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ORIGINAL RESEARCH

IMAGING

Canadian Cost-Effectiveness of Coronary Artery Calcium Screening Based on the Multi-Ethnic Study of Atherosclerosis

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ABSTRACT

BACKGROUND Cost-effectiveness of testing for coronary artery calcium (CAC) relative to other treatment strategies is not established in Canada.

OBJECTIVES The purpose of this study was to evaluate the cost-effectiveness of using CAC score-guided statin treatment compared with universal statin therapy among intermediate-risk, primary prevention patients eligible for statins.

METHODS A state transition, microsimulation model used data from Canadian sources and the Multi-Ethnic Study of Atherosclerosis to simulate clinical and economic consequences of cardiovascular disease from a Canadian publicly funded health care system perspective. In the CAC score-guided treatment arm, statins were started when CAC ≥1. Outcome of interest was the incremental cost-effectiveness ratio at 5 and 10 years; an incremental cost-effectiveness ratio <$50,000 per quality-adjusted life year (QALY) gained was considered cost-effective. Sensitivity analyses examined uncertainty in model parameters.

RESULTS Compared with universal statin treatment at 5 and 10 years, CAC score-guided statin treatment was projected to increase mean costs by $326 (95% CI: $325-$326) and $172 (95% CI: $169-$175), increase mean QALYs by 0.01 (95% CI: 0.01-0.01) and 0.02 (95% CI: 0.02-0.02), and cost $54,492 (95% CI: $52,342-$56,816) and $8,118 (95% CI: $7,968-$8,279) per QALY gained, respectively. The model was most sensitive to statin cost, CAC testing cost, adherence to statin monitoring, and disutility associated with daily statin use. At 5 years, CAC score-guided statin treatment was cost-effective when CAC test costs ranged from $80 to $160 in different scenarios.

CONCLUSIONS CAC score-guided statin initiation in comparison to universal statin treatment was borderline cost-neutral at 5 years and cost-effective at 10 years in statin-eligible Canadian patients at intermediate cardiovascular disease risk. (JACC Adv 2024;3:100886) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

CAC = coronary artery calcium

CAD = coronary artery disease

CCS-GMD = Canadian Cardiovascular Society Guidelines for the Management of Dyslipidemia

CHD = coronary heart disease

CVD = cardiovascular disease

ICER = incremental cost-effectiveness ratio

LDL-C = low-density lipoprotein cholesterol

QALY = quality-adjusted life year

Cardiovascular disease (CVD) is the leading cause of death in Canada and CVD care is estimated to cost over $20 billion per annum.[1,2] About 90% of Canadians have at least 1 CVD risk factor, while 1 in 3 have at least 3 risk factors.[3] For the primary prevention of CVD events, cardiologists rely heavily on traditional risk prediction models to identify patients at risk of events, and then treat according to their risk classification. The 2021 Canadian Cardiovascular Society Guidelines for the Management of Dyslipidemia (CCS-GMD) recommends the initiation of statin therapy for primary prevention of CVD in intermediate-risk patients (ie, 10-year Framingham Risk Score 10.0-19.9%) with high low-density lipoprotein cholesterol (LDL-C) or other risk factors.[4]

When the decision to use long-term statin therapy is uncertain through patient-physician dialogue, coronary artery calcium (CAC) testing is recommended as a secondary test to reclassify risk and aid decision-making.[4] CAC measurement is useful for prognostication, discrimination, calibration, and reclassification for CVD.[5,6] Studies such as the MESA (Multi-Ethnic Study of Atherosclerosis) and the Heinz Nixdorf Recall Study have shown that individuals with elevated CAC scores have a 9- to 16-fold higher risk of coronary heart disease (CHD) events compared to those with a CAC score of 0.[7,8] Accumulating evidence continues to establish CAC as a robust risk restratification method beyond traditional risk scores in primary prevention settings.

