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# Economically efficient approaches to address chronic disease in developing countries



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# Topics Covered

- Both population and personal strategies reduce burden
- Population strategies must begin with tobacco control
- Personal strategies require efficient risk assessment.

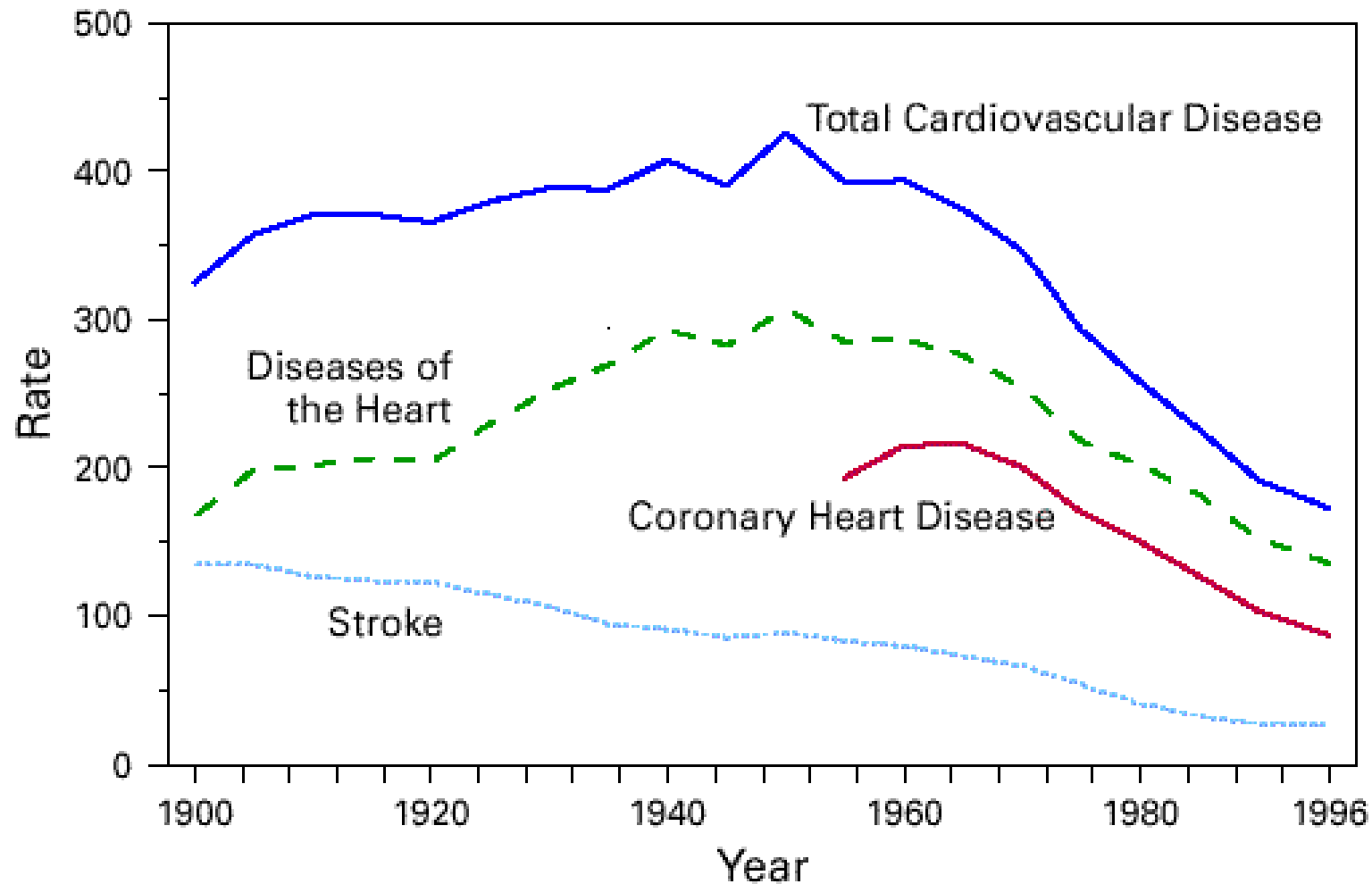
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# Age-adjusted CVD Death Rates United States, 1900-1996

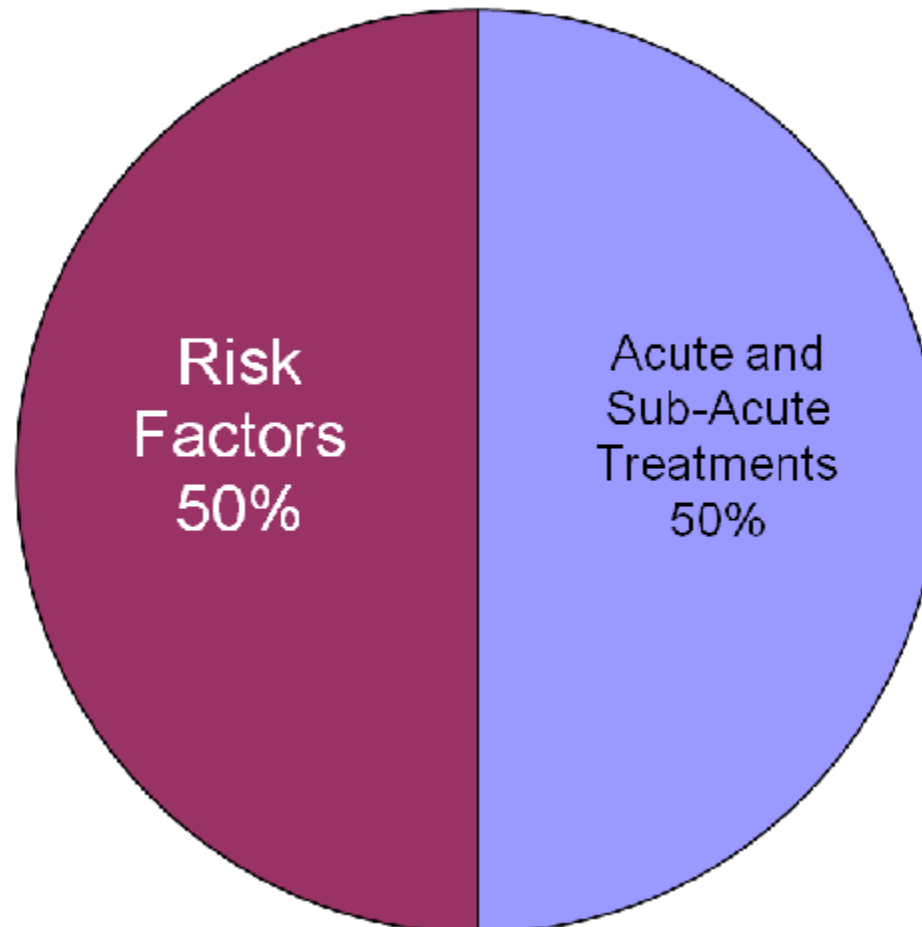
\*Per 100,000 population, standardized to the 1940 U.S. population



