



# THE ART OF CARDIOVASCULAR RISK ASSESSMENT

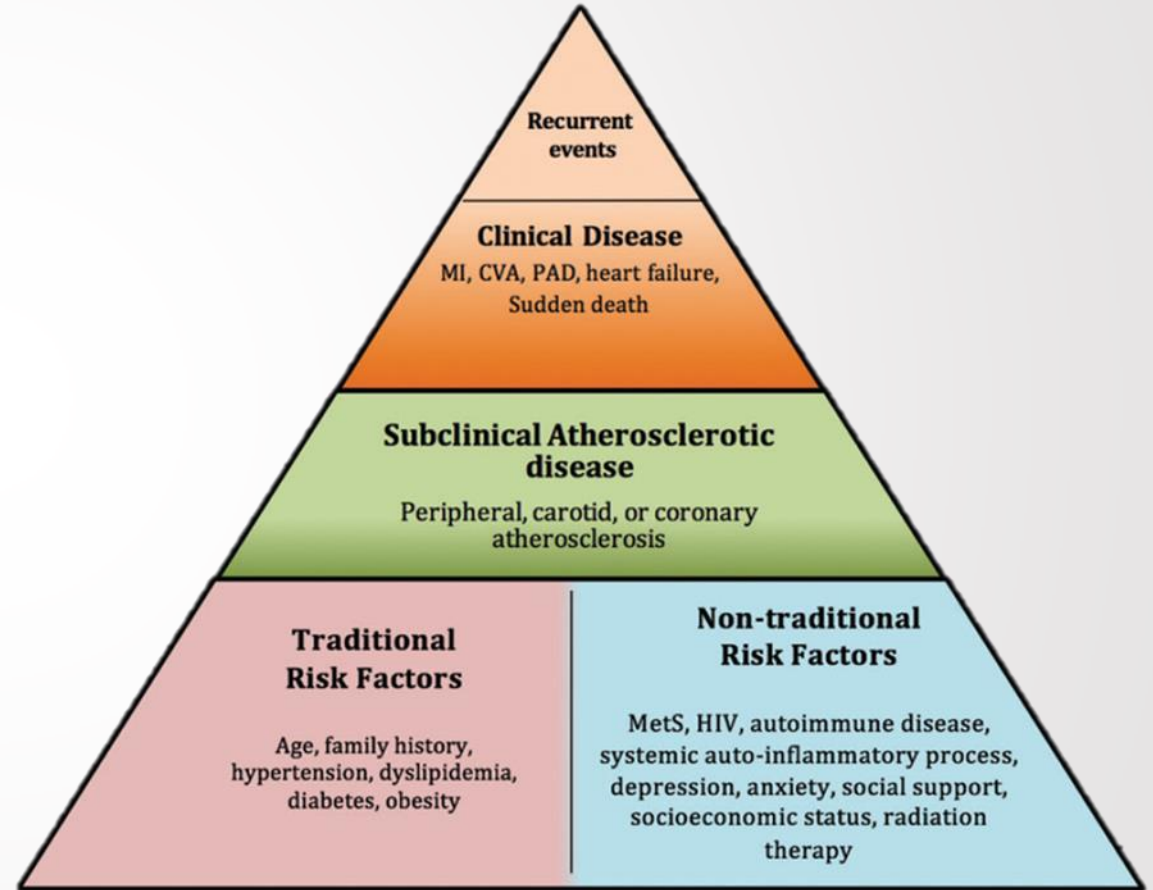
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# OVERVIEW

1. Risk factors of CAD

2. Different risk calculators

3. Clinical applications on primary prevention of CAD



# HOW OFTEN SHOULD CVD RISK BE ASSESSED?

As with any clinical scenario, an individual patient's CVD risk is not static but can vary significantly over time. A person's CVD risk can be positively or negatively influenced depending on the development or treatment of concurrent medical conditions as well as lifestyle choices. As such, risk factors and an estimation of CVD risk should be regularly reassessed over time.

For patients at low CVD risk and with no change in clinical status, we reassess CVD risk every four to six years.

For patients at intermediate or greater CVD risk, we typically reassess CVD risk more frequently than every four to six years, but the primary focus should be on risk factor modification.

Patients with CVD risk factors are typically treated, and the health care provider should endeavor to optimize the CVD risk factors with lifestyle and pharmacologic interventions. Periodic reassessment of CVD risk is of some interest, but the focus should be on the preventive care of the patient with control of risk factors.

# HOW TO ASSESS CVD RISK?

Identify risk factors:

For all individuals, the first step in assessing CVD risk is to determine whether one or more of the traditional risk factors for CVD is present

For individuals  $\geq 20$  years of age, a baseline lipid profile is generally obtained. If severely elevated LDL cholesterol (LDL-C) is present, then the patient will be treated aggressively with recommended lifestyle modifications and lipid-lowering medications

## HOW TO ASSESS CVD RISK?

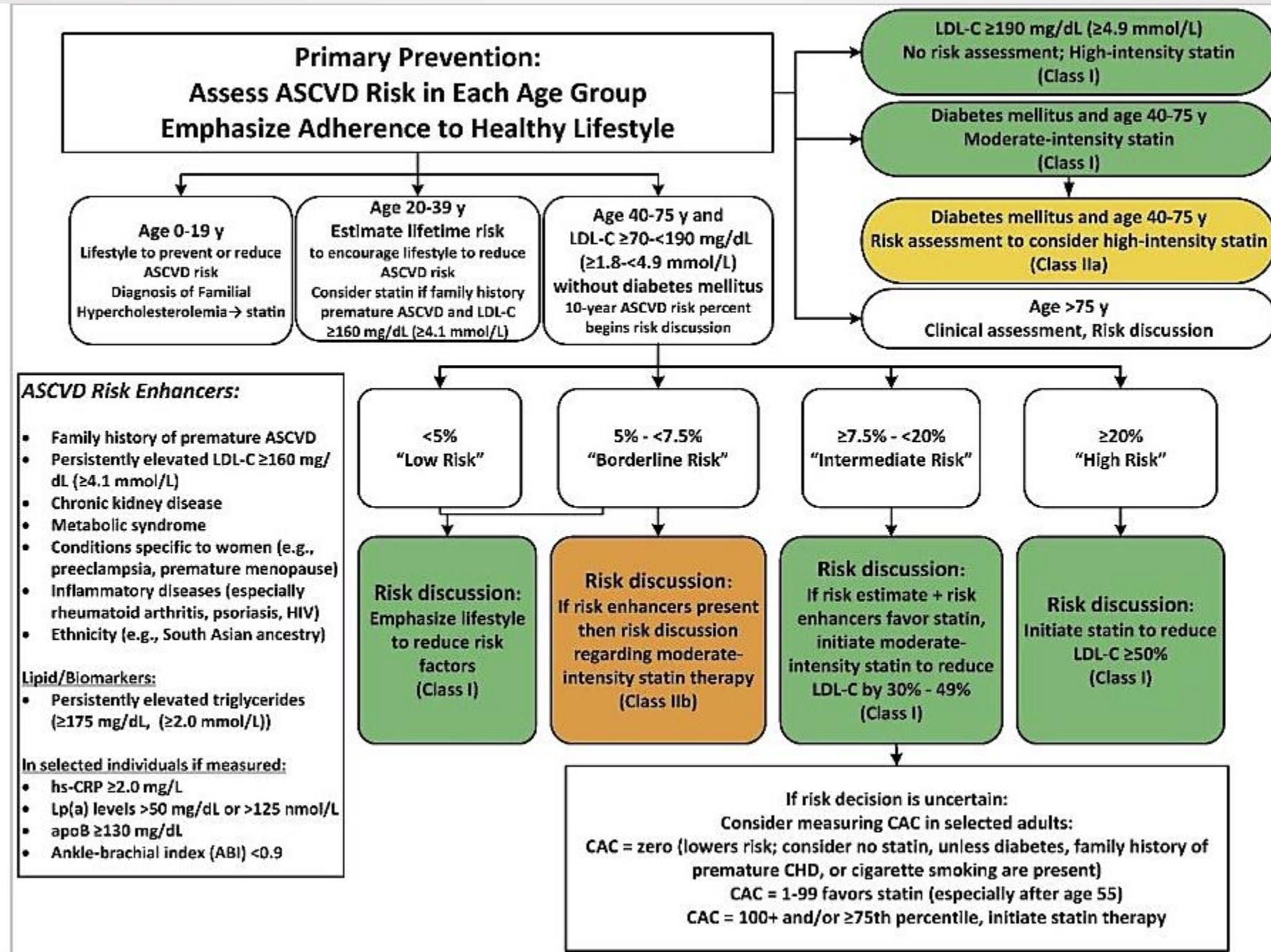
For patients <40 years of age who do not have hypercholesterolemia, but who have other risk factors or diagnoses such as those listed, most guidelines do not provide explicit guidance on CVD risk assessment.

