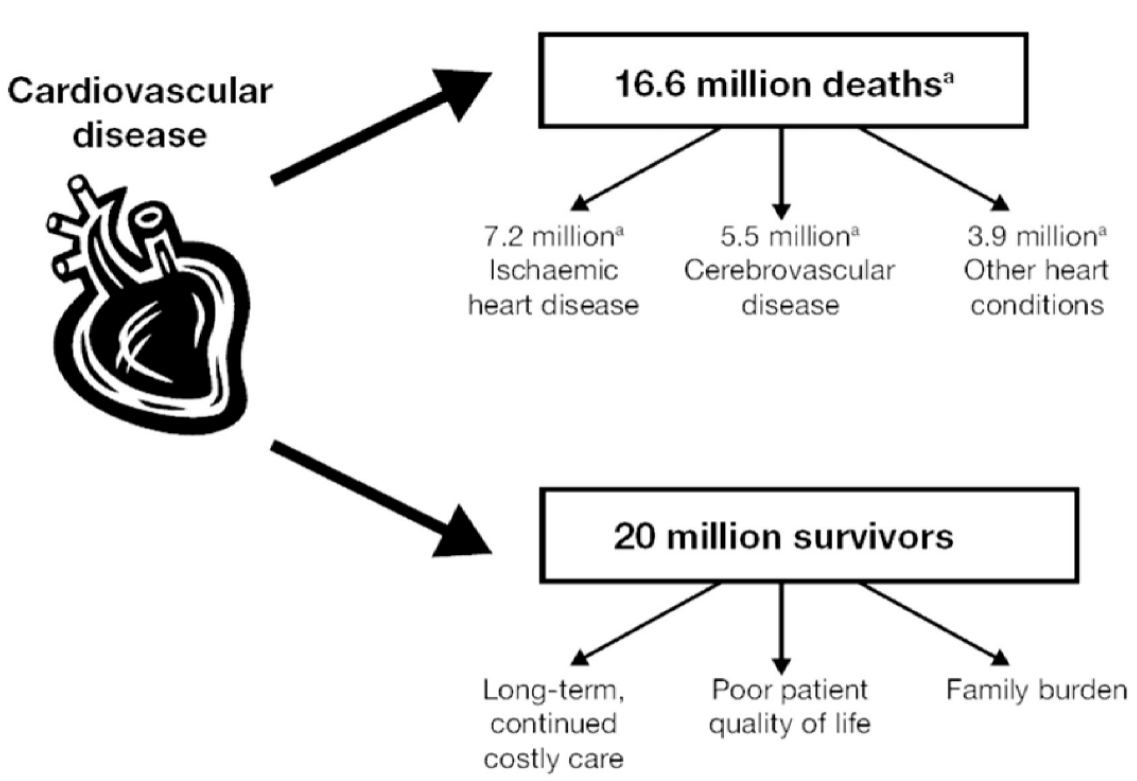
How to Incorporate Noninvasive Imaging Modalities Into Clinical Practice

Improving Risk Management in High Risk Population

Seoul National University Bundang Hospital

Goo-Yeong Cho

2005 WHO



Largely preventable
Large inequalities

Early detection and management of risk factor

Reduction in sickness and premature death

2010 사망원인, 통계청

2010 사망원인, 통계청

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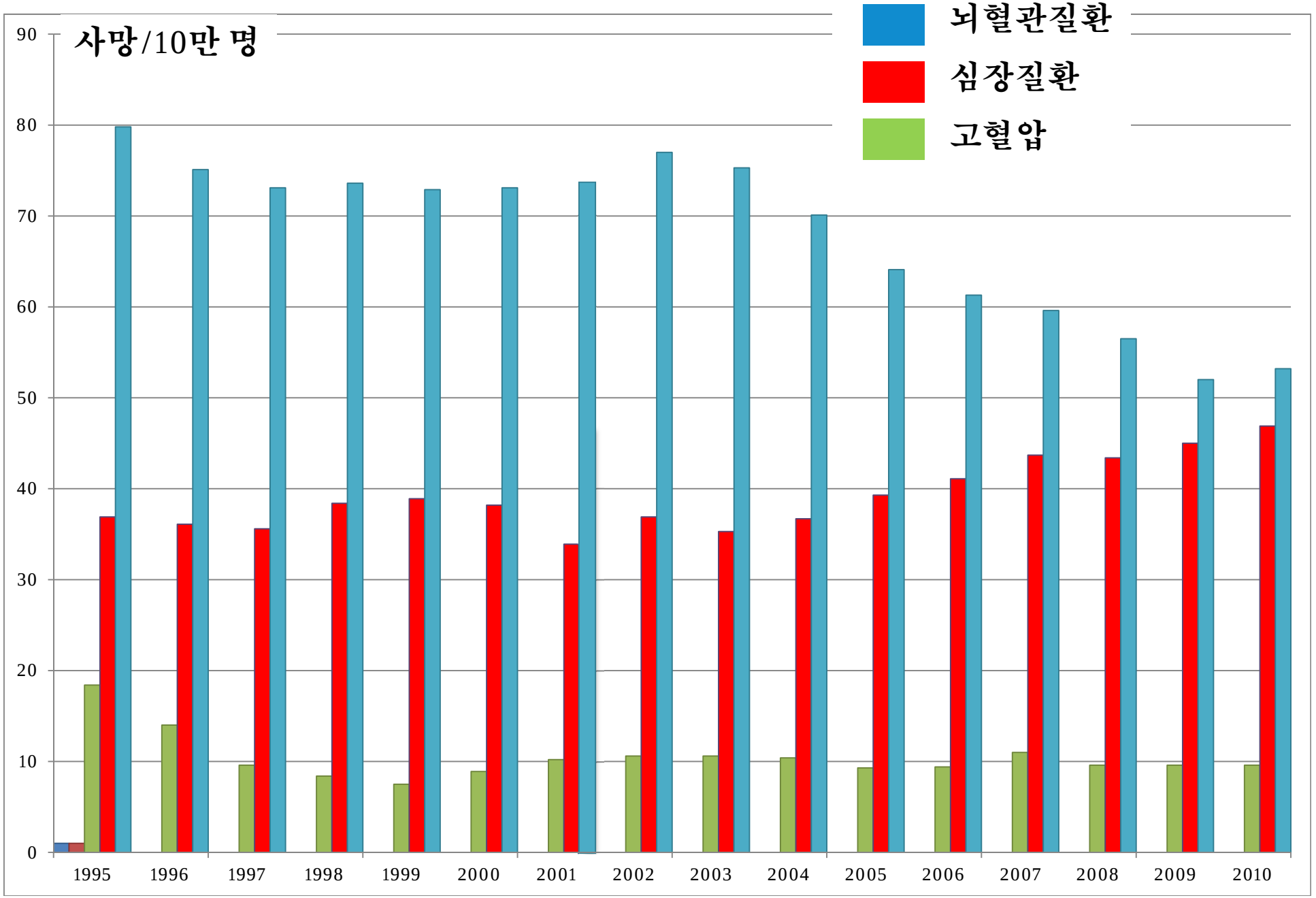


CHD risk assessment in Asx adults

Global risk assessment in all asymptomatic adults

Low risk (~35% of patients)	Intermediate risk (~40% of patients)	High risk (~25% of patients)
• Low risk FRS • No major CHD risk factors	• >one major RF • Global risk est.: 0.6-2.0/yr	• Established CHD • Type 2 DM • High FRS
• Reassurance and retest in 5 yr	• Benefit from non-invasive testing	• Intensive risk intervention • Non-invasive test is not required

Greenland P. circulation 2001;104:1863-67

Major risk factors and protective factors

Category	Factor
Modifiable risk factors	Hypertension Dyslipidemia Cigarette smoking Diabetes Abdominal obesity Excess alcohol Sedentary lifestyle
Non-modifiable risk factors	Increasing age Male gender Family history of premature CVD
Protective factors	Daily consumption of fruit and vegetables Regular moderate alcohol consumption Regular physical activity

