

CT Calcium Scoring & CVS Risk Assessment in 2011

(In 12 Minutes: 10 Points)

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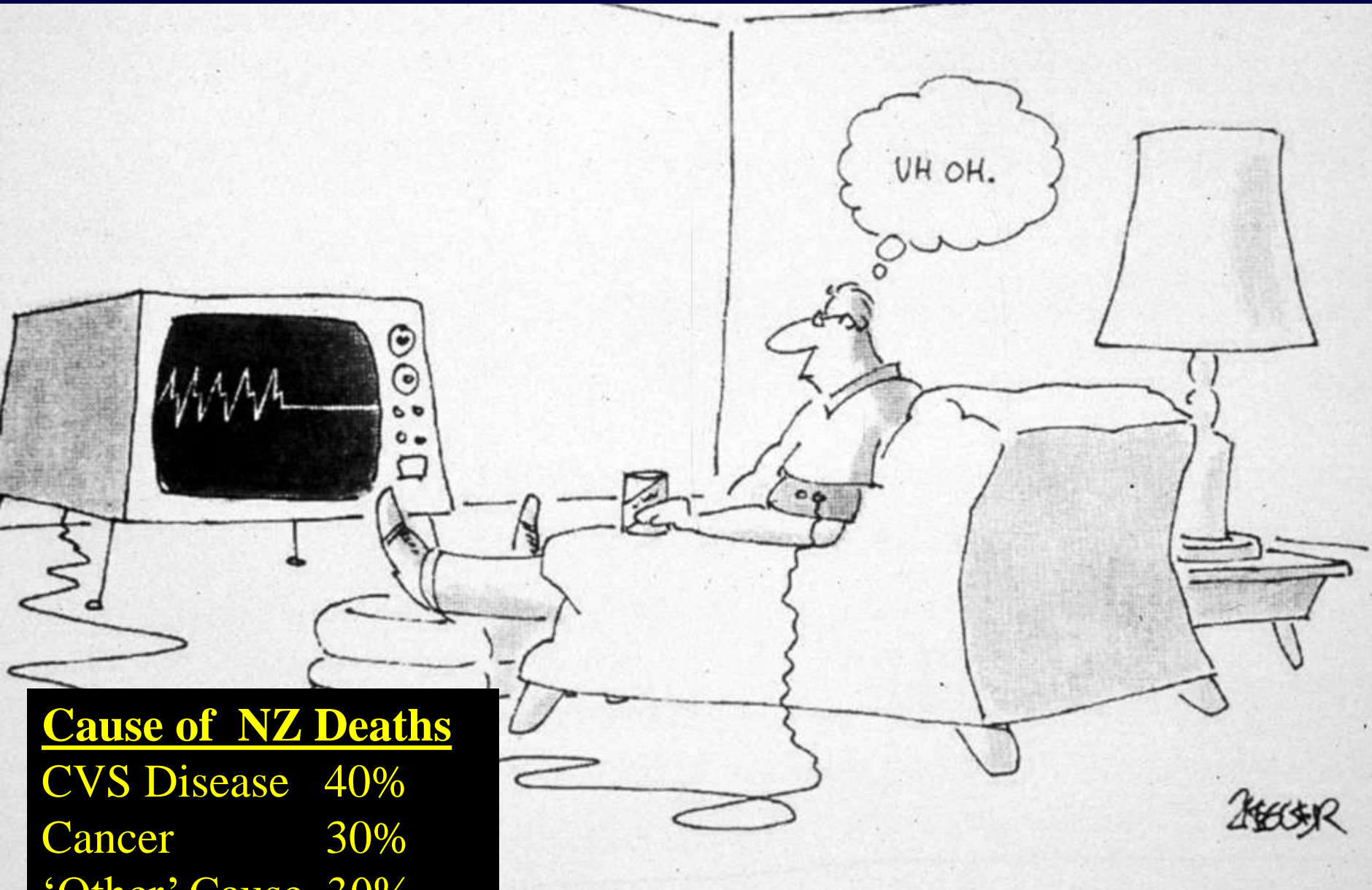
Mercy Hospital



AHG Winter Symposium, Auckland; 6 August 2011



CVS Disease: Is it a Major Problem in New Zealand?



Cause of NZ Deaths

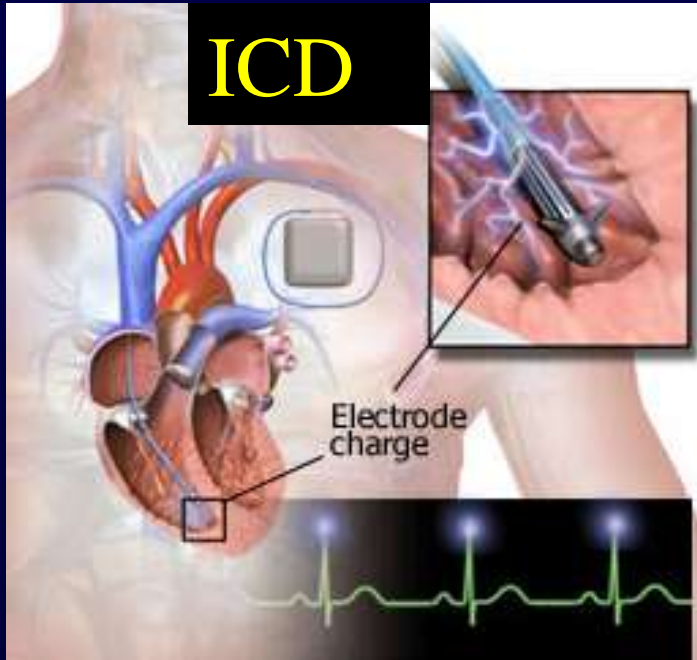
CVS Disease 40%

Cancer 30%

'Other' Cause 30%

Expensive Treatments

ICD



STENTS

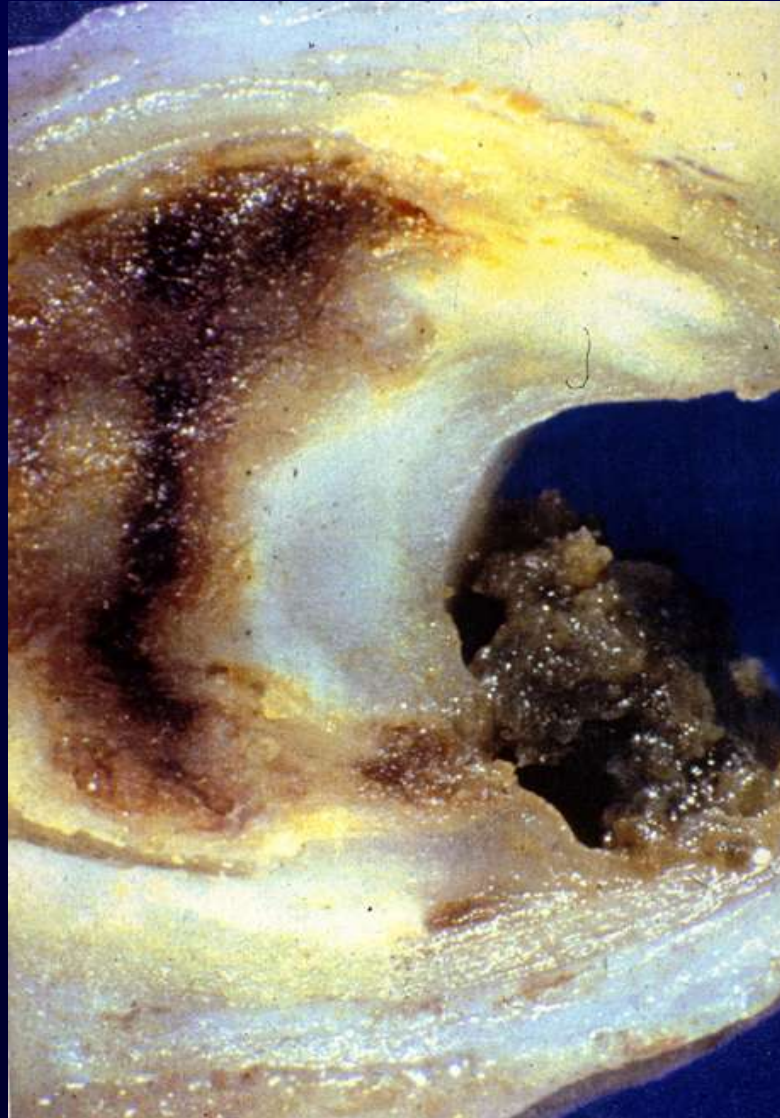


CABG



Point 1: CVS Disease is an Expensive & Major Problem in New Zealand: Prevention is Better than Cure

Do We Really Understand Atherosclerosis?

