

New Outcome Proposal for RiskScape
ASCVD 10 Year Cardiovascular Disease Risk Score

Draft: December 5, 2017

The American College of Cardiology's Atherosclerotic Cardiovascular Disease (ASCVD) Risk Score predicts a patient's risk of developing coronary vascular disease within a 10-year time frame. It incorporates the following variables (see the tables attached below for calculations):

- Age
- Race
- Sex
- Diabetes Type 1 or Type 2 (1= yes, 0=no)
- Current Smoking (1=yes, 0=no)
- Systolic blood pressure in patient on anti-hypertensive treatment
- Systolic blood pressure in patient not on anti-hypertensive treatment
- Total cholesterol
- HDL cholesterol

For every patient age ≥ 20 , calculate ASCVD Risk Score

Add as outcome to RiskScape:

- Dashboard: average 10-year risk amongst adults age 40-80
- Heat map / Demographics / Time Series: average 10-year risk amongst adults age 40-80
- Pick Condition Form: once we know the distribution of scores amongst the full population we'll divide into approximate quintiles and provide these as selection options for both the outcome ("ASCVD 10-Year CVD Risk Score") selector and filters

Add new Continuum of Care Option:

- User selects ASCVC 10-year CVD Risk Score quintile, age group (20 year bands), sex, race-ethnicity
- CoC presents counts of patients in each quintile of risk (risk quintile ranges to be determined once we inspect the data but will likely be <5%, 5-10%, 10-15%, 15-20%, >20%)
- For each quintile include:
 - Count of patients
 - Smoking
 - Count of patients with smoking status recorded within the past 3 years (% of all patients in the quintile)
 - Count of current smokers (% of patients who had their smoking status recorded)
 - Count of current smokers and no prescription for tobacco cessation medications¹ within the past 3 years (% of current smokers)
 - Diabetes

- Count of patients with hemoglobin A1C measured within the past 3 years (% of all patients in quintile)
- Count of patients with known diabetes (% of patients who had their hemoglobin A1C measured)
- Count of diabetes patients with most recent hemoglobin A1C within the past 3 years ≥ 9 (% of diabetes patients)
- Count of patients with hemoglobin A1C ≥ 9 and no prescription for antidiabetic medication within the past 3 years (% of diabetes patients with hemoglobin A1C ≥ 9)
- Cholesterol
 - Count of patients with LDL cholesterol measured within the past 3 years (% of all patients in the quintile)
 - Count of patients with most recent LDL cholesterol within the past 3 years ≥ 160 (% of patients who had LDL cholesterol measured)
 - Count of patients with LDL cholesterol ≥ 160 and no prescription for lipid lowering medication within the past 3 years (% of patients with LDL ≥ 160)
- Blood pressure
 - Count of patients with BP measured within the past 3 years (% of all patients in the quintile)
 - Count of patients with active hypertension (% of patients who had their BP measured)
 - Count of patients with uncontrolled hypertension (% of patients with active hypertension)
 - Count of patients with uncontrolled hypertension and no prescription for antihypertensives within the past 3 years (% of patients with uncontrolled hypertension)

¹Smoking cessation medications

Oral	Chantix (generic name is varenicline)
	Wellbutrin
	Zyban (generic name is bupropion - Buproban)
Patches	Nicoderm CQ
	Habitrol
	Nicotrol
	ProStep
Gums/Lozenges	Nicorette
	Commit

Inhaler	Nicotrol Inhaler
Nasal spray	Nicotrol NS
Miscellaneous	Aplenzin
	Forfivo
	Nicotine
	NRT
	Topamax
	Clonidine

Table 4. Equation Parameters of the Pooled Cohort Equations for Estimation of 10-Year Risk for Hard ASCVD* and Specific Examples for Each Race and Sex Group

(<http://circ.ahajournals.org/content/early/2013/11/11/01.cir.0000437741.48606.98/tab-supplemental>)

	White			African American		
	Coefficient	Individual Example Value	Coefficient × Value†	Coefficient	Individual Example Value	Coefficient × Value†
Women (Example: 55 years of age with total cholesterol 213 mg/dL, HDL-C 50 mg/dL, untreated systolic BP 120 mm Hg, nonsmoker, and without diabetes)						
Ln Age (y)	-29.799	4.01	-119.41	17.114	4.01	68.58
Ln Age, Squared	4.884	16.06	78.44	N/A	N/A	N/A
Ln Total Cholesterol (mg/dL)	13.540	5.36	72.59	0.940	5.36	5.04
Ln Age×Ln Total Cholesterol	-3.114	21.48	-66.91	N/A	N/A	N/A
Ln HDL-C (mg/dL)	-13.578	3.91	-53.12	-18.920	3.91	-74.01
Ln Age×Ln HDL-C	3.149	15.68	49.37	4.475	15.68	70.15
Log Treated Systolic BP (mm Hg)	2.019	-	-	29.291	-	-
Log Age×Log Treated Systolic BP	N/A	N/A	N/A	-6.432	-	-
Log Untreated Systolic BP (mm Hg)	1.957	4.79	9.37	27.820	4.79	133.19
Log Age×Log Untreated Systolic BP	N/A	N/A	N/A	-6.087	19.19	-116.79
Current Smoker (1=Yes, 0=No)	7.574	0	0	0.691	0	0
Log Age×Current Smoker	-1.665	0	0	N/A	N/A	N/A
Diabetes (1=Yes, 0=No)	0.661	0	0	0.874	0	0
Individual Sum			-29.67			86.16
Mean (Coefficient× Value)	N/A	N/A	-29.18	N/A	N/A	86.61
Baseline Survival	N/A	N/A	0.9665	N/A	N/A	0.9533
Estimated 10-Y Risk for hard ASCVD	N/A	N/A	2.1%	N/A	N/A	3.0%