For patients <40 years, at times making an informal CVD risk assessment using a risk calculator can help guide the care of the patient.

## HOW TO ASSESS CVD RISK?

For patients >40 years without established CVD in whom a lipid profile has been obtained, we estimate CVD risk using a risk calculator. The results of the calculator are used to determine if specific preventive therapies such as aspirin or statin are indicated

# IMPLICATION OF ESTIMATED CAD RISK





# DO THE FIRST DEGREE RELATIVES NEED SCREENING IN HIGH RISK PATIENTS

In general, among patients with CVD, or those who are identified as being at high CVD risk, most first degree relatives will be  $\geq 20$  years of age and should be undergoing regular CVD risk factor assessment with their own primary care providers.

If the clinician believes the patient is at increased CVD risk, he/she should be encouraged to discuss the implications with first degree family members, who may then choose to discuss CVD risk with their own primary care providers.

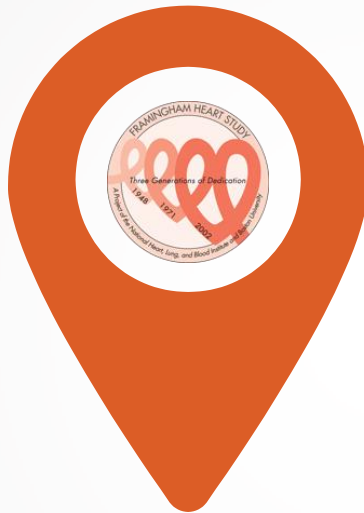


# TRADITIONAL RISK FACTORS



1961

The coining of the term “risk factor”. Identification of an initial set of traditional risk factors for CAD



Framingham Heart Study

Age (males  $\geq 45$  years or females  $\geq 55$  years), male sex, hypertension, dyslipidemia, smoking, and diabetes mellitus



Over the decades

More risk factors were identified



More Risk Factors

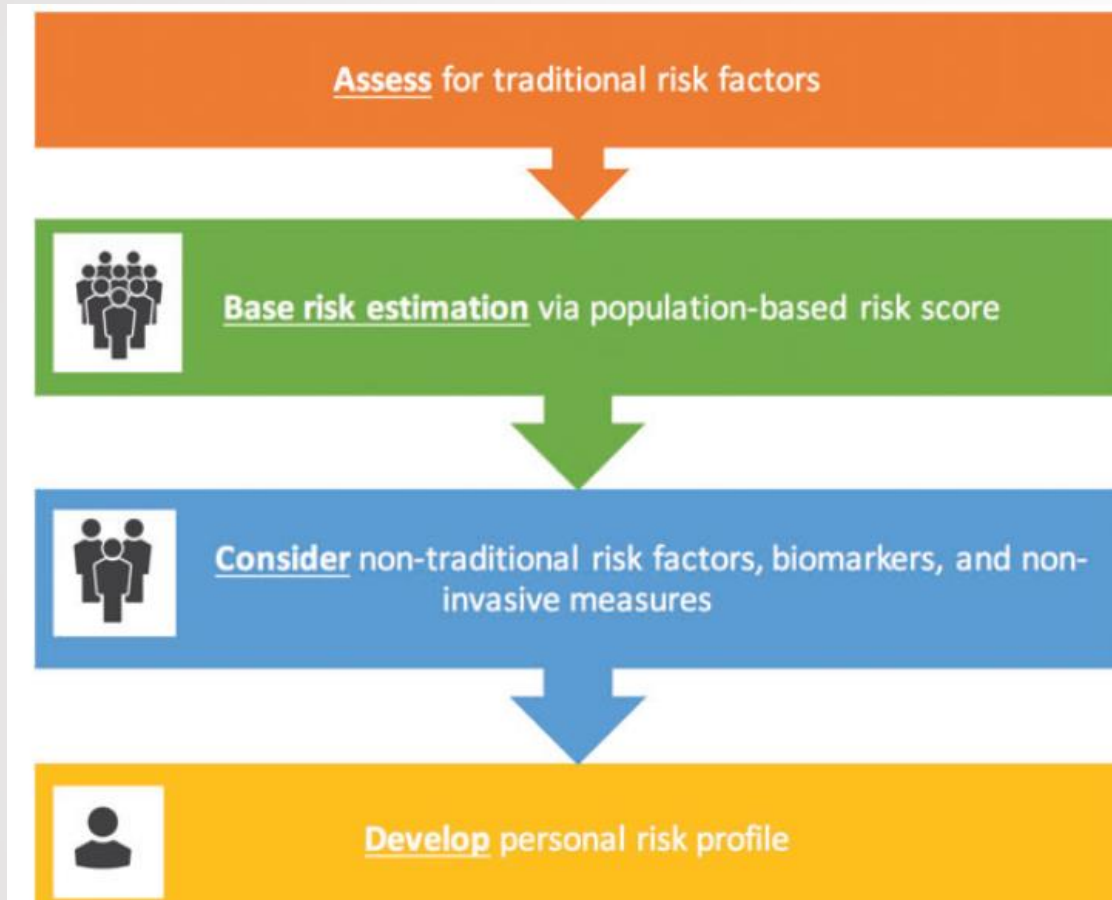
Family history of premature ASCVD

(age  $< 55$  years for males and  $< 65$  years for females)

# CONCLUSION

1. While a general estimate of the relative risk for CVD can be approximated by counting the number of traditional risk factors, a more precise estimation of the absolute risk is desirable
2. All the risk models have advantages and limitations. Use of risk models that predict hard events ( ie death, MI and stroke) are more preferred
3. The CVD risk prediction over a defined period of time ( usually 10 years) may poorly characterize a person's long term CVD risk, particularly in younger patients