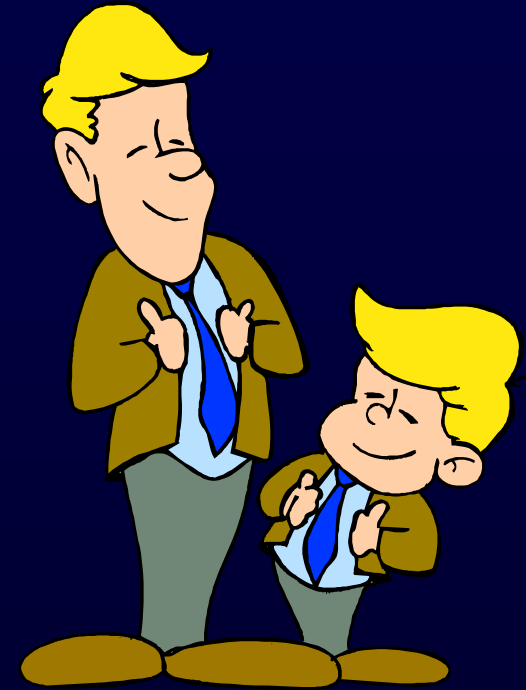


Atherosclerosis: Highly Complex

Lifestyle



Genetic



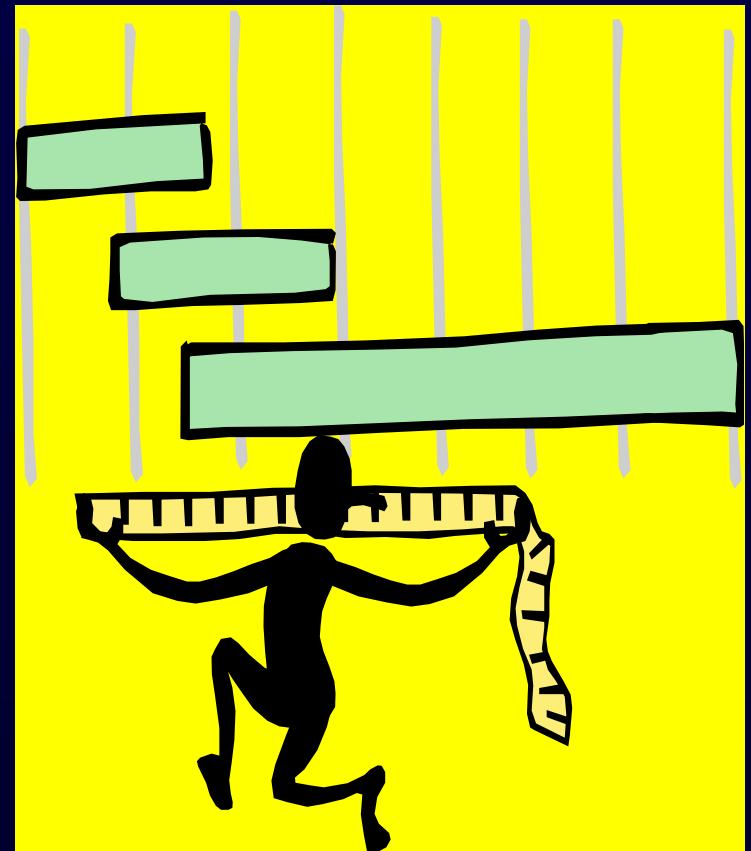
Point 2: Atherosclerosis is Poorly understood:
but is driven by *lifestyle* or *genetic* factors

Atherosclerosis: A Complex Ageing/Disease Process How Do We Assess CVS Risk in New Zealand?



Framingham-Based CVS Risk Tables: Risk Factors Used in NZ

- Age (decades)
- Gender
- Diabetes Status (Y/N)
- Hypertension
- Smoker (Y/N)
- Total Cholesterol/HDL Ratio



Additional 5% CVS Risk Factors (2003/2009 NZ Guidelines)

Family history of premature CHD or ischaemic stroke:

- In a first-degree male relative before the age of 55 years or
- In a first-degree female relative before the age of 65 years

Maori

Pacific peoples or people from the Indian subcontinent

People with both diabetes and microalbuminuria

People who have had type 2 diabetes mellitus:

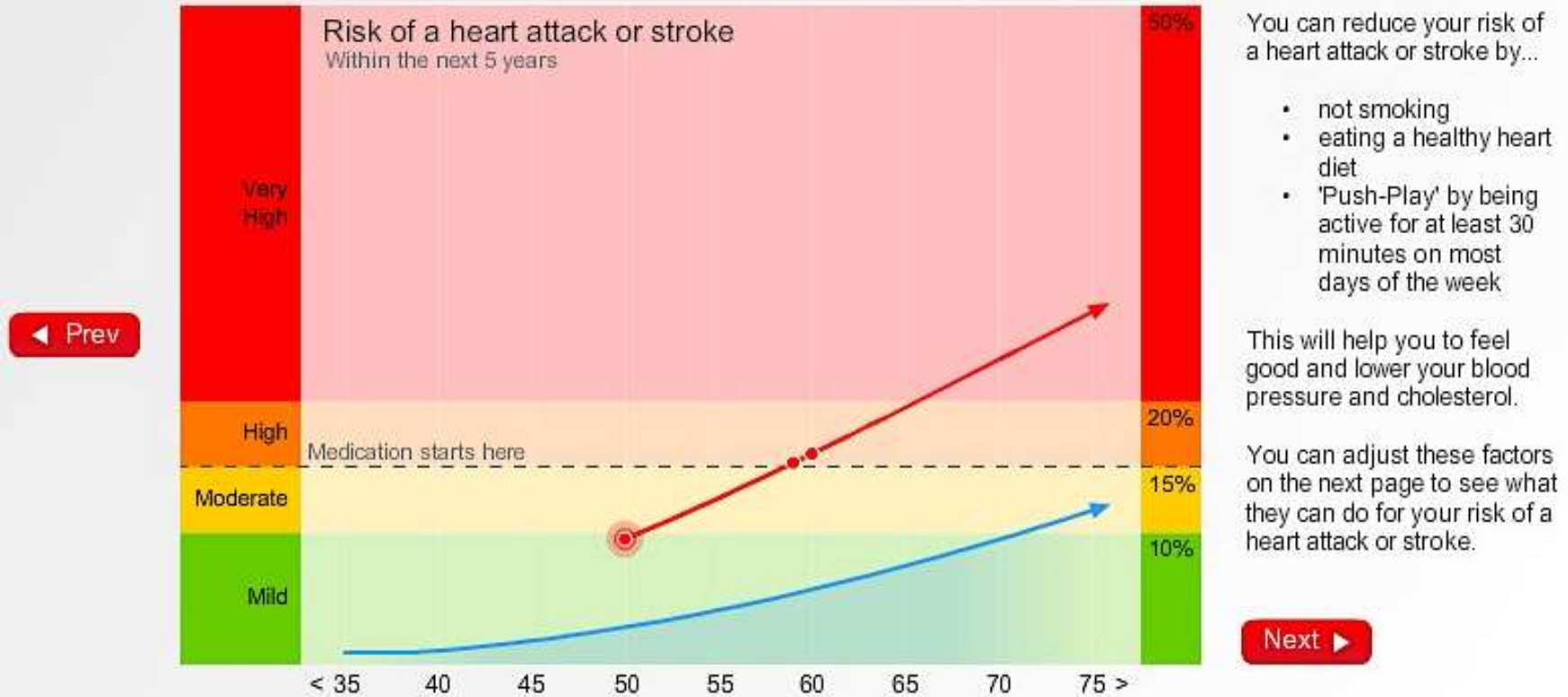
- For more than 10 years or
- Who have an HbA1c consistently greater than 8%

