Should everyone older than 50 have CTA or other imaging?

Yin Ge, MD FRCPC

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Presenter Disclosure

Dr. Yin Ge

Should everyone older than 50 have CTA or other imaging?

Relationships with financial sponsors:

- **Grants/Research Support:** N/A
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- **Patents:** N/A
- **Other:** N/A

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HPI

62 M

- 2-month history of intermittent, left sided chest pain
- Pressure-like; lasts a few minutes
- Occurs at rest, not precipitated by exercise
- Sometimes accompanied by headaches and dizziness

Past Medical History

Hypertension

Home Medications

Valsartan 80mg daily

Physical Exam

VS: BP 117/73 mmHg, HR 88 and regular.
CV: S1, S2 with physiologic split, no murmurs.
Chest: No crackles.

Extremities: No edema. Good equal bilateral pulses.

Labs

Electrolytes: WNL
CBC: WNL

TC: 5.2 mmol/L
HDL 1.1 mmol/L
TG: 1.5 mmol/L
LDL: 3.4 mmol/L

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Question 1:

What is this patient's pre-test probability of having obstructive CAD?

A) 0-10 %

B) 20-30 %

C) 50-60%

D) >90%

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What is the Pre-test likelihood of CAD?

Age, Years	Chest Pain Criteria 1. Substernal chest discomfort with characteristic quality and duration 2. Provoked by exertion or emotional stress 3. Relieved promptly by rest or nitroglycerin					
	Nonanginal Chest Pain 1 of 3 Criteria		**Atypical Angina** 2 of 3 Criteria		**Typical Angina** 3 of 3 Criteria	
	Male	Female	Male	Female	Male	Female
30 – 39	4%	2%	34%	12%	76%	26%
40 - 49	13%	3%	51%	22%	87%	55%
50 - 59	20%	7%	65%	33%	93%	73%
60 - 69	27%	14%	72%	51%	94%	86%

Mancini et al. CJC 2014.

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What is the Pre-test likelihood of CAD?

	Non-anginal		Atypical		Typical		Dyspnoea[a]	
Age	Men	Women	Men	Women	Men	Women	Men	Women
30–39	1%	1%	4%	3%	3%	5%	0%	3%
40–49	3%	2%	10%	6%	22%	10%	12%	3%
50–59	11%	3%	17%	6%	32%	13%	20%	9%
60–69	22%	6%	26%	11%	44%	16%	27%	14%
70+	24%	10%	34%	19%	52%	27%	32%	12%

Knuuti et al. EHJ. 2019.

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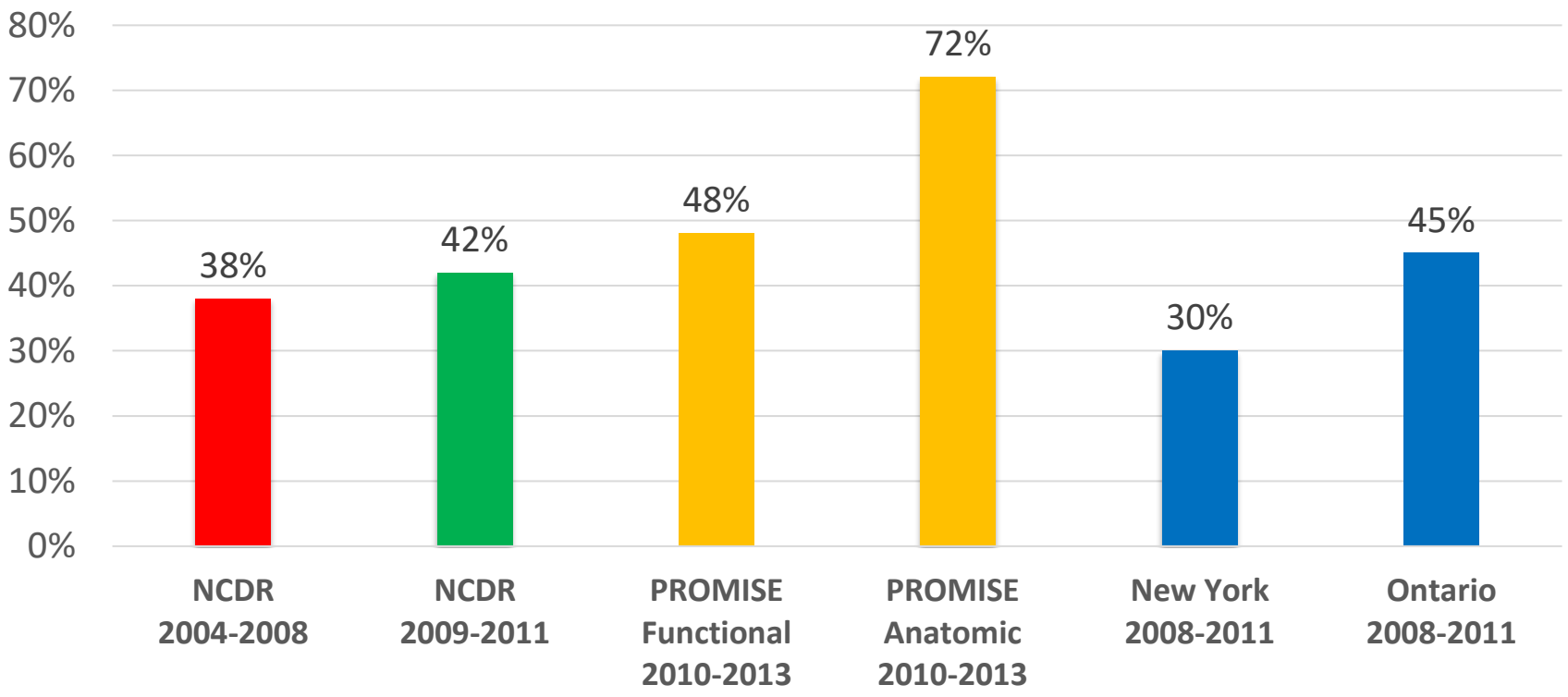
Elective invasive coronary angiography with obstructive CAD



