

A white ECG (heart rate) line is overlaid on a red grid background. The grid consists of a 3x3 square pattern. The ECG line shows a regular rhythm with a prominent QRS complex.

# *Redding Rancheria Northern California Diabetes Conference*

*Mohamed H. Khan MD, FACC, FCCP  
Clinical Hypertension Specialist  
November 2025*

## **Cardiovascular complications Of diabetes**



# Diabetes and CV Disease

**“Why This Topic  
Matters”**



# Diabetes

Heart disease - is the leading  
cause of morbidity and  
mortality in diabetics



# DIABETES-Scope of the PROBLEM

**“ EVERY 20 sec someone  
is diagnosed with diabetes”  
(ADA)**



# DIABETES-Scope of the PROBLEM

“ EVERY 80 sec someone  
with diabetes dies from  
cardiovascular disease”  
(AHA)



# DIABETES-Scope of the PROBLEM

**3,290 EVERY day!**  
**(CDC)**

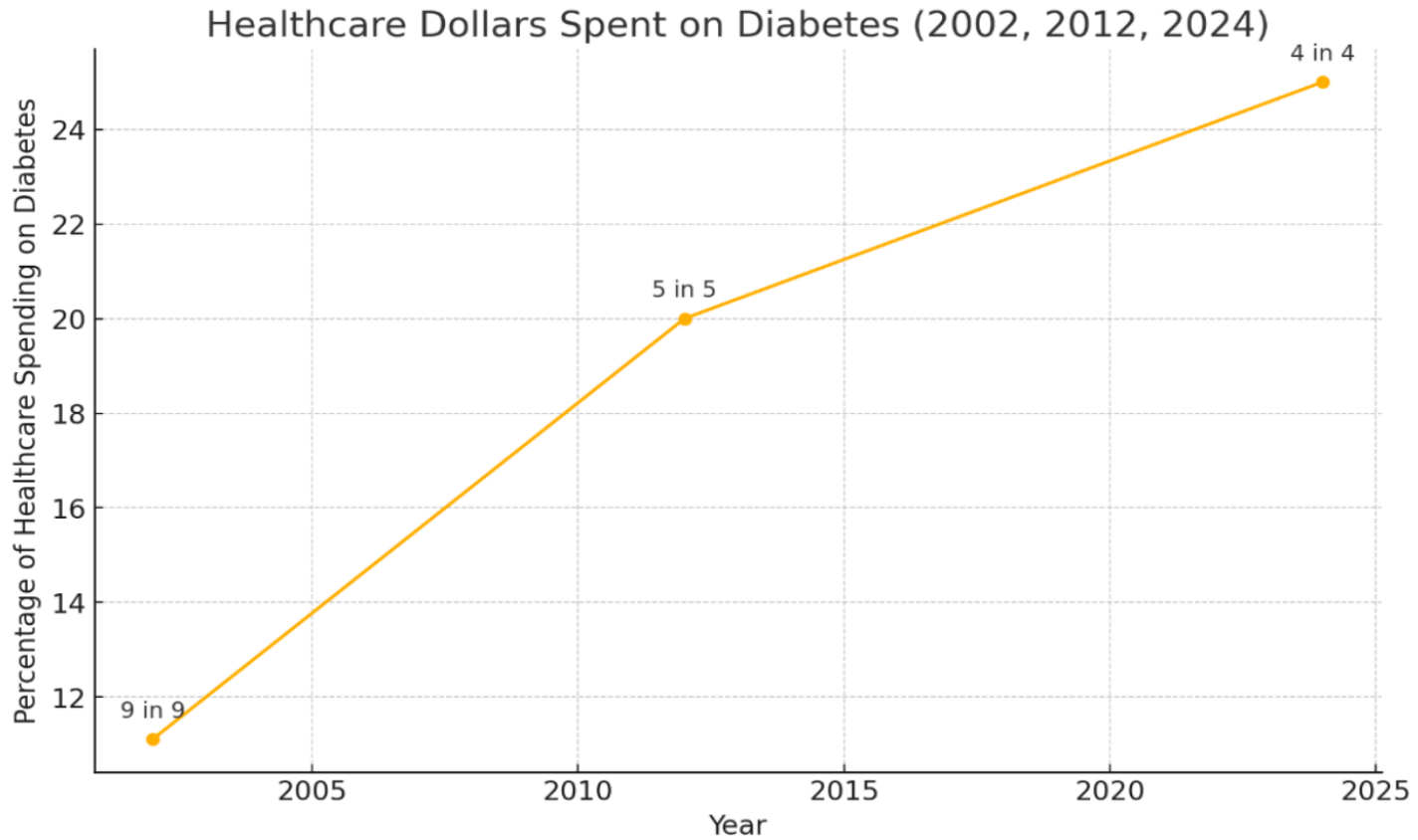


# Diabetes

## Diabetes

- 1 in 3 diabetics will die from CV disease

# DIABETES- Scope of the PROBLEM



## **Cardiovascular complications Of diabetes**



# Diabetes and CV Disease

**CAD**

**PAD**

**CHF**

**CVA**



# Diabetes and CV Disease

**CAD**



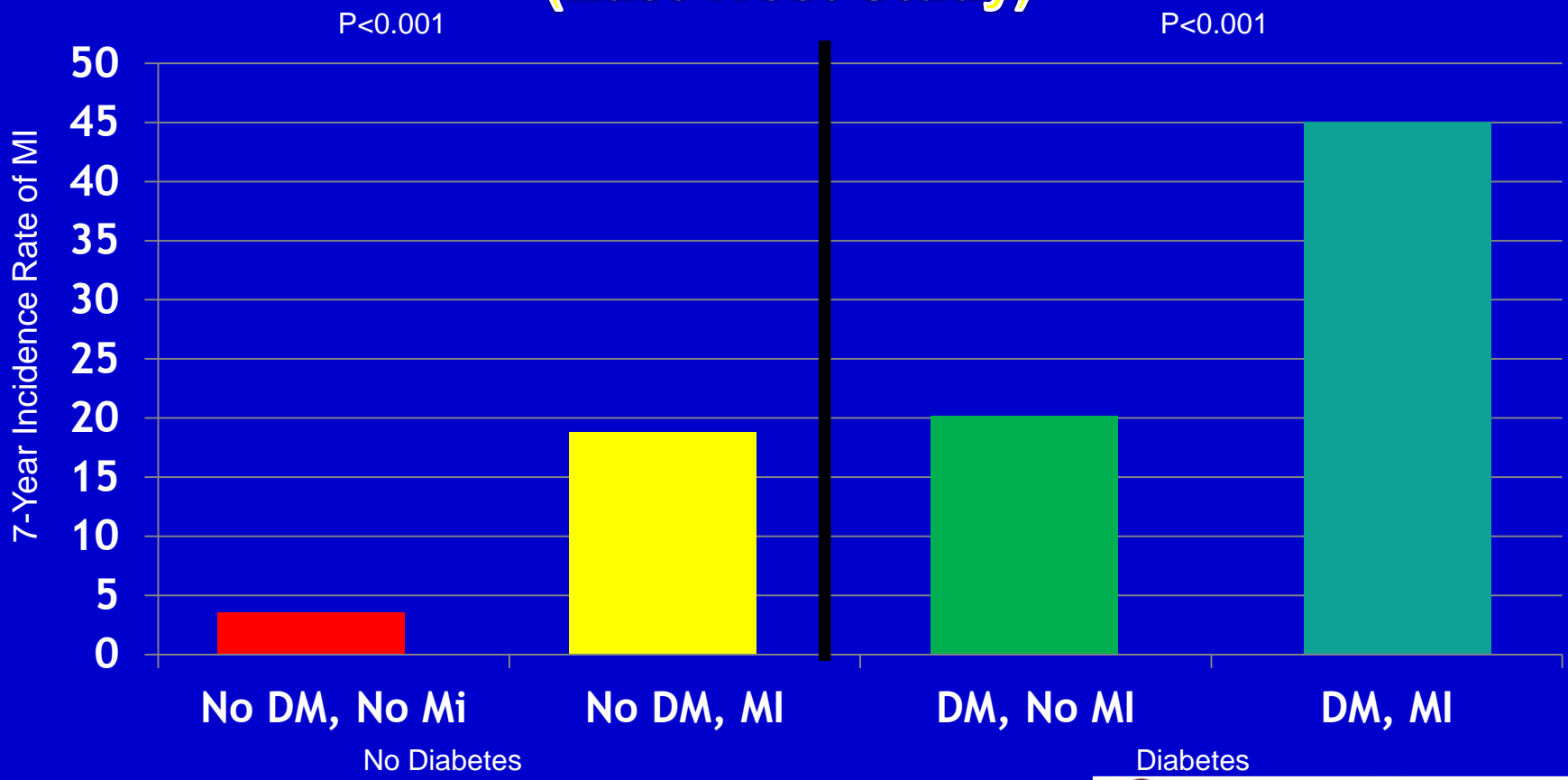
# DIABETES AND CVD

**Diabetes  
Is  
Heart Disease**



# DIABETES AND CVD

## Type 2 Diabetes and CHD 7-Year Incidence of Fatal / Nonfatal MI (East West Study)





Diabetes...

A Coronary Risk Equivalent !



# DIABETES AND CVD

**Diabetes  
Is  
Heart Disease**



# Diabetes

If diabetes is combined with CVD  
(MI or stroke)

— mortality rate is nearly 3 fold >

AND

— life expectancy is estimated  
to decrease by about 12 years!



# Diabetes

## The Challenge ...



# Diabetes

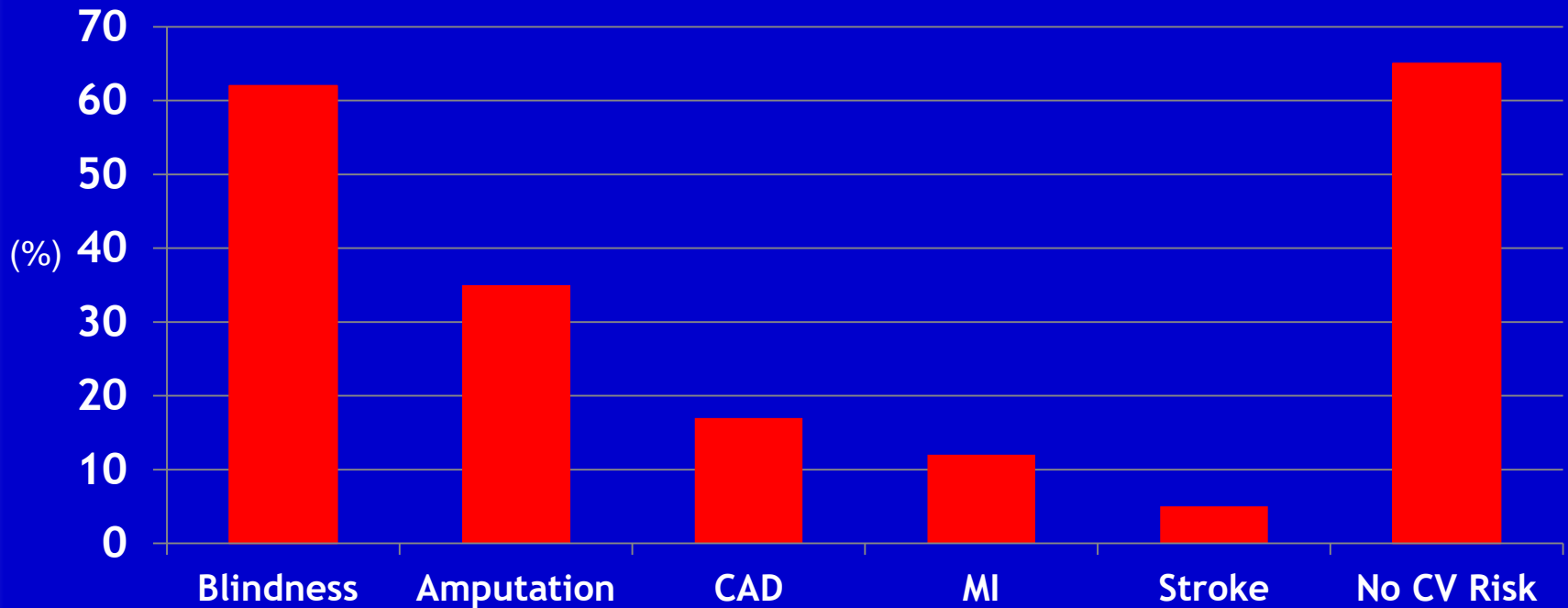
the challenge...  
Education!



# DIABETES AND CVD

## PATIENT BELIEFS ABOUT DIABETES RISKS

ACC /ADA Diabetes Knowledge Survey (n=2008)

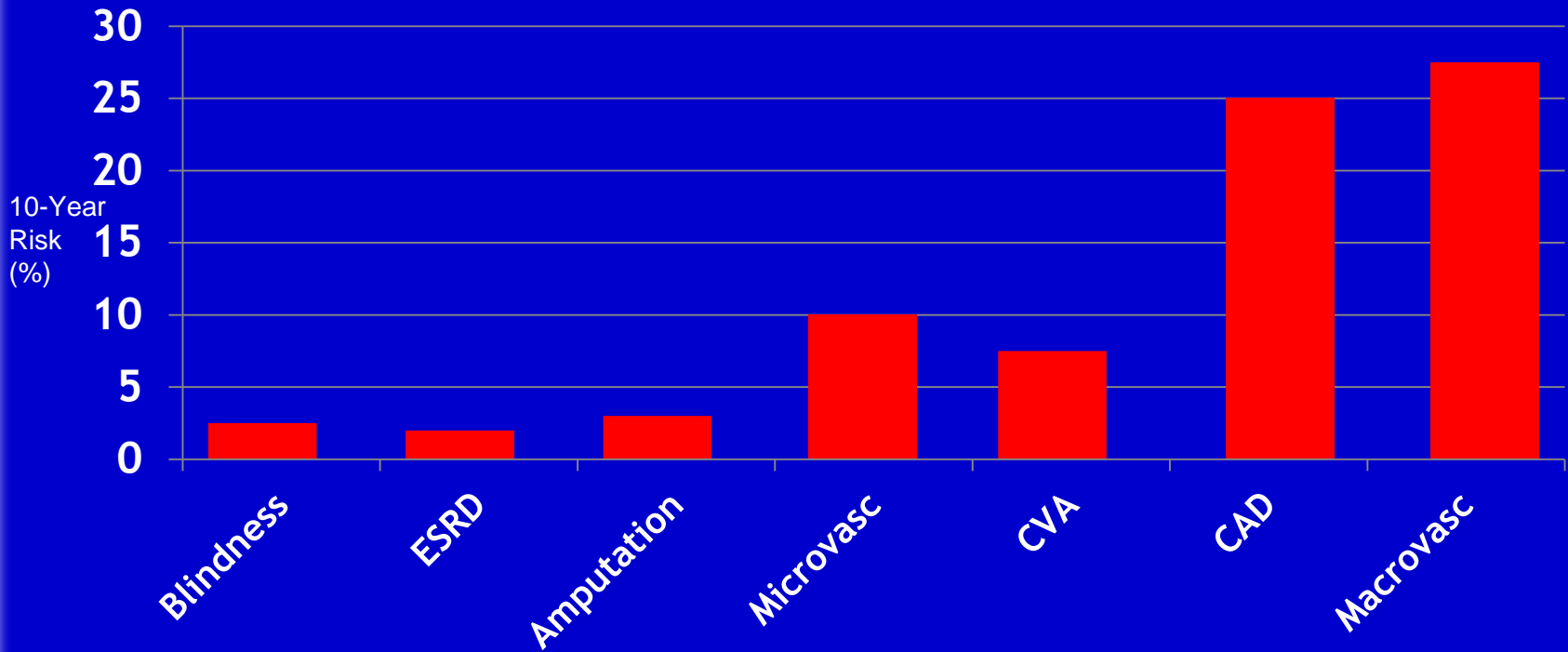




# DIABETES AND CVD

## DIABETES MELLITUS A CARDIOVASCULAR DISEASE

United Kingdom Prospective Diabetes Study (n=3867)