(People with the metabolic syndrome) GONE 2009

IF Total Cholesterol ≥ 8 then risk $\geq 15\%$

if Total Cholesterol/ HDL ≥ 8 then risk $\geq 15\%$

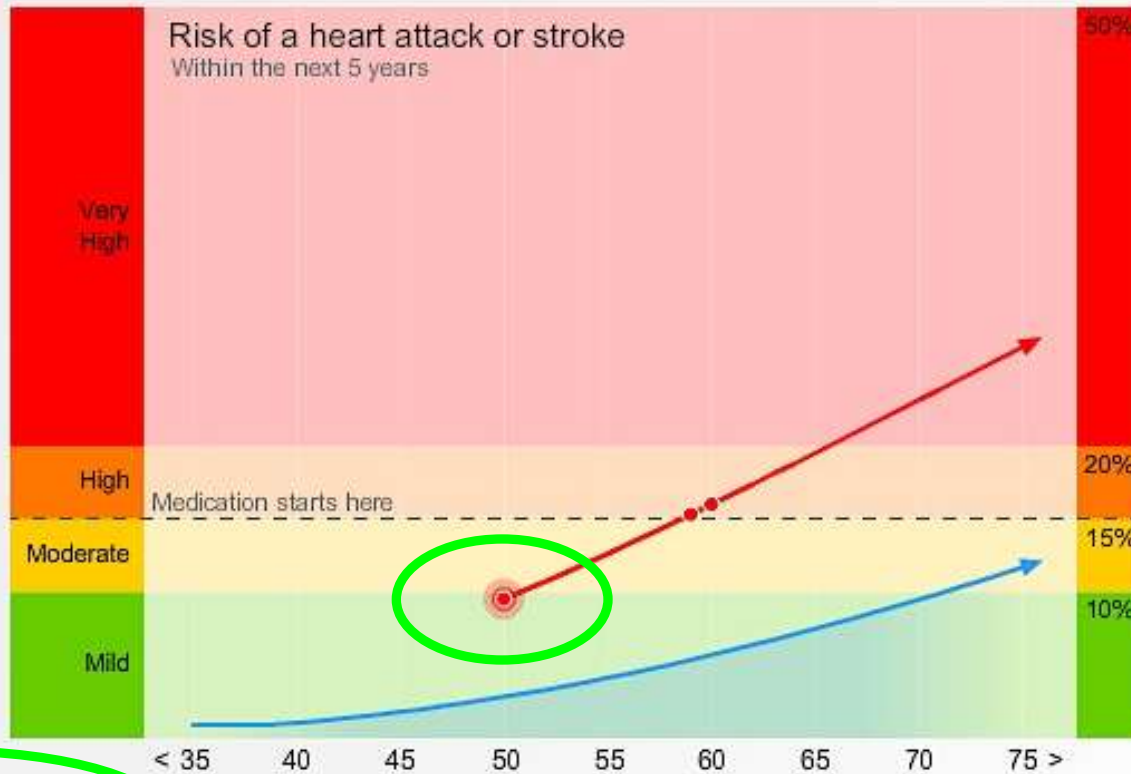
if BP consistently $\geq 170/100$ then risk $\geq 15\%$



Point 3: In NZ We Assess this Complex Ageing/Disease Process with only 6 Major and a few additional Minor Risk Factors from a 50 year-old Study of 5,600 people in the USA.....

Can the USA Framingham Tables Really Predict CVS Risk: in Young ACS Patients in New Zealand?





You can reduce your risk of a heart attack or stroke by...

- not smoking
- eating a healthy heart diet
- 'Push-Play' by being active for at least 30 minutes on most days of the week

This will help you to feel good and lower your blood pressure and cholesterol.

You can adjust these factors on the next page to see what they can do for your risk of a heart attack or stroke.

Next ▶

● Your current risk right now

-- Point where heart pills are recommended (15% risk)

— Your ideal risk zone
(Based on Non-Smoker, TC/HDL ratio:4, BP: 120/80)

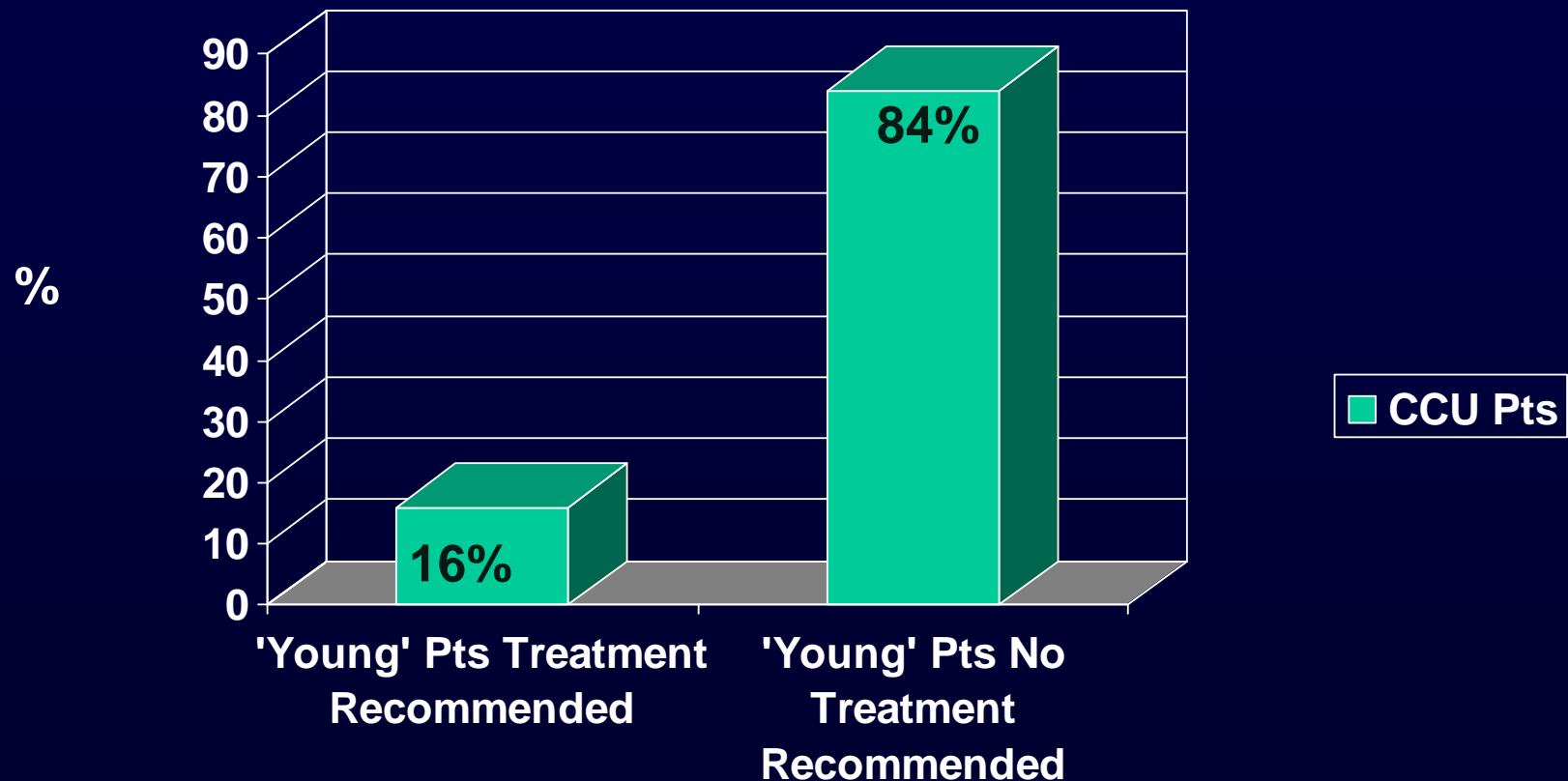


“Your current risk right now”.....[Really?!]