Patel et al. NEJM 2010. Patel et al. AHJ 2014. Douglas et al. NEJM 2015. Ko et al. JAMA. 2013.

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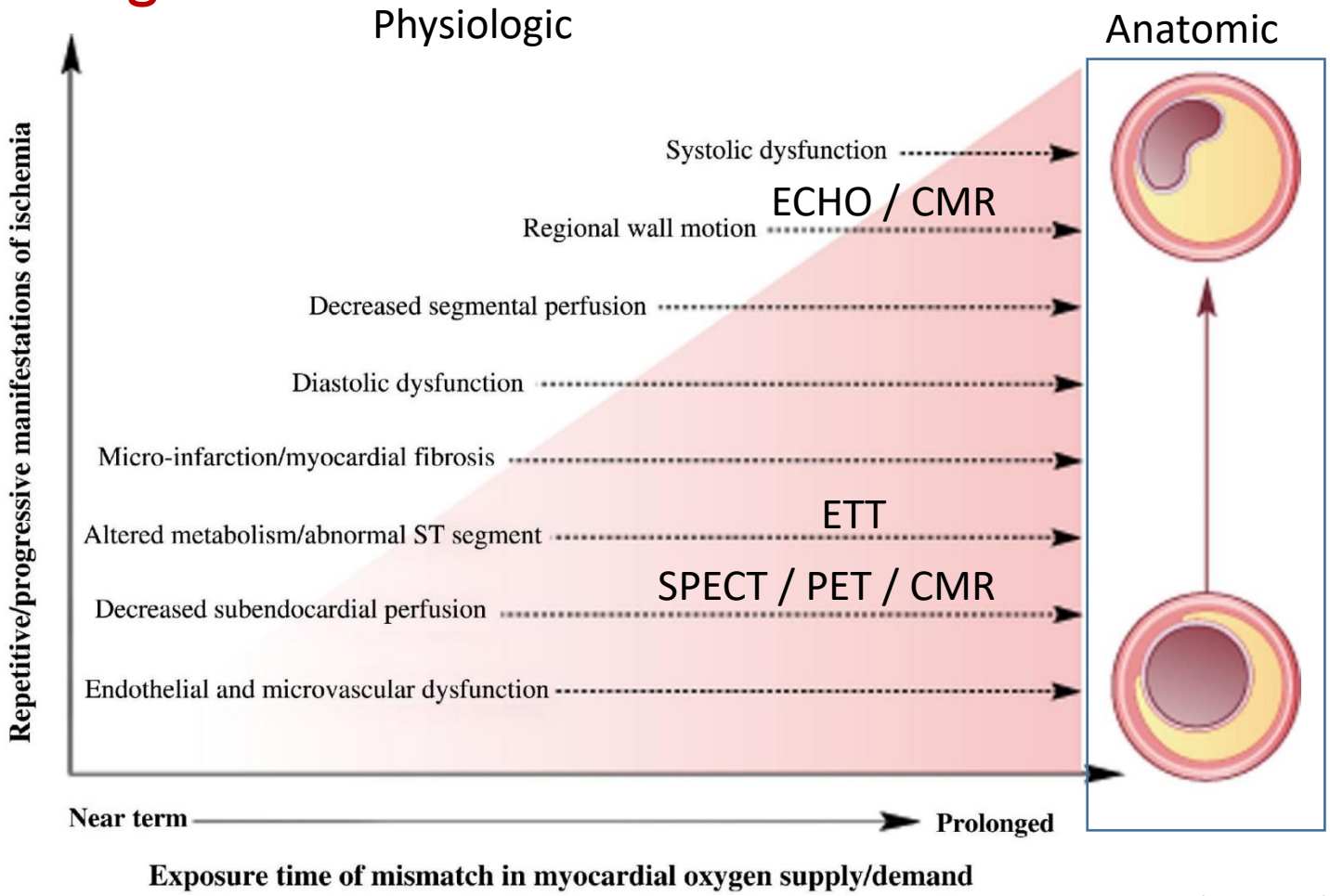
Diagnosing CAD



Shaw et al. JACC. 2009.