Decline in deaths from heart disease and stroke--United States, 1900-1999. MMWR Morb Mortal Wkly Rep 1999; 48(30):649-56. [Accessed 13 Feb 2005]. Available from URL: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4830a1.htm>

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# Causes of CHD mortality reduction



# Background Cost-effectiveness Thresholds

## Acceptability of \$US/DALY by region

Region	GDP/Capita X 3
East Asia Pacific	3017
Eastern Europe/Central Asia	6226
Latin America/Caribbean	11426
Middle East/North Africa	4885
South Asia	1387
Sub-Saharan Africa	1562
High Income	75000

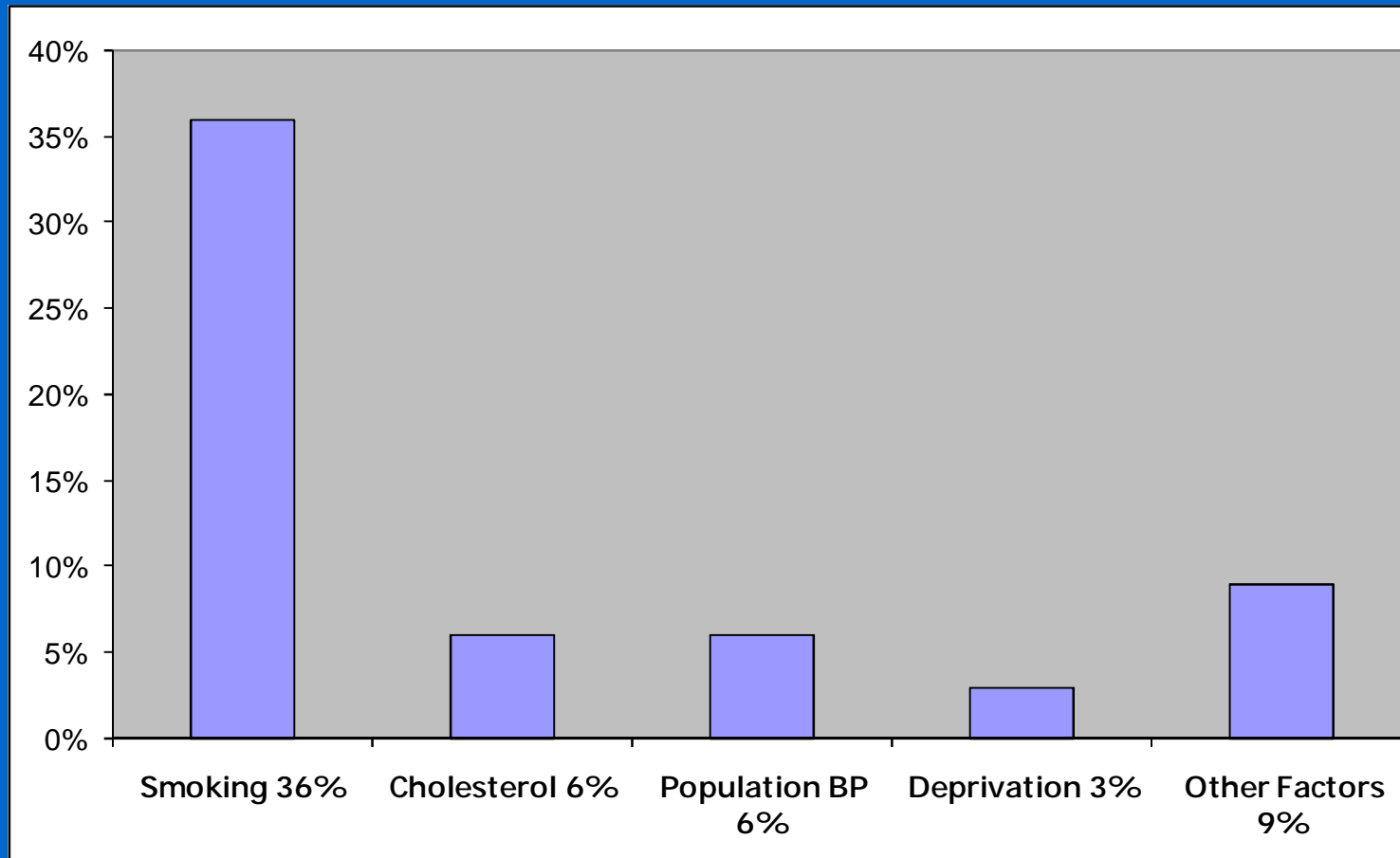
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## Contribution of population risk factor changes



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## Population Based Strategies (\$/DALY)

- **Tobacco**
  - Pricing Policies 2-85
  - Non Pricing Policies 33-1432
- **Salt reduction**
  - 8 mm Hg BP reduction Cost-saving-100
  - 2 mm Hg BP reduction 110 -250



