Review

PREVENT Versus the Pooled Cohort Equations: Implications for Contemporary Atherosclerotic Cardiovascular Risk Assessment

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ABSTRACT: Background: Cardiovascular disease (CVD) encompasses multiple vascular conditions, including heart disease, stroke, and coronary artery disease, driven by traditional risk factors. Prompt identification of individuals at high risk of CVD is important for initiation of lifestyle modifications and pharmacotherapy to reduce the risk of major adverse cardiovascular events. Methods: Narrative evaluation of contemporary CVD risk prediction models, focusing on comparison between the PREVENT equation and prior Pooled Cohort Equations (PCE). Results: Multiple risk scores have been developed, including SCORE2 and PCE, with PREVENT introduced in 2023. The 2026 American College of Cardiology/American Heart Association dyslipidemia guideline now recommends using the PREVENT equation for CVD risk stratification. PREVENT provides updated risk estimates but introduces differences from PCE that may affect clinical decision-making. Conclusion: PREVENT represents a guideline-endorsed advancement in CVD risk prediction with potential advantages over PCE, though understanding its limitations is essential for appropriate application in clinical practice.

KEYWORDS: *Cardiovascular disease, PREVENT equation, ASCVD risk, dyslipidemia, heart failure, coronary artery disease, diabetes mellitus, hypertension.*

Introduction

Cardiovascular disease (CVD) remains the leading cause of disability and death worldwide [1].

The Global Burden of Disease study estimates that in 2021, CVD led to 19 million deaths globally and accounted for 438 million disability adjusted life years lost [2].

It is an umbrella term that includes stroke, coronary artery disease (CAD), and heart failure (HF) that may begin as early as the second decade of life (Figure 1) [1-3].

Early identification of patients at risk is important as the timely initiation of lifestyle modification and pharmacotherapy may reduce the risk of major adverse cardiovascular events.

Over the past decades, several risk stratification tools have been developed to predict CVD risk, including SCORE, SCORE2, Pooled Cohort Equations (PCE), and more recently, the Predicting Risk of Cardiovascular Disease Events (PREVENT) [4,5].

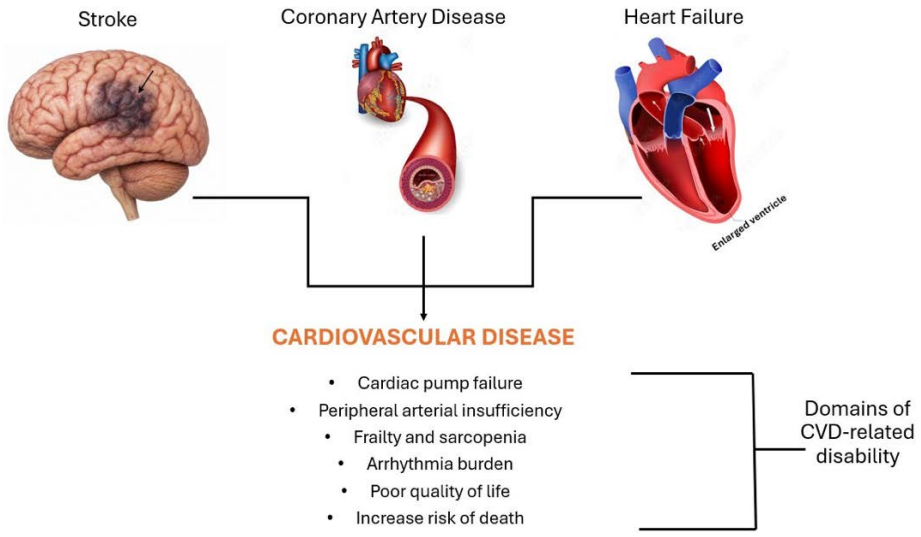


Figure 1. Illustration showing how the combination of stroke, coronary artery disease, and heart failure leads to cardiovascular disease.

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The PCE has served as the cornerstone of cardiovascular risk assessment in the United States for more than a decade, forming the basis of contemporary American College of Cardiology/American Heart Association (ACC/AHA) primary prevention guidelines.

Developed from large US cohorts, the PCE estimates the 10-year risk of atherosclerotic cardiovascular disease (ASCVD)-including myocardial infarction (MI) and stroke-using traditional risk factors such as sex, age, race, blood pressure, diabetes status, cholesterol levels, and smoking status [5,6].

By translating individual risk factor burden into an absolute 10-year risk estimate, the PCE operationalized a risk-based treatment paradigm, guiding decisions regarding statin initiation, antihypertensive therapy, and intensity of preventive interventions.

However, evolving epidemiology, shifts in population risk profiles, concerns regarding calibration across diverse populations, and the growing recognition of cardiometabolic and kidney contributions to cardiovascular risk have prompted the development of updated risk prediction models.