Auckland City Hosp CCU Pts 1 June 06 to 30 June 07

J Looi, CJ Ellis et al CSANZ 2008

Pts with NZ Framingham CVS Risk > 15% over 5 Years



229 pts: 'Young' (male<55, female<65 years), no prior CVS disease

Point 4: The NZ Framingham Guideline
Tables Cannot Predict CVS Risk in
Young ACS Patients in New Zealand



We will soon have the 'PREDICT'
New Zealand Data, so we won't need
to use Framingham Tables

[Unfortunately Wrong]

PREDICT ICD 10 AM Codes: Endpoints (1)

Outcomes	ICD-10-AM codes	Number of first events (N) ^a
<p>Coronary heart disease</p> <p>Cardiac arrest or sudden cardiac death</p>	<p>I20–I25 (except I252) Acute coronary syndromes, chronic ischemic heart diseases E1053, E1153, E1453 Coronary heart disease I461 Sudden cardiac death, so described R96 Other sudden death, cause unknown R98 Unattended death 3530400–3530501 Coronary angioplasty or stent 3531000–531005 Percutaneous coronary intervention</p>	<p>770</p>
<p>Coronary procedures</p>	<p>3849700–3850304, 9020100–9020103 Coronary artery bypass 3863700 Re-operation for reconstruction of occluded coronary artery 3845619 Other intrathoracic procedures on arteries of heart without cardiopulmonary bypass 3865308 Other intrathoracic procedures on arteries of heart with cardiopulmonary bypass 3850500 Open coronary endarterectomy I63 Cerebral infarction I64 Stroke, not specified as haemorrhage or infarction I66 Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction I678 Other specified cerebrovascular diseases I693 Sequelae of cerebral infarction I694 Sequelae of stroke, not specified as haemorrhage or infarction I698 Sequelae of other and unspecified cerebrovascular diseases</p>	<p>301</p>

PREDICT ICD 10 AM Codes: Endpoints (2)

Ischaemic cerebrovascular disease	G45 (except G453), G46 Transient ischaemic attack I670 Dissection of cerebral arteries, nonruptured I671 Cerebral aneurysm, nonruptured	1098
Peripheral arterial disease	I65 Occlusion and stenosis of precerebral arteries I71 Aortic aneurysm and dissection (other arterial dissection) I72 Other aneurysm I74 Arterial embolism and thrombosis	120
Peripheral procedures	I739 Peripheral vascular disease, unspecified I7021, I7022, I7023, I7024 Intermittent claudication, gangrene, or diabetic peripheral angiopathy with or without gangrene 330–331 Repair aneurysm 3270000–3276318 Artrial bypass graft 3350000–3355400 Endarterectomy and patch graft artery	38
	3855000–3857101, 3857200, 3870000, 3870001, 3871200 (Repair/replacement of aorta) 9023000 Embolectomy or thrombectomy of other artery 9022900 Other endarterectomy	
Total		2327

40% of Endpoints are 'TIAs'Is This Accurate?

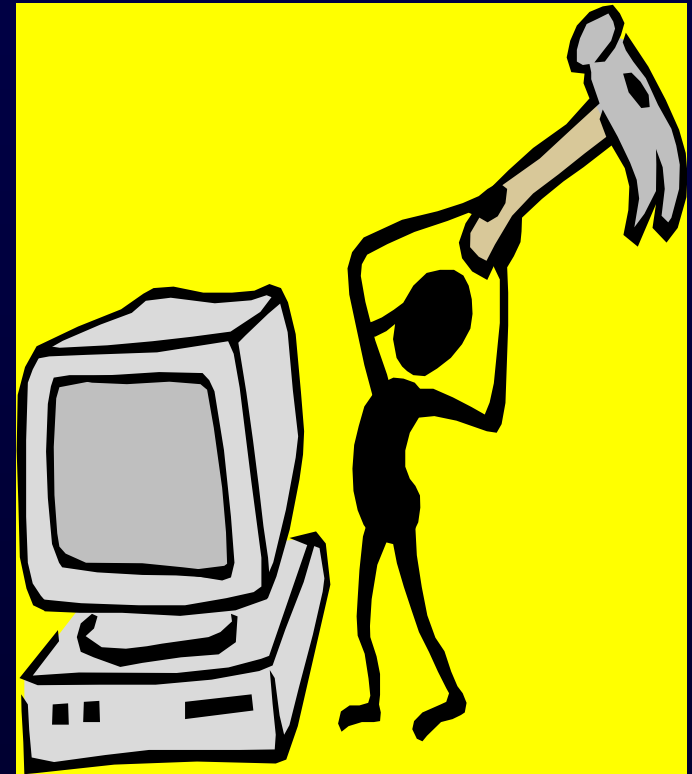
*One person may have multiple ICD codes for a first cardiovascular event.

Some Problems with PREDICT 10 Comparison Study: “Framingham vs. New Zealand Data”

- Framingham data collected by careful FU with Research Nurse [expensive study]
- PREDICT cohort is based on public hospital admissions linked to deaths & readmissions [cheap]
 - House surgeon & coder dependent
 - Accuracy uncertain e.g. Excess of ‘TIAs’ [40% endpoints]
- Other Inaccuracies:
 - Only 14% of eligible patients enrolled ?which
 - Silent MI, UAP, TIAs (in community): not recorded
 - Private hospital admissions: not recorded
 - PCIs/CABGs: not recorded
 - MIs/ UAP/PVD: not recorded
 - Heart failure admissions etc.: not recorded

Point 5: Unfortunately the PREDICT CVS Risk Assessment Programme is Flawed in Design

- The best Epidemiological models of CVS risk assessment are inaccurate
- PREDICT has some useful ideas, but is fundamentally flawed in design
 - Especially relying on weak endpoints to drive the study



Are We Surprised that Epidemiological Studies Struggle to Accurately Detect CVS Risk for Individuals in New Zealand?



Illogical Process?

In Other Areas of Medicine, we '*Look for Disease*'

- Breast Cancer: Mammogram
- Colon Cancer: Colonoscopy

BUT

- Coronary Artery Disease: 'Coloured Charts' or Equations of Risk Factors?

What happens if we '*Look for Disease*' in Coronary Artery Disease?

- Calcium Scoring
- CT Cardiac Angiography

Calcified Coronary Arteries

- Intuitive for CVS Risk
 - *Look for disease*
 - Concept used elsewhere
- Coronary Atherosclerosis & calcification is the 'End Product' of all CVS risk factors [known or unknown]

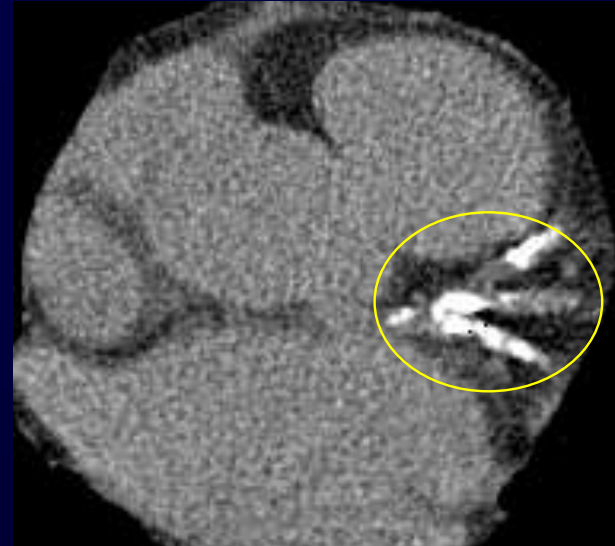


“Is Coronary Calcium Scoring: the Logical Way to Assess CVS Risk?”

Point 6: Beware: CT Coronary Calcium Scoring is challenging the established [and entrenched?] epidemiological concepts of CVS risk assessment

What is a CT Calcium Score Test?