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Diagnostic performance

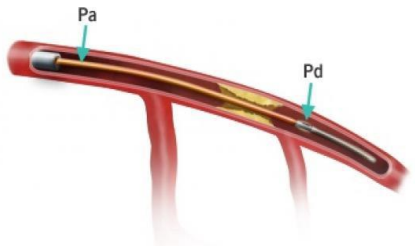
Anatomically significant CAD		
Test	**Sensitivity (%), (95% CI)**	**Specificity (%), (95% CI)**
Stress ECG	58 (46–69)	62 (54–69)
Stress echo	85 (80–89)	82 (72–89)
CCTA	97 (93–99)	78 (67–86)
SPECT	87 (83–90)	70 (63–76)
PET	90 (78–96)	85 (78–90)
Stress CMR	90 (83–94)	80 (69–88)

Functionally significant CAD		
Test	**Sensitivity (%), (95% CI)**	**Specificity (%), (95% CI)**
ICA	68 (60–75)	73 (55–86)
CCTA	93 (89–96)	53 (37–68)
SPECT	73 (62–82)	83 (71–90)
PET	89 (82–93)	85 (81–88)
Stress CMR	89 (85–92)	87 (83–91)

Gold standard: ICA with FFR

$$FFR = \frac{\text{Distal Coronary Pressure (Pd)}}{\text{Proximal Coronary Pressure (Pa)}}$$

(During Maximum Hyperemia)



Knutti et al. EHJ. 2018.

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Question 2:

Which of the following test have the best *negative* predictive value?

A) Stress echo

B) CCTA

C) SPECT

D) ETT

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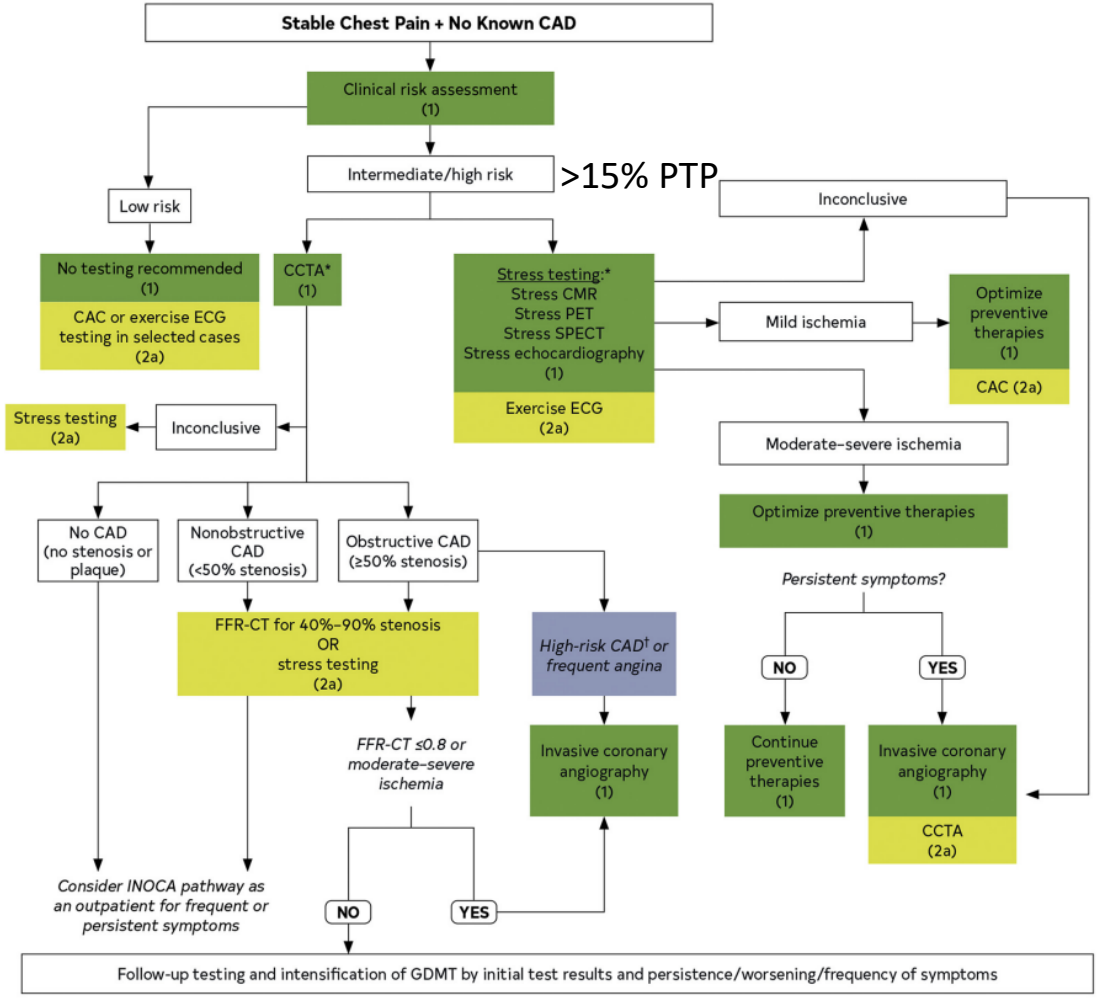
Diagnosing CAD



Gulati et al. JACC. 2021.

