

Clinical Assessment of Patient Specific Risk

TCTAP 2011

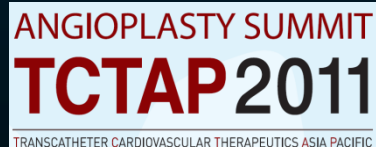
April 27-29, 2011 Seoul, Korea

Wm Guy Weigold, MD, FACC, FSCCT

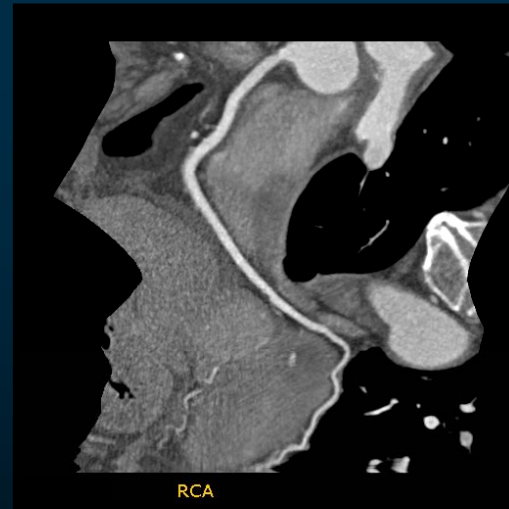
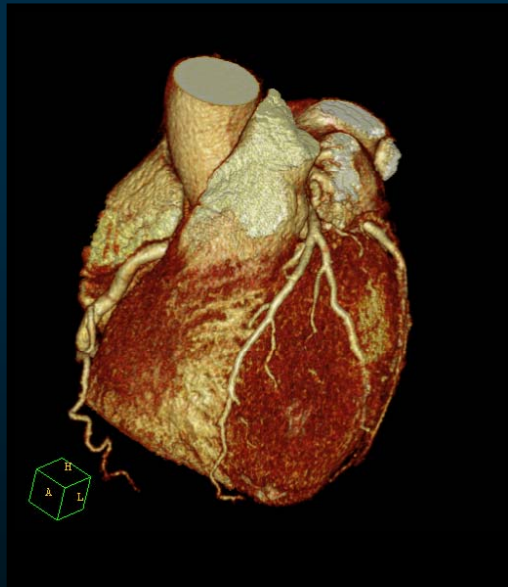
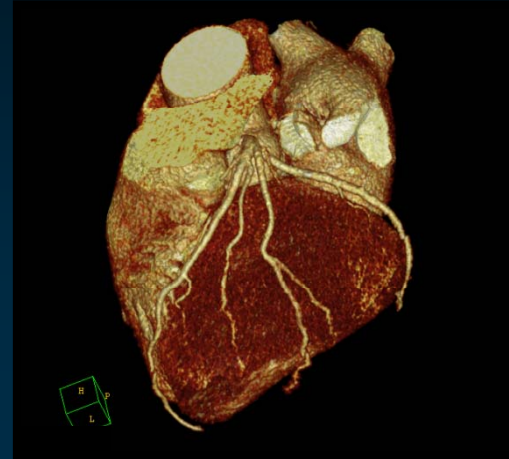
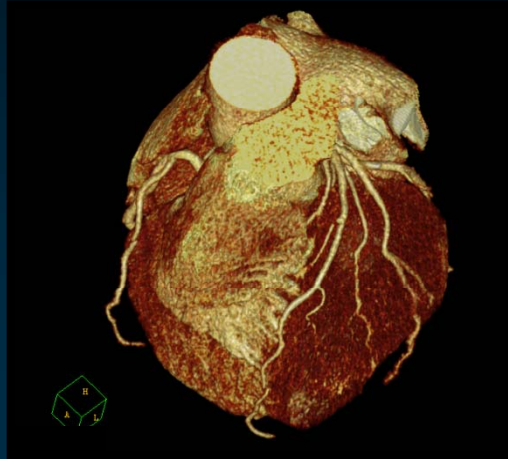
Director, Cardiac CT

Washington Hospital Center

Washington, D.C.



Cardiac CT: Coronary CT Angiography



Cardiac CT: Coronary Calcium Scan



1990

- Calcium scoring method
 - Agatston, Janowitz, Hildner, Zusmer, Viamonte, Detrano

The Problem

- Coronary Heart Disease remains a leading cause of death and disability
 - > 45% of MI's are fatal
 - > ½ million deaths per year (US)
 - > 4 million deaths (all CVD) per yr (Europe)
 - 25% of deaths from CHD occur before hospitalization
 - At least 25% of SCD and non-fatal MI occur *without prior symptoms*
-
- Heart and Stroke Statistical Update. www.americanheart.org
 - European Guidelines on CVD Prevention. EHJ 28:2375-2414
 - Myerburg RJ, Kessler KM, Castellanos A. Ann Int Med. 119:1187-97

The Detection Gap

BETHESDA CONFERENCE REPORT

34th Bethesda Conference:
“Can Atherosclerosis Imaging
Techniques Improve the Detection of
Patients at Risk for Ischemic Heart Disease?”*

Allen J. Taylor, MD, FACC, *Conference Co-Chair*

C. Noel Bairey Merz, MD, FACC, *Conference Co-Chair*

James E. Udelson, MD, FACC, *Conference Co-Chair*

TASK FORCES

Task Force #1—Identification of Coronary
Heart Disease Risk: Is There a Detection Gap?