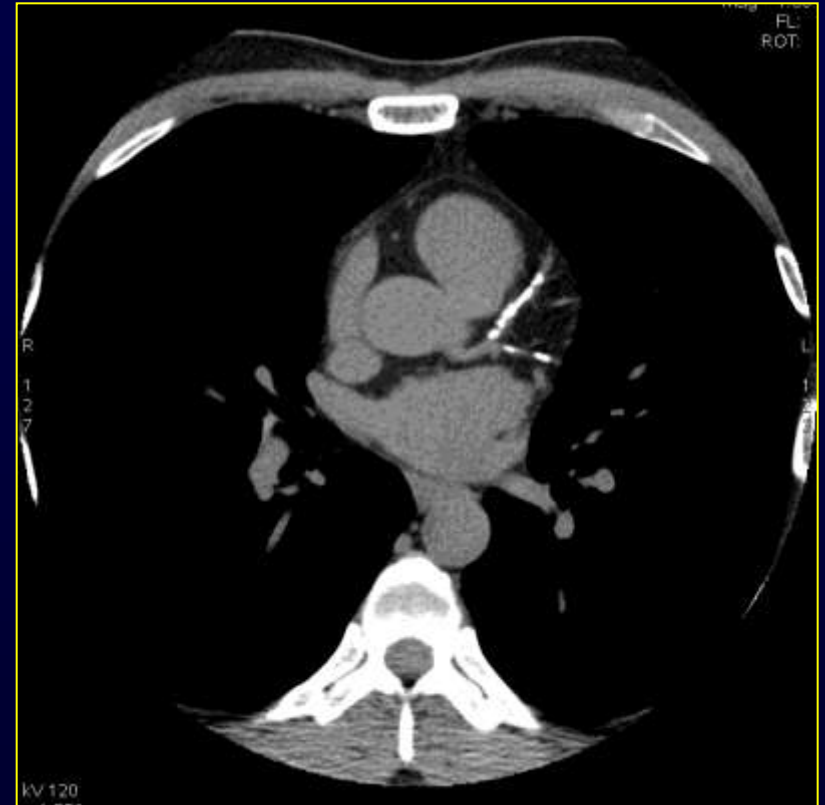
- X-Ray ‘slices’ of the heart
- 3mm Intervals
- About 50 cardiac slices per scan
- Computer-assisted algorithm
- Score relates to volume and density of calcium in the coronary arteries (Units: “Agatston”)



Images from a CT Calcium Score Test



No calcium



Heavy calcium

GE MEDICAL SYSTEMS
LightSpeed VCT
Ex:
Se: 2
Im: 1
SN I100.00 Ax
DFOV 25.0cm
STND

A 133

TS1
M46Y
AW148002216.937.1305529664
Mar 08 2010
02:40:45 PM
SEGM512 X 512

Mag = 1.00
FL:
ROT:

R
1
0
8

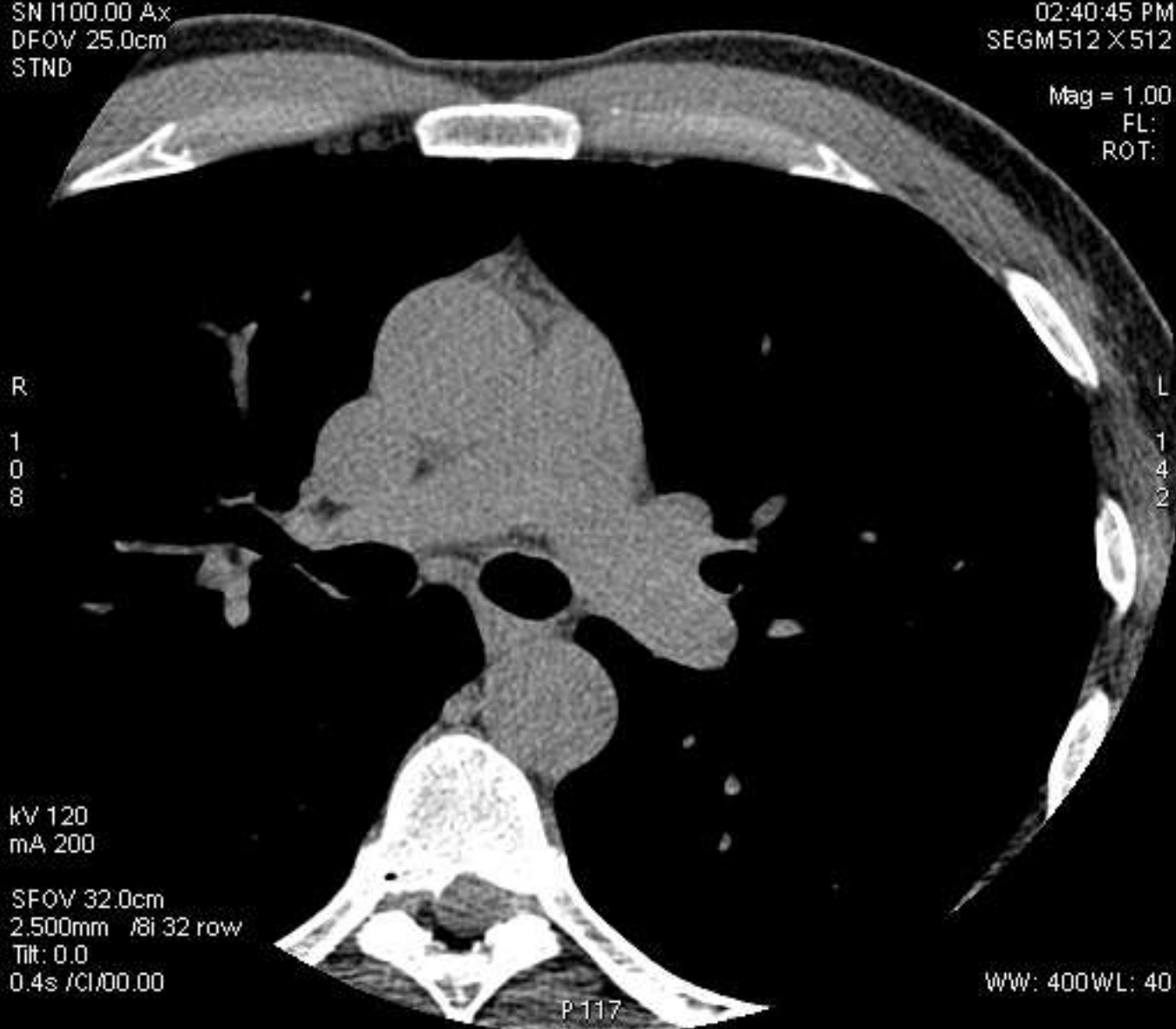
L
1
4
2

kV 120
mA 200

SFOV 32.0cm
2.500mm /8i 32 row
Tilt: 0.0
0.4s /CI/00.00

WW: 400WL: 40

P 117



GE MEDICAL SYSTEMS
LightSpeed VCT
Ex:
Se: 2
Im: 1
SN I54.75 Ax
DFOV 25.0cm
STND

A 125

VS
M48Y
AW1700651958.994.1305536230
Mar 07 2011
02:56:32 PM
SEGM512 X 512

Mag = 1.00
FL:
ROT:

R
1
2
7

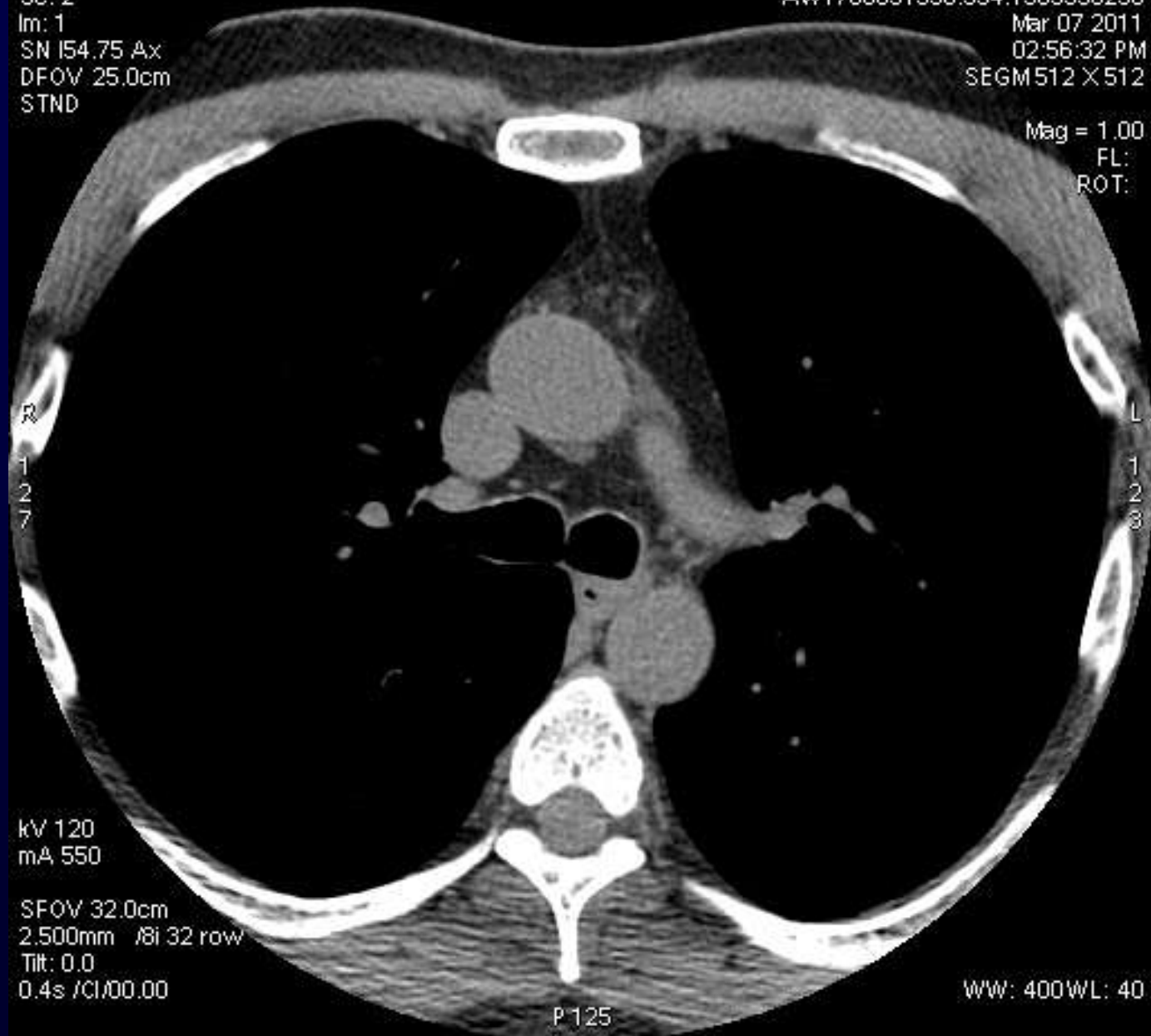
L
1
2
8

kV 120
mA 550

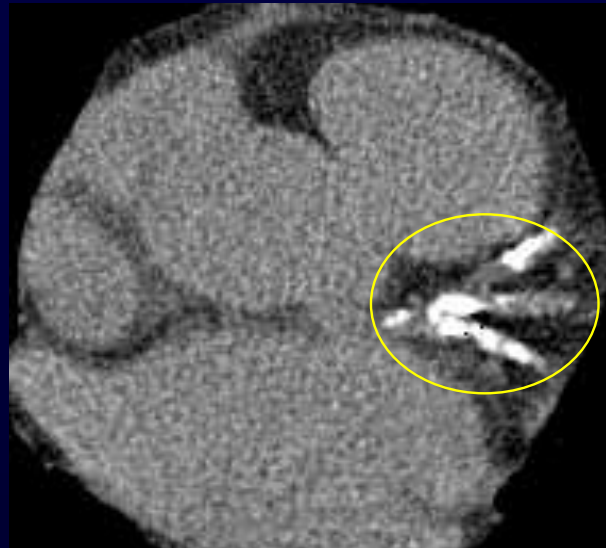
SFOV 32.0cm
2.500mm /8i 32 row
Tilt: 0.0
0.4s /CI/00.00

P 125

WW: 400WL: 40



Does a CT Calcium Score Test Help with CVS Risk Assessment?



St Francis Heart Study [of 4,613 Asymptomatic People]

Arad et al. JACC 2005;46: 158-65, 166-72.

A Coronary Calcium Score of ≥ 100 Agatston units

- x 10 times increase risk of a CVS events

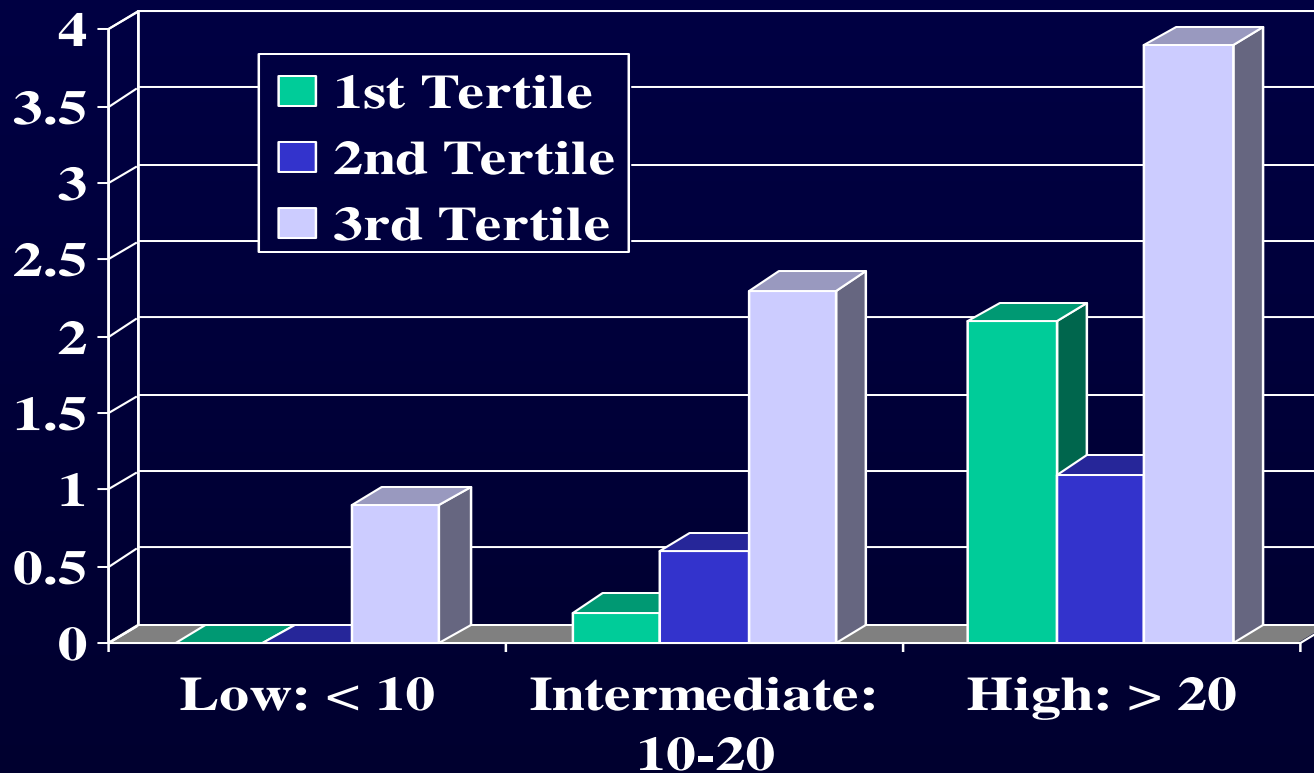
The Coronary Calcium Score

- Was superior to the Framingham Risk Equation (Receiver-operator curve 0.79 ± 0.03 vs 0.69 ± 0.03 , $p=0.0006$)
- Enhanced stratification of Framingham Risk categories, low, intermediate, high risk ($p<0.0001$)

St Francis Heart Study: Coronary Event Rates as a function of Calcium Score within Framingham Risk Groups

Arad JACC 2005;46:158-65

% per year (CVS Events)



% per 10 Years (Predicted)

THE NEW ZEALAND MEDICAL JOURNAL

Journal of the New Zealand Medical Association



High calcium scores in patients with a low Framingham risk of cardiovascular (CVS) disease: implications for more accurate CVS risk assessment in New Zealand