**F** **FAT AUDIENCES**  
Some food may not be suitable for children

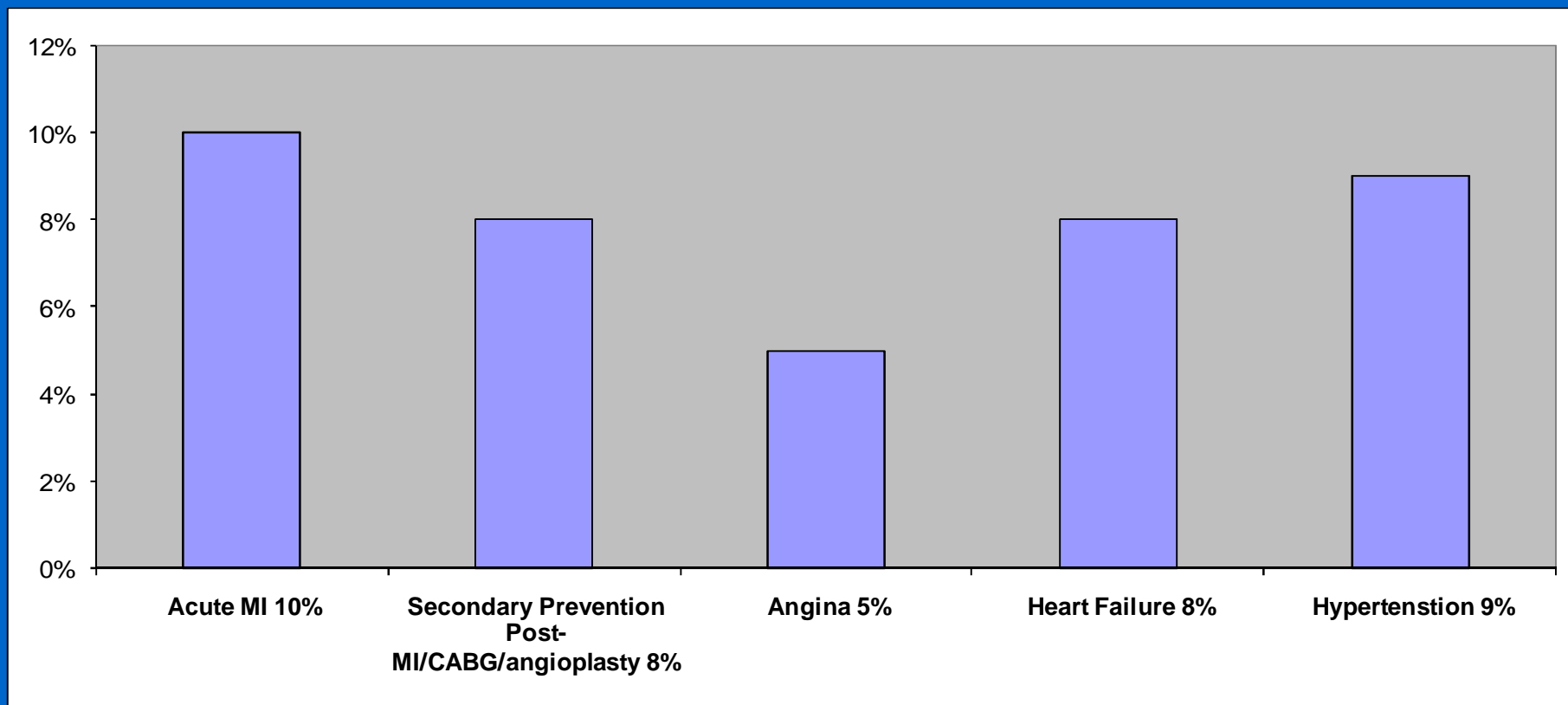
Spurlock M. et al 'Super Size Me' 2004

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## Contribution of individual therapies in Scotland



# Acute or Secondary Interventions

Strategy	Cost/DALY
ACEI (CHF)	0
ASA/Beta-blocker (post MI)	0
ASA (AMI)	9
ASA/BB (AMI)	11
ACEI/BB (CHF)	218
Streptokinase (AMI)	634
ASA/Beta-blocker ACEI (post MI)	660
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tPA (AMI)	15900
CABG (post MI)	24000