Richard C. Pasternak, MD, FACC, *Co-Chair*, Jonathan Abrams, MD, FACC, *Co-Chair*,

Philip Greenland, MD, FACC, Lynn A. Smaha, MD, PhD, FACC, Peter W. F. Wilson, MD,

Nancy Houston-Miller, RN, BSN

The Detection Gap

- ATP III: 36 million in US require Rx for LDL
- 10-15 million in US on lipid-lowering Rx

- Est. prevalence of HTN: 50 million in US
- Guidelines est. one-third HTN undetected

- Est. 650,000 primary SCD and MI per year
- High risk individuals: 2% risk per year
- 32 million at high risk

34th Bethesda Conference

- “A major problem of detection, treatment, and prevention of CHD exists in the large population who have no symptoms of heart disease yet are at increased risk to develop CHD.”
- “A detection gap in CHD prognosis exists. The precise size of this gap is unknown, but is likely substantial.”

Current Approach to Cardiac Risk Stratification

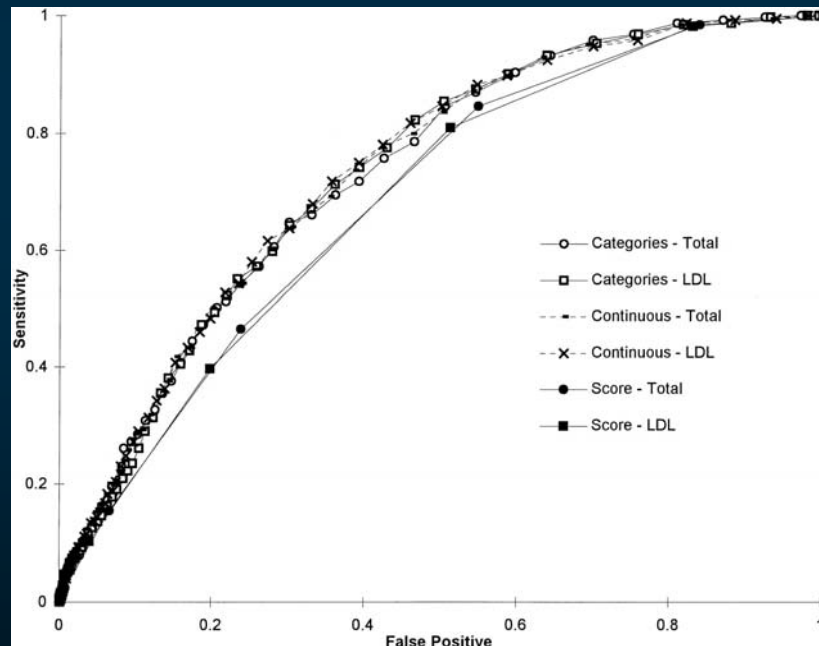
Table 1. Examples of Approaches to Risk Assessment With Multiple Coronary Heart Disease Risk Factors*

National Cholesterol Education Program Guidelines (NCEP)
European Societies of Cardiology, Atherosclerosis, and Hypertension
Framingham Risk Score
British Regional Heart Study (BRHS) Risk Score
Sheffield Coronary Risk Tables
GREAT (General Rule to Enable Atheroma Treatment)
Munster Heart Study (PROCAM) Risk Score
Dundee Coronary Risk Disc
National Heart Foundation of New Zealand Guidelines
West of Scotland Cardiovascular Event Reduction Tool (CERT)

- Greenland P, Smith JS Jr, Grundy. Circulation 2001; 104:1863-7

Is There a Role for Non-Invasive Testing in Risk Stratification?

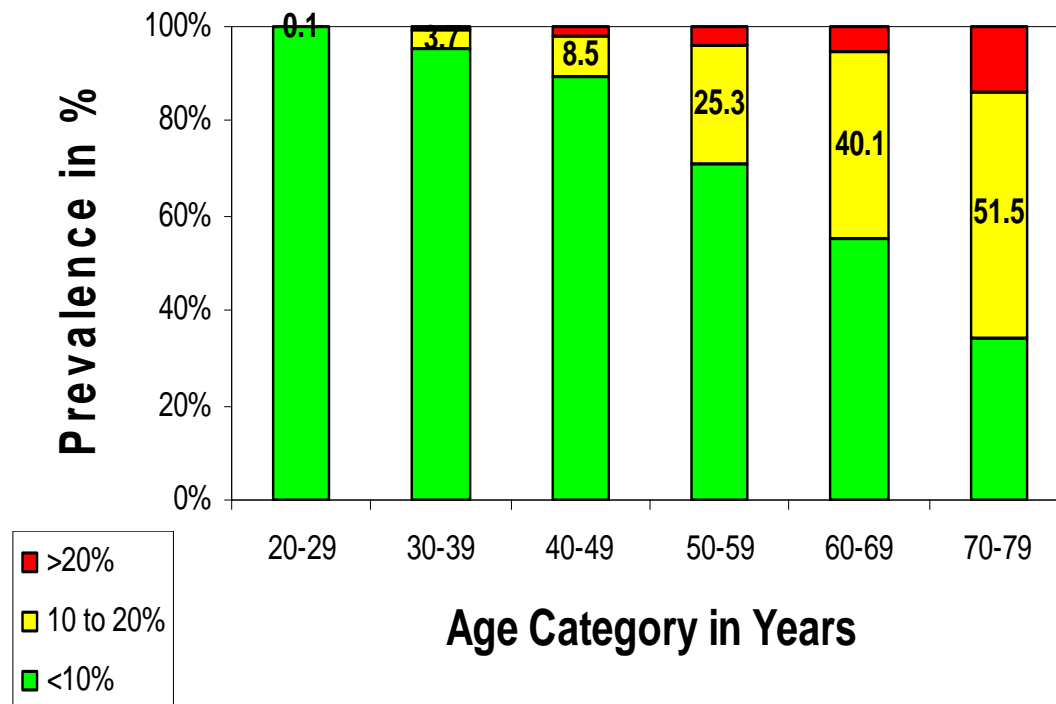
- Most clinical risk predictors are only moderately accurate and may underestimate or misclassify patients