Managing risk factors

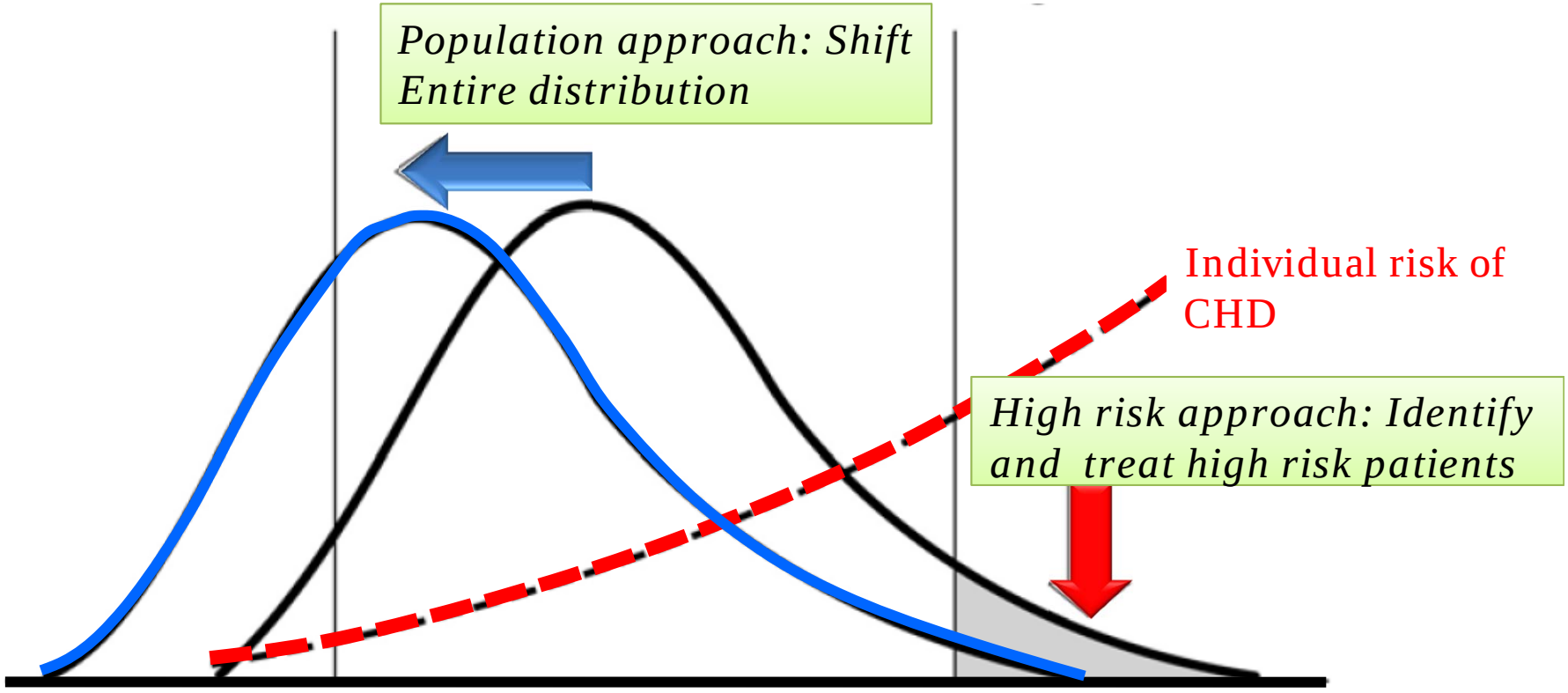
- High risk approach?
- Population based approach?

Pictorial representation of risk for CV disease

~5% Low risk factor level

~70% Average risk factor level

~25% High risk factor level



Distribution of cases according to risk-factor level

High risk vs. population based?

- Most CV events do not occur in the small number of high-risk individuals, but rather in much larger population in the low-to-moderate risk stratum
  - 75% of stroke: occur among normal BP

	Advantages	Disadvantages
Individualized high risk approach	Easy to motivate the patient Provides high risk: benefit ratio	Limited potential for impact Weak predictive power More CVD cases among the large numbers at low-medium risk
Population approach	Radical Large potential benefit for impact by reducing the number of those at risk	Small benefit to the individual Difficult to motivate the patient Risk: benefit ratio unknown

Global Risk Management

CARDIOVASCULAR RISK MANAGEMENT

Heart Foundation®

- 38% of all death: CV disease
- Death in Maori
  - 4 times higher than Pakeha
  - 33% lost between 45-64

Heart Foundation 2011-12

- Systemic assessment of the ‘at risk’ population, and effective management of high risk or living with heart disease

Know Your Numbers

EPA-cardio project

Improving Cardiovascular Prevention and Risk Management in European Primary Care

Project Report for the conference on 18 – 19 June 2009 in Berlin

Michel Wensing, Jan van Lieshout, Stephen Campbell, Sabine Ludt,
Eckhard Volbracht, Richard Grol

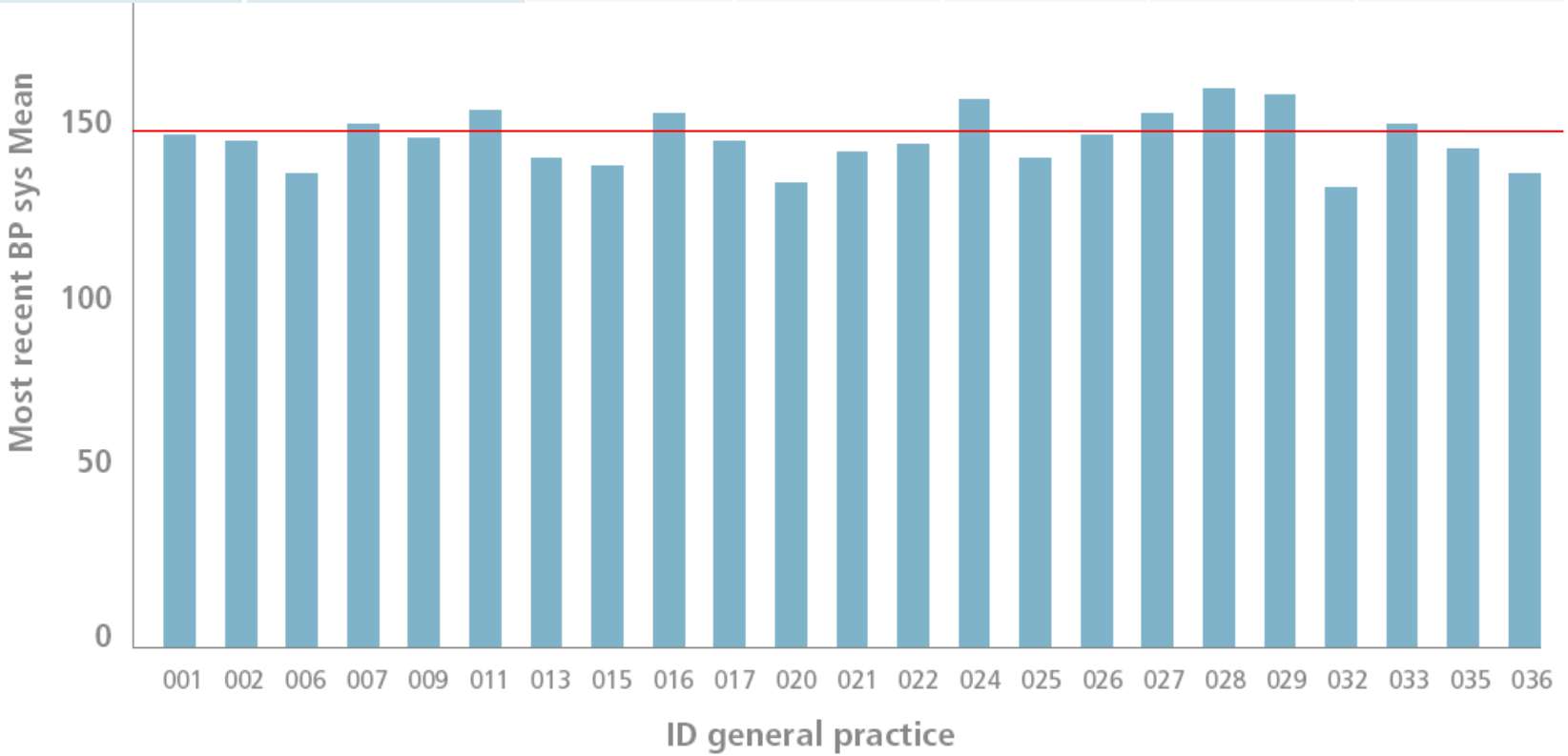
- Retrospective cross-sectional

Cardiovascular prevention in patients at high risk

- 5,106 medical records from 10 countries (without diagnosis of CVD)
  - Comprehensives recording of CV risk factors?
    : None of countries
  - Lifestyle intervention?
    : mixed figures

	Smoking status recorded	Smokers of those with a record of the smoking status
Austria	215 (72 %)	59 (27 %)
Belgium	181 (74 %)	72 (40 %)
England	517 (97 %)	264 (51 %)
Finland	93 (63 %)	39 (42 %)
France	193 (66 %)	47 (24 %)
Germany	336 (77 %)	37 (11 %)
Netherlands	149 (53 %)	38 (26 %)
Slovenia	695 (82 %)	181 (26 %)
Spain	602 (36 %)	602 (100 %)
Switzerland	221 (62 %)	61 (28 %)

Risk	SBP ≤ 140 mmHg		LDL ≤ 2.5 mmol/l	
	% per country	Lowest – highest value per practice (%)	% per country	Lowest – highest value per practice (%)
Austria	54	20–88	14	0–30
Belgium	69	0–100	21	0–67
England	52	13–93	28	0–67
Finland	44	0–100	23	0–67
France	71	13–100	86	0–100
Germany	43	7–86	9	0–58
Netherlands	45	20–71	14	0–33
Slovenia	56	33–91	15	0–41
Spain	36	n.a.	36	n.a.
Switzerland	57	26–90	13	0–39