# CONCLUSION



# NONTRADITIONAL RISK FACTORS

High levels of the following are considered to be risk factors for CAD:

C reactive protein (**CRP**): High levels are related to the presence of inflammation and, according to some research results, may be associated with an increased risk of CAD development and heart attack [2]

**Lipoprotein(a)**

**Homocysteine**: In the general population, mild to moderate elevations are due to insufficient dietary intake of folic acid, but homocysteine levels may also identify people at increased risk for heart disease

Small, dense **LDLC** particles, **Fibrinogen**

# NONTRADITIONAL RISK FACTORS

Tissue plasminogen activator (tPA): An imbalance of the clot dissolving enzymes (eg, tPA) and their respective inhibitors (plasminogen activator inhibitor 1 [PAI1]) may predispose individuals to MI

**Low** serum testosterone levels: Have a significant negative impact on patients with CAD

Hysterectomy: A study suggests that this becomes a risk factor later in life in women who have the surgery at or before age 50 years

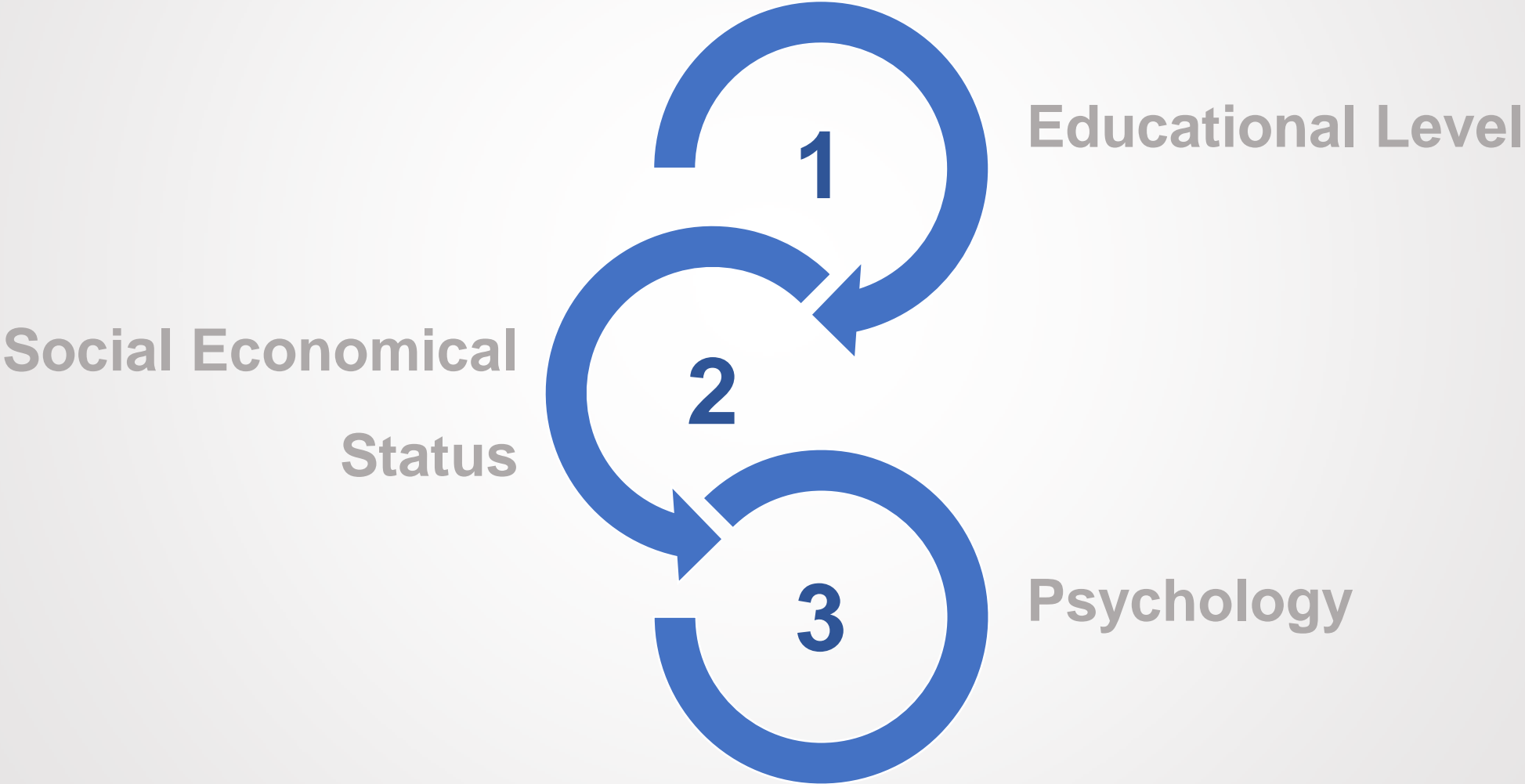
Lack of sleep



## Tip

Many things are beyond **our expectation.**

# NONTRADITIONAL RISK FACTORS



# NONTRADITIONAL RISK FACTORS

## Ultrasound

Carotid intima-media thickness (IMT)

Pulse wave velocity (PWV)

The ankle brachial index (ABI)