**Multivariate risk prediction
based on Framingham data
AUC = 0.7**

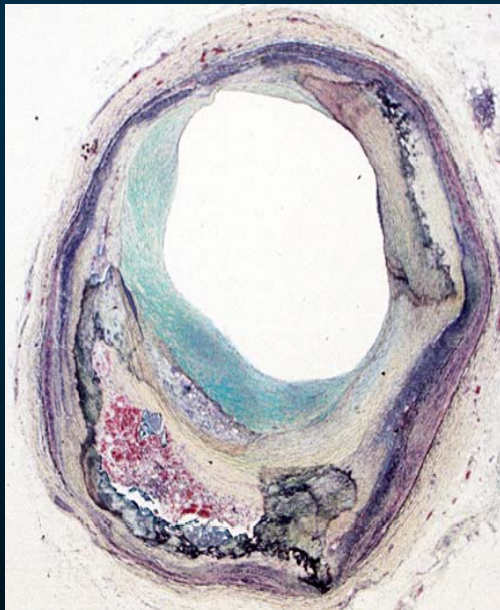
Broad Intermediate Risk Group

NHANES 1988-1994 Men and Women

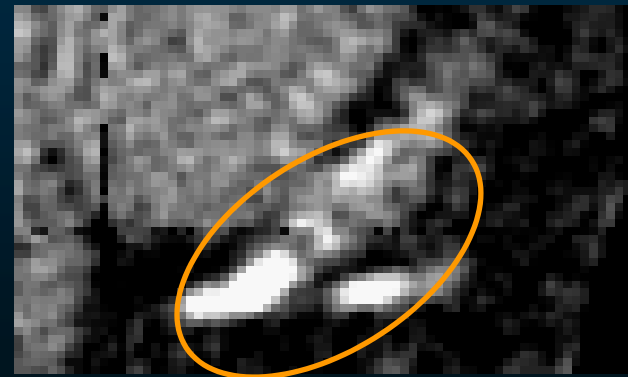


Rationale for an imaging approach

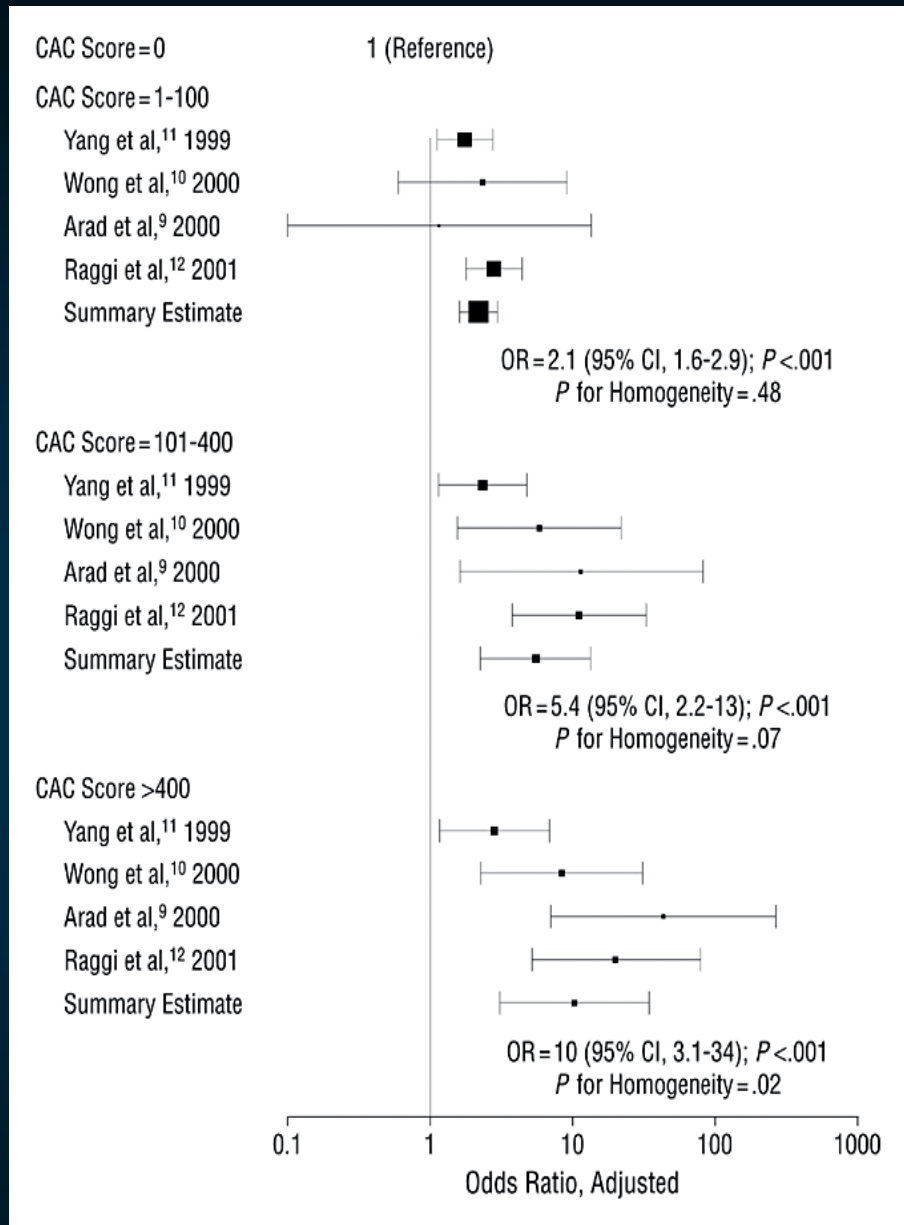
- Pathologic substrate required for event
- Quantification of disease burden
- Disease burden should correlate with events