CV risk management in patients with CHD

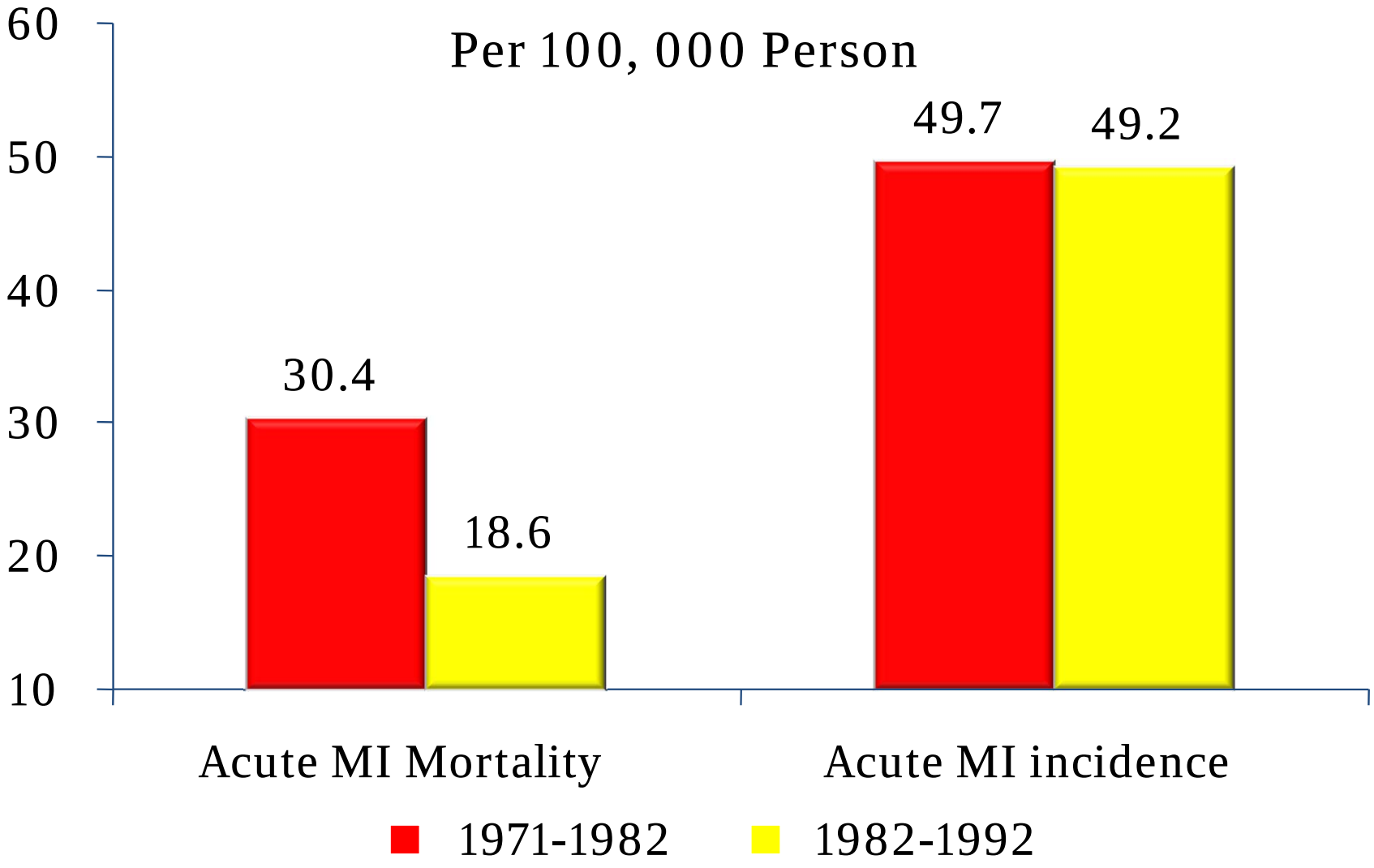
	SBP ≤ 140 mmHg		LDL ≤ 2.5 mmol/l	
	% per country	Lowest-highest per practice (%)	% per country	Lowest-highest per practice (%)
Austria	70	41–100	43	0–91
Belgium	71	0–100	42	0–85
England	78	57–100	54	13–87
Finland	49	0–80	62	0–100
France	75	50–100	83	0–100
Germany	72	25–100	25	0–53
Netherlands	55	25–92	63	13–100
Slovenia	69	25–100	31	0–67
Spain	64	n.a.	64	n.a.
Switzerland	70	41–100	35	0–79

For improving risk management in high risk patients,

Role of imaging????

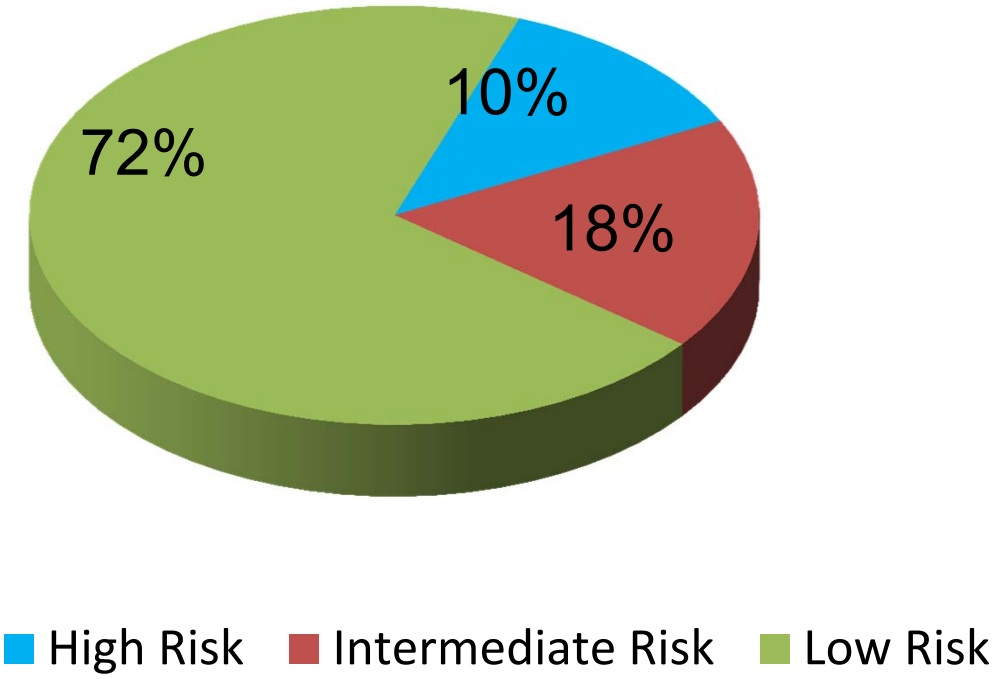
Do traditional risk factors based screening identify the vulnerable patient?

Trends in Age-standardized Mortality & Incidence of Acute MI (NHANES)



Preventing Myocardial Infarction in the Young Adult in the First Place: How Do the National Cholesterol Education Panel III Guidelines Perform?

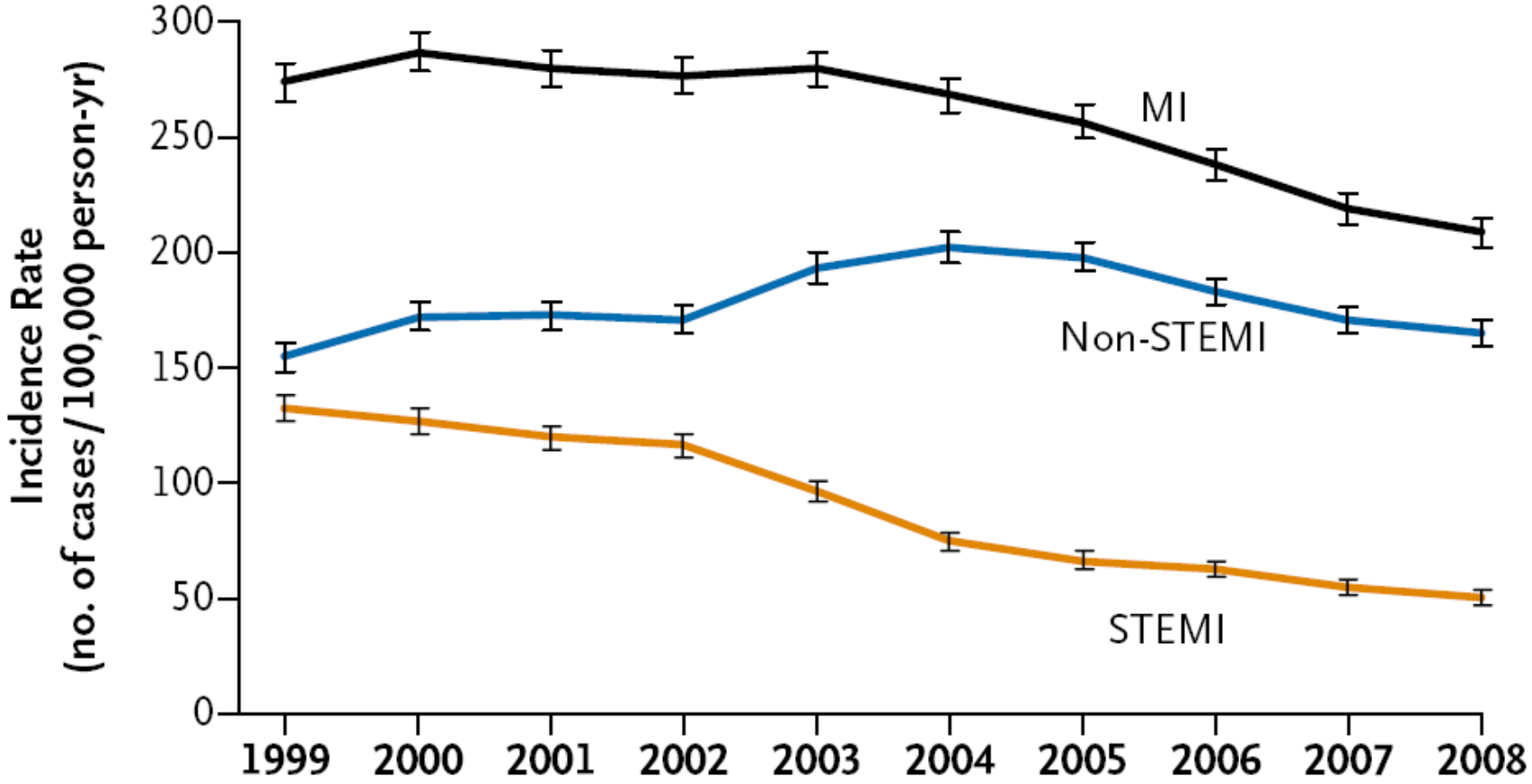
Kwame O. Akosah, MD, Ana Schaper, PHD, Christopher Cogbill, BA, Paul Schoenfeld, MD
La Crosse, Wisconsin