Chris J Ellis, Malcolm E Legget, Colin Edwards, Niels Van Pelt, John A Ormiston,
Jonathan Christiansen, Helen Winch, Mark Osborne, Greg Gamble

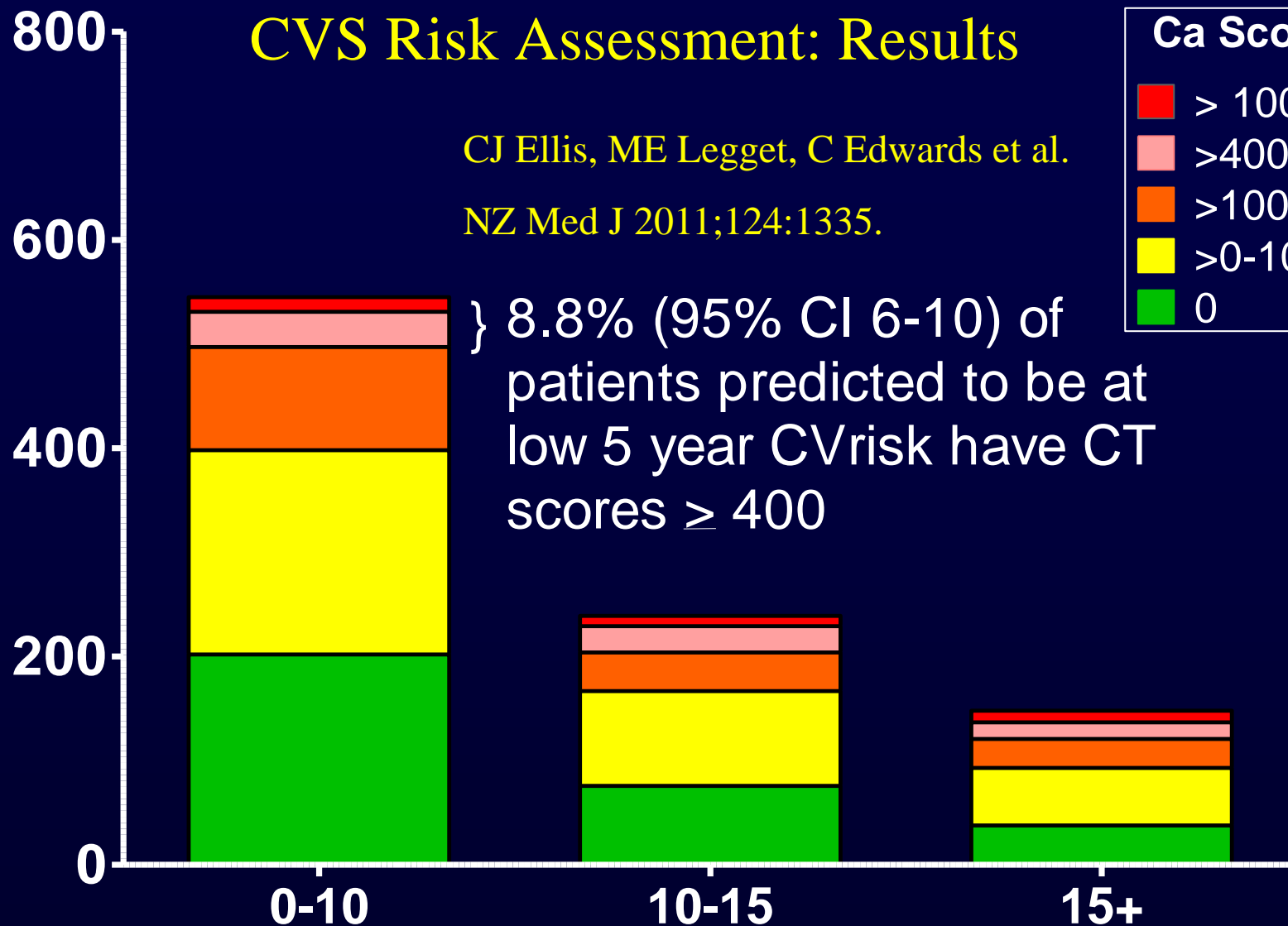
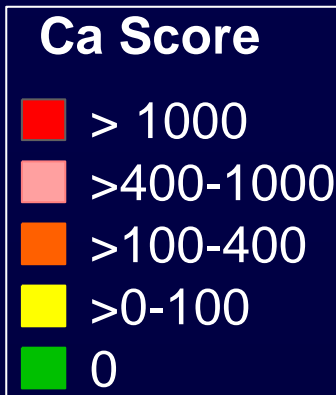
NZMJ 27 May 2011, Vol 124 No 1335; ISSN 1175 8716

URL: <http://www.nzma.org.nz/journal/124-1335/4676/>

Calcium Score & More Accurate CVS Risk Assessment: Results

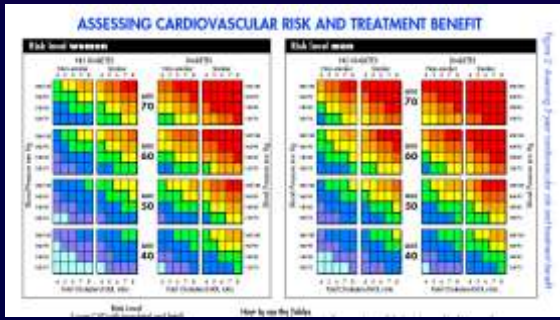
CJ Ellis, ME Legget, C Edwards et al.

NZ Med J 2011;124:1335.



} 8.8% (95% CI 6-10) of patients predicted to be at low 5 year CVrisk have CT scores ≥ 400

Framingham CVS 5 Year Risk Estimate %
Incorporating 2003 NZGG Adjustments



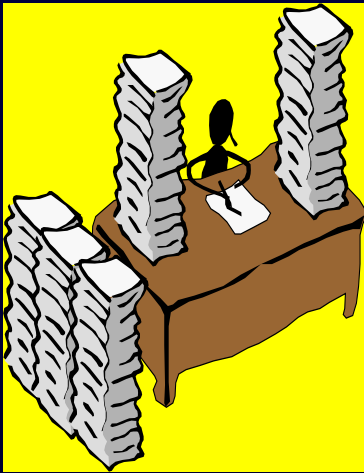
Point 7: A Calcium Score is MORE Predictive of CVS Risk than the *Entire* Framingham Equation



**Framingham-Based:
5 or 10-Year Risk &
“Lifetime-Risk”**

Family History

CVS Risk Assessment



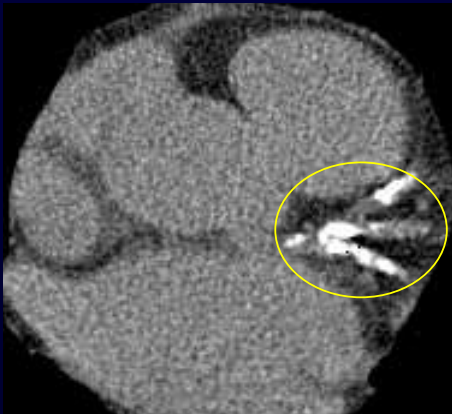
“Modern Risk Factors”

Calcium Scoring (& CT Angiography)

CT Cardiac 'Scans'

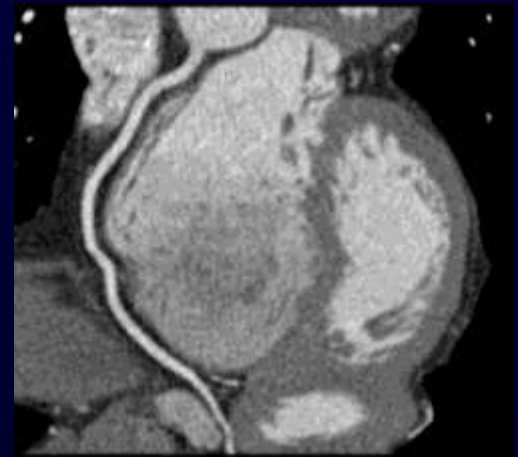


1. Calcium Score Test



2. 'Full' CT Cardiac Angiogram
[Always get a Ca Score as well!]