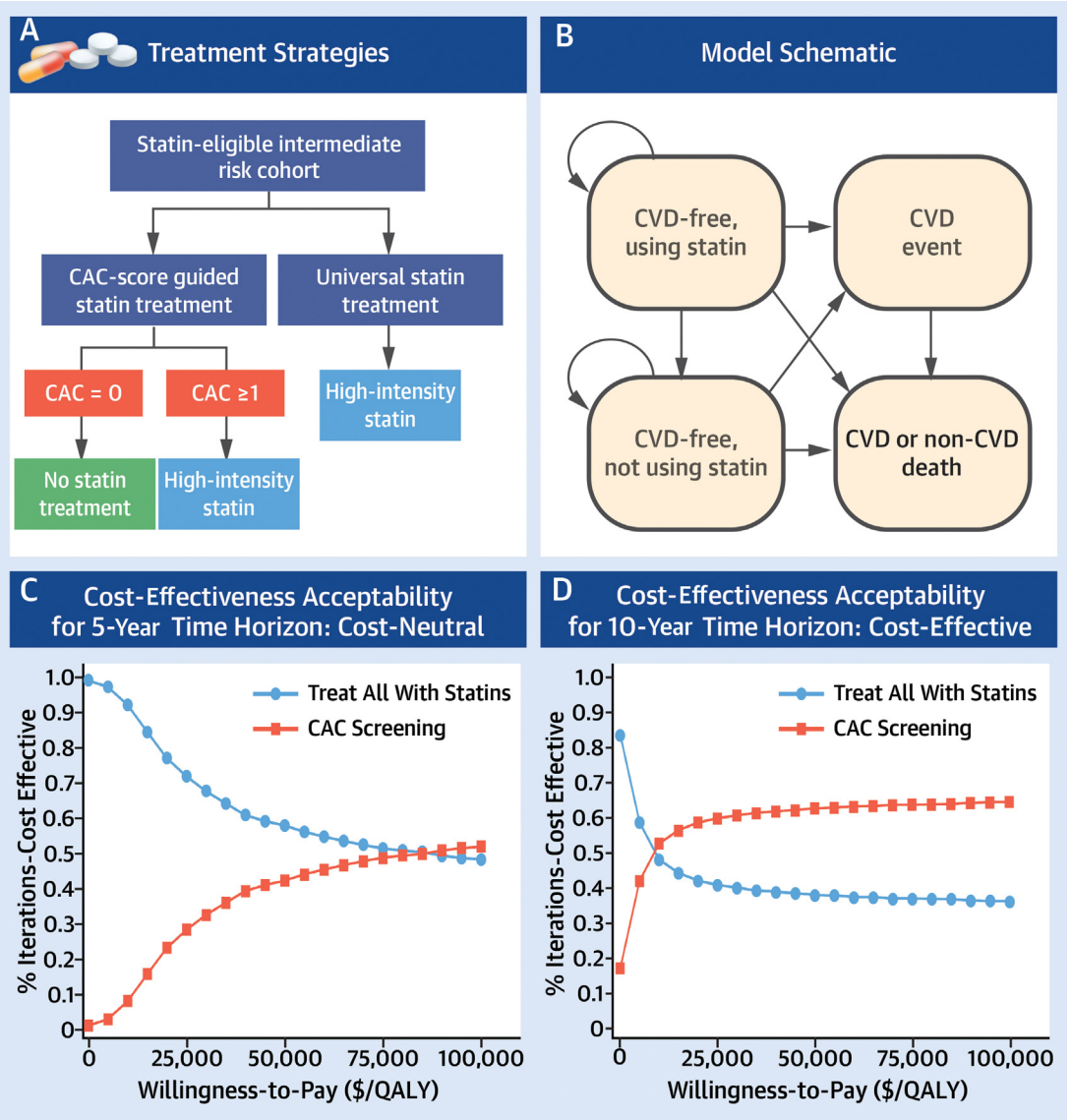
CAC testing is not widely used in routine clinical practice, and the cost-effectiveness of using CAC testing to guide statin therapy relative to other treatment strategies has not been established in Canada. However, analyses in other jurisdictions such as the United States are generally favorable.[9-15] We therefore evaluated the cost-effectiveness of using CAC score-guided statin treatment compared with universal statin therapy among CVD-free, statin-eligible patients at intermediate risk of CVD over 5 and 10 years from a Canadian health care system perspective.