Widely used, noninvasive modalities for evaluating atherosclerosis



# NONTRADITIONANL RISK FACTORS

## Ultrasound

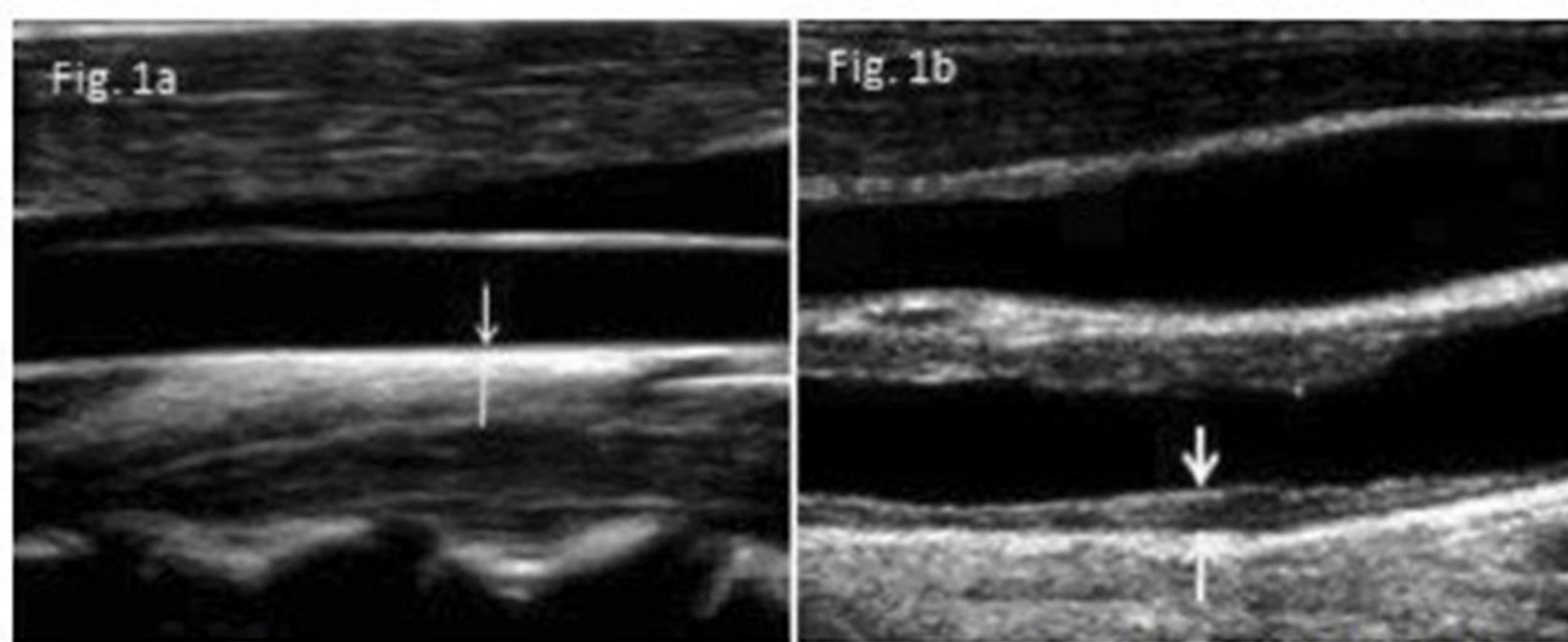
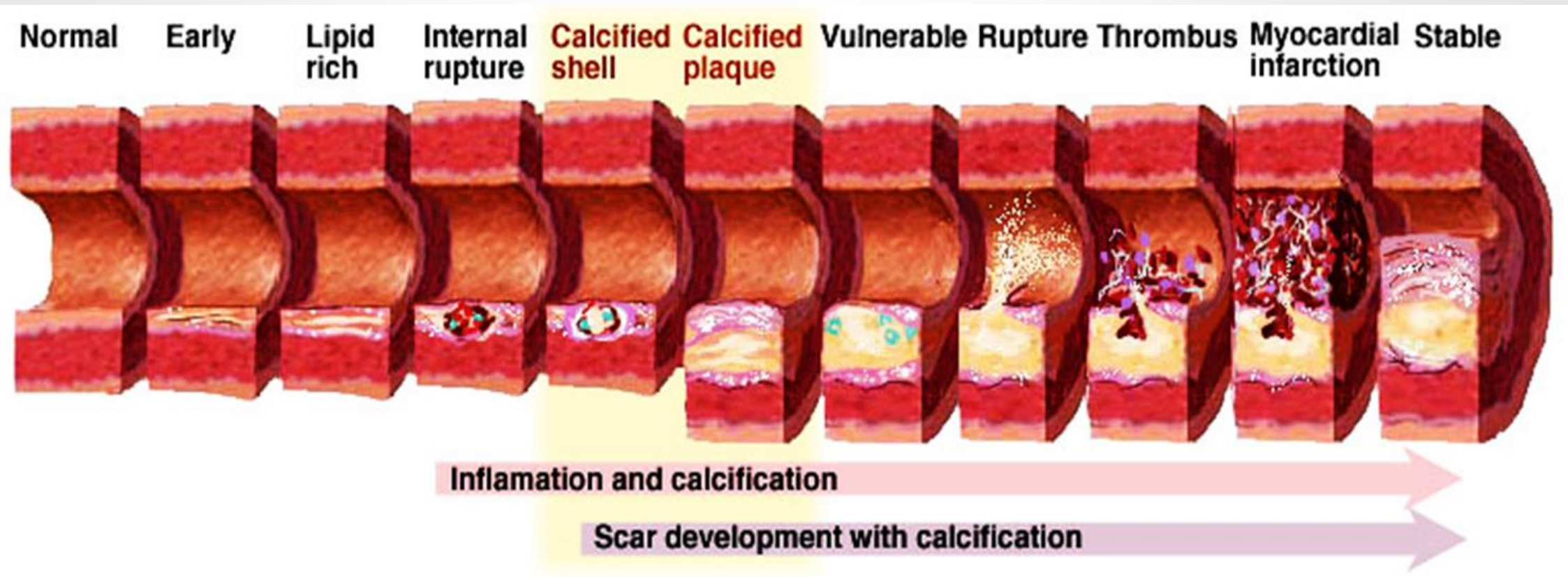


Fig. 1. Ultrasonographic examination of carotid intima media thickness (distance between arrows) at the wall of the common carotid artery is shown: a) normal CIMT b) increased CIMT.