# Diabetes

the challenge...  
Silent Ischemia



# Diabetes

50% of patients with type 2  
diabetes have preexisting  
CAD



# Diabetes

50% with atypical  
Or  
No symptoms



# Diabetes

1 / 3 diagnosed when  
presenting with ACS



# Diabetes

**More severe disease**  
**Microvascular disease**



# Diabetes

Worse  
Outcomes



# Diabetes

PAD



# Diabetes

2005 -  
Underdiagnosed and  
Undertreated



# Diabetes

2025 - Still  
Underdiagnosed and  
Undertreated



Pad in primary care

**PARTNERS TRIAL**

**PAD IN PRIMARY CARE**

## PARTNERS TRIAL

- Patients > 70 years of age
  - Patients > 50 with h/o diabetes or smoking
- (Using ABI)

# Ankle Brachial Index

ABI = Lower Extremity Systolic BP  
Brachial Artery Systolic BP

95% Sensitive; 99% Specific

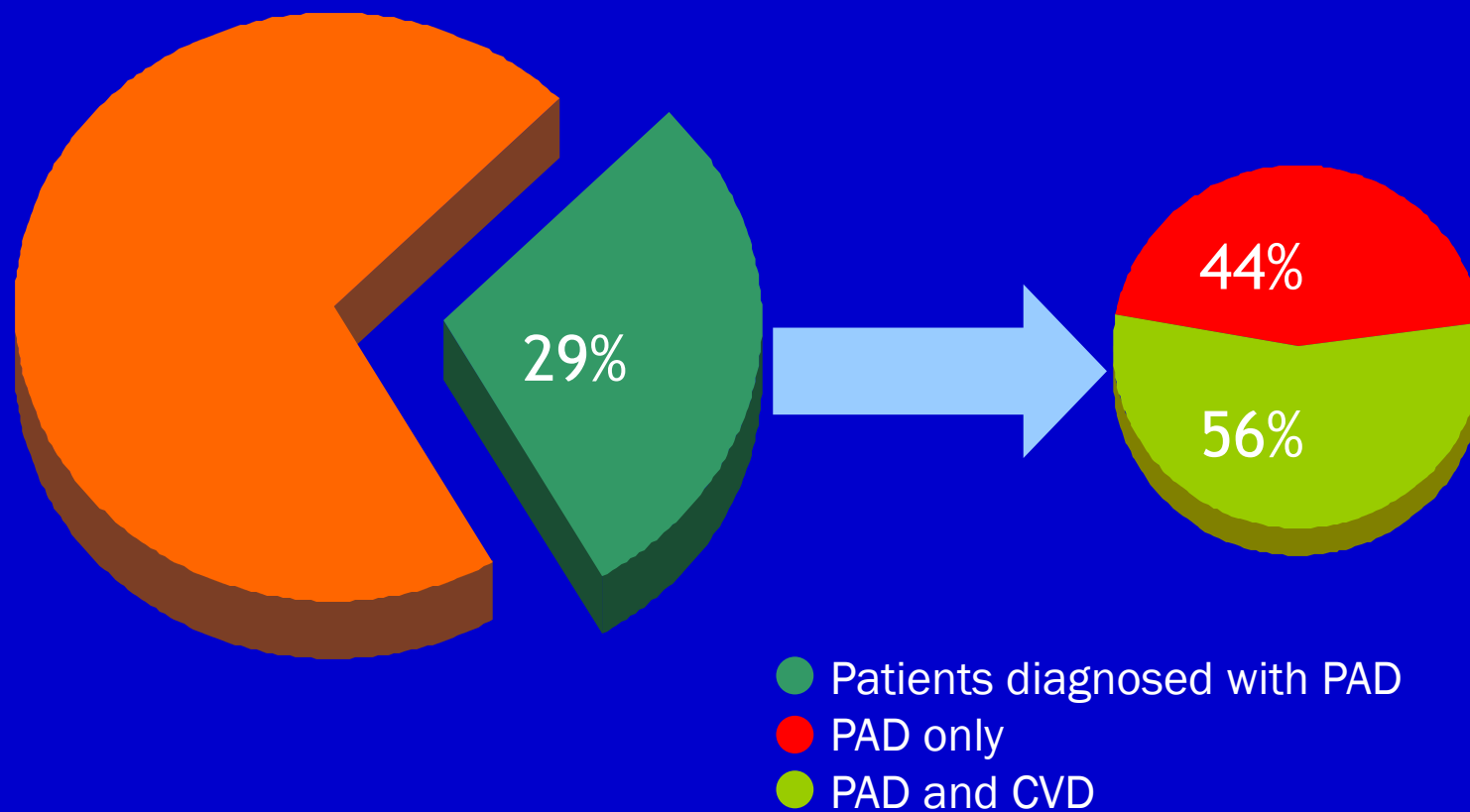


**Normal 0.9 – 1.2**

**PAD < 0.9**

# PARTNERS: Prevalence of PAD and Other CVD in Primary Care Practices

29% of Patients in a Target Population Were Diagnosed With PAD Using An Office-Based ABI



**PAD is a manifestation of  
systemic CVD !**



# Diabetes

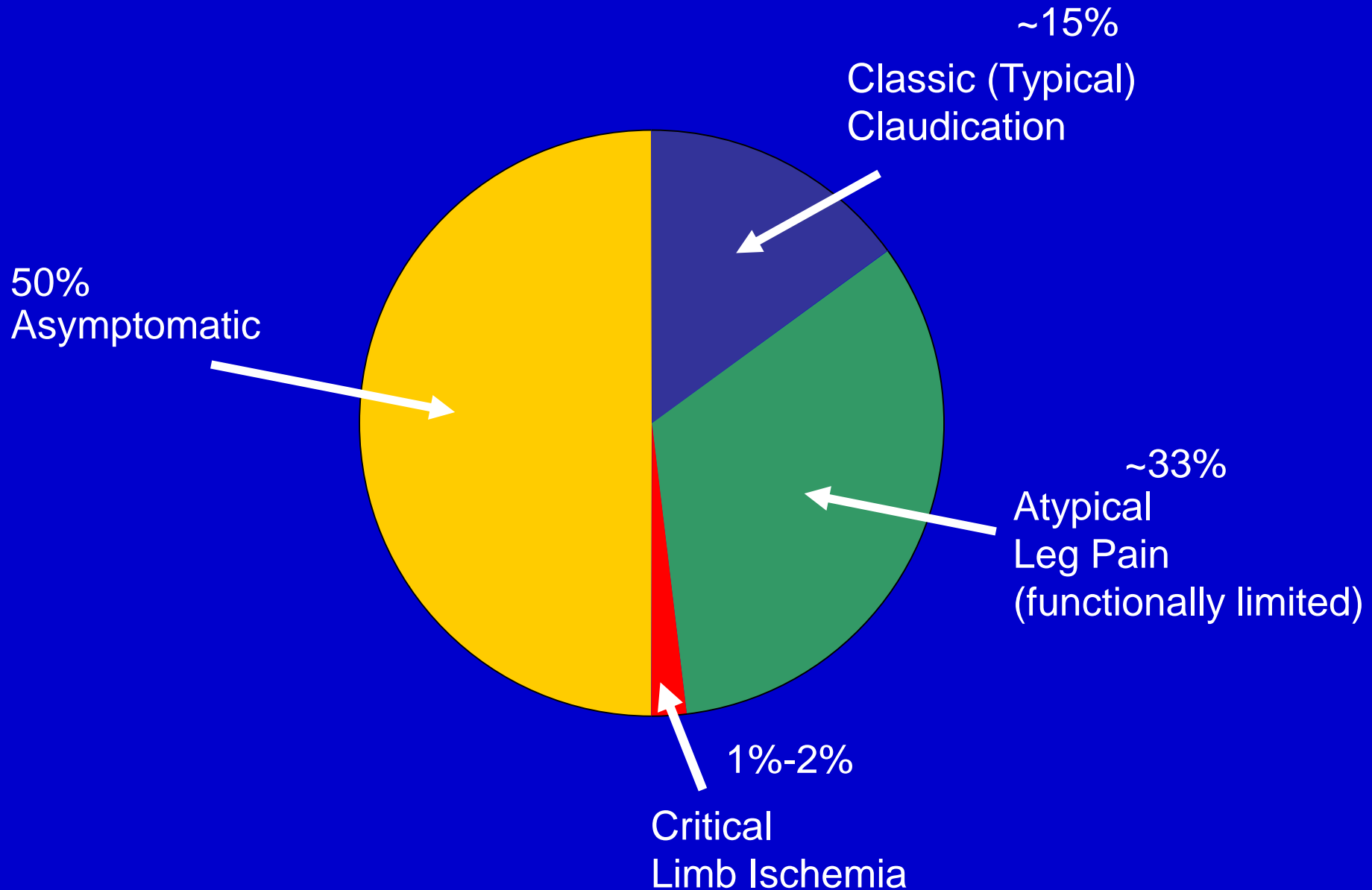
## The Challenge ...



PAD

“Intermittent  
Claudication”

# Clinical Presentations of PAD



# PAD

**When your  
patient says he  
gets cold feet...**





# Signs & Symptoms

Any exertion or limitation of the lower extremity muscles or any history of walking impairment (fatigue, aching, numbness, or pain in the buttock, thigh, calf, or foot)



# Diagnosis

The Most Effective, Accurate  
and Practical Method of  
Detecting PAD

**ABI**

# Ankle Brachial Index

ABI = Lower Extremity Systolic BP  
Brachial Artery Systolic BP

95% Sensitive; 99% Specific



**Normal 0.9 – 1.2**

**PAD < 0.9**



# ABI as a Screening Test

**Table 1. Effectiveness of the ABI vs Other Common Screening Tests**

Diagnostic Test	Sensitivity, %	Specificity, %
Pap smear <sup>37</sup>	30-87	86-100
Fecal occult blood test <sup>38</sup>	37-78	87-98
Mammography <sup>39</sup>	75-90	90-95
ABI <sup>5,35,36</sup>	95	100

Abbreviation: ABI, ankle-brachial index.



PAD

Who needs an ankle  
brachial index ?



# ABI

- Adults > 65 years of age
- Adults > 50 - with CV risk factors or family history of PAD
- Adults < 50 with diabetes and one additional risk factor
- Patients with atherosclerotic disease in other vascular beds
- Patients with signs and symptoms of PAD



# Interpreting the Ankle-Brachial Index

<b>ABI</b>	<b>Interpretation</b>
1.00–1.29	Normal
0.91–0.99	Borderline
0.41–0.90	Mild-to-moderate disease
$\leq 0.40$	Severe disease
$\geq 1.30$	Noncompressible



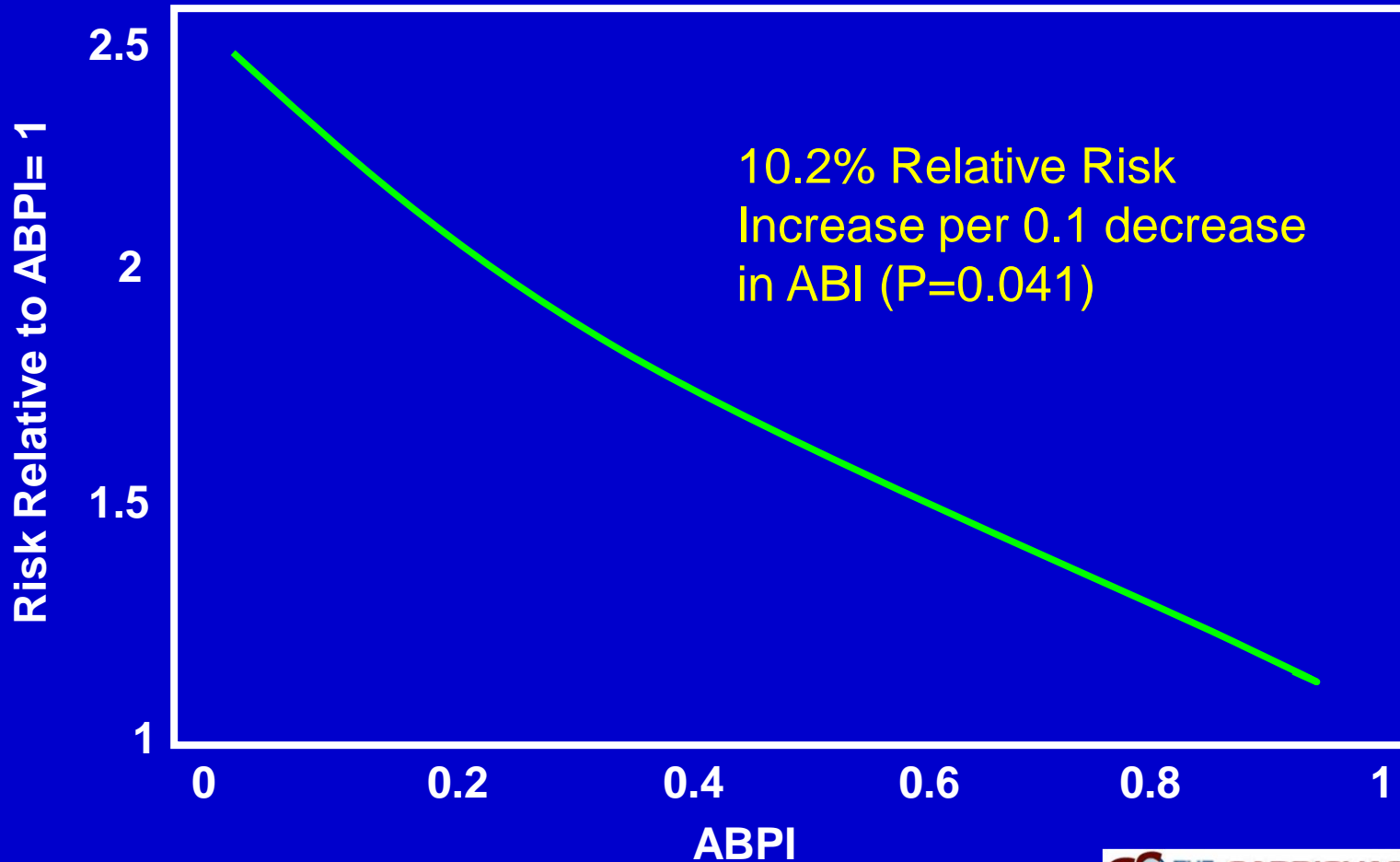
PAD

“The Underappreciated  
Marker of Death”