J Am Coll Cardiol 2003;41:1475–9

Trends in Age-standardized Mortality & Incidence of Acute MI (NHANES)

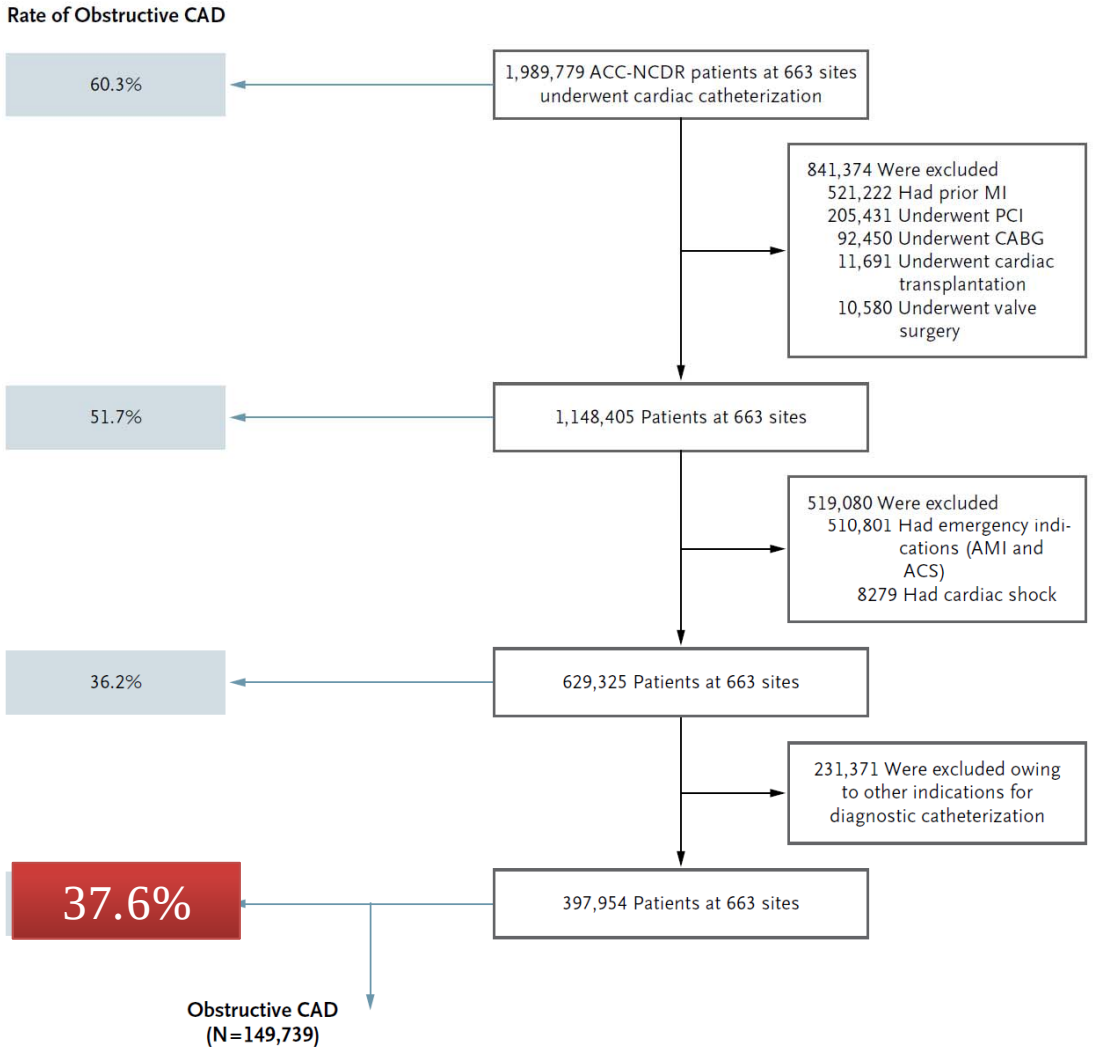
Per 100, 000 person-yr



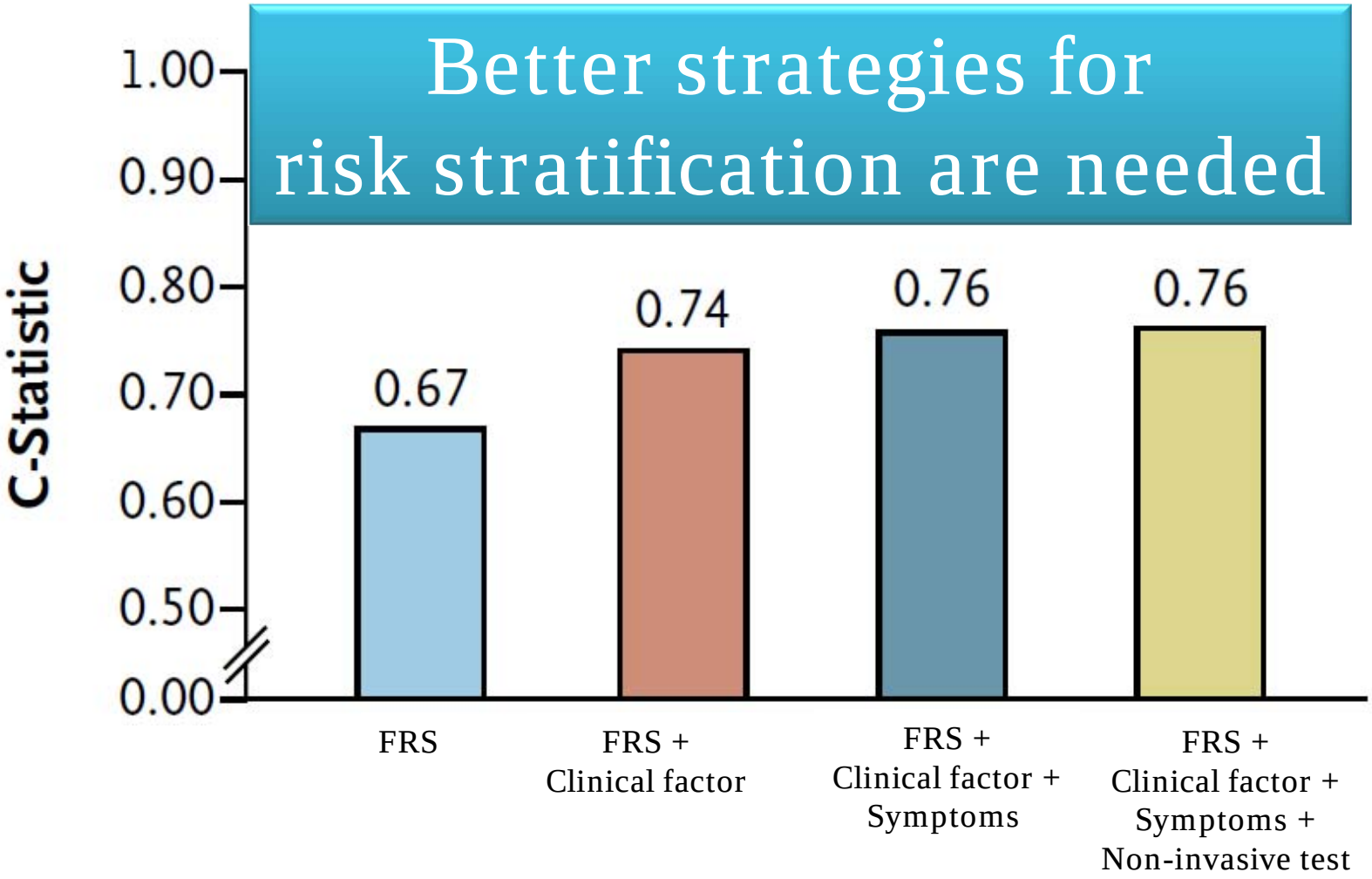
Low diagnostic yield of elective coronary angiography