METHODS

STATISTICAL METHODS. Model overview. A published state-transition, microsimulation model was adapted for the current analysis using TreeAge Pro 2023.[9] The model simulated the clinical and economic consequences of CVD primary prevention strategies among 10,000 intermediate-risk individuals from a Canadian publicly funded health care system perspective. The model compared 2 strategies: 1) universal statin treatment, that is, high-intensity statin treatment in all individuals, and 2) CAC score-guided statin treatment, that is, 1-time CAC testing with high-intensity statin initiation for those with CAC ≥1 and no treatment for those with CAC = 0 (**Central Illustration**). We simulated outcomes over 5- and 10-year time horizons. Each year of the simulation, individuals could remain CVD-free (not taking statins or taking statins), experience their first CVD event, or die from non-CVD causes (**Central Illustration**). CVD events included CHD (myocardial infarction, angina pectoris, and fatal CHD), stroke (ischemic/hemorrhagic stroke and transient ischemic attack), heart failure, peripheral artery disease, and percutaneous coronary intervention (Supplemental Tables 1 and 2).[16] The health and economic consequences were captured by the model each year, and the simulation progressed until the first CVD event, non-CVD death, or the time horizon was reached. Health outcomes were valued as the number of averted CVD events and quality-adjusted life years (QALYs). Effectiveness of treatment, quality of life weights, and transitions probabilities were obtained from published literature, expert opinion, and analysis of MESA participants. Direct health care costs were obtained from the analysis of Alberta Administrative health data sets and published literature.

PARTICIPANT SAMPLE. The simulation model was populated with a hypothetical cohort of 10,000 asymptomatic, intermediate risk, statin-eligible adults. The hypothetical cohort was constructed to replicate the age and CAC distribution observed in MESA participants (Supplemental Table 3). MESA, described elsewhere,[17] is a community-based prospective cohort study of 6,814 participants from 6 different field centers in the United States with ages ranging from 45 to 84 years at the first exam. The objectives of MESA were to investigate the progression and prognostic implications of subclinical CVD. MESA was approved by the Institutional Review Boards of the participating institutions, and all participants gave written informed consent. In the current analysis, we identified 1,203 MESA participants with a CAC score who were classified as intermediate risk and statin eligible by the CCS-GMD (4): Framingham Risk Score of 10.0%-19.5%, LDL-C <5 mmol/L, no diagnosis of chronic kidney disease or diabetes, aged 45 to 75 years, no current statin use, and no prior CHD or CVD events. The University of Alberta's Health

CENTRAL ILLUSTRATION Cost-Effectiveness of CAC Score-Guided Vs Universal Statin Therapy in Intermediate CVD-Risk Statin-Eligible Canadians



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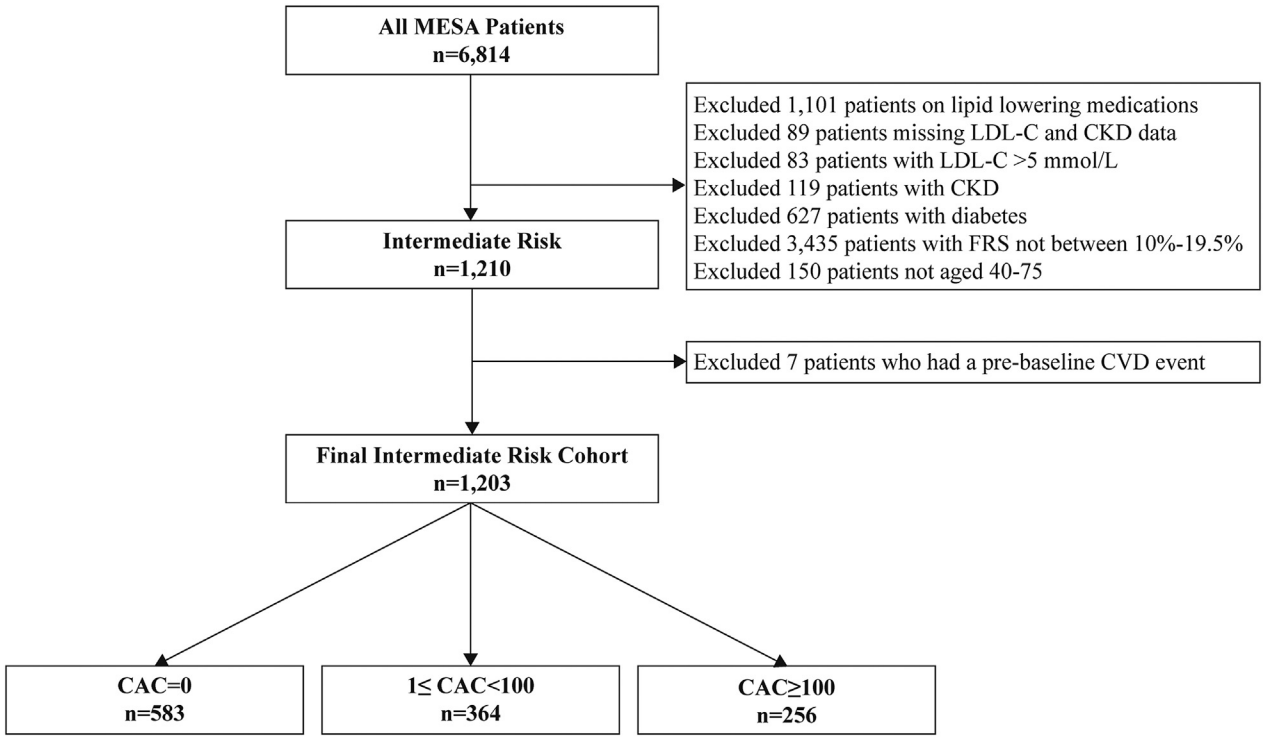
(A) Treatment strategies. (B) Model schematic. Cost-effectiveness acceptability curves demonstrate the probability that a given strategy is the most cost-effective using a range of willingness-to-pay thresholds plotted on the horizontal axis against the probability that the intervention will be cost-effective at that threshold on the vertical axis for the (C) 5-year time horizon, (D) 10-year time horizon.
CAC = coronary artery calcium; CVD = cardiovascular disease; QALY = quality-adjusted life year.