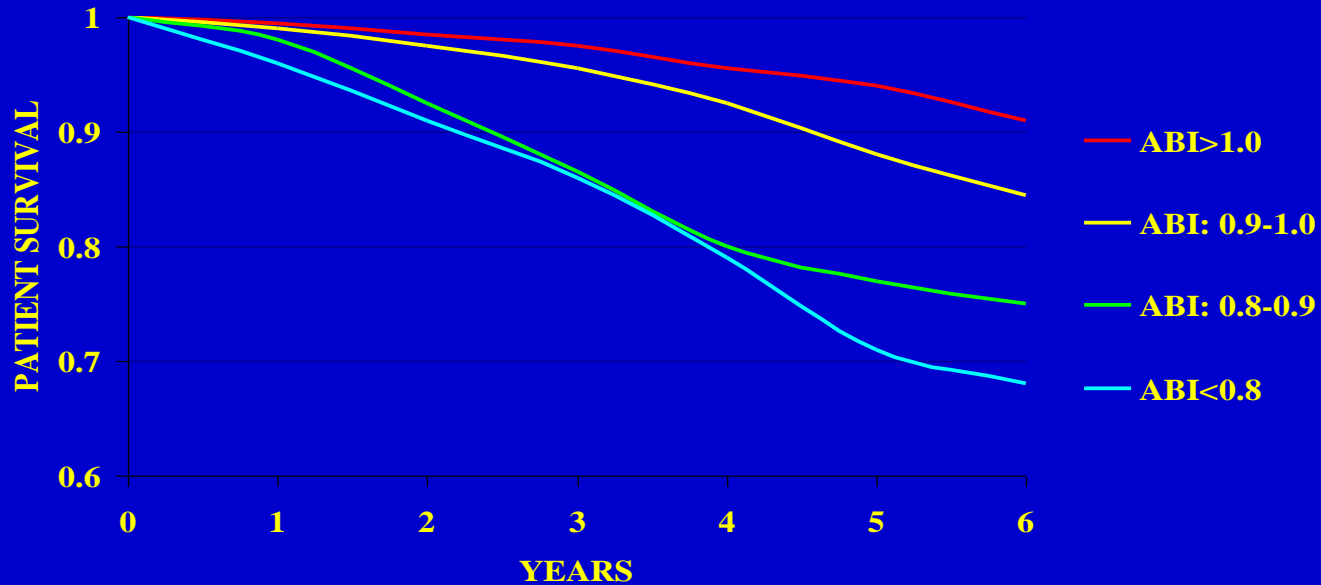
# CAPRIE Study

## ABI Predictor of Ischemic Events

ABI – Inverse Relationship with 3 year risk of Cardiovascular Events and Deaths



# Patient Survival by Ankle-Brachial Index





# DIABETES AND CVD

ABI -

is a poor mans Cardiac cath!



# ABI

ABI = 0.9

5 yr Survival → 91%

ABI < 0.5

5 yr Survival → 63%



# Diabetes

CHF

Upto 30% of Heart Failure  
patients  
are diabetics



# DIABETES AND CVD

*“Diabetic  
Cardiomyopathy”*

## Heart Failure with preserved ejection fraction (HFpEF)



# Diabetes and CV Disease

- HFpEF
- HFrEF
- (symptoms -> echo; BNP)



# Diabetes

Worse  
Outcomes

## DM with HF

5-year mortality is up to 50%



# Diabetes

**DM + HTN =**

**Heart Failure Multiplier**



# Diabetes and CV Disease

“ A diabetic without htn  
is a risk;  
A diabetic with htn is HF  
waiting to happen”



# Diabetes

Having diabetes and  
hypertension, can  
increase risk  
of HF up to 5- 8 times



# Diabetes

CVA

Diabetes is an  
independent risk factor-  
2-4 times more likely to  
experience a stroke



# Diabetes

DM + HTN =

4-5 x higher stroke risk

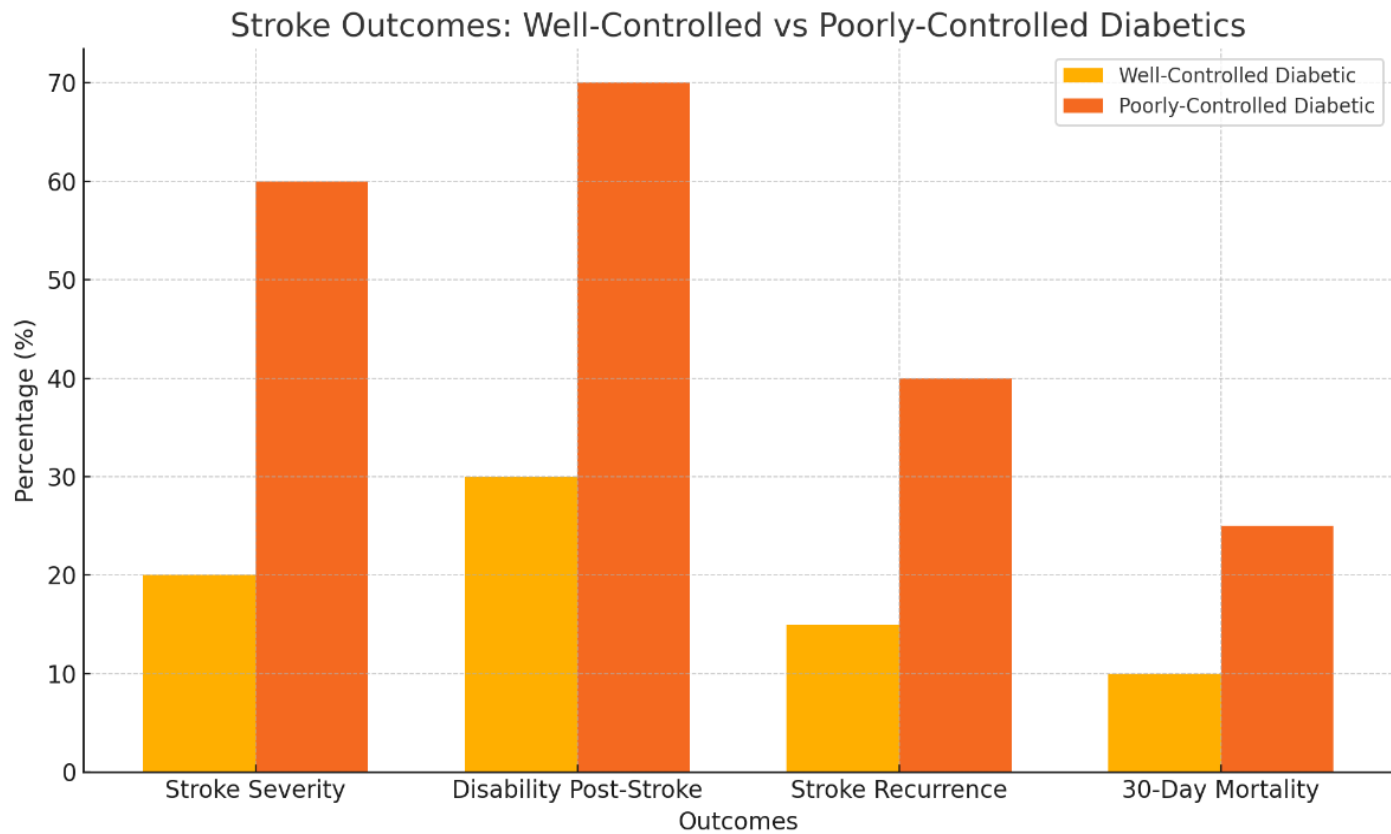
The “triple threat” -  
diabetes, hypertension  
and dyslipidemia accounts  
for > 70% of all strokes



# Diabetes and CV Disease

Worse Outcomes

# Diabetes



# Management

- Education
  - Early Identification
  - Aggressive Management



# DIABETES AND CVD

## Treatment of CV Risk Factors

ABC'S

**A**

- A1C and Aspirin

**B**

- Blood Pressure

**C**

- Cholesterol and Cigarettes

DEF

**D**

- Pre-Diabetes

**E**

- Exercise

**F**

- Food Choices

## LIFESTYLE MODIFICATION

- Smoking
- Alcohol Consumption
  - Weight Loss
  - Exercise

## LIFESTYLE MODIFICATION

- Smoking
- Alcohol Consumption
  - Weight Loss
  - Exercise



# ASA in Diabetics - PRIMARY PREVENTION

# ASPIRIN



# CAD

## ASA – Primary prevention -Diabetics

**NOT ROUTINELY  
RECOMMENDED!**



# CAD

## ASA – Primary prevention -Diabetics

DM > 50yrs with AT LEAST one  
additional major CV risk factor  
AND  
Low bleeding risk



# CAD

## ASA – Primary prevention -Diabetics

NOT routinely recommended in patients :

- >70yrs
- High bleeding risk



# BP in Diabetics - PRIMARY PREVENTION

## BLOOD PRESSURE

## PREVENTION:

Tight BP control (UKPDS)

-44% stroke & 56% HF reduction



# BP in Diabetics

Every 10mmHg BP  
reduction =  
12-13% stroke risk  
reduction

Each 10mmHg decrease in mean systolic BP is associated with reduction of:

- 11% for myocardial infarction
- 12% for any diabetic related complication
- 13% for microvascular complications
- 15% for deaths related to diabetes



# BP in Diabetics

< 130/80 mmHg

“Rule of 10s”



# BP in Diabetics

< 140/90mmHg acceptable for:

- Low CV risk patients

OR

- When achieving <130/80 may be burdensome or unsafe



# Treatment Algorithms

**BP > 130/80 mmHg**



**ACE Inhibitor or ARB**



**If still not at goal...**



**Add Ca Blocker  
Then a diuretic**



# BP in Diabetics - PRIMARY PREVENTION

# STATINS



# Diabetes

**LDL-c(CTT)**  
**-21% in major vascular**  
**events/1mm/L**  
**(ACC/AHA/ADA)**



# BP in Diabetics

Statin therapy =

20-25% stroke risk  
reduction



# Statins in Diabetics

## ADA/ACC/AHA

- >Adults 40-75 with Diabetes
  - Moderate Intensity statin
  
- >High risk patients
  - High intensity statin

## GLYCEMIC AGENTS

**GLP-1 Agonist  
SGLT 2 inhibitors**

**- preferably in all patients**



# Diabetes

**PREVENTION:**

**GLP-1/SGLT2i**

**(Empa-reg/Canvas/Declare)**

**-30-38% reduction in HF hosp &  
CV death**



# BP in Diabetics

Both classes reduce CV morbidity and mortality

(beyond glucose control)

>Chose GLP-1 RA for atherosclerotic disease and obesity

>Chose SGLT2i for HF and CKD

**THE FUTURE :**  
**combination therapy =**  
**Dual benefit in CV, renal**  
**and metabolic outcomes**



# Diabetes

GLP-1 + SGLT 2 =

“Peanut butter and jelly of  
diabetes care”



# DIABETES AND CVD

***“Diabetes is NOT destined to cause heart disease-  
UNTREATED risk factors  
are”***

## STENO- 2 TRIAL :

The strongest evidence  
that heart disease is  
preventable in diabetics

## STENO- 2 TRIAL : Intensive Therapy vs usual care in diabetes

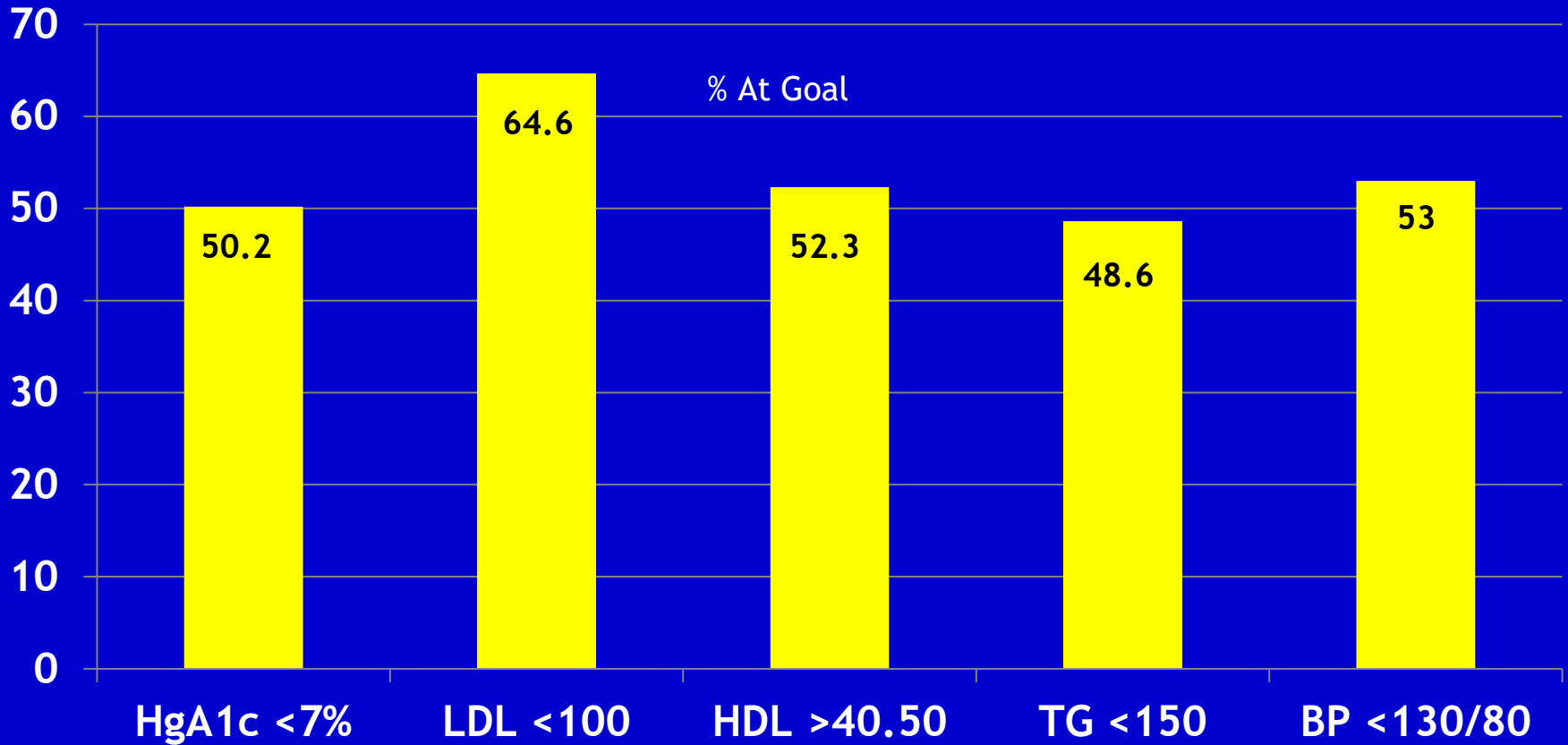
## Steno-2 13 year results:

- >53% reduction in CV events
- >46% in all cause mortality
- >73% in progression to nephropathy