# Primary Prevention Challenge

## Individual Risk Factors

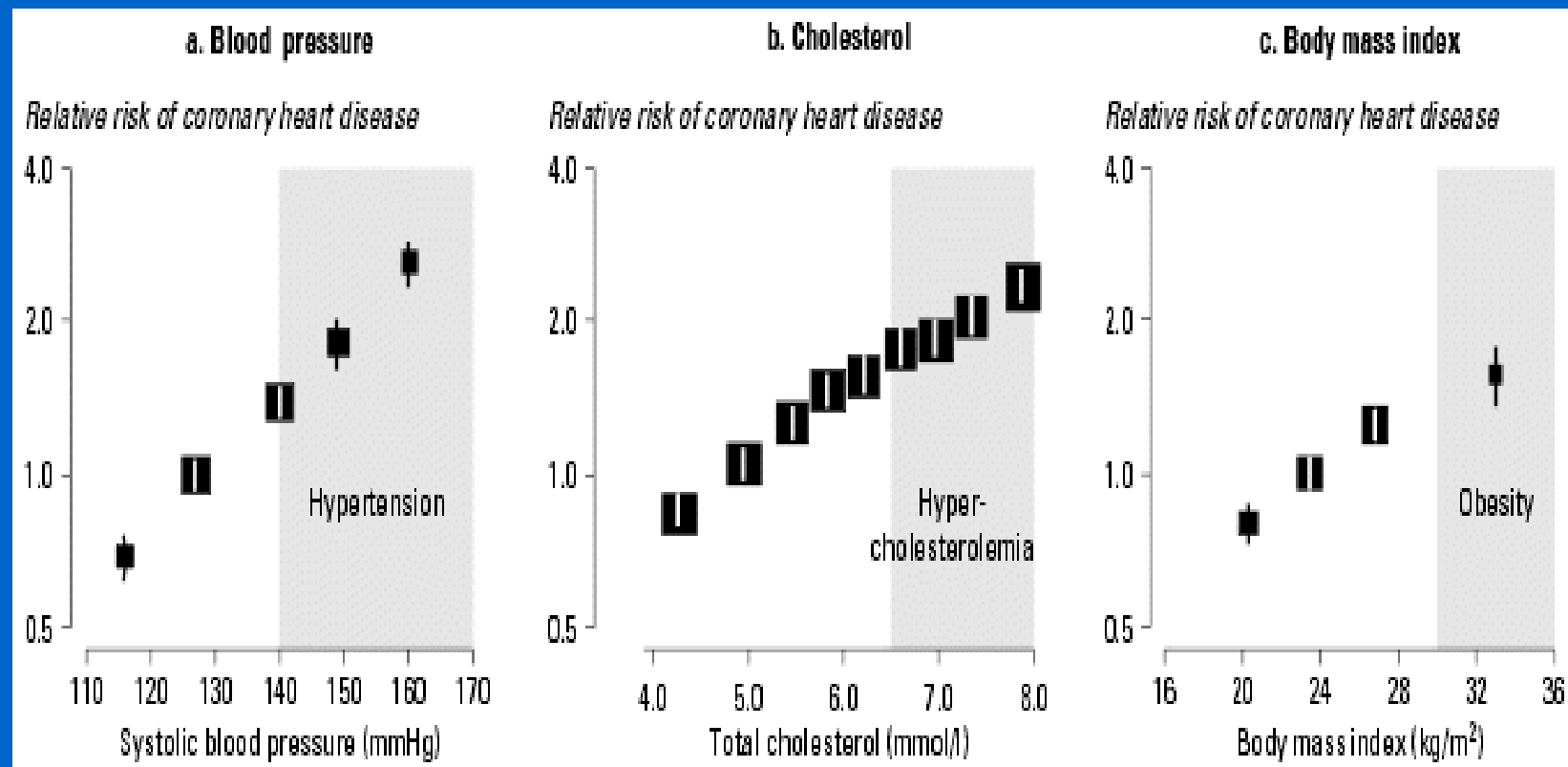
Hypertension or  
Cholesterol

- Focuses on arbitrary levels
- Crude estimate of true risk
- Examples
  - WHO/ISH
  - JNC VII
  - South Africa

## Absolute Risk

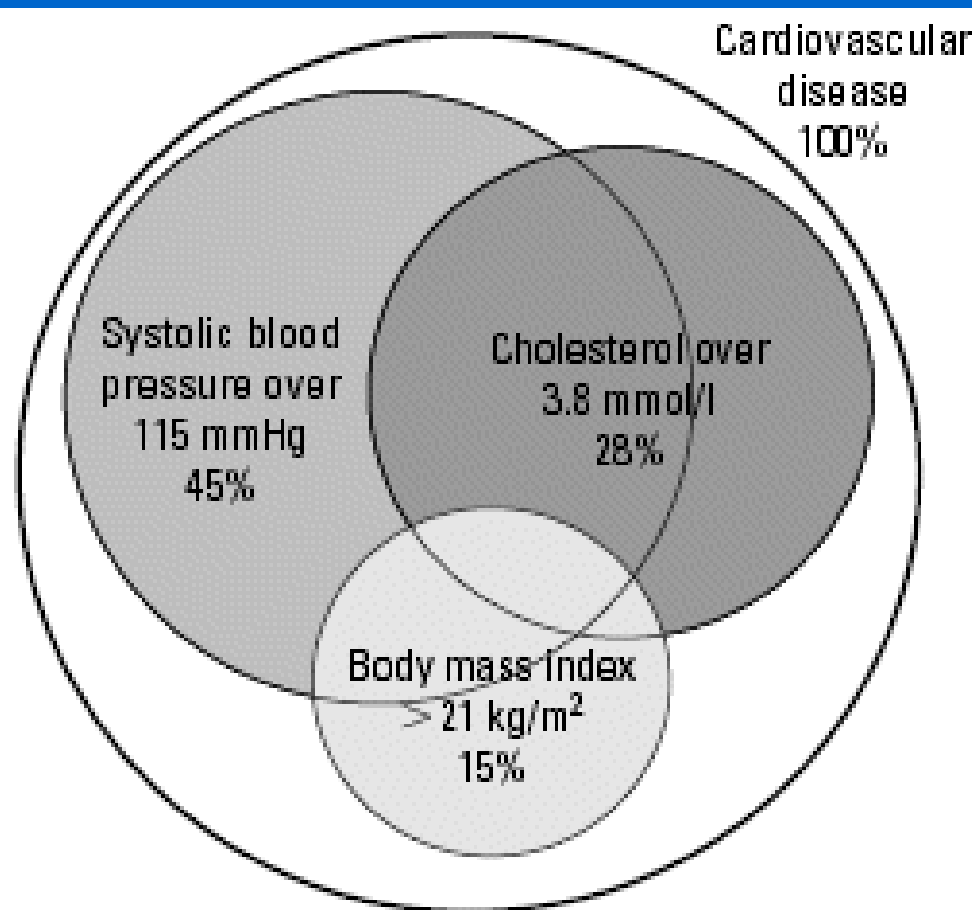
- Focus on risk for CVD
- Improved risk estimate
- Examples
  - New Zealand
  - British Hypertension Society

# Continuous Risks of Blood Pressure, Cholesterol, and Body Mass and Coronary Heart Disease Risk



Source: Asia Pacific Cohort Studies Collaboration 1999, 2003a,b, 2004; Prospective Studies Collaboration 1995, 2002; Law, Wald, and Thompson 1994; Willett and others 1995.