Research Ethics Board approved this study (Pro00121056).

MESA AND CVD EVENT RATES. Patient-level data from MESA were used to determine the annual probability of CVD events and non-CVD death by CAC score (measured in MESA visit 1): CAC = 0 (including scores 0.0-0.99), 1 ≤ CAC<100, and CAC ≥ 100 (**Figure 1**). Kaplan-Meier 5- and 10-year cumulative incidence estimates from MESA were converted to annual risk probabilities (Supplemental Table 4). The distribution of CVD event types experienced is provided in Supplemental Table 5. In a secondary analysis, only CHD events were considered (Supplemental Tables 6 and 7). To assess the generalizability of the

FIGURE 1 MESA Subgroup Patient Flow Diagram



CAC = coronary artery calcium; CKD = chronic kidney disease; CVD = cardiovascular disease; FRS = Framingham Risk Score; LDL-C = low-density lipoprotein cholesterol; MESA = Multi-Ethnic Study of Atherosclerosis.

rates derived from MESA to the population of Canada, sex-stratified all-cause mortality rates observed in the overall MESA population were compared with the expected rates based on the general population of Canada aged 45 to 84 years (Supplemental Table 8).

STATIN TREATMENT. The relative risk of CVD with high-intensity statin treatment was derived from a published meta-analysis of 15 trials of statin use for the primary prevention of CVD in adults (Supplemental Table 9).[18] The CVD composite outcome in the meta-analysis included myocardial infarction, angina, transient ischemic attack, fatal and nonfatal stroke, revascularization, heart failure, and cardiovascular mortality. For the secondary analysis, the relative risk of CHD was derived from a Canadian meta-analysis of high-intensity statin treatment in low CVD risk patients, which was weighted using the relative frequencies of event types in MESA (Supplemental Tables 7 and 9).[19] We also applied the relative risk for all-cause mortality to the risk of non-CVD death (Supplemental Table 9).[19]

No statin dose adjustments or tapering of statin efficacy were assumed over the duration of the model. We assumed 55% of individuals remained adherent to statins in the universal treatment arm.[20] Previous studies report that patients who visualize calcium deposits in their coronary arteries have a higher likelihood of adherence to statin therapy;[21-24] therefore, the proportion remaining adherent to statins was increased to 65% in the CAC score-guided treatment arm.[9,10] The risk of statin treatment-related adverse events (myalgia and rhabdomyolysis) was derived from published literature and patients discontinued treatment, if they experienced the adverse event.[14,25]

INCIDENTAL FINDINGS WITH CAC. CAC testing may uncover incidental noncardiac findings that warrant follow-up examinations. Studies have found that these incidental findings occur in 4% to 8% of patients. Although incidental findings could reveal early-stage cancers, studies have found that very few noncalcified lung nodules ultimately prove cancerous.[26-29] A sensitivity analysis included re-scanning 8% of patients in the CAC testing arm,[26-28] conservatively assuming no future health or cost benefits from the follow-up scans.