In response, the AHA/ACC recently introduced the PREVENT equations in their new guideline-designed to provide contemporary, race-neutral estimates of total CVD risk, including both ASCVD and HF -and represents the next evolution in risk-based primary prevention [7].

In this article, we evaluate the PREVENT risk stratification tool and its advantages, clinical implications, and controversies.

Historical Development of Pooled Cohort Equations

The PCE were derived from five US epidemiologic cohorts (Cardiovascular Health Study, Coronary Artery Risk Development in Young Adults, Atherosclerosis Risk in Communities, Framingham Heart Study, and Multi-Ethnic Study of Atherosclerosis) with approximately 25,000 participants who were followed between the 1940s and 1980s [5,6].

The equations foreshadowed the 10-year risk of ASCVD (CAD death, nonfatal MI, and nonfatal/fatal stroke) using race, age, sex, systolic blood pressure, total cholesterol, hypertension treatment, and smoking status. The PCE was a Class I recommendation in the 2013 ACC/AHA dyslipidemia guidelines and 2019 primary prevention guidelines for adults 40-70 years [8,9].

However, several external validation studies revealed poor calibration in modern cohorts (Table 1) [10-12].

Table 1. Summary of limitations and corresponding evidence of the Pooled Cohort Equations.

Limitation	Evidence
Overestimation of risk	Mean calibration ratio 1.80-2.18 (PCE predicted nearly double the observed events) in a cohort of 559,241 adults.[10]
Racial bias	Overestimated risk in Black adults; race variable did not improve prediction and perpetuated health disparities.[11]
Outdated cohorts	Derivation cohorts predated widespread statin use and contemporary risk factor patterns (obesity, CKD epidemics).[12]
Limited outcomes	Only ASCVD; did not include heart failure

[10]2025 comparative analysis of ASCVD risk at 10 years using the AHA's PREVENT Base and Full equations with PCE.

[11]2025 retrospective cohort study that assessed the performance of the PCE and PREVENT equations in estimating ASCVD, accounting for statin exposure during a 10-year follow-up.

[12]2025 review citing the good, the bad, and the ugly of the PREVENT equation.

Development and Structure of PREVENT

The AHA Cardiovascular-Kidney-Metabolic-Scientific Advisory Group created PREVENT using >3.3 million individuals for derivation and >3.3 million for external validation, making it the largest sample size for any major cardiovascular risk prediction model.

This also encompassed electronic health records data from 1922 to 2022.

Some key features of PREVENT include race-neutral prediction, which eliminates race as a variable and replaces it with a social deprivation index (SDI) [zip code-based] to address social determinants of health. PREVENT also expanded the age range to 30-79 years, enabling earlier risk assessment.

Another key feature includes multiple outcomes where there are separate equations for 10-year and 30-year risk of ASCVD (MI, stroke, CAD death).

Other outcomes include the integration of HF and total CVD (ASCVD+HF). PREVENT provides kidney-metabolic integration, with the base model including age, sex, total/high-density lipoprotein cholesterol, blood pressure, smoking, diabetes, eGFR, statin use, antihypertensive use, and body

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mass index, and the full model adding hemoglobin A1c, urine albumin-creatinine, and SDI.

Lastly, PREVENT also accounts for non-CVD death, recognizing that older adults may die from competing illnesses before experiencing cardiovascular events

PCE versus PREVENT Risk Thresholds

The ACC/AHA 2026 cholesterol guidelines established equivalent risk categories accounting for PREVENT's lower absolute risk estimates (Table 2) [7].

The guideline panel selected ≥3% 10-year risk as the threshold for considering lipid-lowering therapy, and ≥5% as the threshold for stronger consideration, based on net benefit demonstrated in primary prevention RCTs.

Table 2. Comparison table of risk estimates between the Pooled Cohort Equations and PREVENT equations.

Risk Category	PCE (2013)	PREVENT-ASCVD (2023/2026)
Low	<5%	<3%
Borderline	5% to <7.5%	3% to <5%
Intermediate	7.5% to <20%	5% to <10%
High	≥20%	≥10%

Comparative Performance: PCE versus PREVENT

Comparative performance analyses reveal that the PREVENT equations demonstrate superior calibration but similar discrimination to the PCE [10,13].

Multiple large-scale validation studies consistently show that PREVENT estimates substantially lower 10-year ASCVD risk than PCE (approximately 50% lower on average) with calibration slopes near 1.0 versus 0.4-0.5 for PCE, indicating that PCE overestimates risk by roughly 50-80% in contemporary populations [11,14,15].