## Global CVD Burden Caused by High Blood Pressure, Cholesterol, and Bodyweight



Source : Ezzati and others 2004; WHO 2002.

# Question

- A) 44 year old man
- non smoker
  - non-diabetic
  - TC:HDL ratio of 4
  - BP of 149/85.



- B) 60 year old man
- smoker
  - non-diabetic
  - TC:HDL ratio of 6
  - BP of 139/84

**Who gets treated according to JNC guidelines – A or B?**

# Target Level Treatment

- A) 44 year old man
- non smoker
  - non diabetic
  - TC:HDL 4
  - BP of 145/85.



- B) 60 year old man
- smoker
  - non-diabetic
  - TC:HDL ratio of 6
  - BP of 139/84

A. Gets treated.

2.5 - 5%

20- 25%

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# Framingham Risk Score

- Population
  - 5573 Caucasians without CVD
- Risk Factors
  - Age, SBP (DBP), Total and HDL Cholesterol, Diabetes, Smoking, Hypertension Rx
- Outcome
  - CHD
  - CVD

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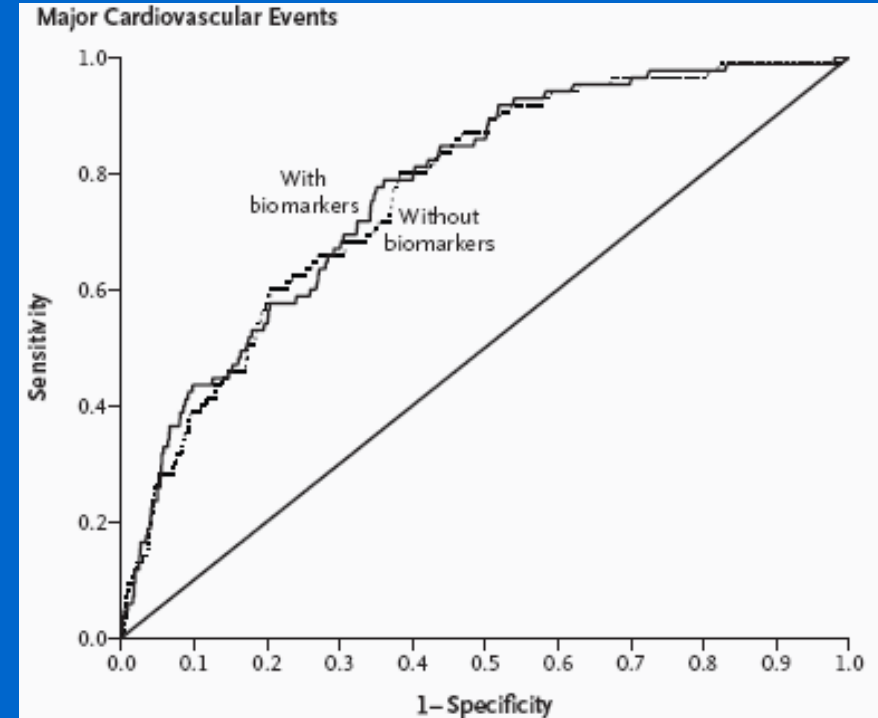
## Framingham : C-statistics

- Framingham Population
  - Male 0.79
  - Female 0.83
- Other Populations
  - Asian and Native Americans 0.69-0.72
- After Calibration
  - China 0.71 M 0.74 F

# Added Value of “Novel” Risk Factors

- Wang, T NEJM 2006
  - Framingham Cohort
  - Compared traditional RFs to one with additional biomarkers
  - BNP, CRP, albumin to creat ratio, homocysteine, renin

Risk Model	Outcome	
	Death	Major CVD Events
Framingham	0.80	0.76
F + Biomarkers	0.82	0.77



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## What About Subtracting Risk Factors?

- Age
- Sex
- Diabetes
- LDL ← Laboratory necessary
- HDL ← Laboratory necessary
- Tobacco
- Blood pressure

Wilson, *et al.* Circulation. 1998;97:1837-1847.

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## Cost of Stratification Using Cholesterol

- Total cost: \$4-100
- Health care/patient/year (India): \$30

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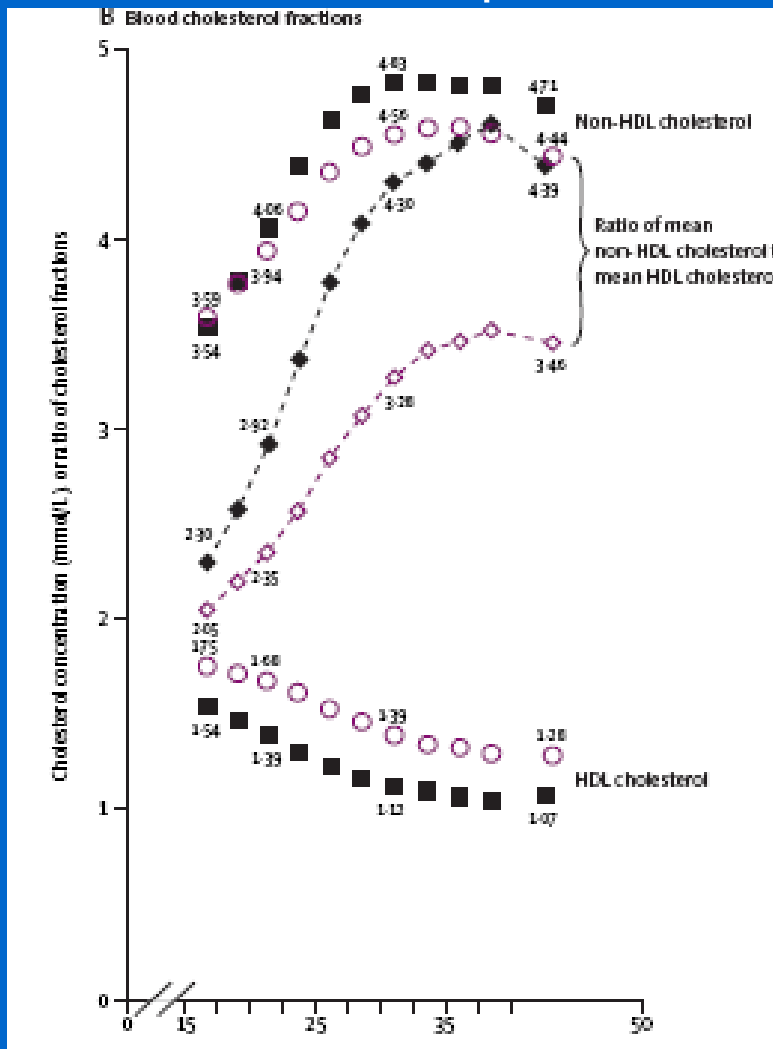
# Substitutes for Cholesterol