# DIABETES AND CVD

## Under-Treatment of Cardiovascular Risk Factors Amongst U.S. Adults with Diabetes





# DIABETES AND CVD

## Under-Treatment of Cardiovascular Risk Factors Amongst U.S. Adults with Diabetes





# Diabetes

**Thank You !**



# DIABETES AND CVD

***“Diabetes is a  
Cardiovascular Disease”***



# DIABETES AND CVD

*“Diabetes is a  
Cardiovascular Disease”*

**DIABETES is HEART DISEASE**



# Diabetes

- ABI
- TBI

(If abn -> High CV risk)



Diabetes

# Diabetic CARDIOMYOPATHY



# Diabetes

# MEDICAL INTERVENTIONIST!

# KEY Takeaway Points...



# DIABETES AND CVD

## THE SCOPE OF THE PROBLEM

- One out of every 5 health care dollars is spent caring for someone with Diabetes
- One out of every 10 health care dollars is directly attributed to diabetes care
- Diabetes Costs the USA \$174 billion/year  
(↑ 32% since 2002)

*ADA Nov. 2012*



# DIABETES AND CVD

## THE SCOPE OF THE PROBLEM

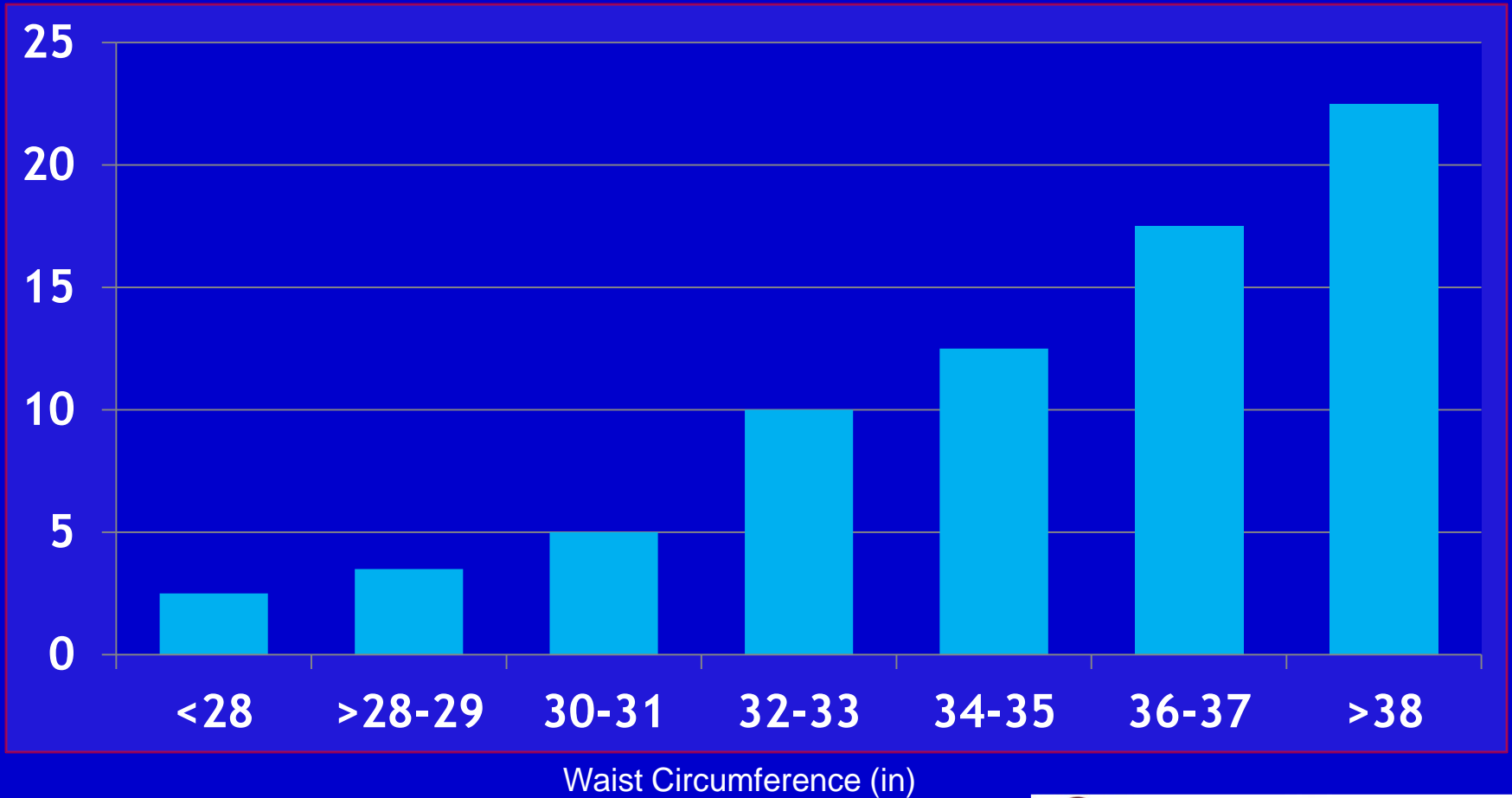
- 23 million Americans have Diabetes  
(~6 million don't know it)
- 57 million have prediabetes
- 1.6 million NEW cases diagnosed each year

*ADA Nov. 2012*



# DIABETES AND CVD

## ABDOMINAL ADIPOSITY IS ASSOCIATED WITH INCREASE RISK OF DIABETES





# DIABETES AND CVD

**TASTE WORTH DYING FOR!®**



**SINGLE BYPASS BURGER®**



**DOUBLE BYPASS BURGER®**



**TRIPLE BYPASS BURGER®**



**QUADRUPLE BYPASS BURGER®**



**BUTTERFAT SHAKE™**

*World's Highest ButterFat Content!*



**FLATLINER FRIES®**

**DEEP FRIED IN PURE LARD!**



**CANDY!**



**BEER  
CIGARETTES  
SODA**

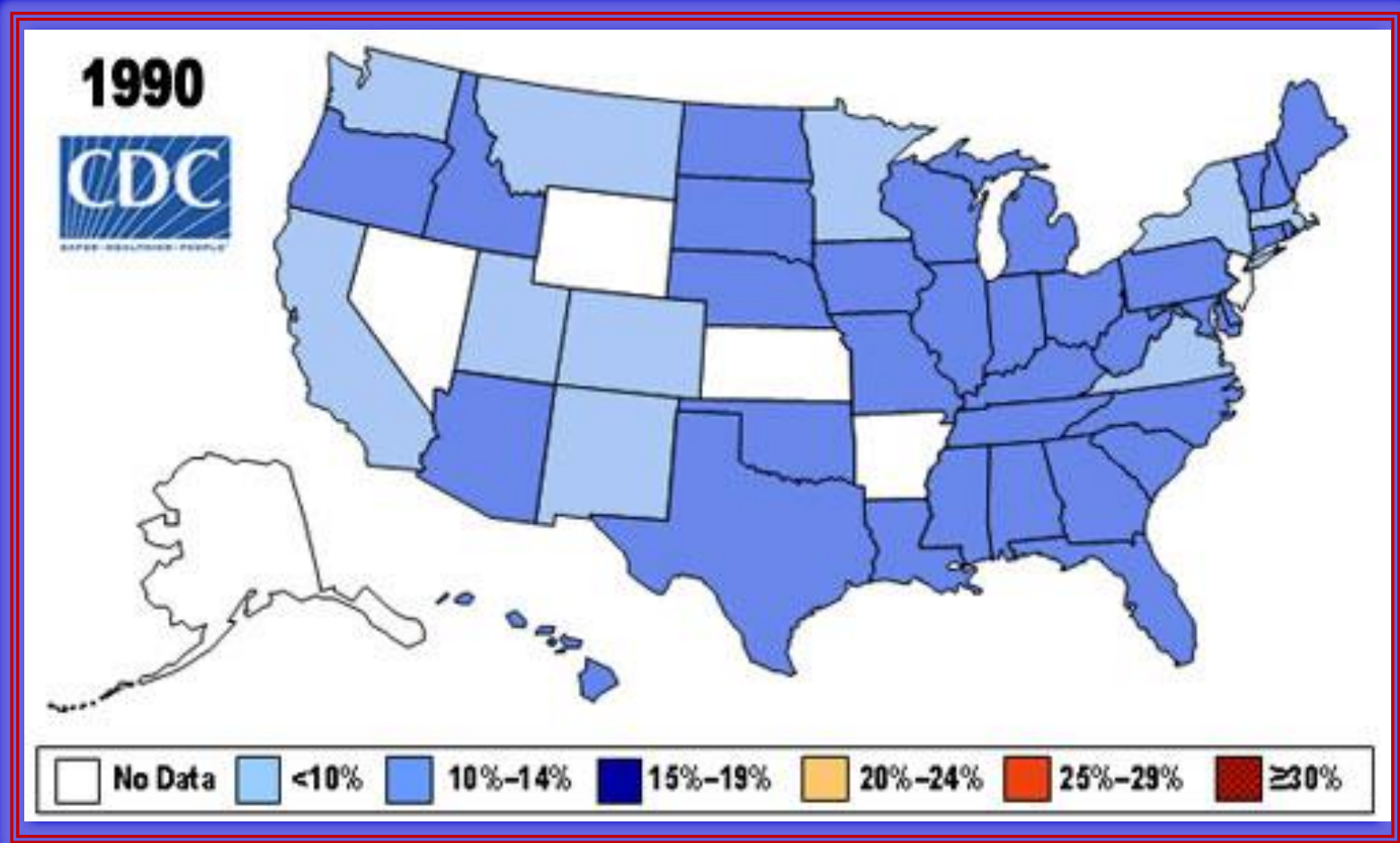
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# DIABETES AND CVD

## OBESITY TRENDS US ADULTS: BRFSS - 1990





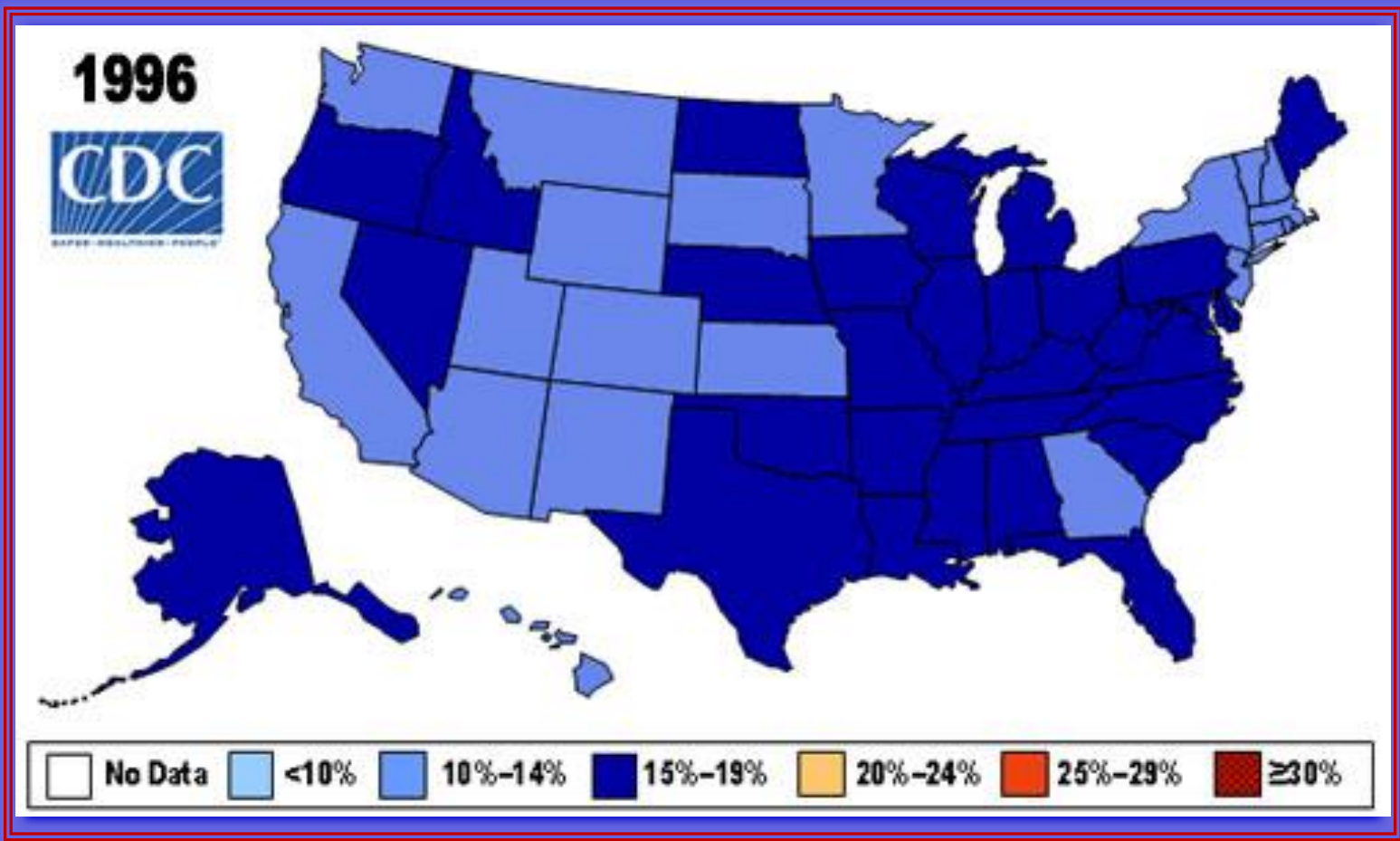
# DIABETES AND CVD

Diabetes -  
  
is HEART DISEASE



# DIABETES AND CVD

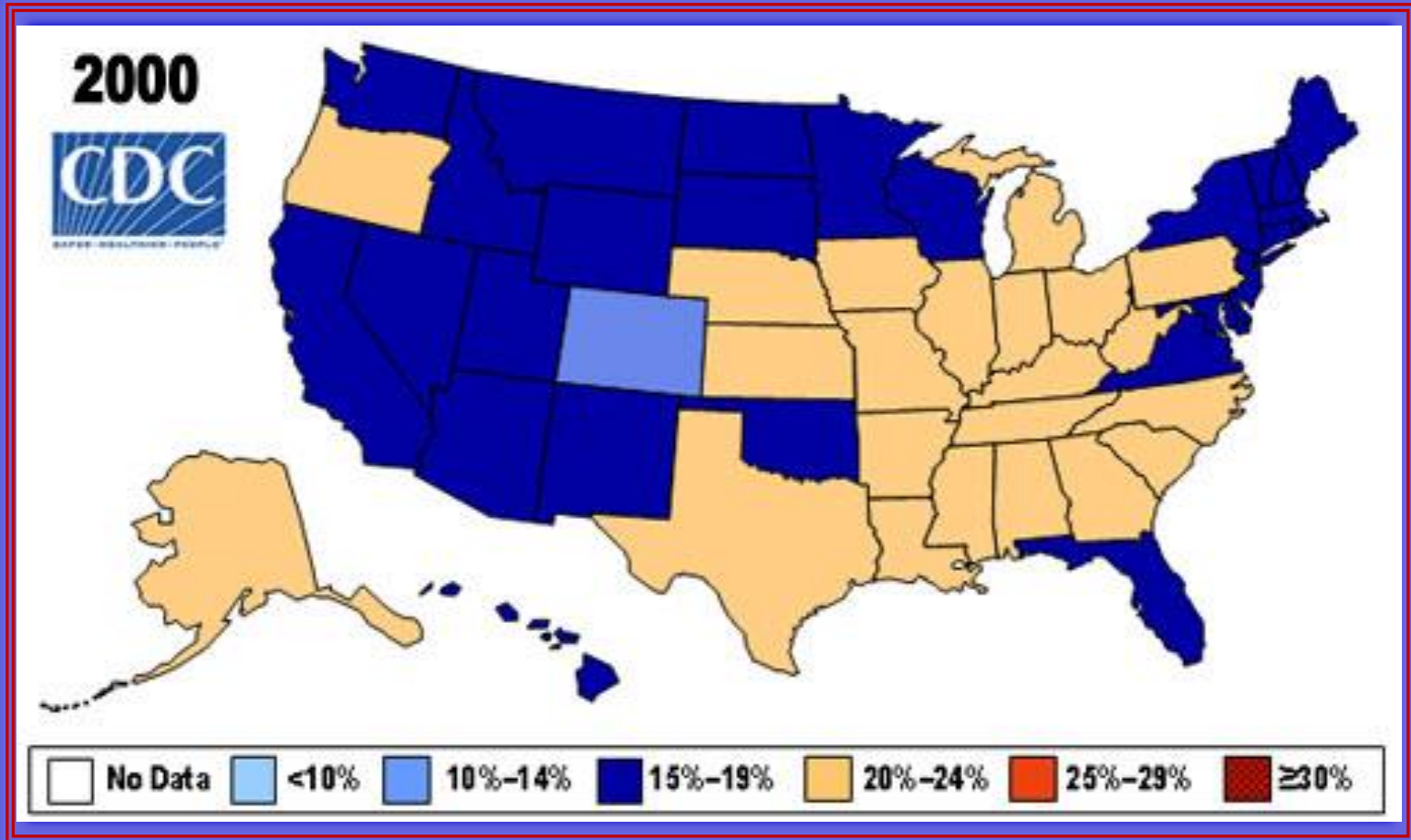
## OBESITY TRENDS US ADULTS: BRFSS - 1996