COSTS. All cost inputs were inflated to 2021 Canadian dollars using the Statistics Canada Consumer Price Index.[30] Mean incident CVD event costs were determined from analyzing administrative provincial Ministry of Health (Alberta Health) databases and published literature (Supplemental Tables 10 to 12). CVD costs included hospitalization and ambulatory care costs and were estimated using the cost of standard hospital stay methodology.[31,32] Angina costs included Community Physician billings, using the paid amount for fee-for-service physicians and for non-fee-for-service estimated shadow billing claims were used. Percutaneous coronary intervention cost was extracted from the literature. The mean cost of an incident CVD event was the weighted average using the relative frequencies of event types in MESA. We determined the average generic unit cost for high-intensity dose statin (atorvastatin 40-80 mg or rosuvastatin 20-40 mg)[4,33-35] as $0.21/tablet per the Alberta Drug Formulary Drug Benefit List.[34] This excludes pharmacy markups and dispensing fees (Supplemental Table 12). Based on product monographs, we assumed 1 pill daily. Patients on statin therapy were considered to warrant monitoring costs each year: 2 annual follow-up visits with the general practitioner, 2 lipid tests, and 1 liver and 1 muscle test (Supplemental Table 12). Myalgia treatment cost was equivalent to a general practitioner assessment and rhabdomyolysis treatment cost was extracted from the literature. The cost of CAC screening ($475) was extracted from a private clinic in Alberta.[36] We assumed there would be 1 additional general practitioner visit after CAC screening for patients to discuss their results.

HEALTH-RELATED QUALITY OF LIFE. Age-specific health-related quality of life was assessed using utilities, which range from 0 (death) to 1 (perfect health), derived from published literature (Supplemental Table 13). Reductions in utility due to the consumption of a daily statin and statin-induced myalgia and rhabdomyolysis were included.[9,37] CVD utility reductions were condition-specific losses weighted using the relative frequencies of event types in MESA.[38,39] CAC testing entails exposure to modest doses of ionizing radiation (~1 mSv); therefore, lifetime cancer risk and the associated probability of mortality were represented by weighted probabilities of sex-specific utility.[40,41]

MODEL VALIDATION. We validated the model by comparing the expected CVD time-to-event data from MESA to the predicted CVD events from the microsimulation model, assuming patients were not treated with a statin (Supplemental Figure 1). The model also produced a consistent mean age and percentage of CAC scores with the MESA participants. To ensure the model produced stable estimates, we examined outcomes when varying the number of individuals simulated from 2,000 to 10,000; no substantial differences were observed.

BASE-CASE ANALYSIS. Our analyses followed best practices for cost-effectiveness analysis recommended by the Consolidated Health Economics Evaluation Reporting Standards (Supplemental Table 14).[42] We used a Canadian publicly funded health care system perspective and future costs and QALYs were discounted at a 1.5% rate based on the Canadian guidelines.[43] The base-case cost and QALY projections for each treatment arm were calculated as the mean of 10,000 patients in the hypothetical cohort. The incremental cost-effectiveness ratio (ICER) was calculated using the difference in direct health care costs divided by the difference in QALYs. In Canada, there is no formal cost-effectiveness threshold. However, the Canadian Agency for Drugs and Technologies in Health often cites a threshold of CAD$50,000 per QALY as a benchmark.[43,44] Therefore, we used this commonly accepted threshold (strategy is cost-effective if ICER <50,000/QALY gained). We also calculated the incremental number of incident CVD events avoided.

SENSITIVITY ANALYSES. Assumptions and uncertainty in the base-case analysis were assessed by conducting a series of sensitivity analyses. One-way and 2-way sensitivity analyses varied key model parameters independently and jointly, respectively, over a range of plausible values while holding all other parameters constant. In addition, we performed a threshold analysis to determine the CAC testing cost that would result in CAC score-guided statin treatment becoming cost-effective/cost-saving in both time horizons. Lastly, we performed a probabilistic sensitivity analysis to assess uncertainty in model parameters by drawing 1,000 random samples for each model parameter from prespecified distributions and repeating the simulation for each parameter set.[45] We used beta distributions for probabilities and utilities, lognormal distribution for relative risks, and gamma distributions for costs. The distributions used published or calculated standard errors and 95% CI when available; otherwise, input parameters were varied by 20%.