## Anthropomorphic Data

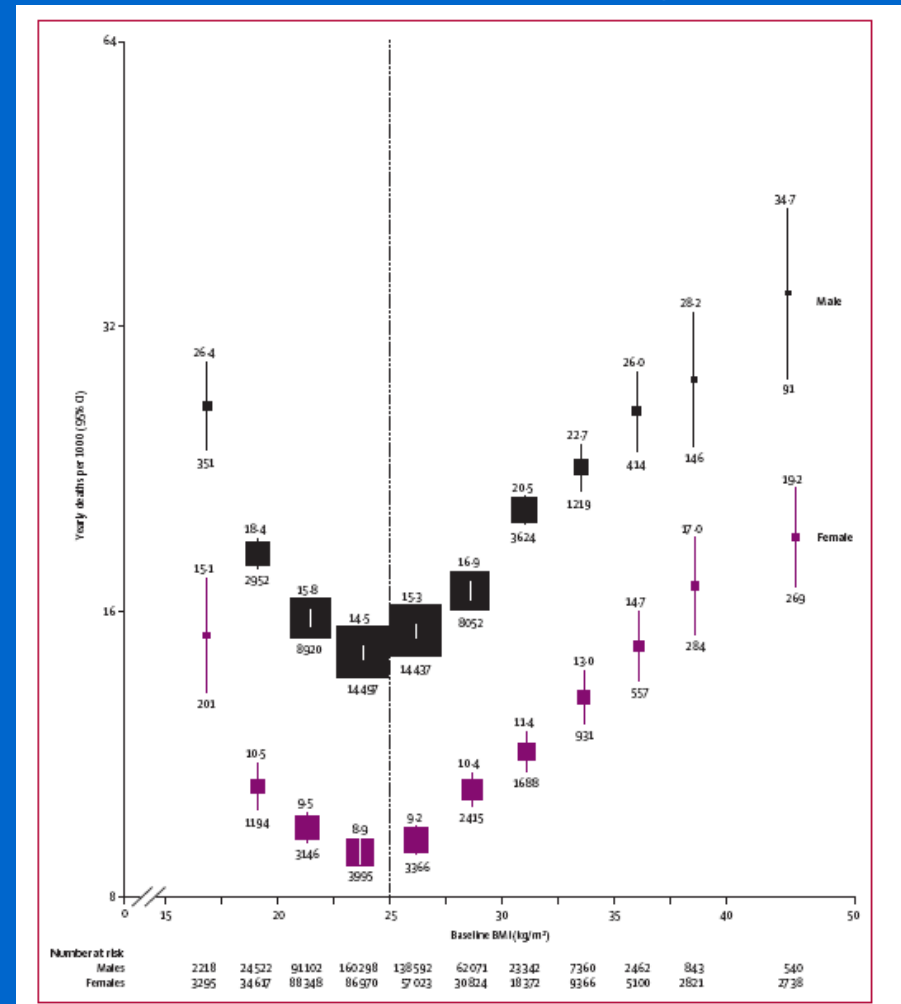
- BMI
- Waist/Hip ratio

# BMI

## BMI vs Lipids



## BMI vs total mortality



Prospective Studies Collaboration, Lancet 2009;373:1083

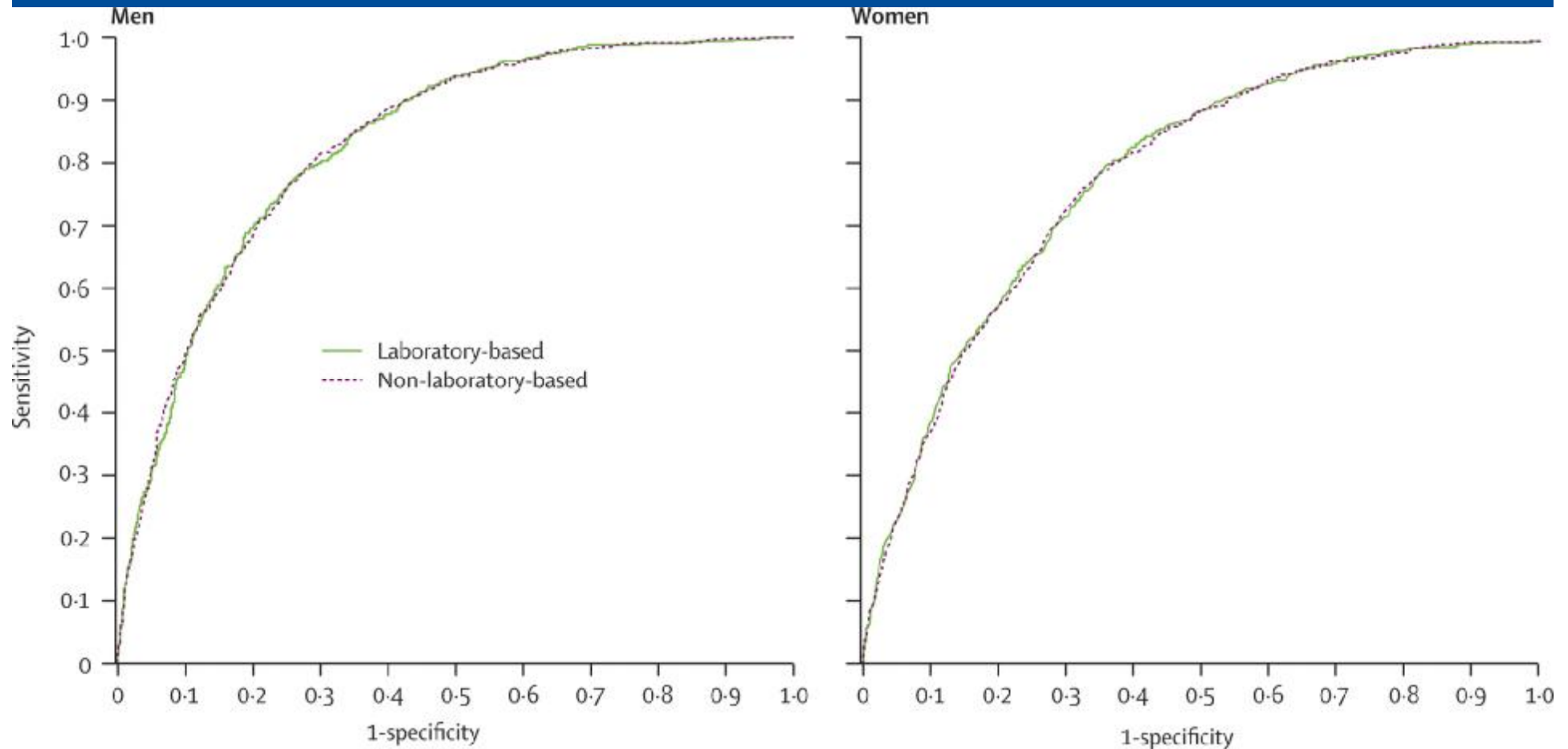
# NHANES Study Design

## Two Risk Models

- Laboratory-based (using Framingham RFs)
- Non-laboratory-based: substitute BMI for cholesterol