# DIABETES AND CVD

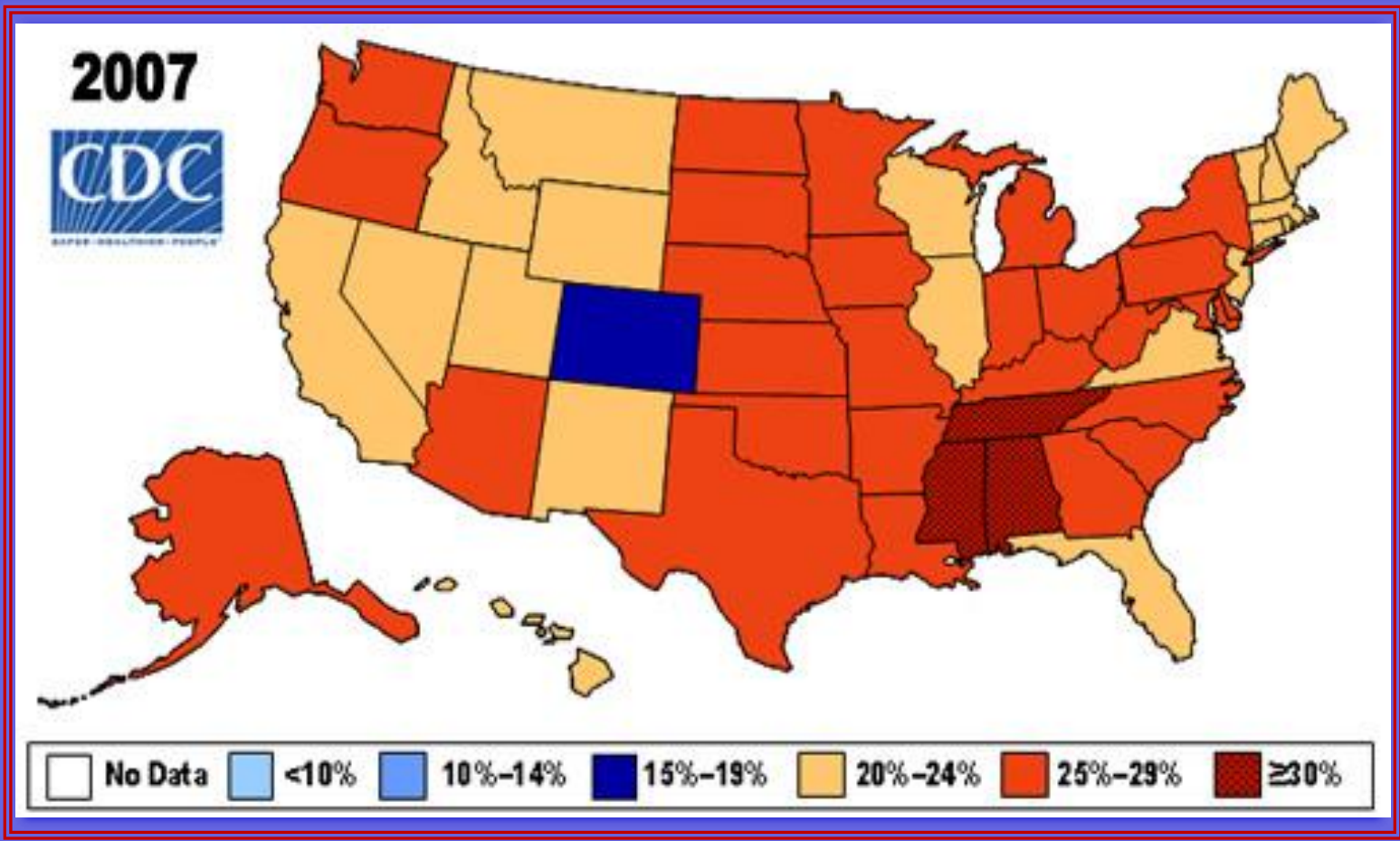
## OBESITY TRENDS US ADULTS: BRFSS - 2000





# DIABETES AND CVD

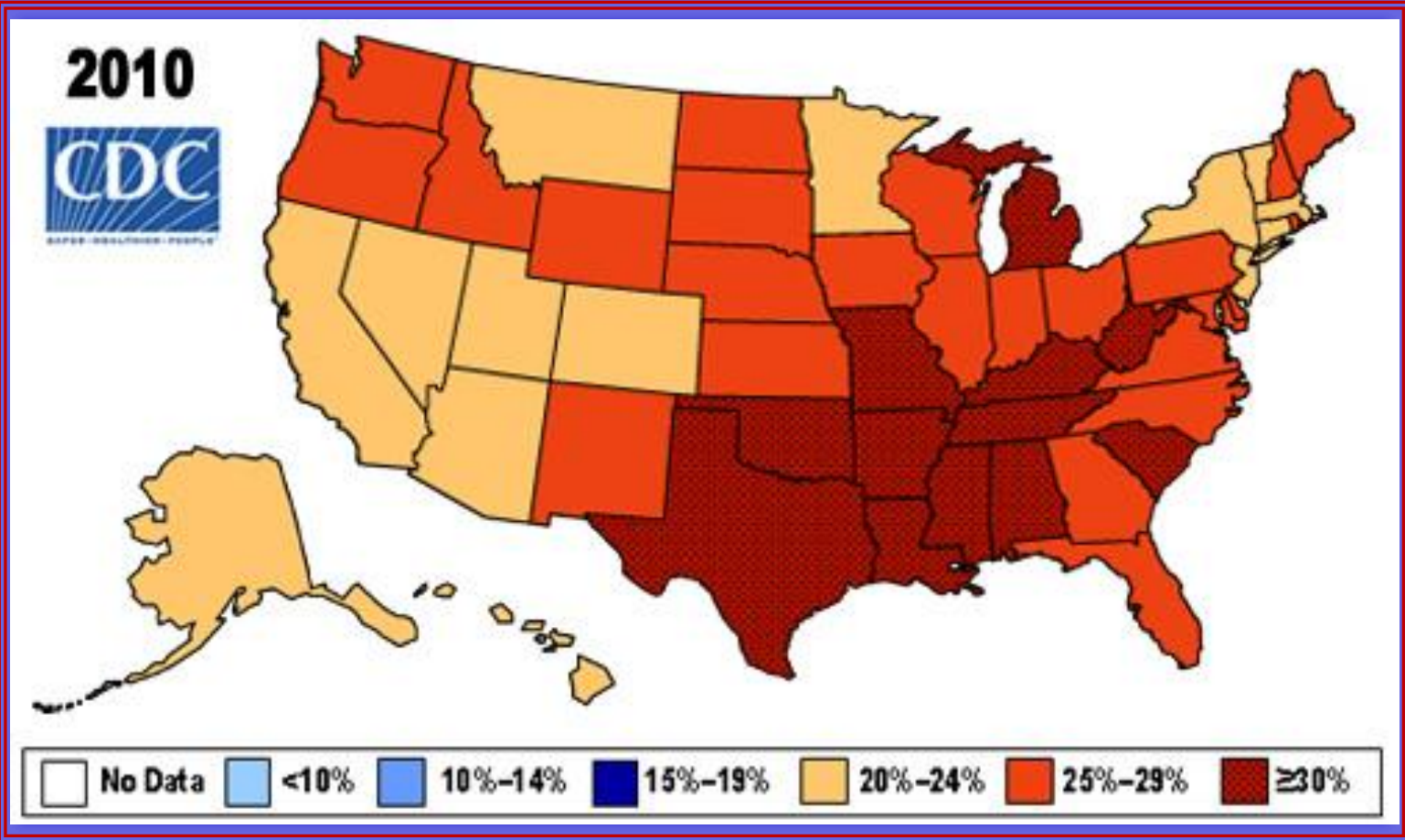
## OBESITY TRENDS US ADULTS: BRFSS - 2007





# DIABETES AND CVD

## OBESITY TRENDS US ADULTS: BRFSS - 2010





# DIABETES AND CVD

1/3 of patients presenting with myocardial infarction have undiagnosed diabetes mellitus

*ACC SAP*



# DIABETES AND CVD

## Artherosclerotic Complications

- 80% of mortality in patients with diabetes
- Results in 75% of hospitalizations for diabetic complications

*ACC SAP*



# DIABETES AND CVD

## *“Diabetic Cardiomyopathy”*



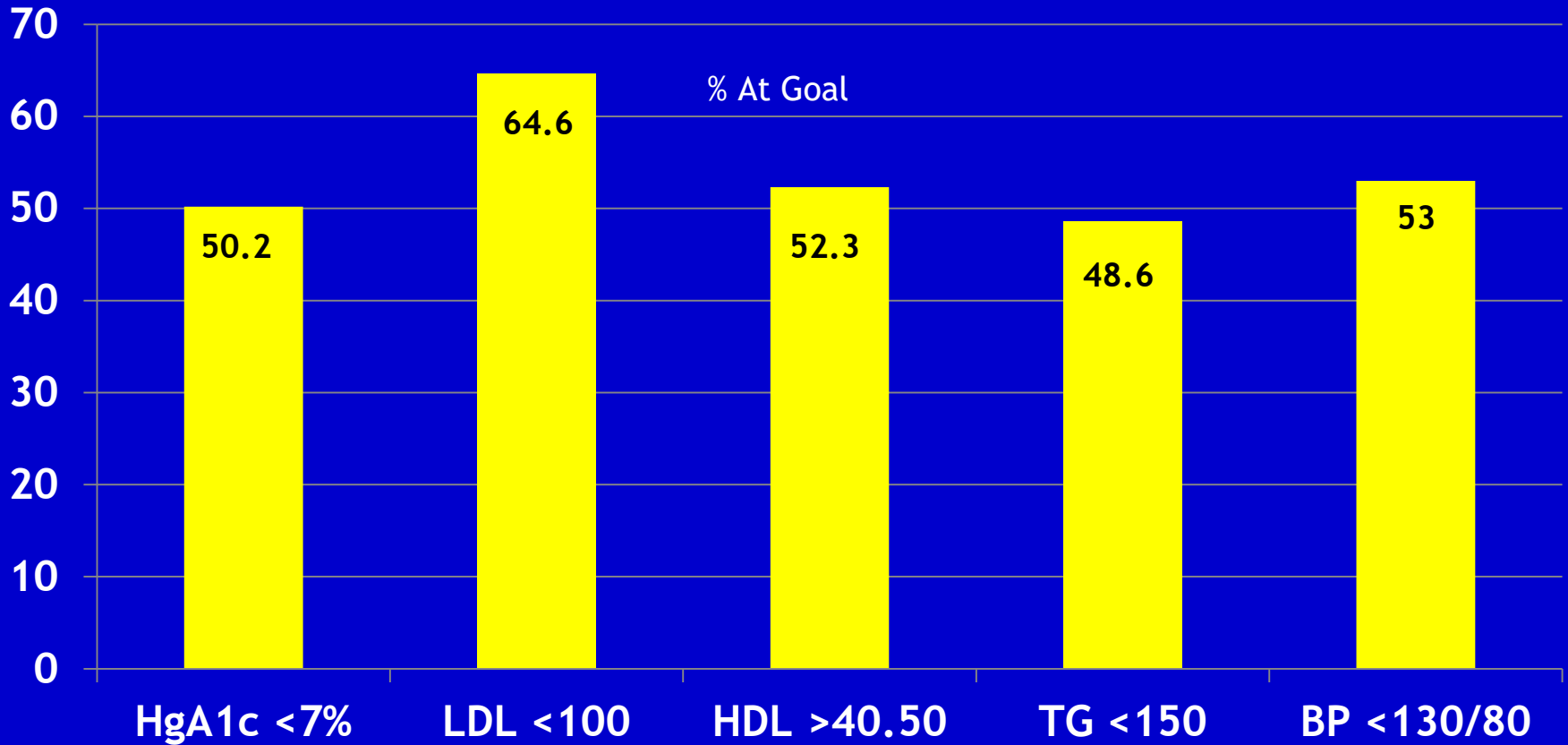
# DIABETES AND CVD

Diabetes -  
A Coronary Risk Equivalent!