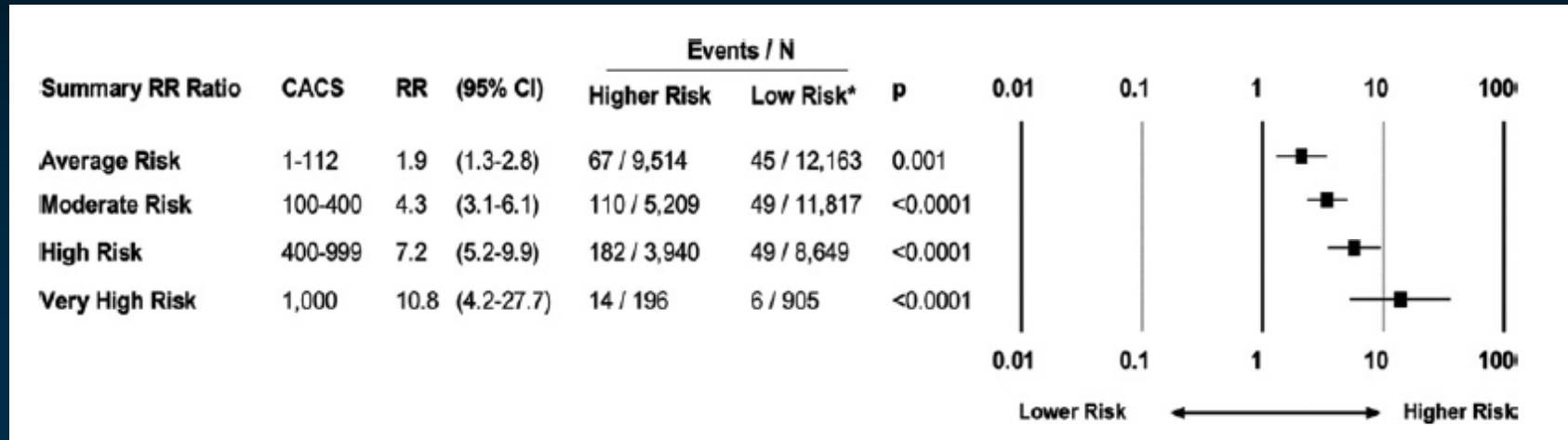
- Originally developed with EBCT- subsequently with MDCT
- Good reproducibility, low radiation exposure



Incremental predictive value of CACS



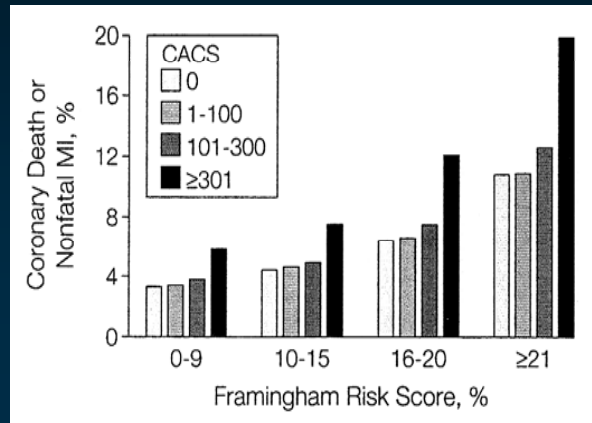
2007 ACC Consensus Document: CHD death or MI



- Higher CAC scores associated with higher event (CHD death or MI) rates and higher RR ratios
 - High risk rate: 4.6%
 - Very high risk rate: 7.1%
 - (rates at 3-5 years)