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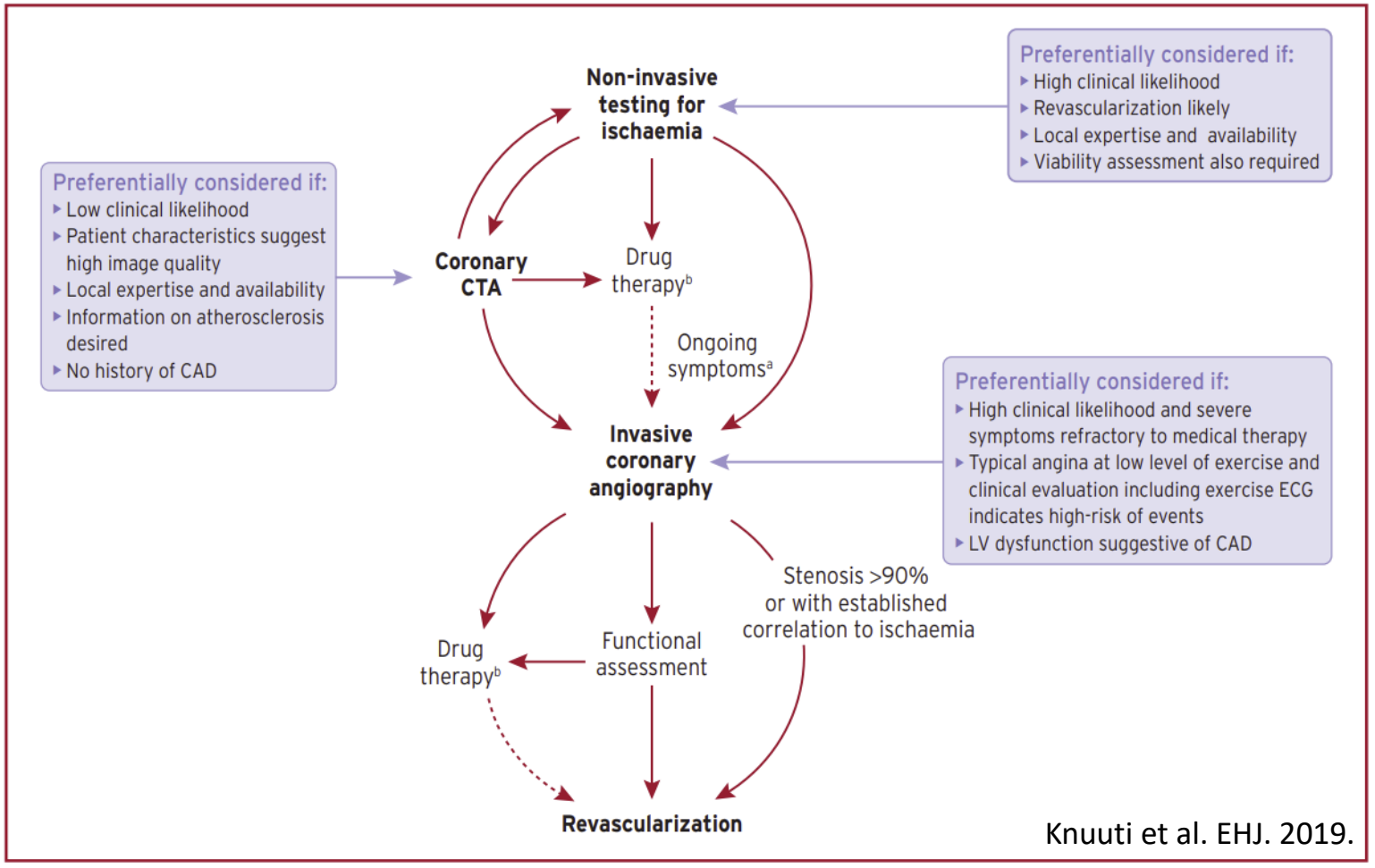
Diagnosing CAD



Knuuti et al. EHJ. 2019.

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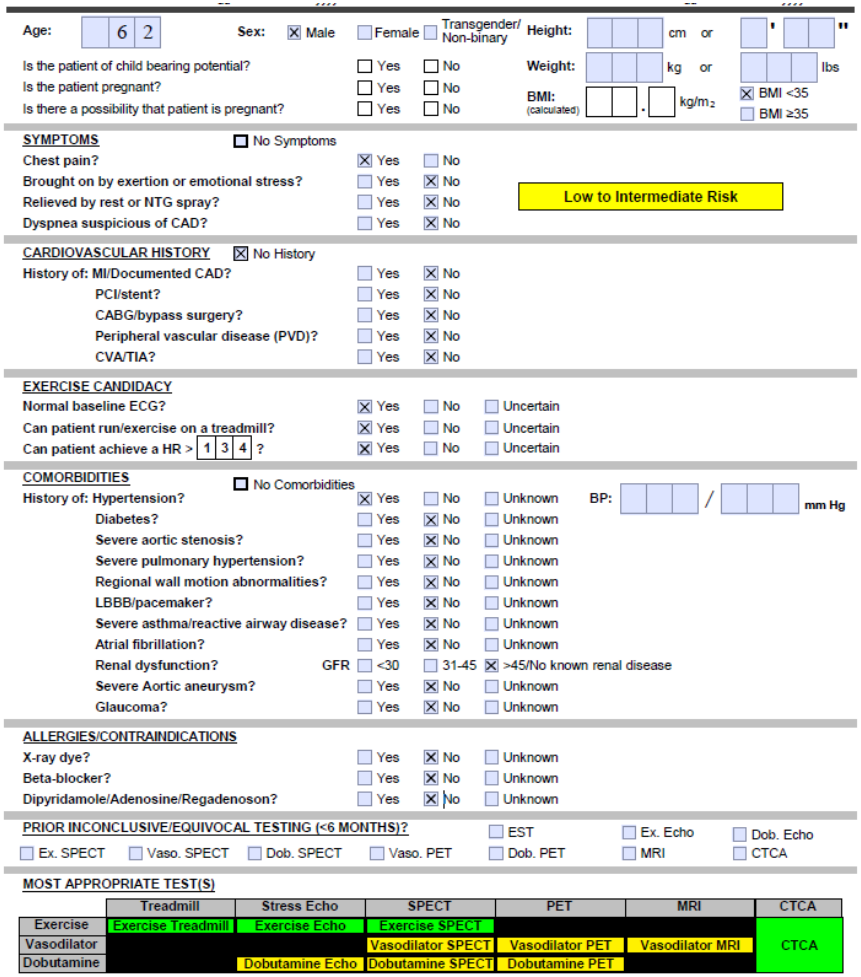
Diagnosing CAD