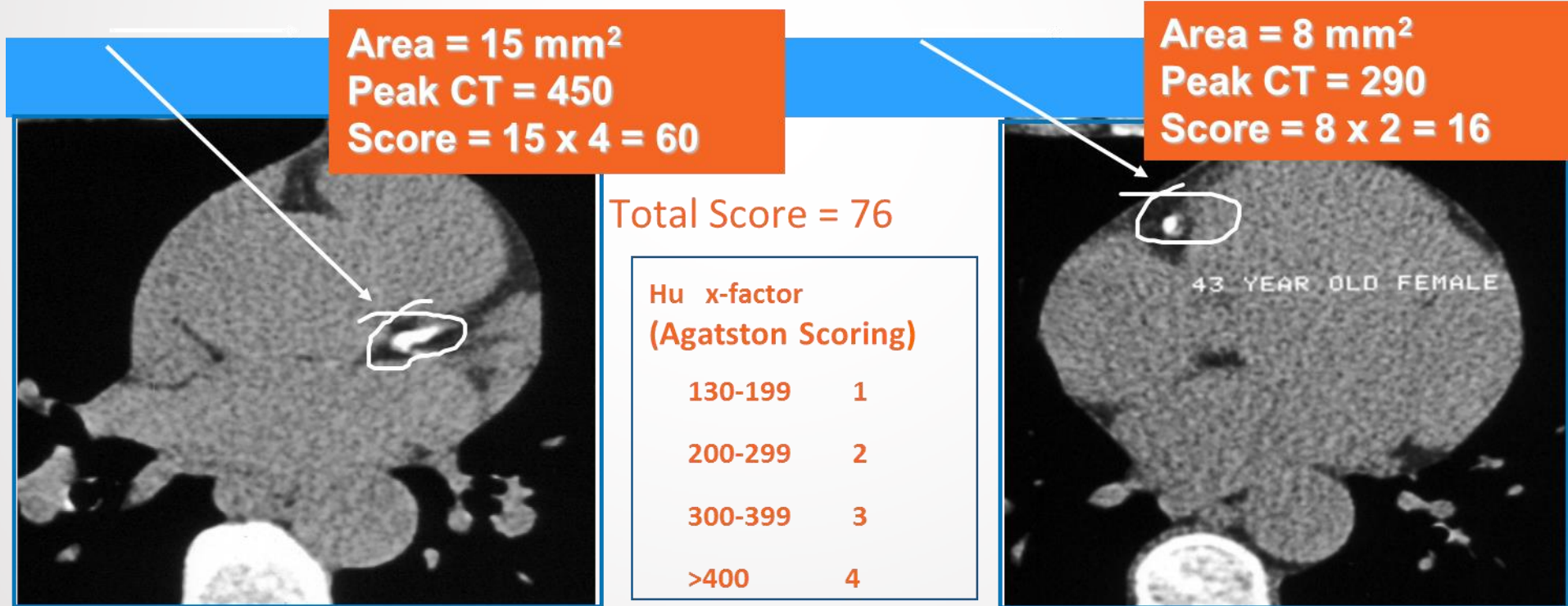
# STAGES OF ATHEROSCLEROSIS



# NONTRADITIONANL RISK FACTORS

## CT Heart

### Calcium Scoring



# NONTRADITIONAL RISK FACTORS

## Calcium Scale Scoring

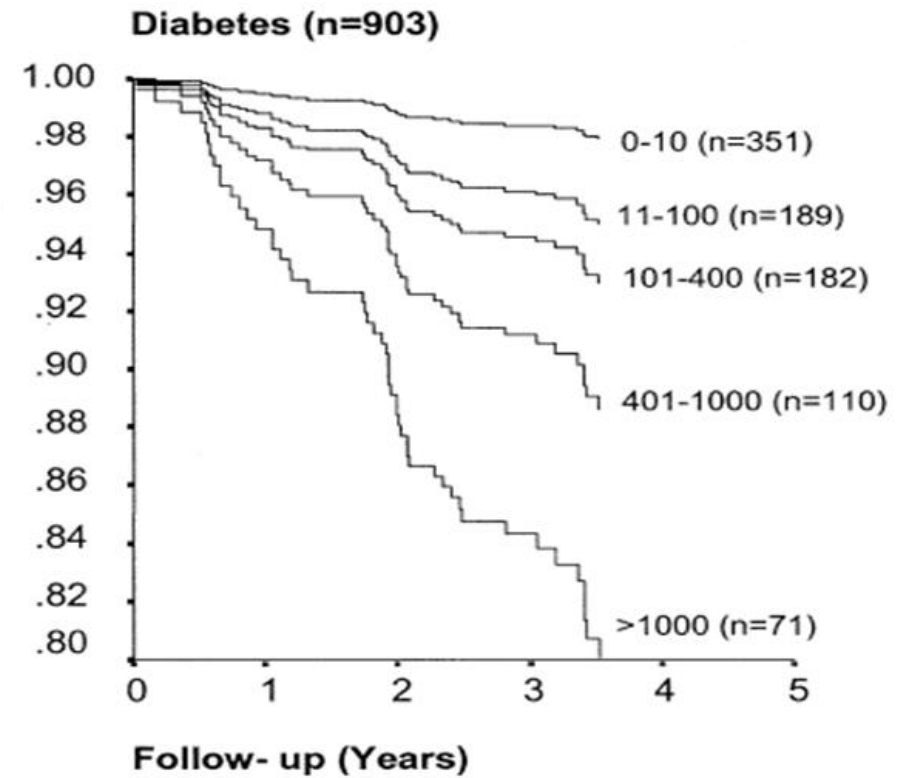
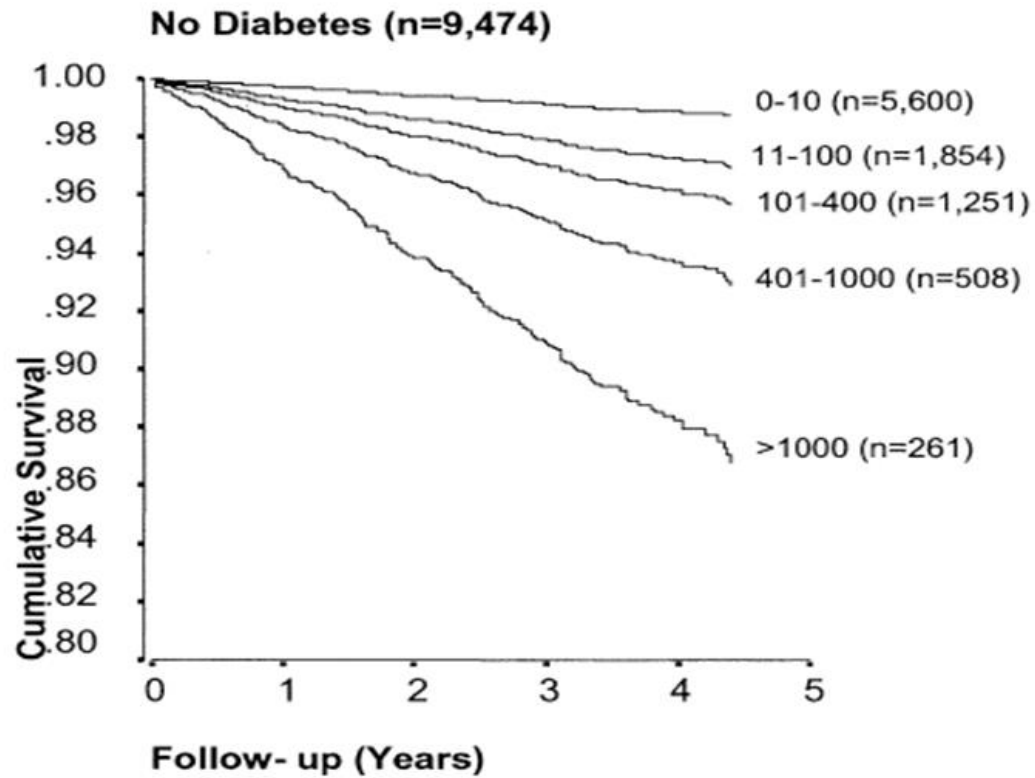
The calcium scale is a linear scale with 4 calcium score categories:

0	none
1-99	mild
100-400	moderate
>400	severe

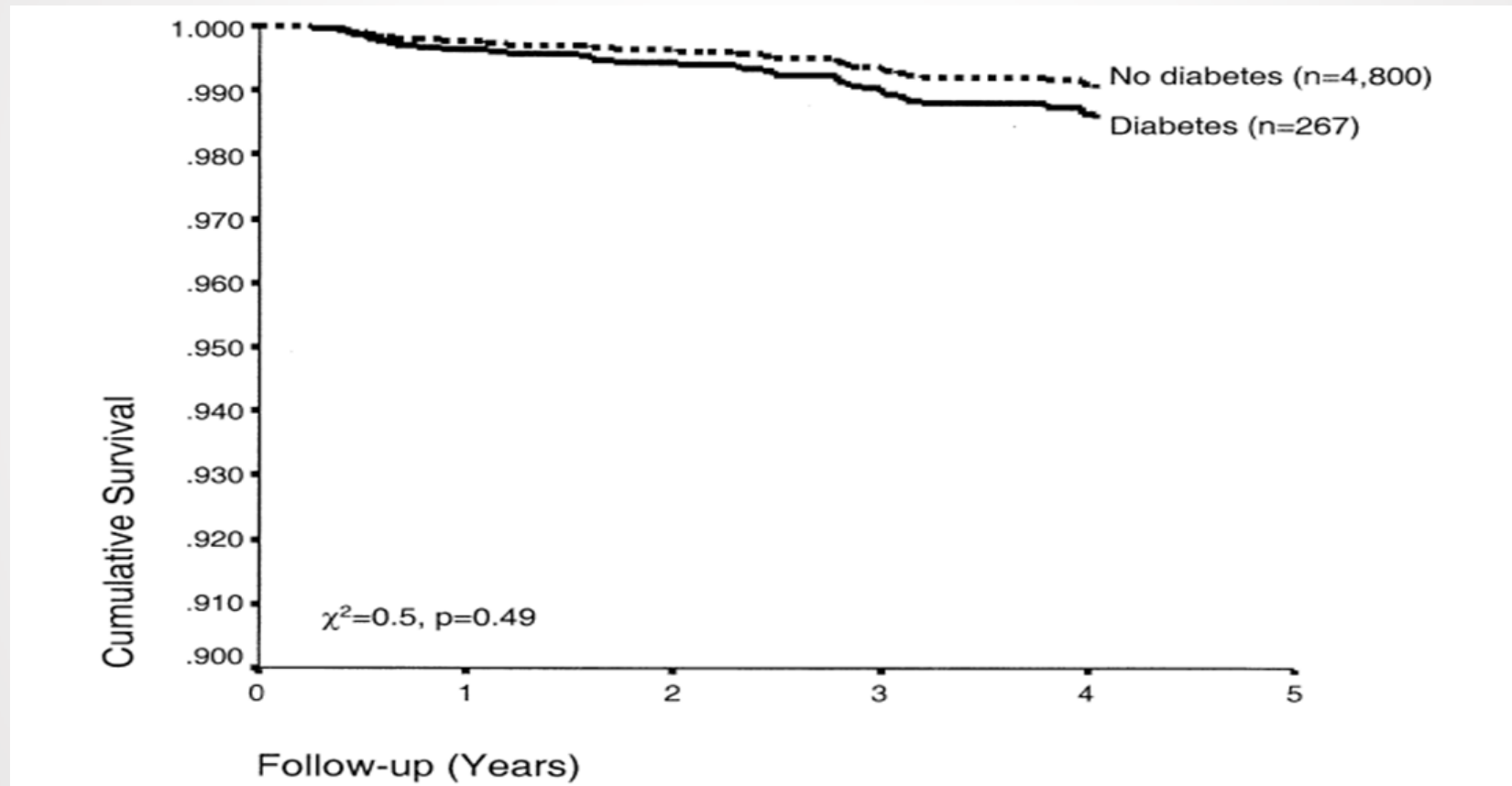
\*Calcium score correlates with risk of events and likelihood of obstructive CAD\*