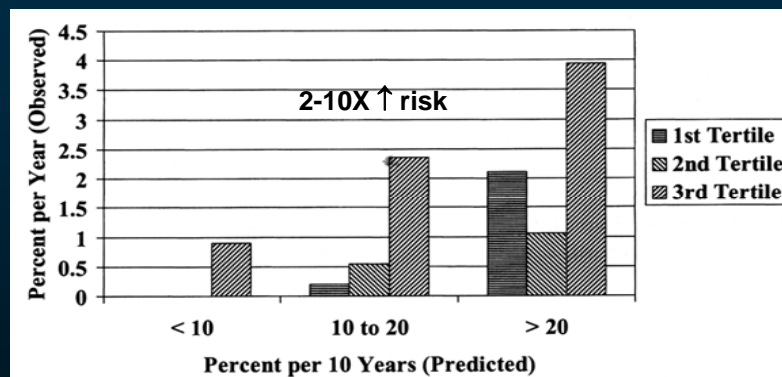
Following this meta-analysis, 4 more prospective studies

South Bay Heart Watch: Middle aged, higher risk



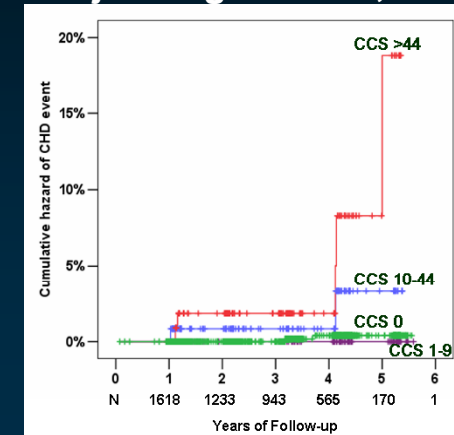
Greenland. JAMA 291:210-215.