Age: 62 Sex: ☒ Male ☐ Female ☐ Transgender/Non-binary Height: cm or ' "

Is the patient of child bearing potential? ☐ Yes ☐ No Weight: kg or lbs

Is the patient pregnant? ☐ Yes ☐ No

Is there a possibility that patient is pregnant? ☐ Yes ☐ No BMI: (calculated) kg/m2 ☒ BMI <35 ☐ BMI ≥35

SYMPTOMS ☐ No Symptoms

Chest pain?	☒ Yes	☐ No
Brought on by exertion or emotional stress?	☐ Yes	☒ No
Relieved by rest or NTG spray?	☐ Yes	☒ No
Dyspnea suspicious of CAD?	☐ Yes	☒ No

Low to Intermediate Risk

CARDIOVASCULAR HISTORY ☒ No History

History of: MI/Documented CAD?	☐ Yes	☒ No
PCI/stent?	☐ Yes	☒ No
CABG/bypass surgery?	☐ Yes	☒ No
Peripheral vascular disease (PVD)?	☐ Yes	☒ No
CVA/TIA?	☐ Yes	☒ No

EXERCISE CANDIDACY

Normal baseline ECG?	☒ Yes	☐ No	☐ Uncertain
Can patient run/exercise on a treadmill?	☒ Yes	☐ No	☐ Uncertain
Can patient achieve a HR > 134 ?	☒ Yes	☐ No	☐ Uncertain

COMORBIDITIES ☐ No Comorbidities

History of: Hypertension?	☒ Yes	☐ No	☐ Unknown	BP: / mm Hg
Diabetes?	☐ Yes	☒ No	☐ Unknown	
Severe aortic stenosis?	☐ Yes	☒ No	☐ Unknown	
Severe pulmonary hypertension?	☐ Yes	☒ No	☐ Unknown	
Regional wall motion abnormalities?	☐ Yes	☒ No	☐ Unknown	
LBBB/pacemaker?	☐ Yes	☒ No	☐ Unknown	
Severe asthma/reactive airway disease?	☐ Yes	☒ No	☐ Unknown	
Atrial fibrillation?	☐ Yes	☒ No	☐ Unknown	
Renal dysfunction? GFR	☐ <30	☐ 31-45	☒ >45/No known renal disease	
Severe Aortic aneurysm?	☐ Yes	☒ No	☐ Unknown	
Glaucoma?	☐ Yes	☒ No	☐ Unknown	

ALLERGIES/CONTRAINDICATIONS

X-ray dye?	☐ Yes	☒ No	☐ Unknown
Beta-blocker?	☐ Yes	☒ No	☐ Unknown
Dipyridamole/Adenosine/Regadenoson?	☐ Yes	☒ No	☐ Unknown

PRIOR INCONCLUSIVE/EQUIVOCAL TESTING (<6 MONTHS)?

☐ EST ☐ Ex. Echo ☐ Dob. Echo ☐ Ex. SPECT ☐ Vaso. SPECT ☐ Dob. SPECT ☐ Vaso. PET ☐ Dob. PET ☐ MRI ☐ CTCA

MOST APPROPRIATE TEST(S)

	Treadmill	Stress Echo	SPECT	PET	MRI	CTCA
Exercise	Exercise Treadmill	Exercise Echo	Exercise SPECT			CTCA
Vasodilator			Vasodilator SPECT	Vasodilator PET	Vasodilator MRI	
Dobutamine		Dobutamine Echo	Dobutamine SPECT	Dobutamine PET		

Chow et al. CJC Open. 2023.

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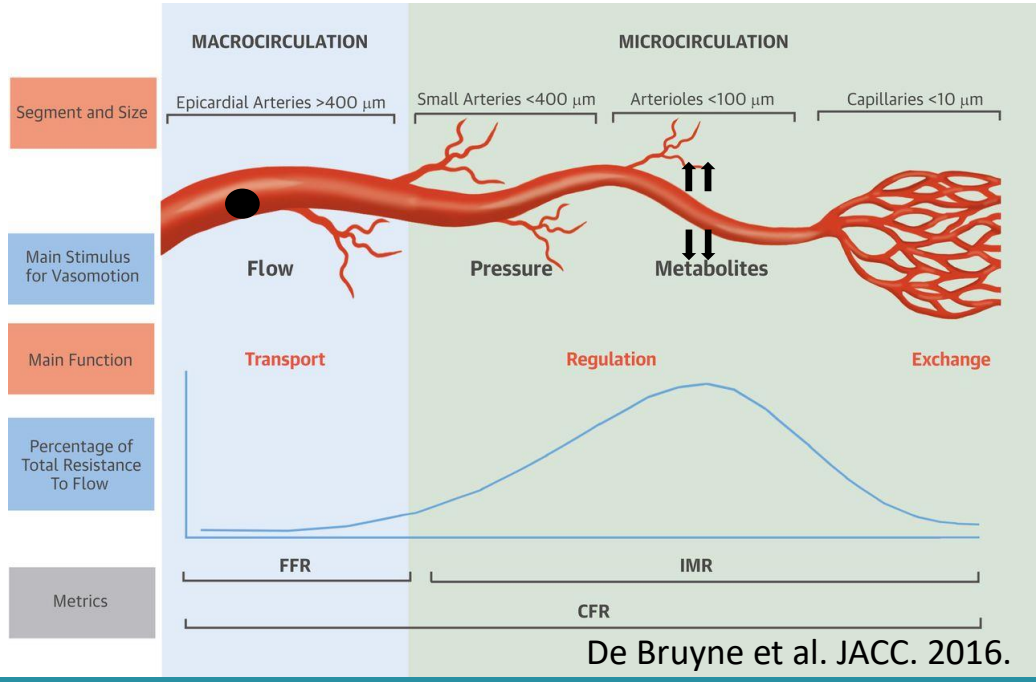
Diagnosing CAD