# Prognostic Value of Coronary Ca screening in Patients with & without DM



# Prognosis of patients with & without DM with zero calcium score



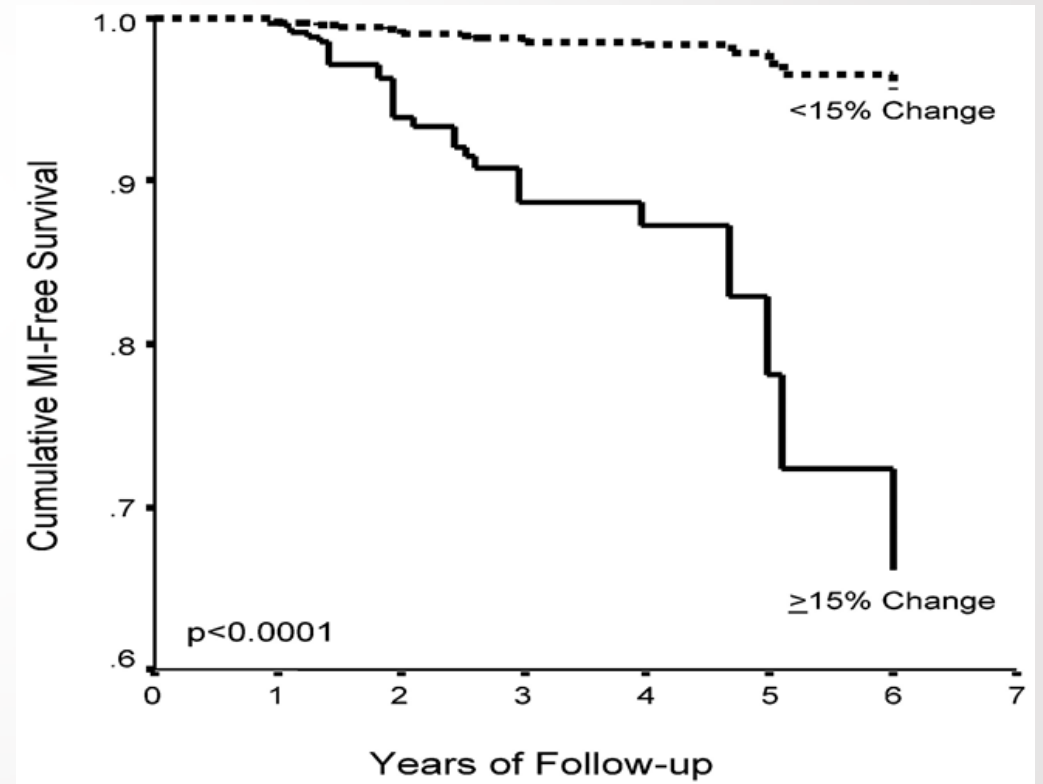
# Progression of Coronary Artery Calcium & Risk of First MI

## 495 Asymptomatic Patients Started on Statin Therapy

MI in 41 pts during  $3.2 \pm 0.7$  years

LDL levels similar in MI and non-MI pts

Relative risk of MI in presence of CAC progression was 17.2-fold higher ( $P < 0.0001$ )