Discrimination, measured by the C-statistic, is comparable across models (approximately 0.72-0.74), with PREVENT showing modest improvements in specific subgroups, including men, non-Hispanic Black adults, and individuals aged 65-79 years.

Notably, PREVENT's risk estimates align more closely with observed event rates in statin-treated populations, whereas in statin-untreated patients, PREVENT may underestimates risk, while PCE more accurately reflects untreated risk.

A summary of the key differences between the two calculators is shown in Table 3.

Table 3. Summary of key differences between the Pooled Cohort Equations and the PREVENT equations.

Character	PCE	PREVENT	References
Derivation cohort	~25,000 from 5 cohorts (1940s-1980s recruitment)	~3.3 million from contemporary cohorts+EHR data (1992-2022)	[5-7]
Age range	40-79 years	30-79 years	[5-7]
Race as input	Yes (Black vs. non-Black)	No (race-neutral)	[5-7]
Kidney function (eGFR)	No	Yes (required)	[5-7]
Statin use	No	Yes (required)	[5-7]
Optional variables	None	HbA1c, UACR, social deprivation index (SDI)	[6,10,14]
Outcomes predicted	ASCVD only (MI, stroke, CV death)	ASCVD, heart failure, and total CVD	[5-7,10,14]
Risk horizon	10-year only	10-year and 30-year	[5-7,10,15]
Calibration	Overestimates risk ~2-fold in contemporary populations	Close to 1 (well-calibrated)	[5-7,10,14,15]

Clinical Implications and Controversies

Potential reduction in statin eligibility

Using PREVENT instead of PCE could reduce the number of adults eligible for statin therapy from approximately 45.4 million to 28.3 million, with 17.3 million no longer eligible for statin therapy, including 4.1 million currently taking statins [11,16].

This has raised concerns about potential undertreatment, particularly in young adults with premature MI, where only 3% of young-MI registry patients met the PREVENT ≥7.5% threshold, and 29% met the≥3% threshold [16,17].

Other groups include people with human immunodeficiency virus, for whom PREVENT predicted a 2.2% risk versus 4.4% with PCE in the REPRIEVE trial; here, 28.6% strongly recommended statins vs 67.3% with PCE [18].

In the study, people living with human immunodeficiency virus experience elevated inflammatory and cardiometabolic cardiovascular risk that may not be fully captured by conventional risk calculators.

Lastly, statin ineligibility may become more prevalent in the chronic kidney disease (CKD) population, where substantial residual cardiovascular risk persists despite adjustment for traditional risk factors.

PREVENT partially addresses this limitation by incorporating kidney function variables, such as eGFR and an optional urine albumin-creatinine ratio, recognizing the strong association between renal dysfunction, endothelial injury, heart failure, and ASCVD.

A cross-sectional study evaluating CVD risk estimates in the US CKD population found that PREVENT estimates were lower than PCE by 5.2 percentage points, yet a substantial unmet need for statins persisted [19].

This raises concerns that PREVENT may improve calibration at the expense of sensitivity for identifying younger high-risk individuals.

Statin exposure paradox

A critical finding from *JAMA Network Open* in 2025 revealed that among patients not exposed to statins during follow-up, PREVENT underestimated risk, whereas PCE estimates more closely approximated the observed risk without treatment [11].

Because many patients in the PREVENT study populations were already receiving statin therapy, the model may reflect treated rather than untreated cardiovascular risk.

Implementation considerations

Statin implementation should be carefully considered in certain circumstances.

The 2026 guidelines maintain that physicians should personalize decisions in patients with risk-enhancing factors (family history of premature ASCVD, low-density lipoprotein cholesterol ≥160mg/dL, CKD, inflammatory disorders, elevated lipoprotein(a), etc.) that are at borderline risk (3% to <5%).

Coronary artery calcium (CAC) scoring remains crucial for reclassification when risk-based decisions remain unclear [12].

A CAC score >100 or ≥75th percentile should favor statin initiation.

Lastly, PREVENT's inclusion of SDI acknowledges structural factors, though validation in rural and highly segregated areas remains incomplete.

Conclusion

In summary, the 2026 ACC/AHA/ Multisociety guideline on the management of dyslipidemia provides class I recommendation that clinicians should use the PREVENT-ASCVD equations for adults aged 30-79 years without subclinical atherosclerosis or ASCVD, with low-density lipoprotein cholesterol between 70-189mg/dL.

The guideline emphasizes the 30-year risk for younger adults to inform patients on lifestyle counseling and a long-term risk perspective; heart failure risk as a separate outcome relevant to blood pressure management decisions; and shared decision-making, incorporating patient preferences, risk-enhancing factors, and CAC when appropriate.

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Institutional Review Board

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Consent Statement

Not applicable

Data Availability

All data presented in the manuscript are available from the authors upon request.

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