- Widely available in Ontario
  - ETT
  - Echo
  - SPECT
- Available at SMH
  - ETT
  - Echo
  - SPECT
  - *CTA
  - *CMR
  - †PET (soon)

*Wait time



De Bruyne et al. JACC. 2016.

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HPI

62 M

Asymptomatic

Past Medical History

Hypertension

Home Medications

Valsartan 80mg daily

Physical Exam

VS: BP 117/73 mmHg, HR 88 and regular.
CV: S1, S2 with physiologic split, no murmurs.
Chest: No crackles.

Extremities: No edema. Good equal bilateral pulses.

Labs

Electrolytes: WNL
CBC: WNL

TC: 5.2 mmol/L
HDL 1.1 mmol/L
TG: 1.5 mmol/L
LDL: 3.4 mmol/L

Diagnosing CAD

- Limited role (evidence) for non-invasive testing in the asymptomatic individuals.
- Coronary calcium is an underutilized tool.

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FRAMINGHAM RISK SCORE (FRS)

Estimation of 10-year Cardiovascular Disease (CVD) Risk

Date: _____

Patient's Name: _____

Step 1[1]

In the "points" column enter the appropriate value according to the patient's age, HDL-C, total cholesterol, systolic blood pressure, and if they smoke or have diabetes. Calculate the total points.

Risk Factor	Risk Points		Points
	Men	Women	
Age			
30-34	0	0	
35-39	2	2	
40-44	5	4	
45-49	7	5	
50-54	8	7	
55-59	10	8	
60-64	11	9	
65-69	12	10	
70-74	14	11	
75+	15	12	
HDL-C (mmol/L)			
>1.6	-2	-2	
1.3-1.6	-1	-1	
1.2-1.29	0	0	
0.9-1.19	1	1	
<0.9	2	2	
Total Cholesterol			
<4.1	0	0	
4.1-5.19	1	1	
5.2-6.19	2	3	
6.2-7.2	3	4	
>7.2	4	5	

Systolic Blood Pressure (mmHg)	Men: Not Treated	Men: Treated	Women: Not Treated	Women: Treated
<120	-2	0	-3	-1
120-129	0	2	0	2
130-139	1	3	1	3
140-149	2	4	2	5
150-159	2	4	4	6
160+	3	5	5	7

Smoker	Yes	4	3
	No	0	0
Diabetes	Yes	statin-indicated condition	
	No	0	0
Total Points			

1 Adapted from: D'Agostino RB et al.(i). General cardiovascular risk profile for use in primary care. The Framingham Heart Study. Circ 2008;117:743-53.
2 Adapted from: Genest J et al.(i). 2009 Canadian Cardiovascular Society/Canadian guidelines for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease in the adult. Can J Cardiol. 2009;25(10):567-579.
3 Adapted from: Anderson T et al.(i). 2012 Update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. Can J Cardiol. 2013;29(2):151-167.

§ apoB: apolipoprotein B stat, CVD: cardiovascular disease, FRS: Framingham Risk Score, HDL-C: high-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol.
* Statins indicated as initial therapy
** Consider LDL-C < 1.8 mmol/L for subjects with acute coronary syndrome (ACS) within past 3 months

Provided courtesy of Canadian Cardiovascular Society
Leadership. Knowledge. Community.

Step 2[1]

Using the total points from Step 1, determine the 10-year CVD risk (%).*

Total Points	10-Year CVD Risk (%)*	
	Men	Women
-3 or less	<1	<1
-2	1.1	<1
-1	1.4	1.0
0	1.6	1.2
1	1.9	1.5
2	2.3	1.7
3	2.8	2.0
4	3.3	2.4
5	3.9	2.8
6	4.7	3.3
7	5.6	3.9
8	6.7	4.5
9	7.9	5.3
10	9.4	6.3
11	11.2	7.3
12	13.3	8.6
13	15.6	10.0
14	18.4	11.7
15	21.6	13.7
16	25.3	15.9
17	29.4	18.51
18	>30	21.5
19	>30	24.8
20	>30	27.5
21+	>30	>30

* Double cardiovascular disease risk percentage for individuals between the ages of 30 and 59 without diabetes if the presence of a positive history of premature cardiovascular disease is present in a first-degree relative before 55 years of age for men and before 65 years of age for women. This is known as the modified Framingham Risk Score.[3]

Step 3[1]

Using the total points from Step 1, determine heart age (in years).