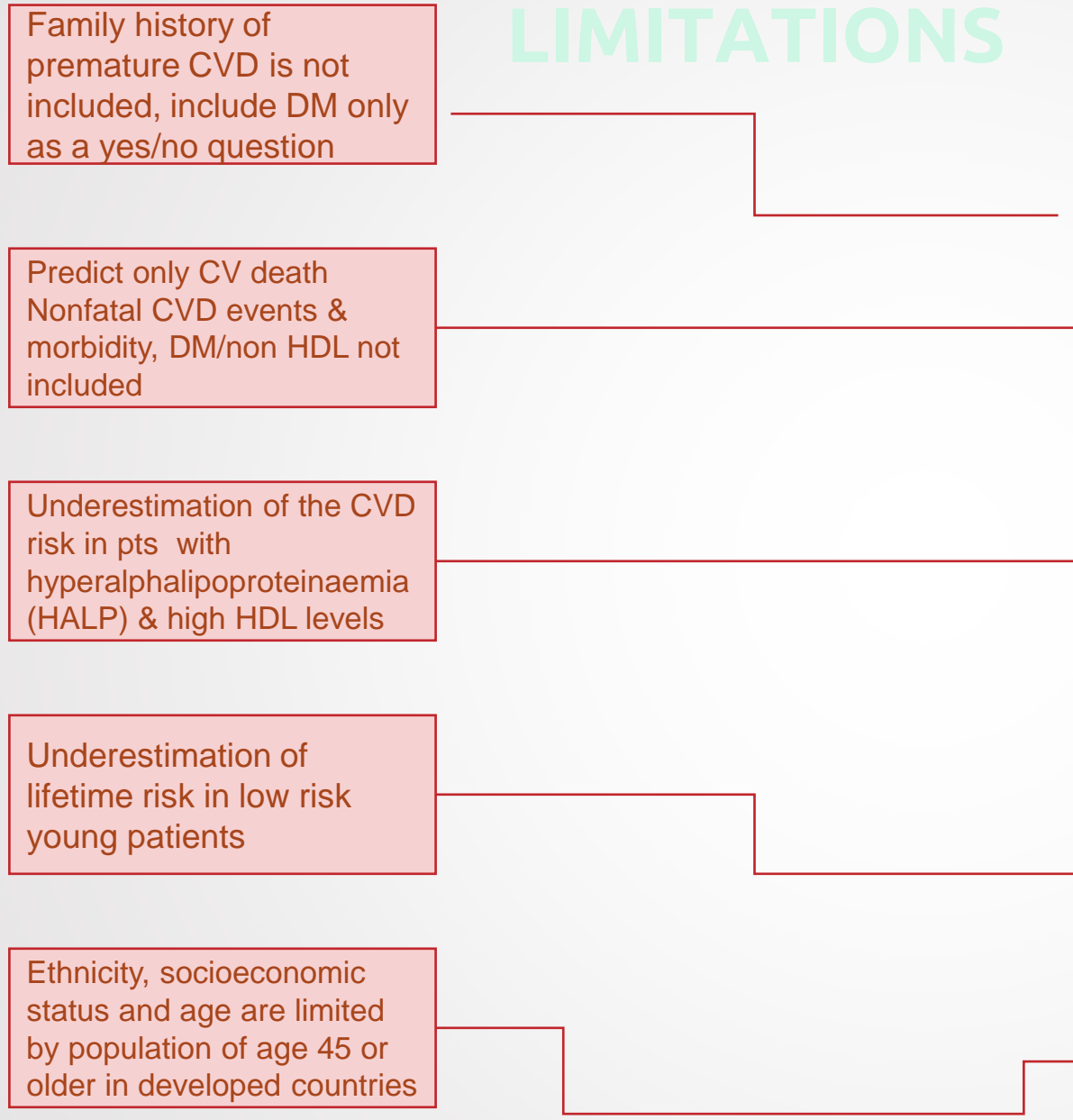




# POPULATION BASED RISK SCORE

Cardiovascular disease risk scores			
ACC/AHA pooled cohort hard CVD risk calculator (2013)	<ul style="list-style-type: none"> <li>Age (validated only in patients 40 to 79 years of age)</li> <li>Gender</li> <li>Total cholesterol (mg/dL)</li> <li>HDL cholesterol (mg/dL)</li> <li>Systolic blood pressure (mmHg)</li> <li>Blood pressure treatment (yes or no)</li> <li>Diabetes mellitus (yes or no)</li> <li>Current smoking (yes or no)</li> </ul>	<ul style="list-style-type: none"> <li>Family history of CVD (yes or no)</li> </ul>	<ul style="list-style-type: none"> <li>CHD death</li> <li>Nonfatal MI</li> <li>Fatal stroke</li> <li>Nonfatal stroke</li> </ul>
JBS3 risk score (2014)	<ul style="list-style-type: none"> <li>Age</li> <li>Gender</li> <li>Ethnicity</li> <li>Total cholesterol (mg/dL)</li> <li>HDL cholesterol (mg/dL)</li> <li>Systolic blood pressure (mmHg)</li> <li>Blood pressure treatment (yes or no)</li> <li>Diabetes mellitus (yes or no)</li> <li>Current smoking (yes or no)</li> <li>Family history of CVD in first degree relative aged &lt;60 years (yes or no)</li> <li>Chronic kidney disease</li> <li>Atrial fibrillation</li> <li>Rheumatoid arthritis</li> <li>Region of United Kingdom (score based on levels of unemployment, overcrowding, car ownership, home ownership)</li> <li>Body mass index (kg/m<sup>2</sup>)</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>CHD death</li> <li>Nonfatal MI</li> <li>Coronary insufficiency or angina</li> <li>Coronary revascularization</li> <li>Fatal or nonfatal stroke</li> <li>Transient ischemic attack</li> <li>Intermittent claudication</li> </ul>
MESA risk score (2015)	<ul style="list-style-type: none"> <li>Age</li> <li>Gender</li> <li>Ethnicity (non-Hispanic white, Chinese American, African American, Hispanic)</li> <li>Total cholesterol (mg/dL)</li> <li>HDL cholesterol (mg/dL)</li> <li>Lipid lowering treatment (yes or no)</li> <li>Systolic blood pressure (mmHg)</li> <li>Blood pressure treatment (yes or no)</li> <li>Diabetes mellitus (yes or no)</li> <li>Current smoking (yes or no)</li> <li>Family history of MI at any age (yes or no)</li> <li>Coronary artery calcium score</li> </ul>	<ul style="list-style-type: none"> <li>Family history of CVD other than MI</li> </ul>	<ul style="list-style-type: none"> <li>CHD death</li> <li>Nonfatal MI</li> <li>Resuscitated cardiac arrest</li> <li>Coronary revascularization in patient with angina</li> </ul>
China-PAR risk predictor (2016)	<ul style="list-style-type: none"> <li>Age</li> <li>Gender</li> <li>Total cholesterol (mg/dL)</li> <li>HDL cholesterol (mg/dL)</li> <li>Lipid lowering treatment (yes or no)</li> <li>Systolic blood pressure (mmHg)</li> <li>Blood pressure treatment (yes or no)</li> <li>Diabetes mellitus (yes or no)</li> <li>Current smoking (yes or no)</li> <li>Waist circumference (cm)</li> <li>Geographic region (northern or southern China)</li> <li>Urbanization (yes or no, only in males)</li> <li>Family history of ASCVD (yes or no, only in males)</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>CHD death</li> <li>Nonfatal MI</li> <li>Fatal or nonfatal stroke</li> </ul>

# LIMITATIONS



Risk Algorithm	Components
ACC/AHA ASCVD Pooled Cohort Risk Calculator	Assesses risk of an adverse CV event (CHD death, nonfatal MI, fatal stroke, and nonfatal stroke) over 10 years and over lifetime  Comprised of age, sex, race, TC, HDL-C, SBP, DBP, DM status, smoking status, treatment for HTN
European Systematic Coronary Risk Evaluation (SCORE) algorithm	Separated into low and high risk based on European country  Assesses fatal CVD risk over 10 years  Comprised of age, sex, TC, SBP, smoking status
QRISK Calculator (2-2017)	Assesses 10-year adverse events (MI or stroke)  Comprised of age, sex, ethnicity, smoking status, DM status, family history of premature MI, CKD (stage 4/5), AF, treatment for HTN, RA, cholesterol/HDL-C ratio, SBP, BMI
Prospective Cardiovascular Münster (PROCAM) model	Assesses 10-year risk of acute MI or SCD  Comprised of age, LDL-C, HDL-C, TG, smoking status, DM status, family history of premature MI, SBP
Reynolds Risk Score (RRS)	Assesses 10-year risk of MI, stroke, CABG, angioplasty, or CVD death  Comprised of age, sex, SBP, TC, HDL-C, family history of premature MI, hsCRP

# ASCVD RISK ESTIMATOR PLUS

The updated ASCVD Risk Estimator Plus uses recent science and user feedback to help a clinician and patient build a customized risk lowering plan by estimating and monitoring change in 10 year ASCVD risk.

