PREVENT models have corrected the nearly twofold overprediction of the Pooled Cohort Equations, leading to lower risk estimates. We await the development of guidelines that consider the PREVENT equations with actionable thresholds for preventive therapies (eg, statins, those that intensively lower blood pressure, newer therapies). Like any clinical tool, as implementation of this new model is considered, ongoing testing and validation in diverse clinical populations must be a priority.

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