Heart Age, y	Men	Women
<30	<0	<1
30	0	
31		1
32	1	
34	2	2
36	3	3
38	4	
39		4
40	5	
42	6	5
45	7	6
48	8	7
51	9	8
54	10	
55		9
57	11	
59		10
60	12	
64	13	11
68	14	12
72	15	
73		13
76	16	
79		14
>80	≥17	15+

Step 4[2,3]

Using 10-year CVD risk from Step 2, determine if patient is Low, Moderate or High risk.† Indicate Lipid and/or Apo B targets

Risk Level†	Initiate Treatment If:	Primary Target (LDL-C)	Alternate Target
High FRS ≥20%	• Consider treatment in all *(Strong, High)*	• ≤2 mmol/L or ≥50% decrease in LDL-C *(Strong, Moderate)*	• Apo B ≤0.8 g/L or • Non-HDL-C ≤2.6 mmol/L *(Strong, High)*
Intermediate FRS 10-19%	• LDL-C ≥3.5 mmol/L *(Strong, Moderate)* • For LDL-C <3.5 mmol/L consider if: • Apo B ≥1.2 g/L • OR Non-HDL-C ≥4.3 mmol/L *(Strong, Moderate)* • *Men ≥50 and women ≥60 with 1 risk factor: low HDL-C, impaired fasting glucose, high waist circumference, smoker, hypertension*	• ≤2 mmol/L or ≥50% decrease in LDL-C *(Strong, Moderate)*	• Apo B ≤0.8 g/L or • Non-HDL-C ≤2.6 mmol/L *(Strong, Moderate)*
Low FRS <10%	• statins generally not indicated	• statins generally not indicated	• statins generally not indicated
Statin-indicated conditions**	• *Clinical atherosclerosis** • *Abdominal aortic aneurysm* • *Diabetes mellitus Age ≥ 40 years 15-Year duration for age ≥ 30 years (DM1) Microvascular disease* • *Chronic kidney disease (age ≥ 50 years) eGFR <60 mL/min/1.73 m2 or ACR > 3 mg/mmol*		