Use the app to:

Estimate a patient's initial 10-year ASCVD risk using the pooled cohort equation

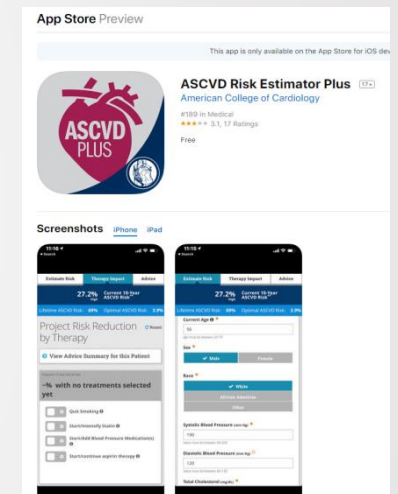
Receive an individualized, risk-based, intervention approach

Project the impact of specific interventions on a patient's risk

Guide clinician-patient discussion around customizing an intervention plan

Update risk at follow-up based on a patient's response to therapy using the

Million Hearts Longitudinal model



Advice from the app is derived from the 2018 ACC/AHA Guideline on the Treatment of Blood Cholesterol, the 2017 Guideline For the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults, the 2013 ACC/AHA Guideline on the Assessment of Cardiovascular Risk, and the 2016 Million Hearts Longitudinal ASCVD Risk Assessment Tool user guide.



Unit of Measure

US SI

Reset All

App should be used for primary prevention patients (those without ASCVD) only.

Current Age ⓘ \*

Age must be between 20-79

Sex \*

 Male  Female

Race \*

 White  African American  Other

Systolic Blood Pressure (mm Hg) \*

Value must be between 90-200

Diastolic Blood Pressure (mm Hg) ○

Value must be between 60-130

Total Cholesterol (mmol/L) \*

Value must be between 3.367 - 8.288

HDL Cholesterol (mmol/L) \*

Value must be between 0.518 - 2.59

LDL Cholesterol (mmol/L) ⓘ ○

Value must be between 0.777-7.770

History of Diabetes? \*

 Yes  No

Smoker? ⓘ \*

 Current ⓘ  Former ⓘ  Never ⓘ

On Hypertension Treatment? \*

 Yes  No

On a Statin? ⓘ ○

 Yes  No

On Aspirin Therapy? ⓘ ○

 Yes  No

Do you want to refine current risk estimation using data from a previous visit? ⓘ ○

 Yes  No

# ASCVD RISK ESTIMATOR PLUS

Do you want to refine current risk estimation using data from a previous visit? ⓘ ○

✓ Yes

No

## Values at Previous Visit

Reset

Age at Previous Visit \*

Age must be between 40-79

Total Cholesterol at Previous Visit (mg/dL) \*

Value must be between 130 - 320

HDL Cholesterol at Previous Visit (mg/dL) \*

Value must be between 20 - 100

LDL Cholesterol at Previous Visit (mg/dL) ⓘ \*

Value must be between 30-300

Systolic Blood Pressure at Previous Visit (mm Hg) \*

Value must be between 90-200

On Hypertension Treatment at Previous Visit? \*

Yes

No

History of Diabetes at Previous Visit? \*

Yes

No

Was a Smoker at Previous Visit (or within a year before the visit)? ⓘ \*

Yes

No





## Visit Summary

Below is a summary of patient's risk, treatment options, and treatment advice based on the data provided.

Email Advice

Print

## Treatment Advice\*

[Expand All](#)

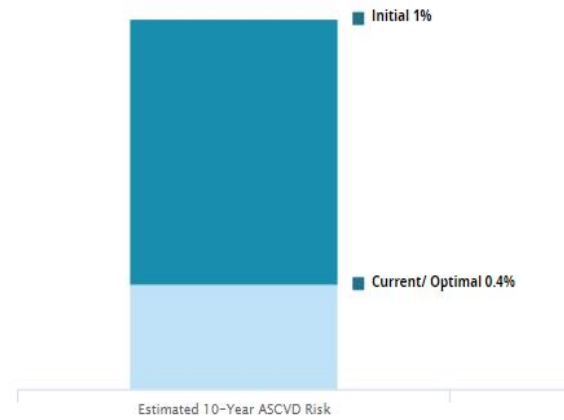
- ▶ LDL-C Management (for this Patient)
- ▶ Blood Pressure Management (for this Patient)
- ▶ Tobacco Cessation (for this Patient)
- ▶ Diabetes Mellitus Management (General)
- ▶ Lifestyle Recommendations (General)
- ▶ Aspirin Use Recommendations (for this Patient)
- ▶ Therapy Safety Information (General)

### ASCVD Risk Profile

10-yr risk for first ASCVD event is:  
**LOW**

ASCVD Risk Profile

10-yr risk for first ASCVD event is:  
**LOW**



Inputs

Inputs

Sex: **Female**

Race: **Other**

Values	Previous	Current
Age:	40	40
Total Cholesterol (mmol/L)	5.2	5.2
HDL Cholesterol (mmol/L)	1.2	0.9
LDL Cholesterol (mmol/L)	2.6	2.6
Systolic Blood Pressure (mm Hg)	140	120



# Using CAC Score to Inform Decisions

## Specific CAC Guideline Recommendations

✕close

COR	LOE	Recommendations
IIa	B-NR	In intermediate-risk or selected borderline-risk adults, if the decision about statin use remains uncertain, it is reasonable to use a CAC score in the decision to withhold, postpone or initiate statin therapy.
IIa	B-NR	<p>In intermediate-risk adults or selected borderline-risk adults in whom a CAC score is measured for the purpose of making a treatment decision, AND</p> <ul style="list-style-type: none"><li>• If the coronary calcium score is zero, it is reasonable to withhold statin therapy and reassess in 5 to 10 years, as long as higher risk conditions are absent (diabetes mellitus, family history of premature CHD, cigarette smoking);</li><li>• If CAC score is 1 to 99, it is reasonable to initiate statin therapy for patients <math>\geq 55</math> years of age;</li><li>• If CAC score is 100 or higher or the 75<sup>th</sup> percentile or higher, it is reasonable to initiate statin therapy.</li></ul>
IIb	B-R	In adults 76 to 80 years of age with an LDL-C level of 70 to 189 mg/dL (1.7 to 4.8 mmol/L), it may be reasonable to measure CAC to reclassify those with a CAC score of zero to avoid statin therapy.

## Specific CAC Score Ethnicity Considerations

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	Ethnic/racial groupings			
	Asian-Americans*	Hispanic/Latino-Americans†	African-Americans	Comments:
<b>Coronary Artery Calcium (CAC) Score</b>	In terms of CAC burden, South Asian men were similar to non-Hispanic white men, but higher CAC when compared to African Americans, Latinos and Chinese Americans. South Asian women had similar CAC to whites and other ethnic women, although CAC burden higher in older age.	CAC predicts similarly in whites and those who identify as Hispanic/Latino.	In MESA (Multi-Ethnic Study of Atherosclerosis), CAC score was highest in Caucasian and Hispanic men, with African-Americans having significantly lower prevalence and severity of CAC.	Risk factor differences in MESA between ethnicities didn't fully explain variability in CAC. However, CAC predicted ASCVD events over and above traditional risk factors in all ethnicities.

\*The term Asian characterizes a diverse population group. Individuals from Bangladesh, India, Nepal, Pakistan and Sri Lanka make up the majority of the South Asian group. Individuals from Japan, Korea, and China make up the majority of the East Asian group.

† The term Hispanics/Latinos in the United States characterizes a diverse population group. This includes white, black, and Native American races. Their ancestry goes from Europe to America, including among these, individuals from the Caribbean, Mexico, Central and South America