# DIABETES AND CVD

## Under-Treatment of Cardiovascular Risk Factors Amongst U.S. Adults with Diabetes





# DIABETES AND CVD

## Treatment of CV Risk Factors

ABC'S

**A**

- A1C and Aspirin

**B**

- Blood Pressure

**C**

- Cholesterol and Cigarettes

DEF

**D**

- Pre-Diabetes

**E**

- Exercise

**F**

- Food Choices



# DIABETES AND CVD

## 2009 ADA/AHA/ACC Statement Recommendations

- Goal of A1C <7% (remains reasonable)
- Incremental microvascular benefit from even lower goals
- Less stringent goals for those with labile glucose control or advanced disease



# DIABETES AND CVD

## Treatment of CV Risk Factors

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# CAD

## **ASA – Primary prevention**

Low dose (75 -162mg)  
may be considered:

- 50-70 yrs with one additional  
risk factor

AND

Low bleeding risk



# DIABETES AND CVD

## Treatment of CV Risk Factors

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# DIABETES AND CVD

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# DIABETES AND CVD

## Diagnosis:

Standard definition for Hypertension  
 $\geq 140 / 90$  mmHg

**ADA recommends < 130 / 80 mmHg for  
Hypertensive Diabetic Patients**



# DIABETES AND CVD

## Treatment Algorithm

Goal:  $< 130/80$  mmHg

130 - 139	80 - 89	Behavioral Treatment <b>Max: 3 mo</b>
$> 140$	$> 90$	Drug Therapy

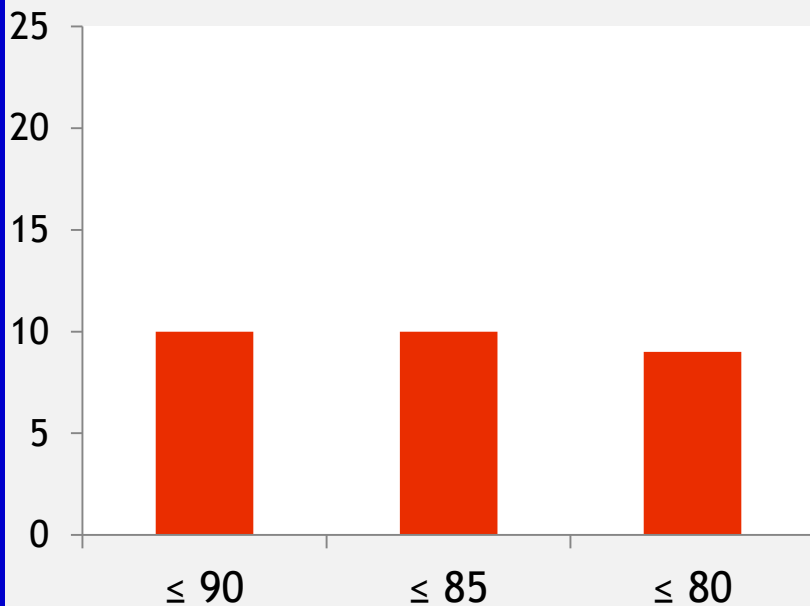


# DIABETES AND CVD

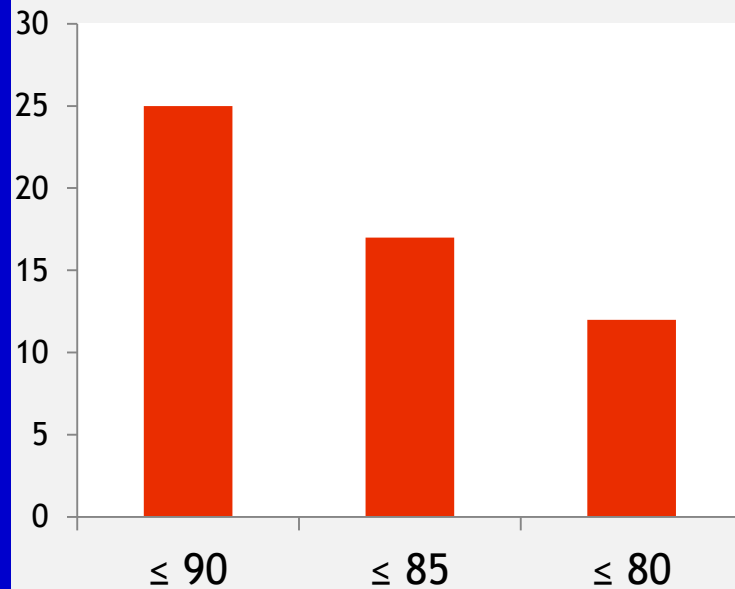
## HOT Trial: Effect of BP Control on CV Event Rate

Major CV Events Per 1000 Patient Yrs

### Overall Study Cohorts



### Patients with Diabetes

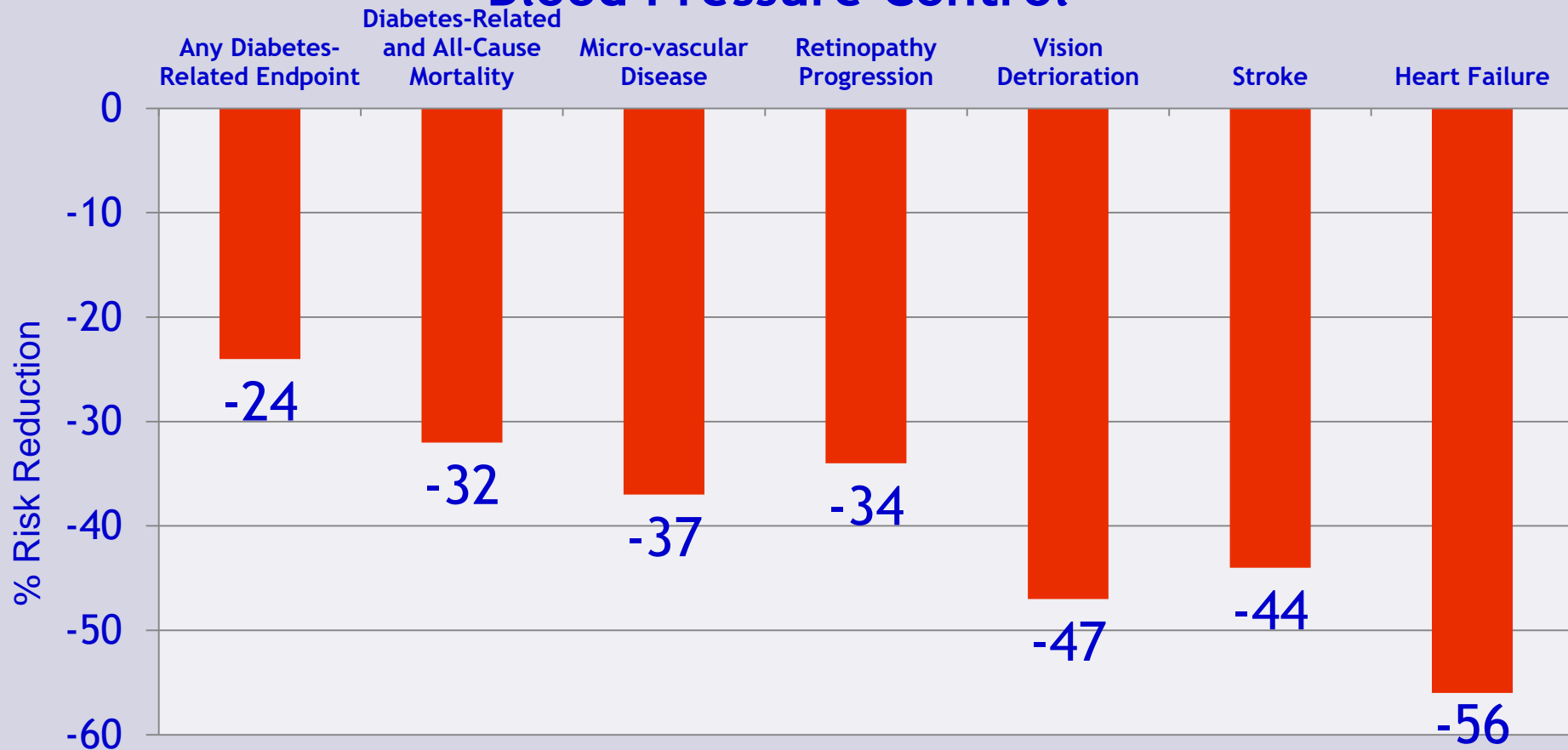


Diabetes Blood Pressure Goal



# DIABETES AND CVD

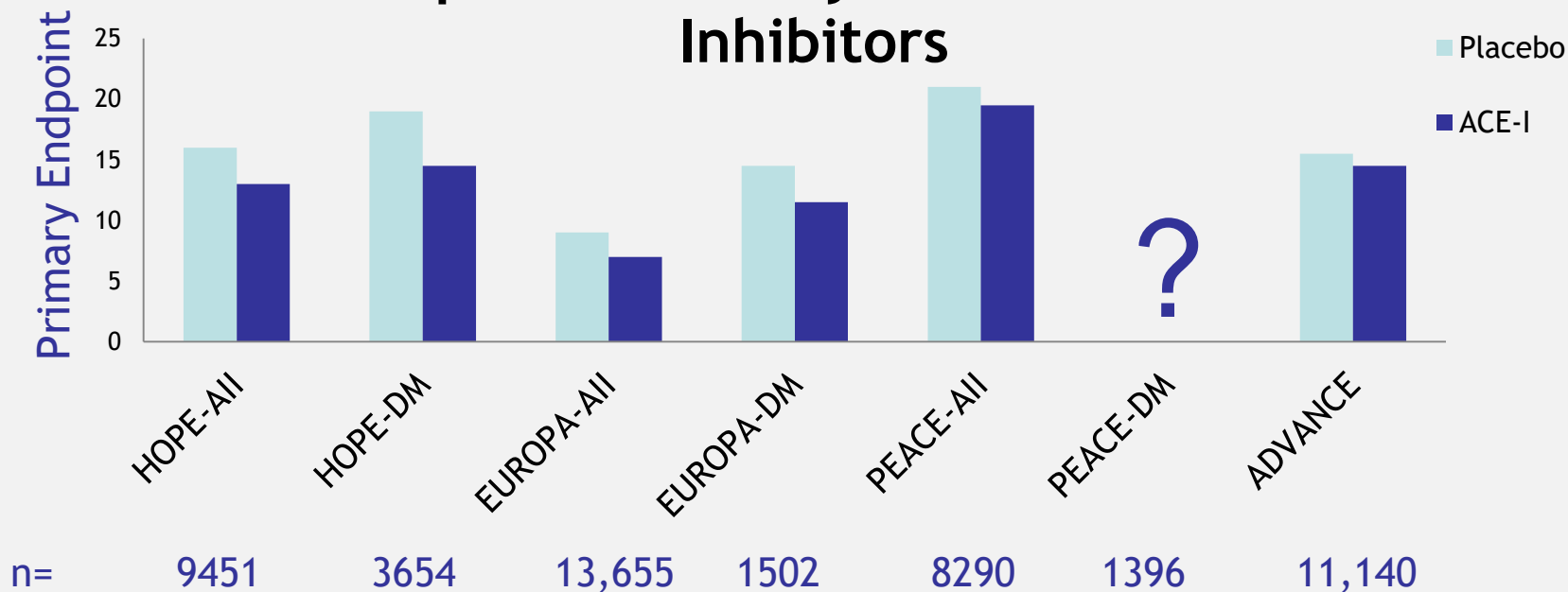
## UKPDS: Effects of Tight vs. Less-Tight Blood Pressure Control





# DIABETES AND CVD

## Therapeutic Efficacy in Diabetes: ACE Inhibitors



\*Experimental therapy was ACEI plus indapamide



# DIABETES AND CVD

## Treatment of CV Risk Factors

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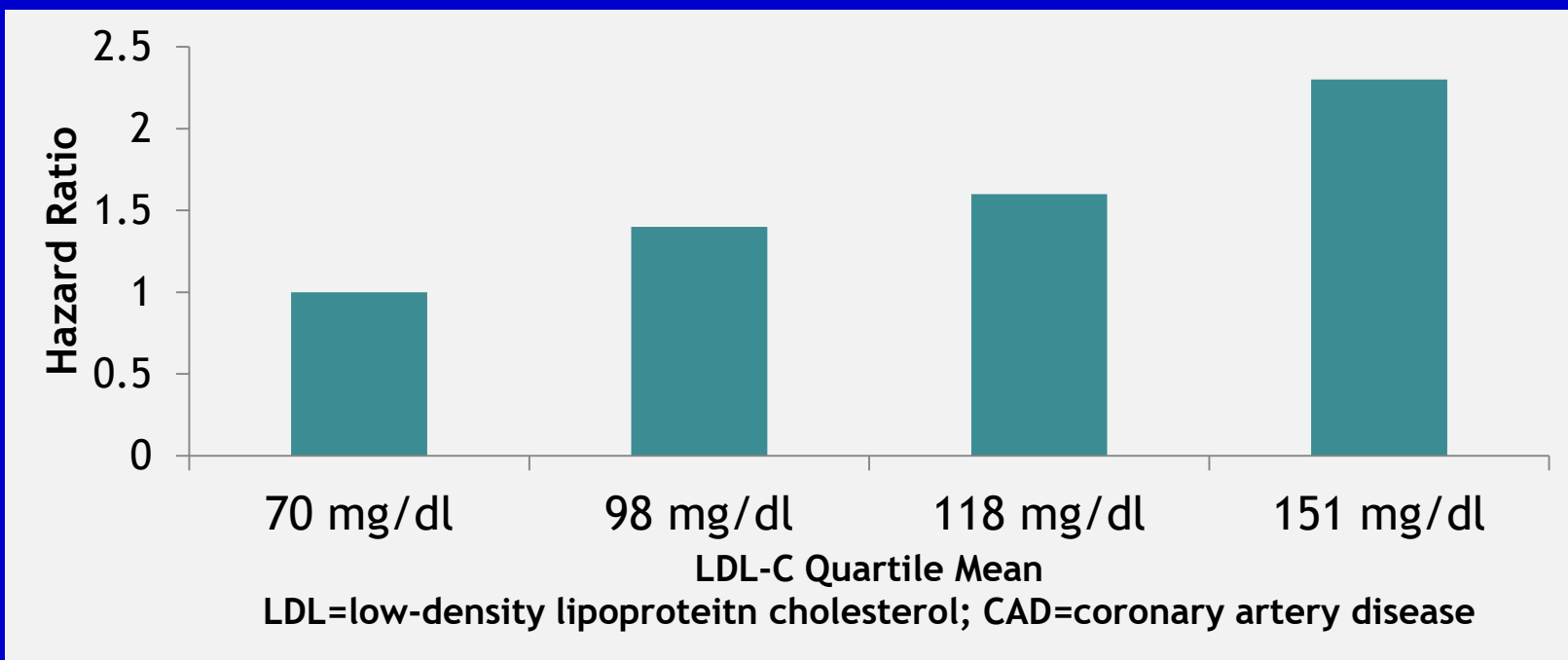
**F**