- Non-invasive testing
  - ECG
  - Echocardiography
  - CT
  - Stress test

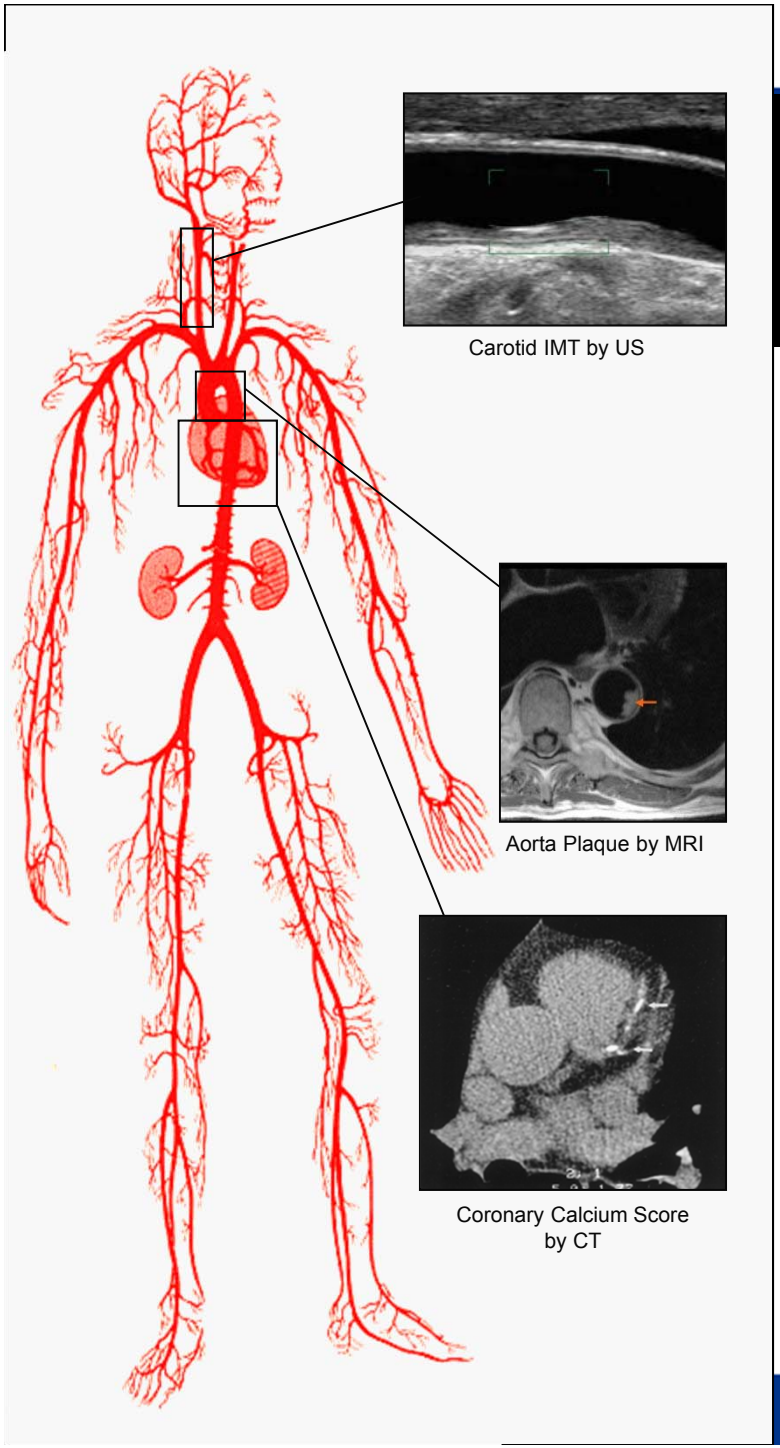
83.9%



Predict obstructive CAD



Image–Guided Prevention



- Evidence supporting the use of non-invasive imaging tests to screen for CAD is gradually accumulating.

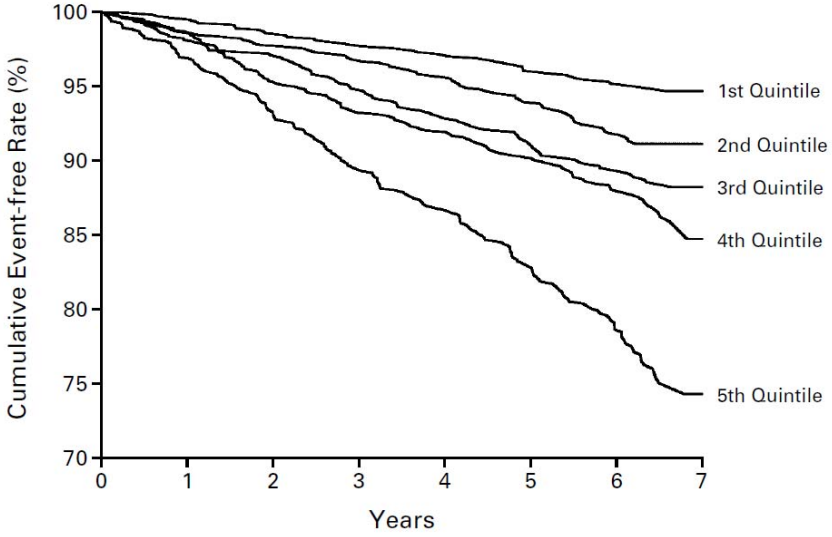
"Future image-guided interventions will enable …to detect critical illnesses at their most curable stage …before any symptoms or signs are noticeable.
The practice of medicine will shift … to one of prediction and prevention in asymptomatic, at-risk populations."

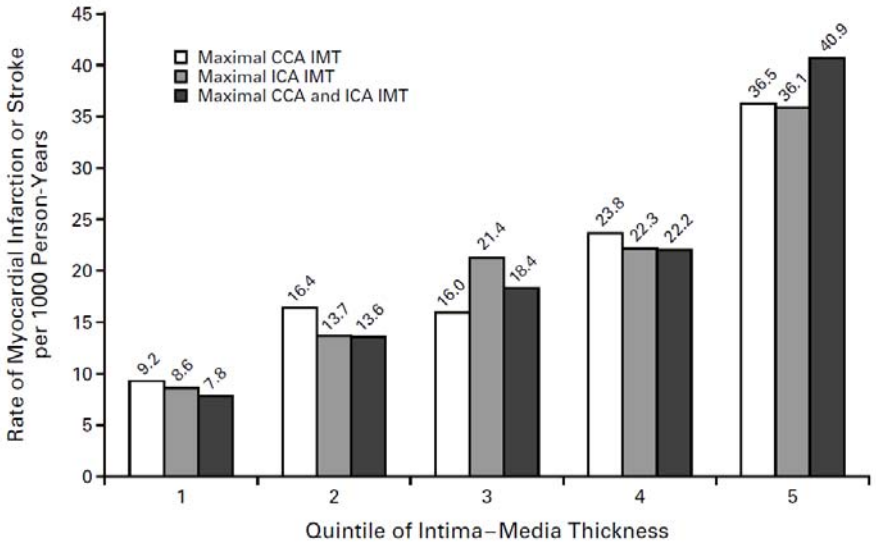
NIH Fact Sheet 'Image Guided Interventions'

The New England Journal of Medicine

CAROTID-ARTERY INTIMA AND MEDIA THICKNESS AS A RISK FACTOR FOR MYOCARDIAL INFARCTION AND STROKE IN OLDER ADULTS

DANIEL H. O'LEARY, M.D., JOSEPH F. POLAK, M.D., M.P.H., RICHARD A. KRONMAL, PH.D., TERI A. MANOLIO, M.D., M.H.S., GREGORY L. BURKE, M.D., M.S., AND SIDNEY K. WOLFSON, JR., M.D., FOR THE CARDIOVASCULAR HEALTH STUDY COLLABORATIVE RESEARCH GROUP





Coronary Calcium as a Predictor of Coronary Events in Four Racial or Ethnic Groups

Robert Detrano, M.D., Ph.D., Alan D. Guerci, M.D., ey Carr, M.D., M.S.C.E., Diane E. Bild, M.D., aron R. Folsom, M.D., Kiang M.D., Dr.P.H., David A. Bl Russell Tracy, Ph.D., Karol Watson ard A. Kronmal, Ph.D.

BACKGROUND

In white populations, computed tomographic measurements of coronary-artery calcium predict coronary heart disease independently of traditional coronary risk factors. However, it is not known whether coronary-artery calcium predicts coronary heart disease in other racial or ethnic groups.

METHODS

We collected data on risk factors and performed scanning for coronary calcium in a population-based sample of 6722 men and women, of whom 38.6% were white, 27.6% were black, 21.9% were Hispanic, and 11.9% were Chinese. The study subjects had no clinical cardiovascular disease at entry and were followed for a median of 3.8 years.

RESULTS

There were 162 coronary events, of which 89 were major events (myocardial infarction or death from coronary heart disease). In comparison with participants with no coronary calcium, the adjusted risk of a coronary event was increased by a factor of 7.73 among participants with coronary calcium scores between 101 and 300 and by a factor of 9.67 among participants with scores above 300 ($P<0.001$ for both comparisons). Among the four racial and ethnic groups, a doubling of the calcium score increased the risk of a major coronary event by 15 to 35% and the risk of any coronary event by 18 to 39%. The areas under the receiver-operating-characteristic curves for the prediction of both major coronary events and any coronary event were higher when the calcium score was added to the standard risk factors.