St. Francis: Middle aged



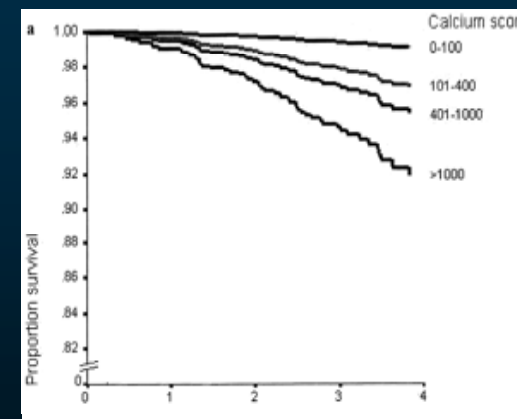
Guerci et al. JACC 46:158

PACC Project: Aged 40-50, low risk



Taylor et al, JACC 46:807-814

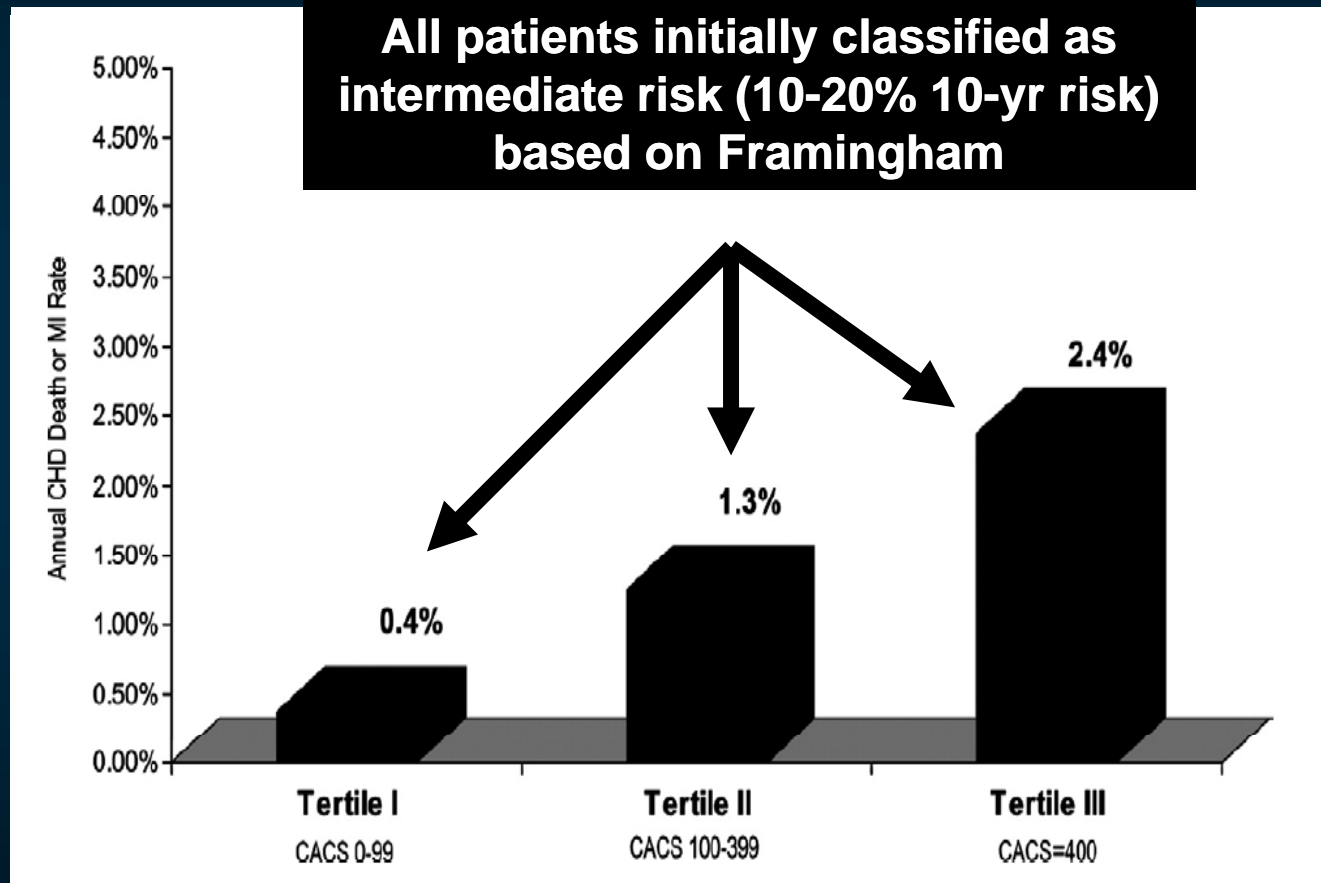
Rotterdam: Elderly



Vliegenthart. Circulation 112:572

Pooled data from 4 studies:

Intermediate Framingham risk patients only (10-20% 10-yr risk)



CAC is an INDEPENDENT predictor (above and beyond clinical risk assessment)

Risk Subset	Year	N	Historical or Measured Risk Factor Data	Univariable RR*	Multivariable RR*	Model Controlling for Additional Variables Besides That Contained in the FRS:
Kondos	2003	8855	Historical	5.8, $p = 0.001$ †	3.9, $p = 0.01$	
Greenland	2004	1461	Measured	3.9, $p < 0.001$	1.3, $p < 0.001$ ‡	
Arad	2005	1293	Measured	26.2, $p < 0.0001$	NR, $p = 0.01$	HsCRP
Taylor	2005	1639	Measured	NR, $p < 0.0001$	11.8, $p = 0.002$	Family history of CHD
Vliegenthart	2005	1795	Measured	8.2, $p < 0.01$	3.2-10.3, $p = 0.03$	Family history of MI and BMI
LaMonte	2005	10 746	Historical	1.6 (men) and 1.3 (women), $p < 0.0001$	NR§	

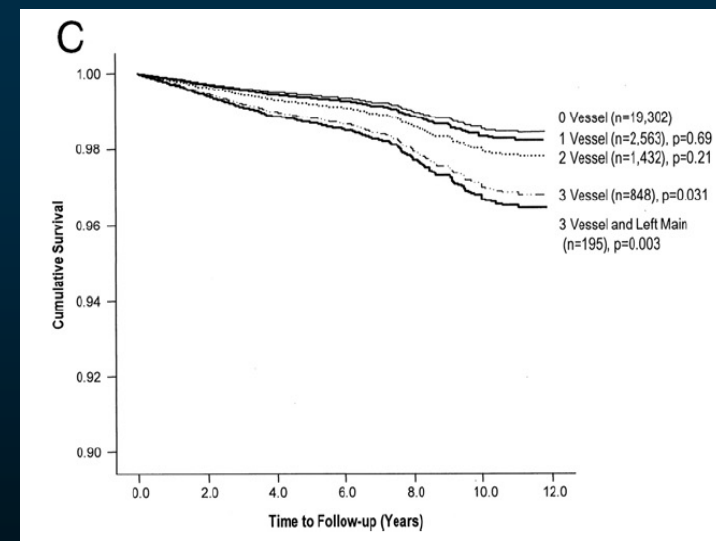
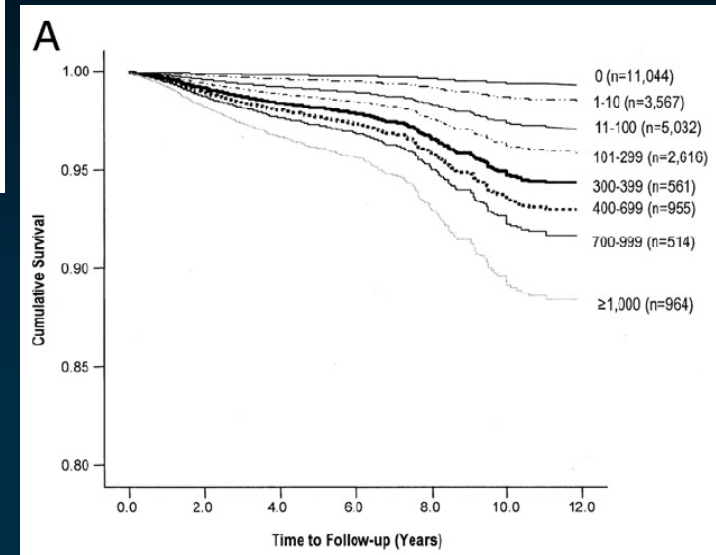
Long-Term Prognosis Associated With Coronary Calcification

Observations From a Registry of 25,253 Patients

Matthew J. Budoff, MD,* Leslee J. Shaw, PhD,† Sandy T. Liu,* Steven R. Weinstein,*
Tristen P. Mosler, Philip H. Tseng,* Ferdinand R. Flores,* Tracy Q. Callister, MD,‡
Paolo Raggi, MD,§ Daniel S. Berman, MD†