Lipid targets LDL-C:_____ or Apo B:_____

10 year FRS: 18.4%

Pearson et al. CJC. 2021

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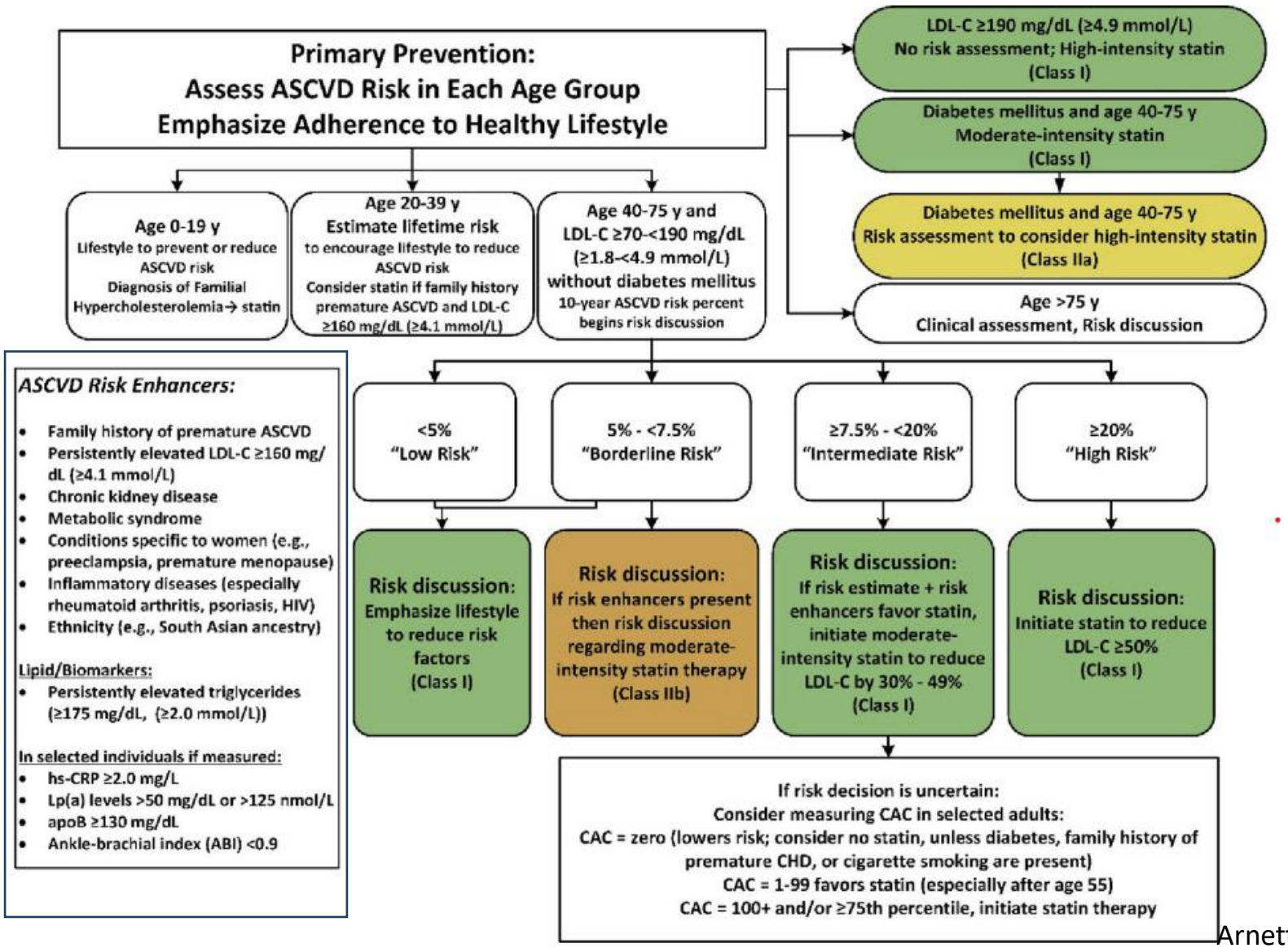
Risk Level†	Initiate Statin Treatment if:	Consider Add-on Therapy or Treatment Intensification
High FRS ≥ 20%	Consider treatment in all (Strong, High)	If LDL-C ≥ 2 mmol/L **or** Non-HDL-C > 2.6 mmol/L **or** ApoB ≥ 0.80 g/L on maximally tolerated statin dose
Intermediate FRS 10-19%	If LDL-C ≥ 3.5 mmol/L **or** (Strong, Moderate) If LDL-C < 3.5 mmol/L initiate if: • non-HDL-C ≥ 4.3 mmol/L **or** • ApoB ≥ 1.05 g/L **or** (Strong, Moderate) • Men ≥ 50 yrs and women ≥60 yrs with 1 additional risk factor: low HDL-C, impaired fasting glucose, high waist circumference, smoker, or hypertension, **or** with the presence of other risk modifiers: hsCRP ≥ 2 mg/L, CAC > 0 AU, family history of premature CAD, Lp(a) ≥ 100 mol/L (≥ 50 mg/dL)	If LDL-C ≥ 2 mmol/L **or** Non-HDL-C > 2.6 mmol/L **or** ApoB ≥ 0.80 g/L on maximally tolerated statin dose
Low FRS < 10%	Statins generally not indicated	N/A
Statin-indicated Conditions** (Consider treatment in all; Strong, High)		
LDL-C ≥ 5 mmol/L **or** non-HDL-C ≥ 5.8 mmol/L **or** ApoB ≥ 1.45 g/L (FH or genetic dyslipidemia)		If LDL-C ≥ 2.5 mmol/L **or** < 50% reduction, **or** non-HDL-C ≥ 3.2 mmol/L **or** ApoB ≥ 0.85 g/L
Most patients with diabetes: • Age ≥ 40 yrs old **or** Age ≥ 30 yrs & DM x ≥ 15 yrs duration **or** Microvascular disease		If LDL-C ≥ 2.0 mmol/L **or** non-HDL-C ≥ 2.6 mmol/L **or** ApoB ≥ 0.80 g/L on maximally tolerated statin dose
Chronic Kidney Disease: • Age ≥ 50 yrs & eGFR < 60 mL/min/1.73 m^2 **or** ACR > 3 mg/mmol.		
Atherosclerotic Cardiovascular Disease (ASCVD): • Myocardial infarction (MI), acute coronary syndrome (ACS), **or** • Stable angina, documented coronary artery disease (CAD) using angiography, **or** • Stroke, TIA, documented carotid disease, **or** • Peripheral arterial disease, claudication, and/or ankle-brachial index (ABI) < 0.9, **or**		If LDL-C ≥ 1.8 mmol/L **or** non-HDL-C ≥ 2.4 mmol/L **or** ApoB ≥ 0.70 g/L on maximally tolerated statin dose



10-year ASCVD: 11.3%

Arnett et al. JACC. 2019

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Diagnosing CAD

- Coronary calcium score has the largest impact on model discrimination (c-statistic) and model reclassification compared to many other 'popular' biomarkers
  - Hs-Troponin
  - NT-proBNP
  - Carotid intima media thickness
  - Enhanced lipid profile
  - Hs-CRP

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Diagnosing CAD: The Multi-Ethnic Study of Atherosclerosis (MESA)

Age (45-84): 62

Gender: male

Race/Ethnicity: white

Observed Agatston Calcium Score (optional): 0

Calculate

The estimat
of age 62 is

Percentil

25
0

The obse
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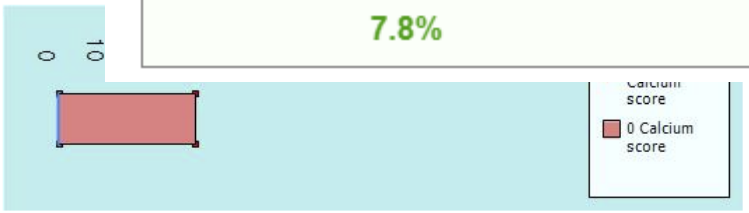
Chart 1: F



Using the Coronary Artery Calcium Score

10 Year risk of a CHD Event	Coronary Age	Difference from Chronologic Age
2.9%	42	-20

Without Considering the Coronary Artery Calcium Score

10 Year risk of a CHD Event	Coronary Age	Difference from Chronologic Age
7.8%	64	+2

Key Messages

- Symptomatic:
  - CTA has high negative predictive value, is favored in those with low pretest probability, without CAD, and no indication for statin.
- Asymptomatic:
  - Coronary calcium is an underutilized tool in primary prevention.

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Thank you