RESULTS

BASE-CASE ANALYSIS. Over 5 years, the model projected that universal statin treatment would avert an average of 27 CVD events per 10,000 individuals

TABLE 1 Base-Case Cost Utility Analysis for CVD Outcome Over 5- and 10-Year Time Horizon

	Universal Statin Treatment	CAC Score-Guided Statin Treatment	CAC-Guided vs Universal Statin Treatment
Base-case assumptions: 5-y time horizon			
CVD events (per 10,000 individuals)	336 (301-371)	363 (327-399)	27 (26-27)
QALYs[a]	3.93 (3.92-3.94)	3.94 (3.93-3.95)	0.01 (0.01-0.01)
Direct health care costs[a] (2021 CAD)	1,207 (1,129-1,286)	1,533 (1,455-1,611)	326 (325-326)
Probability cost-effective at $50,000 per QALY[b] or ICER[a] ($ per QALY gained)	58%[b]	42%[b]	$54,492[a] ($52,342-$56,816)
Base-case assumptions: 10-y time horizon			
CVD events (per 10,000 individuals)	732 (683-781)	810 (758-861)	78 (75-80)
QALYs[a]	7.21 (7.18-7.24)	7.23 (7.20-7.26)	0.02 (0.02-0.02)
Direct health care costs[a] (2021 CAD)	2,496 (2,397-2,594)	2,667 (2,566-2,769)	172 (169-175)
Probability cost-effective at $50,000 per QALY[b] or ICER[a] ($ per QALY gained)	38%[b]	62%[b]	$8,118[a] ($7,968-$8,279)

[a]Mean value based on microsimulations of 10,000 individuals. [b]Mean value based on microsimulation of 1,000 trials and 2,000 samples.
CAC = coronary artery calcium; CAD = coronary artery disease; CVD = cardiovascular disease; ICER = incremental cost-effectiveness ratio; QALY = quality-adjusted life year.

compared with CAC score-guided statin treatment (Table 1) and the mean age was 62 years old. Relative to universal statin treatment, CAC score-guided statin treatment was estimated to increase mean direct health care costs by $326 and, due to reduced pill-taking disutility and fewer treatment-related adverse events, increase mean QALYs by 0.01 per patient, resulting in an ICER of $54,492/QALY gained (Table 1). At a willingness-to-pay threshold of $50,000/QALY, CAC score-guided statin treatment was cost-effective in 42% of the iterations (Central Illustration). CAC score-guided statin treatment was dominated by universal statin treatment (ie, CAC score-guided treatment cost more and was less effective) when considering the cost per CVD event avoided.

When extending the time horizon to 10 years, universal statin treatment was projected to prevent 78 CVD events per 10,000 individuals compared with CAC score-guided statin treatment. CAC score-guided statin treatment was estimated to increase mean costs by $172 and mean QALYs by 0.02 compared with universal statin treatment, resulting in an ICER of $8,118/QALY (cost-effective in 62% of the iterations) (Central Illustration, Table 1). Similar results were seen in the secondary analysis that only considered CHD (Supplemental Table 15).

SENSITIVITY ANALYSIS. The model findings were sensitive to statin costs, CAC testing costs, statin monitoring adherence, and the disutility of a daily statin (Table 2, Supplemental Table 16). When CAC testing costs were ≤$150 and ≤$280, CAC score-guided statin treatment was estimated to dominate universal statin treatment (ie, CAC score-guided statin treatment cost less and gained more QALYs) over the 5- and 10-year time horizons, respectively. At 5 years, when annual statin costs were $100 and $150, CAC score-guided statin treatment was dominant when CAC testing cost ≤$160 and ≤$220, respectively. When there was no disutility associated with a statin, universal statin treatment was dominant. A scenario analysis of MESA events associated with an extreme case of a White race intermediate-risk group was conducted to assess sensitivity to race. In the 5-year time horizon, the difference in costs ($326 vs $280) and QALYs (0.01 vs 0.01) were similar between our base-case intermediate-risk group and the White intermediate-risk group, respectively. Similar patterns are seen in the 10-year time horizon.

In the probabilistic sensitivity analysis, CAC score-guided statin treatment was projected to accumulate mean (95% uncertainty interval) costs of $1,546 ($1,541-$1,552) and 3.936 (3.936-3.937) QALYs, and universal statin treatment $1,225 ($1,219-$1,231) and 3.932 (3.931-3.933) QALYs at 5 years (Central Illustration, Supplemental Table 17, Supplemental Figure 2). The estimated ICER for CAC score-guided vs universal statin treatment was $77,572/QALY gained. At 10 years, similar patterns were projected but with reduced incremental costs and increased incremental QALYs, resulting in an ICER for CAC score-guided vs universal statin treatment of $8,607/QALY gained.