Torrance and Los Angeles, California; Nashville, Tennessee; and Atlanta, Georgia

- Prognosis is excellent in setting of zero or very low CAC scores
 - ...but not 0 when CACS=0
- Number of vessels involved is important
 - Even with CAC < 100



The mortality rate associated with a CACS=0 is 0.87/1000 person-yr 44,052 asympto adults referred by risk ff; screening EBCT

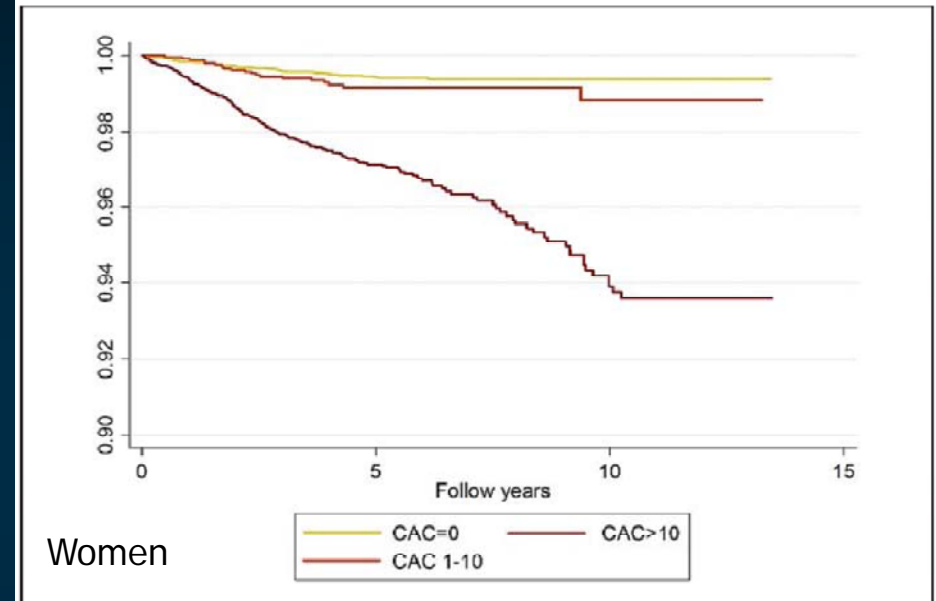
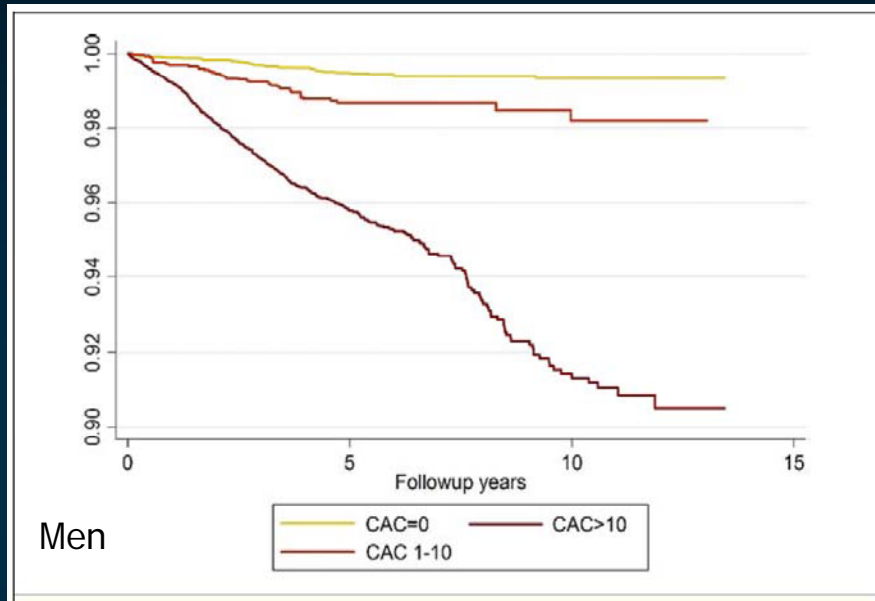


Table 2. All-Cause Mortality Rates by CAC Scores in Overall Population

	No. of Patients	No. of Events	Rate/1,000 Person-Yrs at Risk	95% CI for Rate
CAC = 0	19,898 (45%)	104 (0.52%)	0.87	0.72-1.05
CAC 1 to 10	5,388 (12%)	58 (1.06%)	1.92	1.48-2.48
CAC >10	18,766 (43%)	739 (3.96%)	7.48	6.95-8.04
Total	44,052 (100%)	901 (2.05%)	3.62	3.39-3.89

CAC = coronary artery calcium; CI = confidence interval.