CONCLUSIONS

The coronary calcium score is a strong predictor of incident coronary heart disease and provides predictive information beyond that provided by standard risk factors in four major racial and ethnic groups in the United States. No major differences among racial and ethnic groups in the predictive value of calcium scores were detected.

N Engl J Med 2008;358:1336-45.

Coronary calcium score

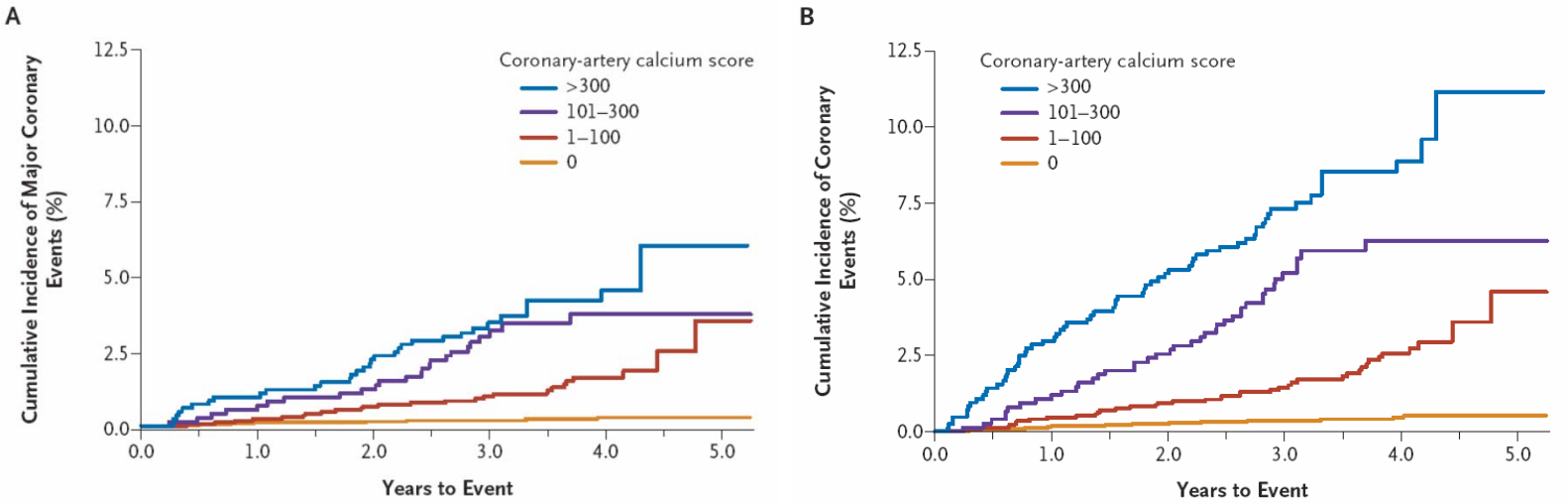


Table 4. Risk of Coronary Heart Disease Associated with Coronary-Artery Calcium Score in Four Racial or Ethnic Groups.*

Racial or Ethnic Group	Major Coronary Event†			Any Coronary Event		
	No.	Hazard Ratio (95% CI)‡	P Value	No.	Hazard Ratio (95% CI)‡	P Value
White	41	1.17 (1.06–1.30)	<0.005	74	1.22 (1.13–1.32)	<0.001
Chinese	6	1.25 (0.95–1.63)	0.11	14	1.36 (1.12–1.66)	<0.005
Black	18	1.35 (1.16–1.57)	<0.001	38	1.39 (1.25–1.56)	<0.001
Hispanic	24	1.15 (1.02–1.29)	<0.025	36	1.18 (1.07–1.30)	<0.001

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Screening for Early Detection and Prevention of Heart Attack

Society for Heart Attack Prevention and Eradication (SHAPE)

Presented at the 2008 Annual Scientific Sessions of the American Heart Association

SHAPE
Society for Heart Attack Prevention and Eradication

Support HEART ATTACK ERADICATION Campaign

Screening for Atherosclerosis

Risk Factors vs Disease

Numerous Risk Factors

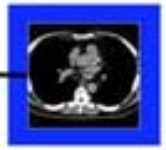
- High LDL
- Low HDL
- High BP
- Diabetes
- Smoking
- CRP
- Metabolic Syn
- Lp(a)
- Homocysteine
- Dense LDL
- Lp-PLA2
- ApoB/ApoA
- Family History
- Sedentary Life
- Obesity
- Stress
- ...
- ?

Over 200 risk factors have been reported.

Examples of Arterial Structure Tests

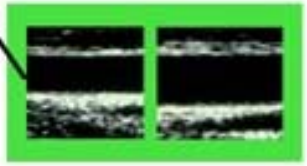
Carotid IMT and Plaque Measured by Ultrasound

Aortic and Carotid Plaque Detected by MRI



Coronary Calcium Score Measured by CT

Ankle Brachial Index



Brachial Vasoreactivity Measured by Ultrasound

Vascular Compliance Measured by Radial Tonometry

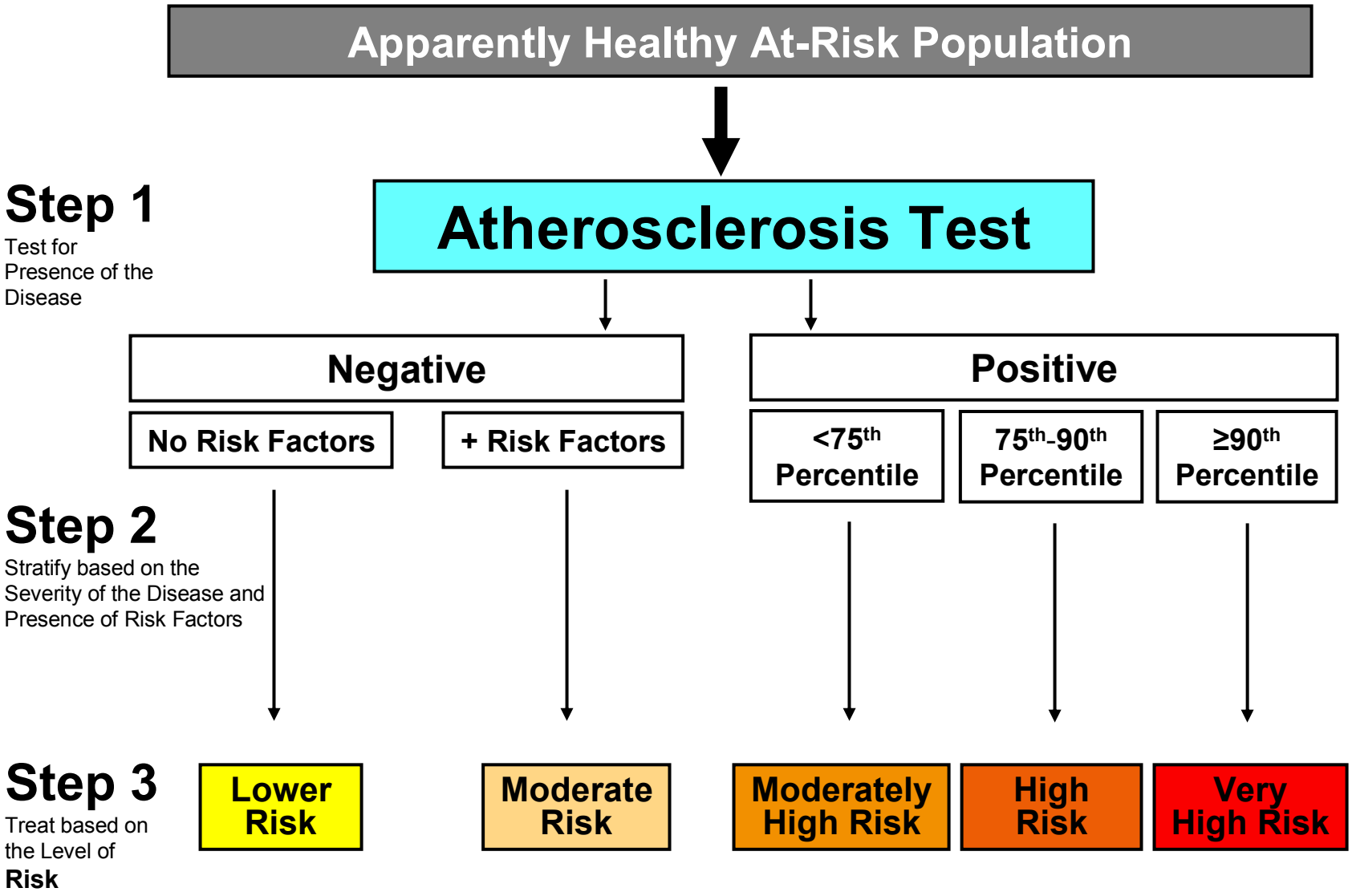
Examples of Arterial Function Tests

Microvascular Reactivity Measured by Fingertip Tonometry

The 1st S.H.A.P.E. Guideline

Towards the National **S**creening for **H**eart **A**ttack **P**revention and **E**ducation (**SHAPE**) Program

Conceptual Flow Chart



The 1st S.H.A.P.E. Guideline

Towards the National Screening for Heart Attack Prevention and Education (SHAPE) Program

Apparently Healthy Population Men>45y Women>55y[1]

Step 1

Very Low Risk[3] ← Exit

Exit → All >75y receive unconditional treatment[2]