DISCUSSION

In this study, we used participant-level analysis of the MESA cohort and adapted a published computer simulation model to project the cost-effectiveness of using CAC scores to guide statin treatment compared with universal statin treatment among patients in

Canada at intermediate CVD risk recommended statins by the CCS-GMD guidelines. Compared with universal statin treatment at 5 years, CAC score-guided statin treatment was estimated to cost $54,000 per QALY gained, above commonly accepted thresholds for cost-effectiveness. However, at 10 years, CAC score-guided statin treatment was cost-effective, costing an estimated $8,000 per QALY gained. The results were sensitive to the cost of CAC screening, statin medication costs, and reductions in quality of life due to daily statin taking, that is, disutility.

To our knowledge, this is the first study to examine the cost-effectiveness of using CAC testing to guide statin treatment in intermediate-risk patients in Canada recommended statin therapy for primary CVD prevention by the CCS-GMD guidelines. Our results are similar to other analyses in different countries. Hong et al[10] estimated that CAC strategies in the United States would be dominant when statin costs per year were between USD $150 and $500/year or when CAC testing was USD $50. They did not find substantial influence of the intensity of statin therapy. In our analysis, we chose to study only high-intensity statins as treatment goals in Canada are to achieve a 50% lowering of LDL-C after statin initiation. Similar to our results, Hong et al showed that in the absence of disutility associated with daily statin therapy, a treat all strategy was dominant. This finding was consistent and robust regardless of the manner in which the disutility was derived. Other studies examining the cost-effectiveness of CAC score-guided statin treatment found it to be cost-effective when CAC testing costs range from USD $50 to $200,[9-11,14,46,47] a range compatible with the findings of the current analysis.

We believe that these analyses underscore the importance of having access to CAC to ensure that the clinician-patient discussion[48] can lead to therapeutic decisions that are as individualized as possible within the relevant socioeconomic treatment setting and context of the patient's perception of the negative impact of long-term or lifelong statin therapy. It is also important, however, that practitioners recognize the large body of evidence showing that statins are both safe and effective and should not promote or advocate avoidance of statins in patients who would benefit from lipid-lowering therapy.[18,49] Additionally, a growing body of evidence has emerged to substantiate that the perception of disutility may be related to nocebo effects.[50-52]

TABLE 2 Sensitivity and Scenarios Analyses

Analysis	ICER ($/QALY)
5-y time horizon	
Base-case	$54,492
CAC test cost	
$150	CAC score-guided dominates
$265	$19,302
$350	$33,546
Annual statin drug cost	
$50	$58,056
$100	$51,290
$150	$44,525
CAC test cost when annual statin drug cost = $100	
$160	CAC score-guided dominates
$220	$8,560
$300	$21,966
CAC test cost when annual statin drug cost = $150	
$160	CAC score-guided dominates
$220	CAC score-guided dominates
$300	$15,200
Proportion adhering to the annual statin monitoring	
0%	$77,666
50%	$66,079
CAC test cost when 50% adhere to annual statin monitoring	
$80	CAC score-guided dominates
$180	$16,646
$250	$28,376
Excluding disutility from a daily statin tablet consumption	Universal treatment dominates
Disutility of myalgia increased by 20%	$54,492
Disutility of rhabdomyolysis decreased by 20%	$54,492
Disutility of CVD events increased by 20%	$51,519
CVD event costs increased by 30%	$50,746
Incidental noncardiac findings from CAC testing included	$57,401
Patients do not visit GP after CAC screening for results interpretation	$48,127
All-cause mortality relative risk reduced by 20%	$66,447
Alternative disutility value (0.001) from a daily statin tablet consumption	$94,681
100% compliance of statin treatment (adherence)	$25,540
MESA event rates of White race only	$39,977

Continued on the next page

STUDY LIMITATIONS. There are limitations to this study. Cost-effectiveness models are based on assumptions about the underlying data and the experience of individuals in clinical practice. First, our analysis only considered the first CVD event and did not include the long-term downstream consequences occurring after an event, such as increased treatment and health care costs and decreased quality of life. Second, there are no population-level CAC score data from Canada nor are there CVD event and non-CVD death rates by CAC score. Therefore, we derived these model parameters from a subset of MESA participants who had CAC testing. MESA is a