Table 3. All-Cause Mortality (HR, 95% CI) for All-Cause Mortality With Low CAC (CAC 1 to 10) and CAC >10 Compared With CAC = 0

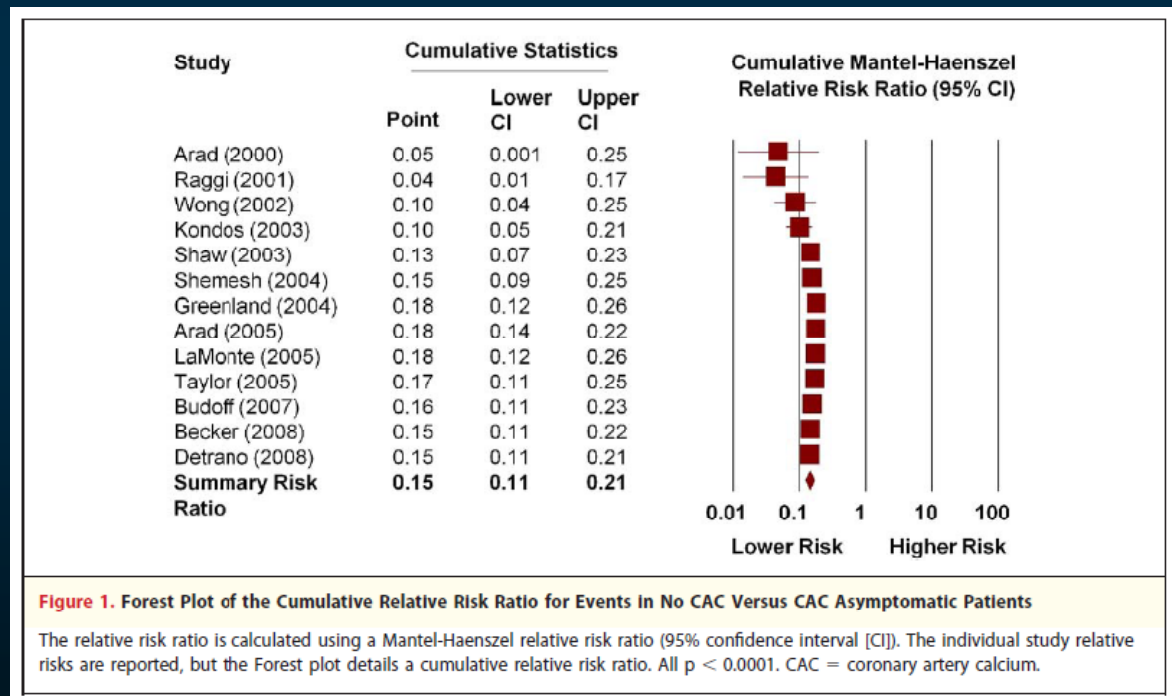
	CAC = 0	CAC 1 to 10	CAC >10
Model 1	1 (ref)	2.19 (1.57-2.99)	8.38 (6.82-102.9)
Model 2	1 (ref)	2.02 (1.47-2.79)	4.96 (4.02-6.11)
Model 3	1 (ref)	1.99 (1.45-2.75)	4.08 (3.30-5.04)

Model 1: unadjusted; Model 2: age-, sex-adjusted; Model 3: age-, sex-, hypertension-, smoking-, diabetes mellitus-, hyperlipidemia-, and family history of coronary heart disease-adjusted.
CAC – coronary artery calcium; CI – confidence interval; HR – hazard ratio.

Meta-analysis of 71,595 asymptomatic adults

Mean f/u 4 yr

- 29,312 (41%) had CACS=0 → 0.47% had event
- 42,283 had CAC → 4.14% had event
- RR ratio 0.15 [0.11-0.21, p<0.001]



Case Example

- 55 yr old man
- Total cholesterol: 170 mg/dL
- HDL cholesterol: 30 mg/dL
- Non-smoker
- Systolic BP: 133 mmHg (on medication)
- 10-yr Framingham risk: 10%

Case Example

- 55 yr old man
- 10-yr Framingham risk: 10%
- Agatston score:
 - <100: No significant impact on CHD risk
 - 100-400: 2-4x increase of CHD risk: **high risk**
 - >400: 5-10x increased of CHD risk: **high risk**

2010 ACCF/AHA Guideline for Assessment of Cardiovascular Risk in Asymptomatic Adults

Developed in Collaboration with the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance

Recommendations for Calcium Scoring



Measurement of CAC is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk).



Measurement of CAC may be reasonable for cardiovascular risk assessment in adults at low to intermediate risk (6% to 10% 10-year risk).



Persons at low risk (<6% 10-year risk) **should not undergo** CAC measurement for cardiovascular risk assessment.

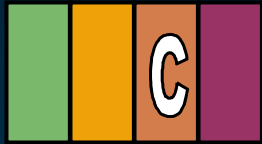
Risk Assessment Considerations for Patients with Diabetes Mellitus



In asymptomatic adults with diabetes, 40 years of age and older, measurement of CAC is reasonable for cardiovascular risk assessment.

Recommendations for Myocardial Perfusion Imaging

I IIa IIb III



Stress MPI may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or asymptomatic adults with a strong family history of CHD or when previous risk assessment testing suggests high risk of CHD, such as a coronary artery calcium (CAC) score of 400 or greater.

Summary

- CHD is widespread and there is a significant detection gap
- Clinical risk stratification tools alone may underestimate and misclassify risk
- Coronary calcium scanning predicts CHD events, independent of and in addition to clinical risk stratification
- Best suited for intermediate and low-to-intermediate risk population
- Absence of coronary calcium confers excellent prognosis

Thank you