Atherosclerosis Test

- Coronary Artery Calcium Score (CACS)
  or
- Carotid IMT (CIMT) & Carotid Plaque[4]

Step 2

Negative Test

- CACS =0
- CIMT <50th percentile

No Risk Factors[5] | + Risk Factors

Positive Test

- CACS ≥1
- CIMT ≥50th percentile or Carotid Plaque

Step 3

Lower Risk	Moderate Risk	Moderately High Risk	High Risk	Very High Risk
		• CACS <100 & <75th% • CIMT <1mm & <75th% & no Carotid Plaque	• CACS 100-399 or >75th% • CIMT ≥1mm or >75th% or <50% Stenotic Plaque	• CACS >100 & >90th% or CACS ≥400 • ≥50% Stenotic Plaque[6]

ABI<0.9
CRP>4mg
→ Optional

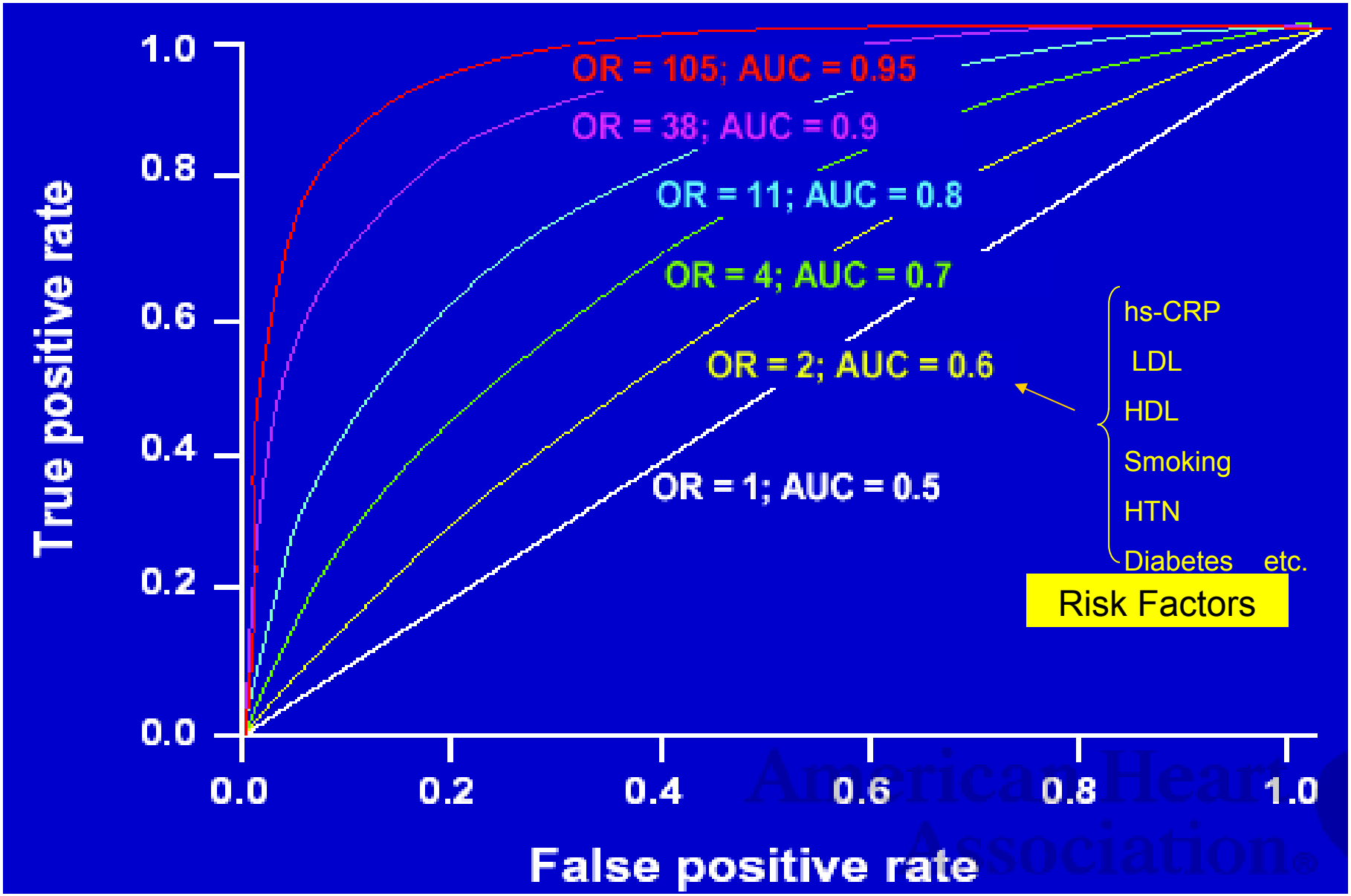
LDL Target	**<160 mg/dl**	**<130 mg/dl**	**<130 mg/dl** **<100 Optional**	**<100 mg/dl** **<70 Optional**	**<70 mg/dl**
Re-test Interval	5-10 years	5-10 years	Individualized	Individualized	Individualized

Myocardial Ischemia Test

Yes → Angiography → Follow Existing Guidelines

No → (back to Atherosclerosis Test)

1: No history of angina, heart attack, stroke, or peripheral arterial disease.
2: Population over age 75y is considered high risk and must receive therapy without testing for atherosclerosis.
3: Must not have any of the following: Chol>200 mg/dl, blood pressure >120/80 mmHg, diabetes, smoking, family history, metabolic syndrome.
4: Pending the development of standard practice guidelines.
5: High cholesterol, high blood pressure, diabetes, smoking, family history, metabolic syndrome.
6: For stroke prevention, follow existing guidelines.



Based on the paper by Pepe e. al. Am J Epidemiol 2004; 159:882-890.

ORIGINAL ARTICLE

Carotid-Wall Intima–Media Thickness and Cardiovascular Events

Joseph F. Polak, M.D., M.P.H., Michael J. Pencina, Ph.D.,
Karol M. Pencina, Ph.D., Christopher J. O'Donnell, M.D., M.P.H.,
Philip A. Wolf, M.D., and Ralph B. D'Agostino, Sr., Ph.D.

The maximum internal and mean common carotid-artery IMT both predict cardiovascular outcomes

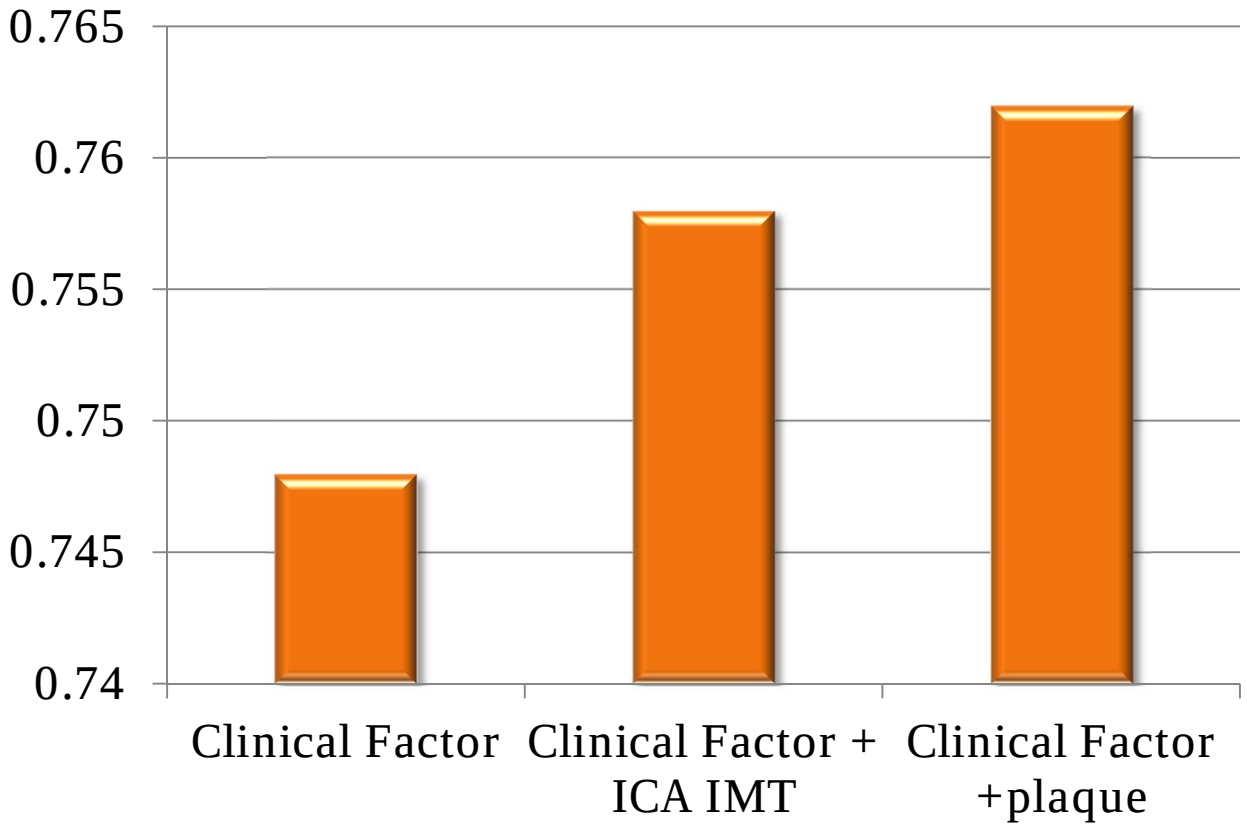
N Engl J Med 2011;365:213-

Table 4. Reclassification of Framingham Risk Score Categories after Addition of Intima–Media Thickness of Internal Carotid Artery.*