Men (Example: 55 years of age with total cholesterol 213 mg/dL, HDL-C 50 mg/dL, untreated systolic BP 120 mm Hg, nonsmoker, and without diabetes)

Log Age (y)	12.3 44	4.01	49.47	2.469	4.01	9.89
Log Total Cholesterol (mg/dL)	11.8 53	5.36	63.55	0.302	5.36	1.62
Log Age×Log Total Cholesterol	– 2.66 4	21.48	–57.24	N/A	N/A	N/A
Log HDL–C (mg/dL)	– 7.99 0	3.91	–31.26	–0.307	3.91	–1.20
Log Age×Log HDL–C	1.76 9	15.68	27.73	N/A	N/A	N/A
Log Treated Systolic BP (mm Hg)	1.79 7	–	–	1.916	–	–
Log Untreated Systolic BP (mm Hg)	1.76 4	4.79	8.45	1.809	4.79	8.66
Current Smoker (1=Yes, 0=No)	7.83 7	0	0	0.549	0	0
Log Age×Current Smoker	– 1.79 5	0	0	N/A	N/A	N/A
Diabetes (1=Yes, 0=No)	0.65 8	0	0	0.645	0	0
Individual Sum			60.69			18.97
Mean (Coefficient× Value)	N/A	N/A	61.18	N/A	N/A	19.54
Baseline Survival	N/A	N/A	0.9144	N/A	N/A	0.8954
Estimated 10-Y Risk for hard ASCVD	N/A	N/A	5.3%	N/A	N/A	6.1%

*Defined as first occurrence of nonfatal MI or CHD death, or fatal or nonfatal stroke.

†Coefficient×Value: For age, lipids, and BP, defined as the natural log of the value multiplied by the parameter estimate. When an age interaction is present with lipids or BP, the natural log of age is multiplied by the natural log of the lipid or BP, and the result is multiplied by the parameter estimate. “N/A” indicates that that specific covariate was not included in the model for that sex-race group; “–” indicates that this value was not included in the example (e.g., this example used untreated systolic BP, not treated systolic BP).

ASCVD indicates atherosclerotic cardiovascular disease; BP indicates blood pressure; CHD, congestive heart disease; HDL–C, high-density lipoprotein cholesterol; MI, myocardial infarction; and N/A, not included.

Table 5. Estimating an Individuals's 10-Year Risk for a First Hard ASCVD Event

The hypothetical profile provided in Table 5 (the "Individual Example Value" column) is identical for each race and sex group and is based on the overall sample mean. The profile assumes an individual 55 years of age (for which the $\text{Ln}[\text{Age}] = 4.01$), with a total cholesterol of 213 mg/dL, HDL-C of 50 mg/dL, and an untreated systolic BP of 120 mm Hg. This individual is not a current smoker and does not have diabetes. For the equations, the values for age, lipids, and systolic BP are log transformed. Interactions between age and lipids or age and systolic BP use the natural log of each variable (e.g., $\text{Ln}[\text{Age}] \times \text{Ln}[\text{Total Cholesterol}]$).

Calculation of the 10-year risk estimate for hard ASCVD can best be described as a series of steps. The natural log of age, total cholesterol, HDL-C, and systolic BP are first calculated with systolic BP being either a treated or untreated value. Any appropriate interaction terms are then calculated. These values are then multiplied by the coefficients from the equation ("Coefficient" column of Table A) for the specific race-sex group of the individual. The "Coefficient×Value" column in the table provides the results of the multiplication for the risk profile described above.

The sum of the "Coefficient×Value" column is then calculated for the individual. For the profile shown in Table A, this value is shown as "Individual Sum" for each race and sex group.

The estimated 10-year risk of a first hard ASCVD event is formally calculated as 1 minus the survival rate at 10 years ("Baseline Survival" in Table A), raised to the power of the exponent of the "Coefficient×Value" sum minus the race and sex specific overall mean "Coefficient×Value" sum; or, in equation form:

$$1 - S_{10} e^{(\text{Ind}X'B - \text{Mean}X'B)}$$

Using White men as an example:

$$1 - 0.9144 e^{(60.69 - 61.18)}$$

equates to a 5.3% probability of a first hard ASCVD event within 10 years.

ASCVD indicates atherosclerotic cardiovascular disease; BP, blood pressure; and HDL-C, high-density lipoprotein cholesterol.