Gaziano, T, Lancet 2008; 371:923

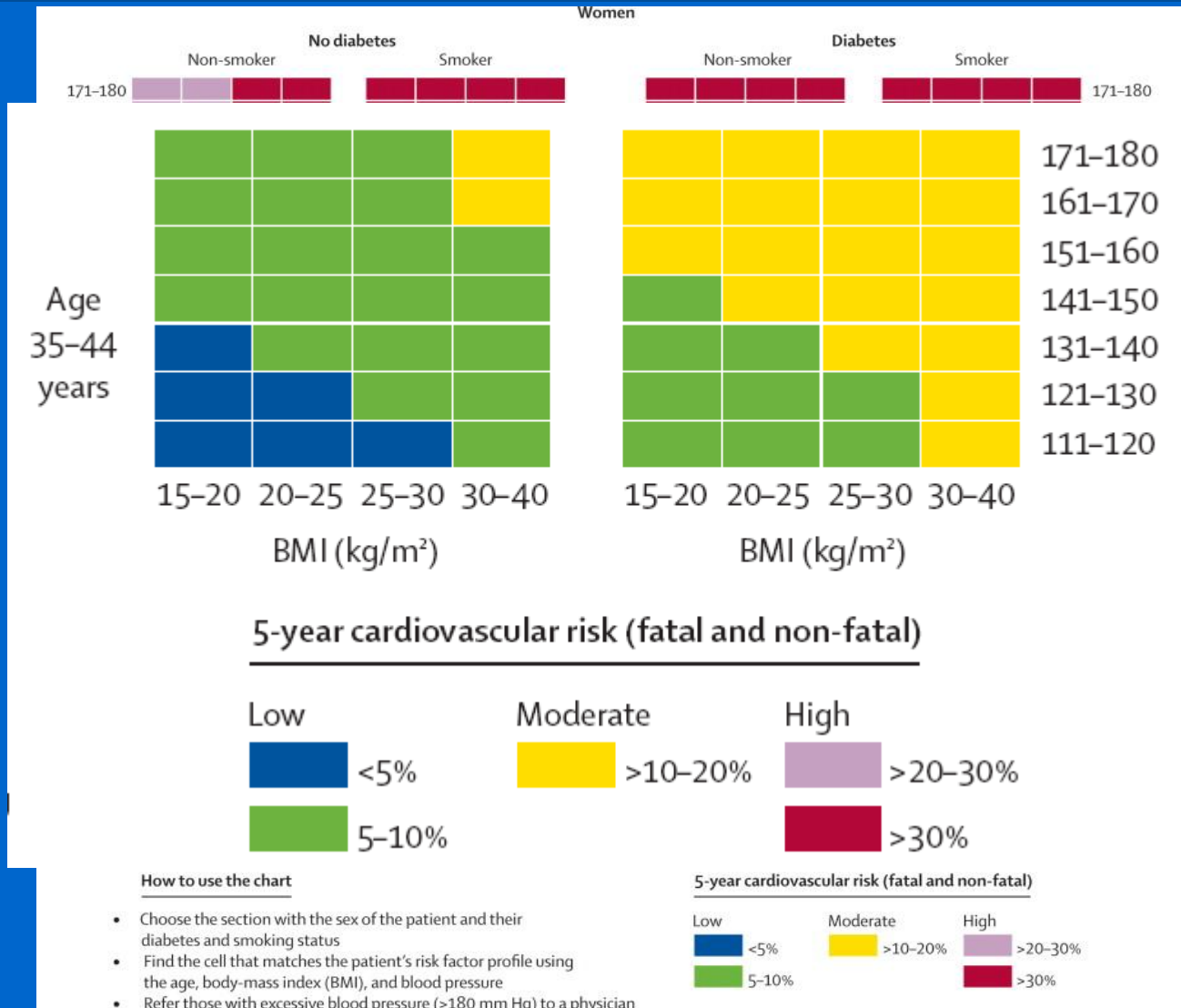
# ROC Curves for Predicting CVD



C-statistic	Men	Women
Lab	.784	.829
Non-lab	.783	.831

Gaziano, T, Lancet 2008; 371:923

# Risk Prediction Chart for CVD Using Non-Laboratory Values

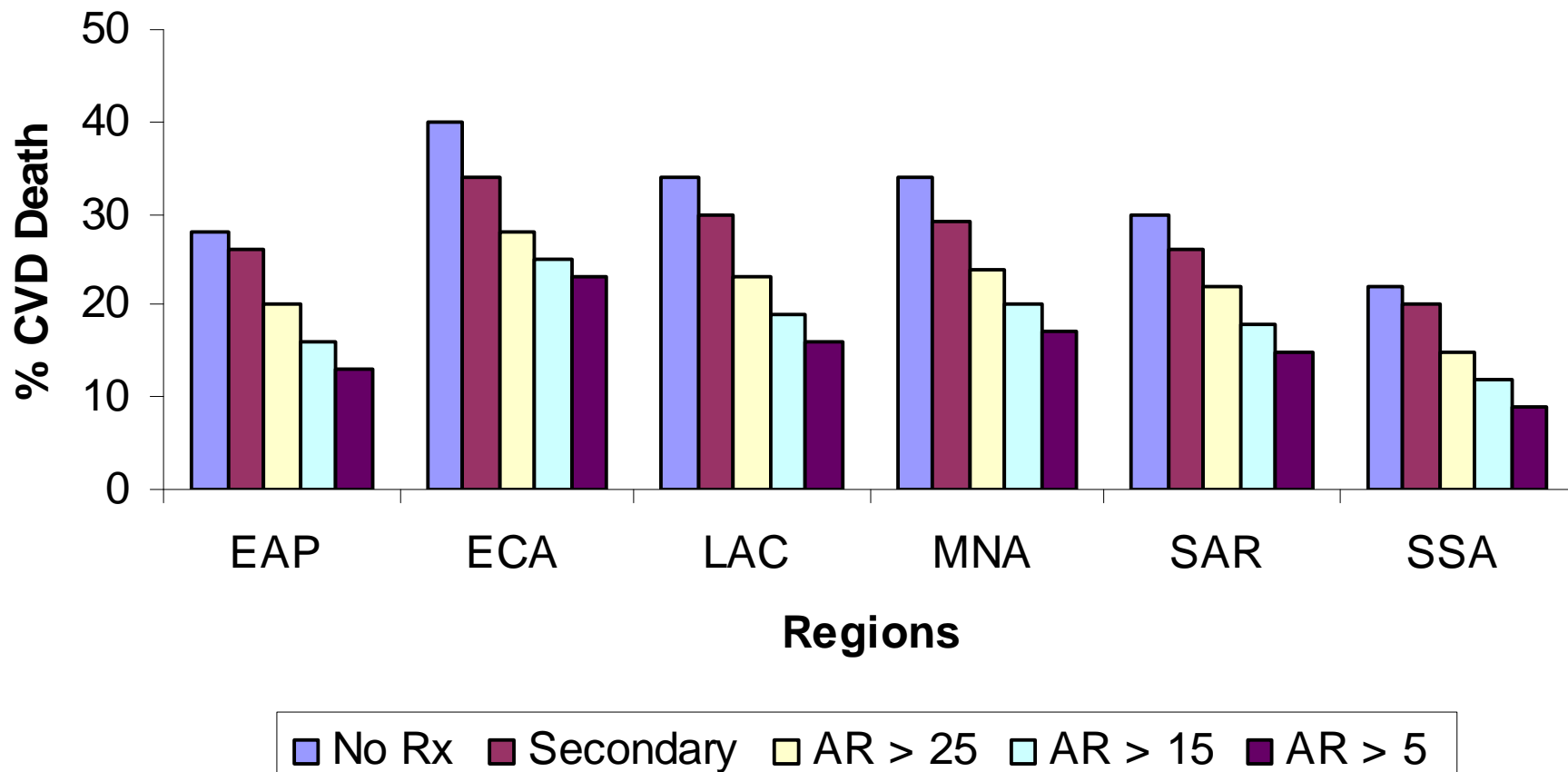


# "The Polypill"



Wald, N et al. *BMJ* 2003;326:1419

# Lifetime CVD Death Risk by Treatment Strategy



# Multi-drug Regimen-Results

## Cost/QALY

Region	Secondary only	Primary Prevention Strategies			GNI X 3*
		AR 25%	15%	5%	
East Asia & Pacific	336	890	923	1214	3180
Europe & Central Asia	362	858	905	1207	6030
Latin America & Caribbean	388	881	930	1219	11010
Middle East & North Africa	341	872	930	1221	6270
South Asia	306	746	790	1039	1320
Sub-Saharan Africa	312	771	846	1145	1410

Gaziano, Opie, Weinstein. Lancet 2006 368; 679-86

# Range for Cost-Effectiveness Results

	Cost of intervention (per head)		
	\$5	\$17	Other
<b>Community intervention</b>			
Hypertension <sup>29</sup>	4000	..	..
Cholesterol <sup>30</sup>			
4% reduction	Cost saving	1370	
2% reduction	3200	38 000	
1% reduction	18 100	88 100	
<b>Multiple risk factor reductions</b>			
North Karelia estimates	Cost saving	5900	
Stanford Five City estimates	Cost saving	600	
<b>Overweight</b>			
Diet, exercise, and behaviour change <sup>31</sup>			12 600
Gastric surgery (morbid obesity) <sup>32*</sup>			5000–35 000
Physical activity <sup>33</sup>			
Over age 65 years			Cost saving–600
Under age 65 years			4500–142 000†
Costs are in US\$ for the year of study report. *Results dependent on age, sex, and starting body-mass index. †Cost saving if cost of time spent exercising not included.			

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# Summary

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