TABLE 2 Continued

Analysis	ICER ($/QALY)
10-y time horizon	
Base-case	$8,118
CAC test cost	
$280	CAC score-guided dominates
$350	$2,350
$400	$4,570
Annual statin drug cost	
$50	$10,243
$100	$6,209
$150	$2,174
Proportion adhering to the annual statin monitoring	
0%	$21,954
50%	$15,036
CAC test cost when 50% adhere to annual statin monitoring	
$150	CAC score-guided dominates
$180	$1,081
$250	$4,392
Excluding disutility from a daily statin tablet consumption	Universal treatment dominates
Disutility of myalgia increased by 20%	$8,118
Disutility of rhabdomyolysis decreased by 20%	$8,118
Disutility of CVD events increased by 20%	$7,821
CVD event costs increased by 30%	$8,473
Incidental noncardiac findings from CAC testing included	$8,939
Patients do not visit GP after CAC screening for results interpretation	$6,321
All-cause mortality relative risk reduced by 20%	$8,125
Alternative disutility value (0.001) from a daily statin tablet consumption	$16,097
100% compliance of statin treatment (adherence)	CAC dominates
MESA event rates of White race only	$6,610

Detailed results including mean, incremental, and uncertainty intervals for costs and QALYs are shown in Supplemental Table 16. Strategies labeled as "dominates" means the strategy is lower in costs and higher in QALYs; thus; superior in comparison to the other strategy.

CAC = coronary artery calcium; CVD = cardiovascular disease; GP = general practitioner; ICER = incremental cost-effectiveness ratio; MESA = Multi-Ethnic Study of Atherosclerosis; QALY = quality-adjusted life year.

U.S.-based cohort study and has a different racial/ethnic and socioeconomic composition than the population in Canada. However, we found that all-cause mortality rates observed in the overall MESA population were similar to the expected rates derived from the general population in Canada. In addition, we found that race between the populations did not have a significant impact on this analysis, possibly due to the intermediate-risk population already have a higher risk of CVD. Third, our model assumed the effectiveness of statin therapy did not vary by CAC score and had a consistent effect over the time periods evaluated. However, evidence shows that the effectiveness of lipid-lowering therapy may grow over time.[49,50] Fourth, the costs of CVD events may be underestimated as we did not include direct and indirect management costs such as drugs, laboratory tests, and loss of productivity. However, we conducted a scenario analysis where we increased the CVD event costs by 20% and this did not affect our conclusions substantially. Fifth, the cost of statins may have been underestimated as we did not include pharmaceutical markups and dispensing fees. However, we did conduct extensive sensitivity analyses to assess the impact of this. Sixth, the risk of developing lifetime cancer from CAC screening could be overestimated, especially in the 5-year time horizon; patients could potentially develop cancer due to CAC screening many years after the screening takes place and possibly even die of other causes before it develops. However, this did not have major impacts on the model results. Seventh, the mean age from the MESA participants in the subanalysis were 62 years old. A lower age group or a higher age group may potentially lead to different results. Lastly, we did not consider other CVD prevention treatment modalities such as antihypertensive treatment, aspirin, or emerging non-statin lipid-lowering drugs that might be relevant to treat the intermediate-risk group (these are generally costlier and/or less accessible). However, since our study focused on the decision strategy of statin initiation, these other treatment strategies were considered beyond the scope of our study.

CONCLUSIONS

In a computer-simulated Canadian population of statin-eligible adults without a history of CVD and at intermediate risk of CVD as identified by Canadian dyslipidemia guidelines, CAC score-guided vs universal statin treatment was estimated to be borderline cost-neutral at 5 years. CAC score-guided treatment would be cost-effective if CAC cost ranged from $80 to $160. At 10 years, CAC score-guided treatment was estimated to be cost-effective. Health care decision-makers should ensure that equitable access to CAC testing is available to inform clinician-patient statin treatment decisions.

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creating the linked database. The interpretation and conclusions are those of the researchers and do not represent the views of the Government of Alberta. Neither the Government of Alberta nor Alberta Health express any opinion in relation to this study.

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PERSPECTIVES

COMPETENCY IN MEDICAL KNOWLEDGE: CAC score-guided vs universal statin treatment was borderline cost-neutral at 5 years and cost-effective at 10 years at a cost-effectiveness threshold of $50,000 per QALY gained.

TRANSLATIONAL OUTLOOK: Wider access to low-cost CAC screening is needed in Canada for those in the intermediate-risk population.

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KEY WORDS coronary artery calcium, dyslipidemia, economic evaluation, intermediate risk, primary prevention, statins

APPENDIX For supplemental tables and figures, please see the online version of this paper.