- Food Choices



# DIABETES AND CVD

## LDL-C as a Predictor of CAD in Patients with Diabetes



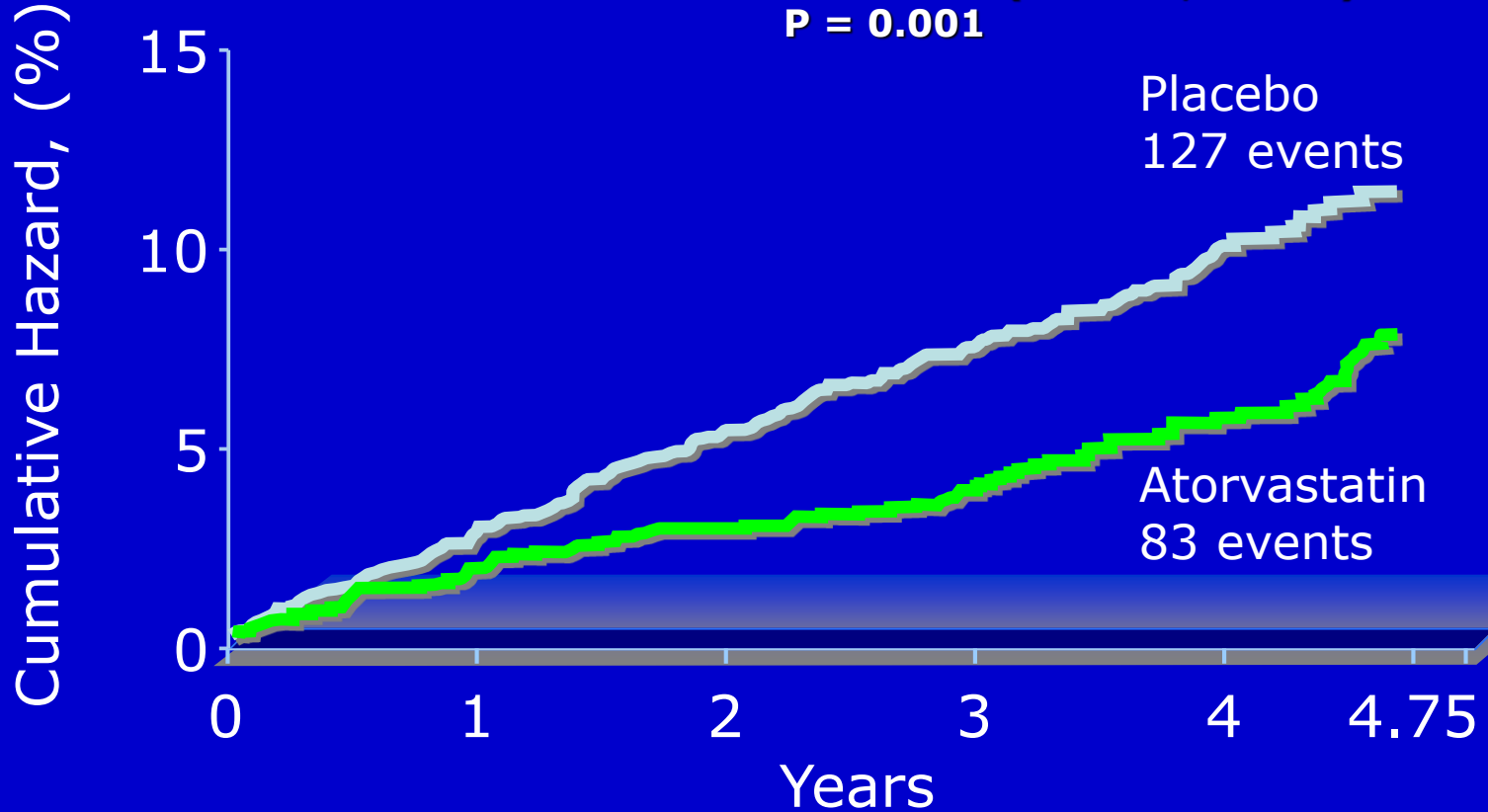


# DIABETES AND CVD

## CARDS: Primary Endpoint

Relative Risk Reduction 37% (95% CI, 17-52)

P = 0.001



Placebo	1410	1351	1306	1022	651	305
Atorvastatin	1428	1392	1361	1074	694	328



# DIABETES AND CVD

## Reducing CVD Risk with Statin Therapy in Patients with Diabetes

- Number needed to treat to prevent 1 major CVD event
  - From meta-analysis
    - Without vascular disease 39
    - With vascular disease 19



# DIABETES AND CVD

## STATIN THERAPY

### SECONDARY PREVENTION

- With Overt CVD

### PRIMARY PREVENTION

- Age > 40 with one additional Risk Factor



# DIABETES AND CVD

## Lipid Treatment Goals for Patients with Type 2 Diabetes

	ADA 2010	ATP III
LDL (mg/dl)	<100 <70 highest risk	<100 <70
TG (mg/dl)	<150	<150
HDL (mg/dl)	>50 >40	*
Non HDL (mg/dl)	<130	<130



# DIABETES AND CVD

## Specific Dyslipidemias: Elevated Triglycerides

### Non-HDL: Secondary Target

- Non-HDL = TC - HDL
- Non-HDL: secondary target of therapy when serum triglycerides are  $\geq 200$  mg/dL (esp. 200-499 mg/dl)
- Non-HDL goal: LDL goal + 30 mg/dL



# DIABETES AND CVD

## Treatment of CV Risk Factors

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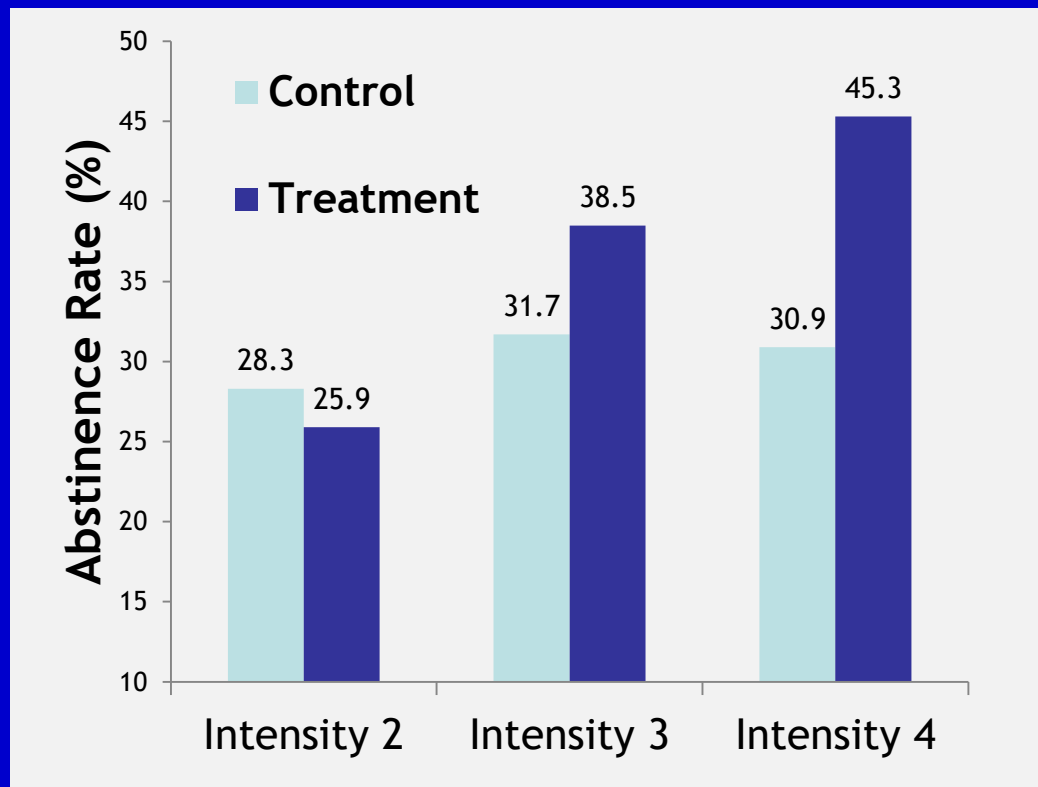
**F**

- Food Choices

# DIABETES AND CVD

## Effectiveness of Smoking Cessation Interventions of CVD Admissions

- Smoking cessation intervention
  - MI = “teachable moment”
  - JCAHO/CMS core measure for MI care
- Meta-analysis of 18 RCTs in CVD, by intensity of intervention
- Only extended support improved abstinence



Summary OR  
95% CI

1.14  
0.9-1.4

1.07  
0.7-1.6

1.81  
1.5-2.2



# DIABETES AND CVD

## Treatment of CV Risk Factors

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# DIABETES AND CVD

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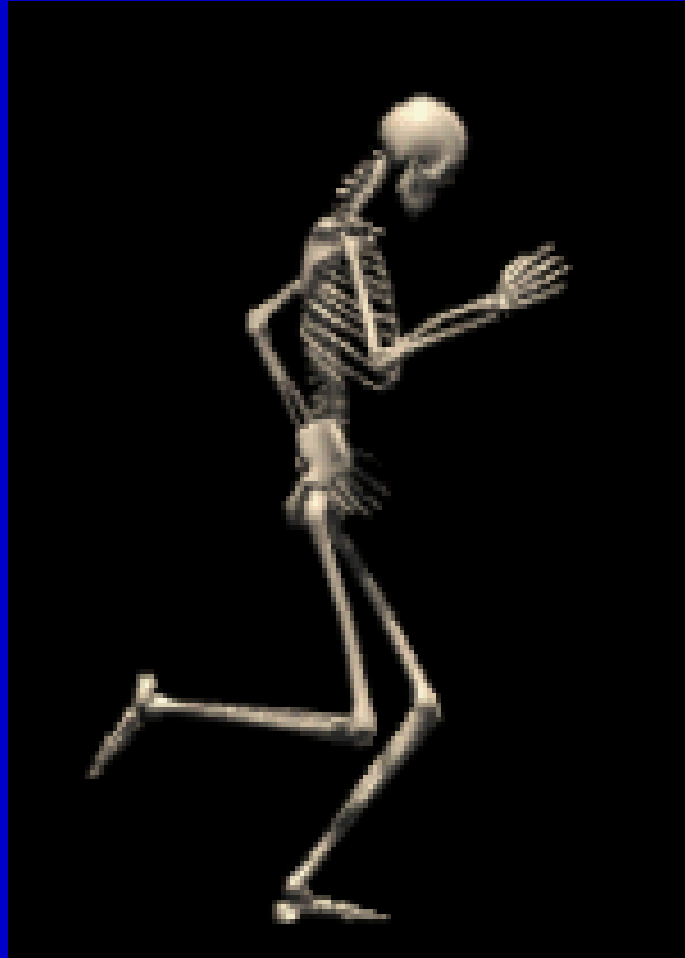
- Exercise

**F**

- Food Choices



# DIABETES AND CVD



# DIABETES AND CVD

## Take and Exercise History and Encourage Increased Physical Activity

- Brisk walking is an ideal physical activity for those without orthopedic issues
- Walking uses the patient's increased body weight to increase energy expenditure
- Pedometers provide daily feedback -



10,000 Steps Per Day

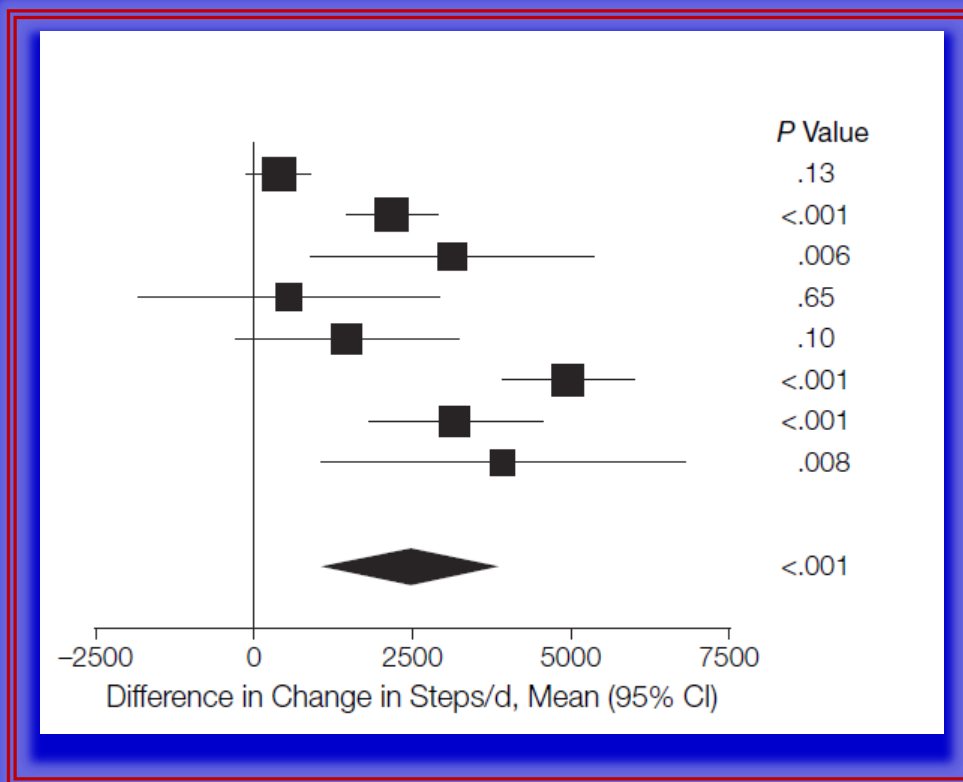


# DIABETES AND CVD

## RCT Trial Assessment of Pedometer Interventions

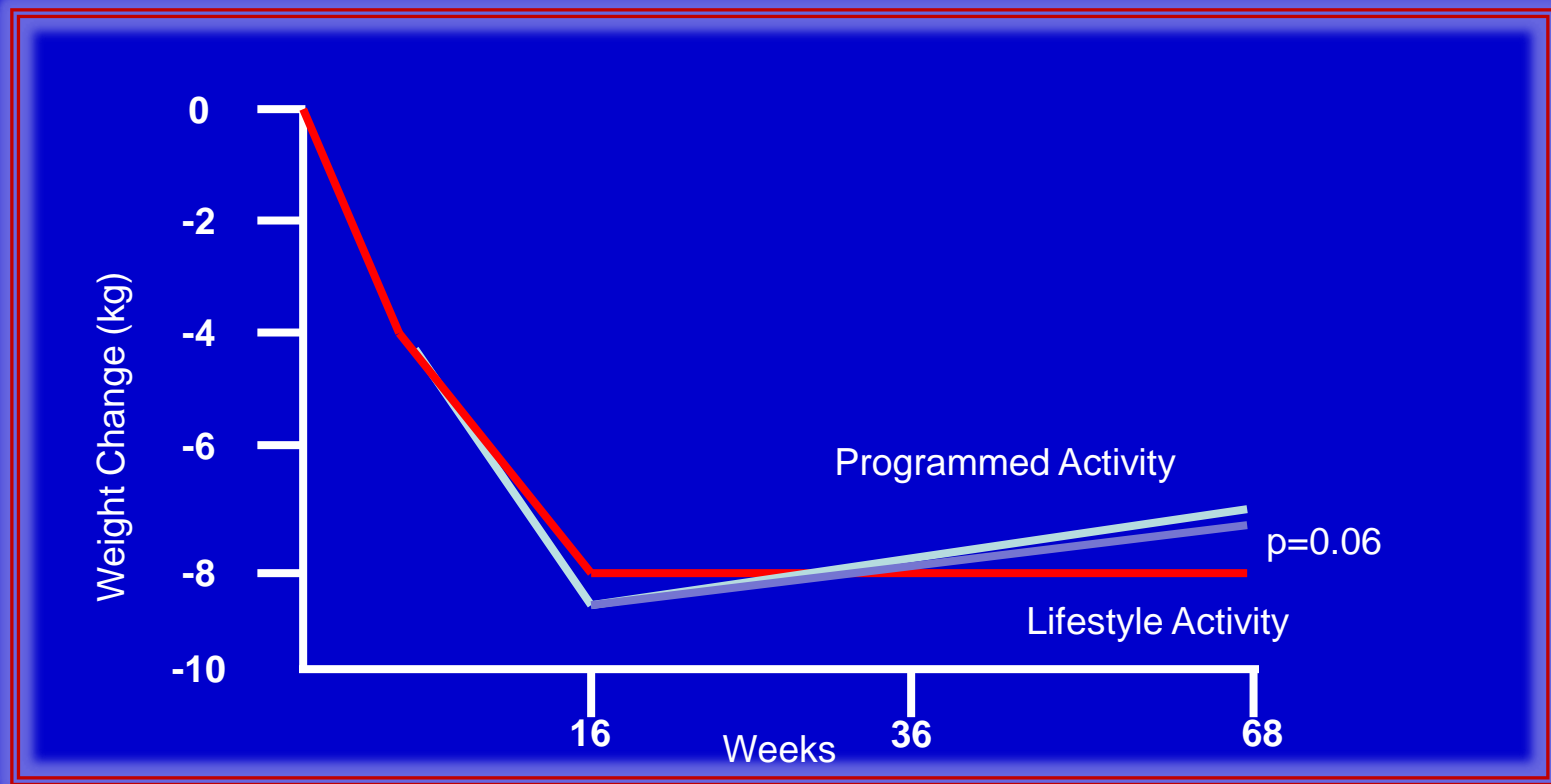
N=277; 8 Trials

Pedometer increase steps by 2500/day



# DIABETES AND CVD

## LIFESTYLE ACTIVITY AS AN ALTERNATIVE TO “WORKING OUT”





# DIABETES AND CVD

## PHYSICAL ACTIVITY RECOMMENDATIONS

MODE OF EXERCISE	INTENSITY	FREQUENCY	DURATION	CLASS
Cardio-Respiratory (Large Muscle)	Moderate Intensity	3 - 7 d/week	150 min/week	1(A)
Cardio-Respiratory (Large Muscle)	Vigorous Intensity	3 d/week	90 min/week	1(A)
Resistance	2 - 4 Sets 8 - 10 Reps	3 d/week		1(A)