Point 8: There are 2
Types of CT Scan
Available



3D

195

TS

Ex:

M 46 AW891998700.532.1304654424

Se: 133 +c

DoB:

Volume Rendering - No cut

Ex: Mar 08 2010

DFOV 15.0cm

STND/C2 Ph:75% (No Fill)

O L O LAO O CRA

R

4
5

L

1
0
5

No VOI

kv 100

mA 647

Rot 0.35s/CH 6.4mm/rot

0.6mm 0.16:1 / 0.6sp

Tilt: 0.0

02:44:49 PM

W = 4095 L = 2048

1245



3D
Ex:
Se: 133 +c
Volume Rendering No cut

SPR

DB
M 50 AW61540060.929.1306033811
DoB:
Ex: May 18 2011

DFOV 15.0cm
STND/C2 Ph:75% (No Filt.)

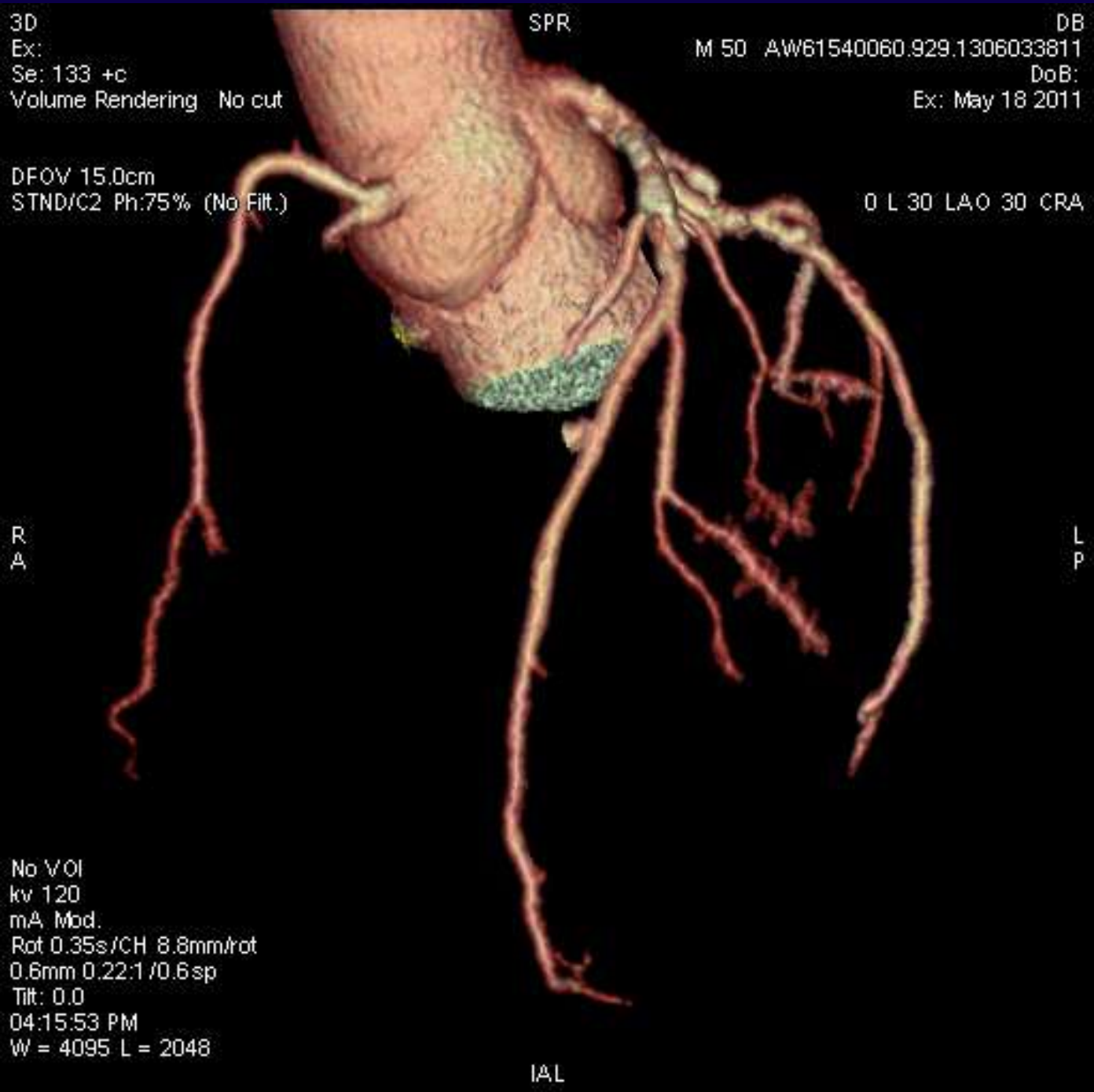
0 L 30 LAO 30 CRA

R
A

L
P

No VOI
kv 120
mA Mod.
Rot 0.35s/CH 8.8mm/rot
0.6mm 0.22:1 /0.6 sp
Tilt: 0.0
04:15:53 PM
W = 4095 L = 2048

IAL



Which Cardiac CT Test is Appropriate?

Calcium Score (Alone)

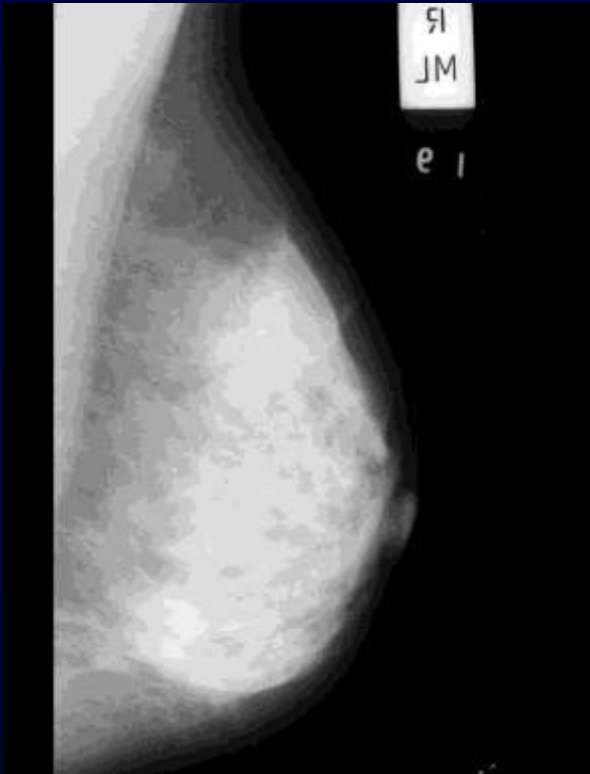
- Asymptomatic (ONLY)
- \$530
- NOT SX-funded
- ‘Screening’
- The most accurate CVS risk assessment tool
- Can refer patient *only* for Ca score: Directly to an AHG Cardiologist
- OR refer for assessment/ETT *and* Ca score

(Full) CT Cardiac Angiogram

- Equivocal symptoms
- Equivocal ECG changes
- \$1600
- (Usually) SX-funded
- Excellent test for selected patients
- ‘Rule Out’ significant coronary disease
- Need to refer patient for initial assessment [not only for a full CT Angiogram]
- (Also get a Ca Score with a full CT angiogram)

Point 9: The Radiation Dose of CT Cardiac Scans Seems to be Reasonable in the Medical Context

Calcium Score (Alone)



~ 1 mSv: Same
as a Mammogram

(Full) CT Cardiac Angiogram



~ 7 mSv: Similar to an Airline Pilots
(3 to 6 mSv) Annual Exposure when Flying
(NB: Annual Background Dose ~ 3 mSv)

Summary: CT Calcium Scoring & CVS Risk Assessment in 2011

(In 12 Minutes!)



Point 10: Calcium Score Testing is Now Here

- The CT Calcium Score Test is available NOW
 - Painless, proven, safe, effective
- Some patients may also be helped by a Cardiology assessment
 - Including a Calcium score/CT Cardiac angiogram
- ‘*Individualised*’ CVS risk assessment is the future
 - It focuses the problem to those who *actually develop* significant atherosclerosis
- Public patient provision for Calcium scoring *could* be undertaken NOW
 - With time, there will [eventually] be access: be patient!



The End
→