Original Risk Category	Reclassification		
	Low Risk	Intermediate Risk	High Risk
	number of participants		
Participants without cardiovascular events			
Low risk	1125	31	0
Intermediate risk	85	1126	45
High risk	0	40	234
Participants with cardiovascular events			
Low risk	27	8	0
Intermediate risk	1	112	13
High risk	0	5	94

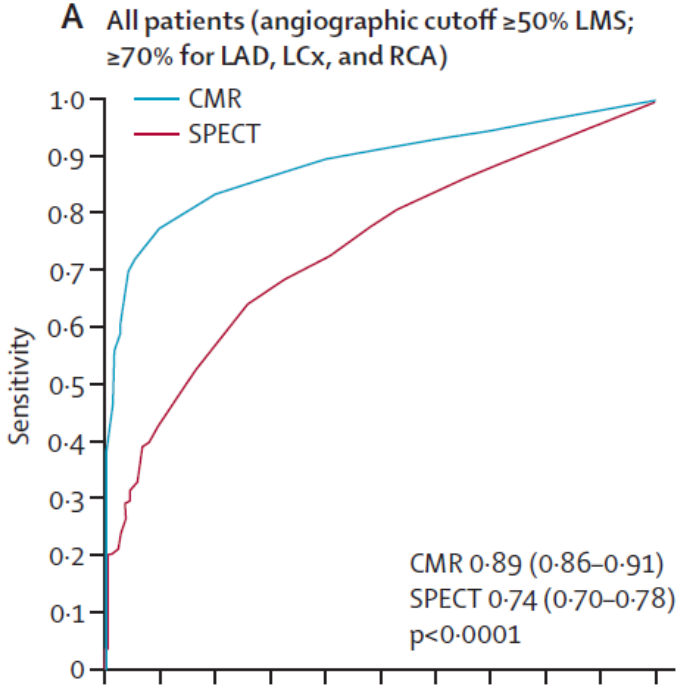
* According to the FRS, the net reclassification index was 1.8% (49 of 2686 participants) for participants without events, 5.8% (15 of 260 participants) for those with events, and 7.6% overall.

C-statistics



CMR and SPECT for CAD (CE-MARC): a prospective trial

- CE-MARC is the largest, prospective, real world evaluation of CMR and has established CMR's high diagnostic accuracy in CHD and CMR's superiority over SPECT.
- It should be adopted more widely than at present for the investigation of CHD



Lancet 2012; 379: 453–60

ATP IV
JNC 8

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Information for Health Professionals

- Clinical Practice Guidelines
- Heart & Vascular Information
- Lung Information
- Blood Information
- Sleep Information
- Interactive Tools and Resources
- Education Campaigns
- National Education Programs
- Continuing Education Opportunities
- HP 2010 Gateway
- Health Observances
- Health Information Network

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Cardiovascular Risk Reduction Guidelines in Adults:
Cholesterol Guideline Update (ATP IV)
Hypertension Guideline Update (JNC 8)
Obesity Guideline Update (Obesity 2)
Integrated Cardiovascular Risk Reduction Guideline

Content

Overview

The National Heart, Lung, and Blood Institute is leading the development of an integrated set of cardiovascular risk reduction guidelines for adults using state-of-the-art methodology. Cholesterol, hypertension, and obesity guidelines are being updated, and an integrated cardiovascular risk reduction guideline is being developed.

Back to Content

Timeline

- ***Cholesterol Guideline Update (ATP IV)***
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012
- ***Hypertension Guideline Update (JNC 8)***
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012
- ***Obesity Guideline Update (Obesity 2)***
  - Expected availability for public review and comment: 2012
  - Expected release date: 2012
- ***Integrated Cardiovascular Risk Reduction Guideline***
  - Timeline TBD

Treatment Categories, LDL-C Goals and Cut-points: ATP-III

Risk Category	LDL-C Goal	Consider Drug Therapy
CHD or CHD risk equivalent	<100 mg/dL	≥130 mg/dL*
≥2 Risk Factors		
10-yr risk 10–20%	<130 mg/dL	≥130 mg/dL
10-yr risk <10%	<130 mg/dL	≥160 mg/dL
<2 Risk Factors	<160 mg/dL	≥190 mg/dL

* 100–129 mg/dL = after TLC, consider statin, niacin, or fibrate therapy

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. *JAMA* 2001;285:2486-2497.

Goals for Therapy: 2004 Addendum

- NCEP ATP III guidelines for LDL Therapy

LDL-C <160 for 1 or less risk factors

LDL-C <130 for 2+ risk factors

< 100 is a therapeutic option

LDL-C <100 for CAD and CAD equivalents

<70 is option for very high risk patients

1. CAD + multiple risk factors, especially diabetes
2. CAD + severe or poorly controlled risk factor(s)
3. CAD + metabolic syndrome
4. Acute coronary syndrome
5. CAD event despite baseline LDL-C < 100

Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel IV)

Expert Panel Membership

Expected Release Date: Fall 2011

Predictions for ATP-IV

1. The goals for LDL-C in primary prevention will be lowered.
2. There will be a stronger statement on hsCRP, but routine use in risk stratification or use as secondary target will not be specifically endorsed.
3. Non-HDL-C will remain the secondary lipid target, but optional use of apo B or LDL-P will be endorsed.
4. A new risk calculator providing lifetime risk estimates will be provided.

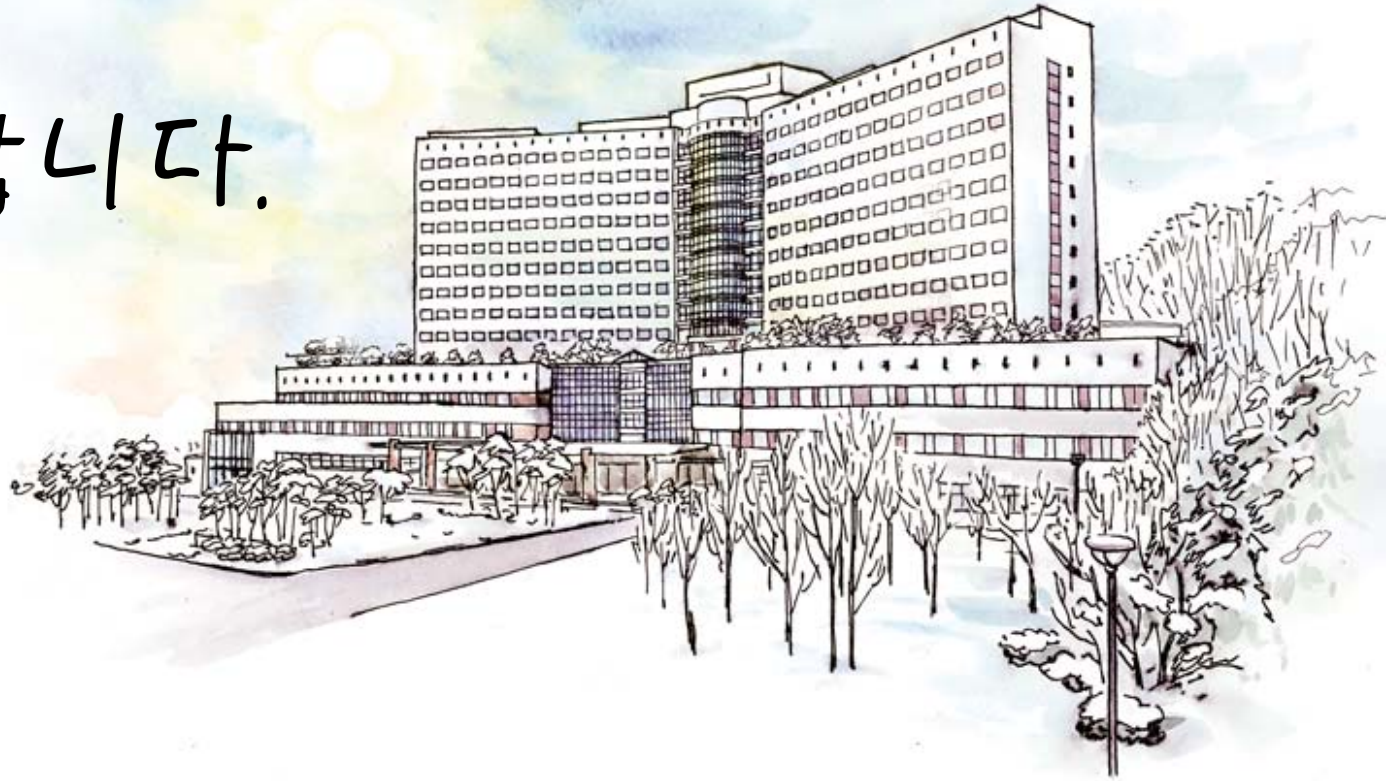
JNC 8

- Prediction of JNC 8

  ??????

- JNC late or JNC wait

감사합니다.



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