# DIABETES AND CVD

## Treatment of CV Risk Factors

ABC'S

**A**

- A1C and Aspirin

**B**

- Blood Pressure

**C**

- Cholesterol and Cigarettes

DEF

**D**

- Pre-Diabetes

**E**

- Exercise

**F**

- Food Choices



# DIABETES AND CVD

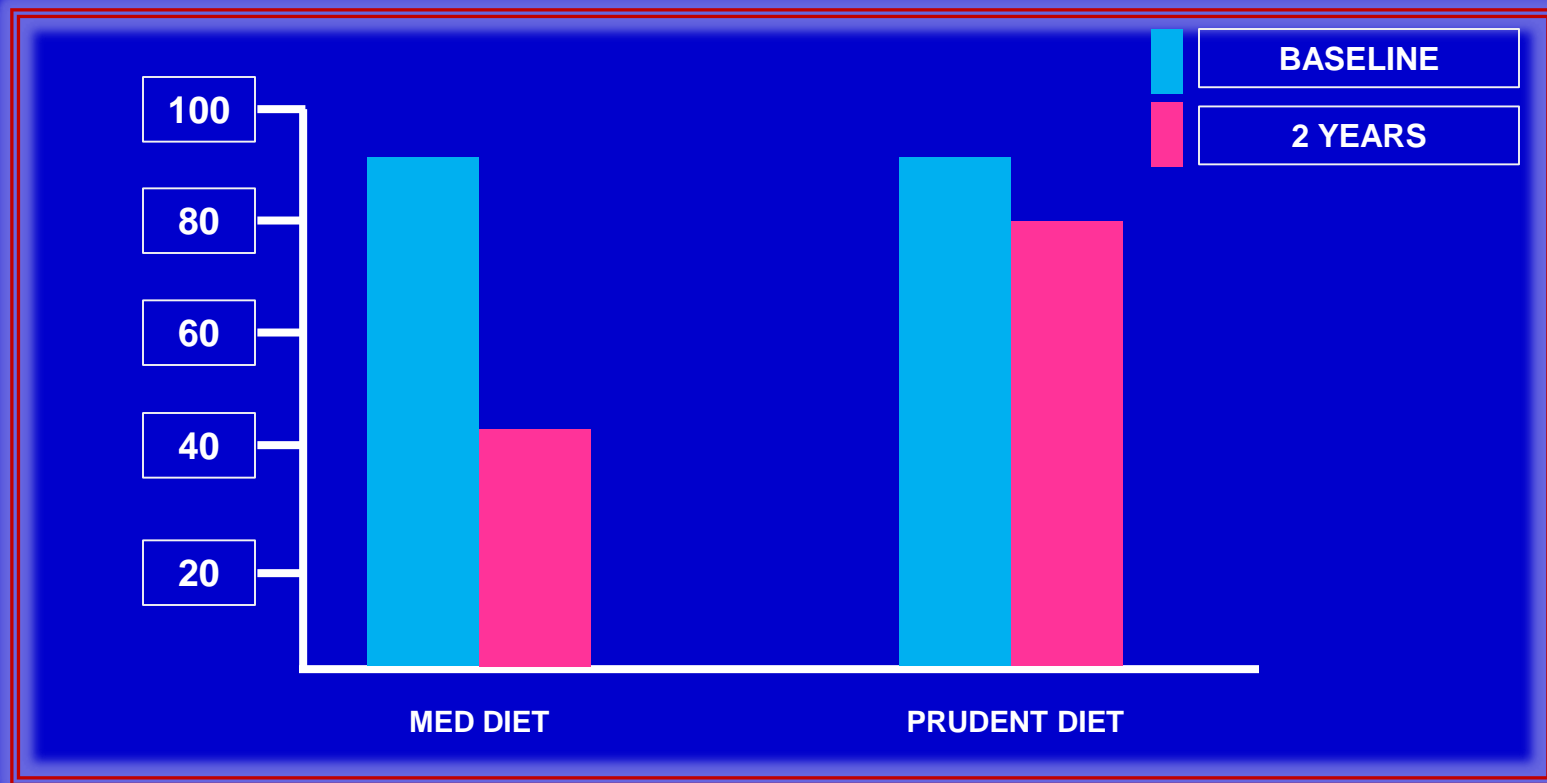
## Food Choices

### Medical Nutritional Guidelines (MNT)

*ALL Patients who have or are at risk for diabetes  
should receive Medical Nutritional Therapy  
(ADA Nutritional Guidelines)*

# DIABETES AND CVD

## EFFECT OF MEDITERRANEAN – STYLE DIET IN THE METABOLIC SYNDROME





# DIABETES AND CVD

## CLINICAL PEARLS



# DIABETES AND CVD

## CLINICAL PEARLS



# DIABETES AND CVD

## CLINICAL PEARLS

### PATIENT WITH DIABETES

- THINK Cardiovascular Disease



# DIABETES AND CVD

## CLINICAL PEARLS

### PATIENT WITH DIABETES

- THINK Aspirin, Statin and Ace Inhibitor



*Shasta Regional Medical Center presents*

# **THE ART & SCIENCE OF DIABETES** SYMPOSIUM 2012

**6 Hours of  
CME / CE  
Credit**



**Target Audience: Physicians, Physician Assistants, Nurse Practitioners & health care providers in the care and management of diabetes.**

# **SATURDAY, SEPTEMBER 22, 2012**

# THE SCOPE OF DIABETES

From the year 2000, one in three Americans, and one in two minorities, will develop diabetes in their lifetime.



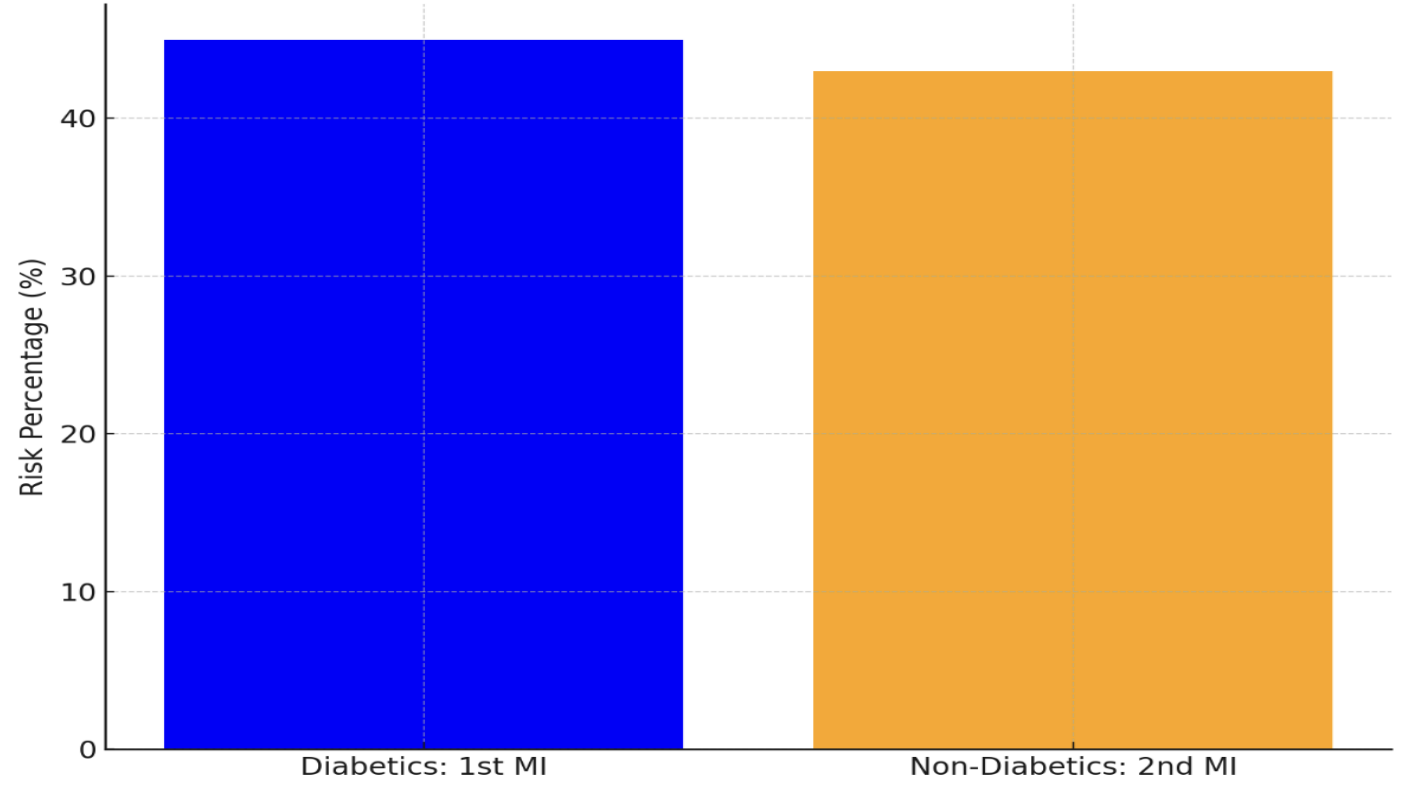


# Diabetes

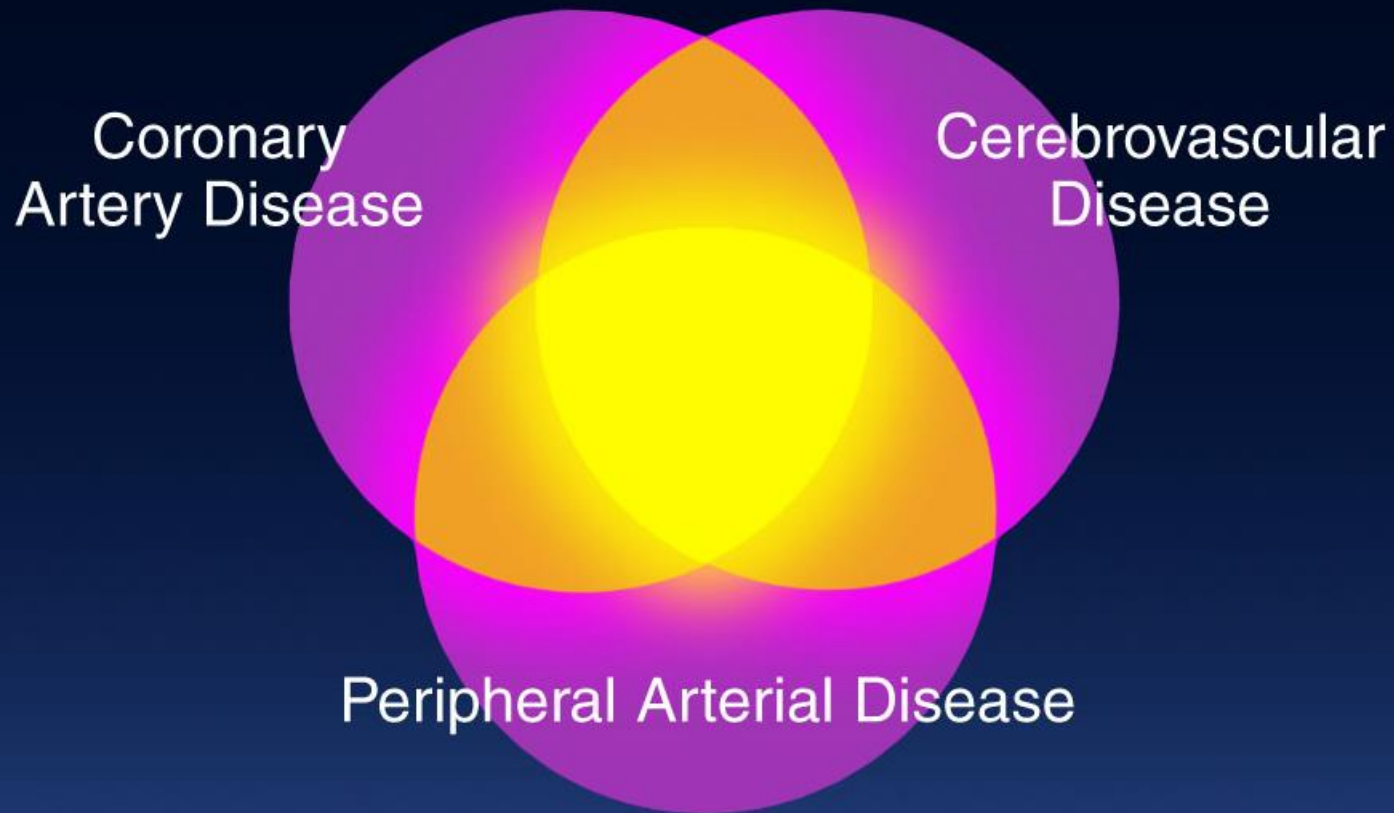




### Risk of Myocardial Infarction: Diabetics vs. Non-Diabetics



# Overlap of Atherothrombotic Disease



Patients with one manifestation often have coexistent disease in other vascular beds.



# Diabetes

## The Challenge ...



# Artherosclerotic Disease

- Post CVA
  - 9 times risk of recurrent Stroke
  - 2-3 times risk of MI
- Post MI
  - 5-7 times risk of recurrent MI
  - 3-4 time risk of TIA/CVA
- PAD
  - 4-5 times risk of MI
  - 2-3 times risk of CVA

1. Adult Treatment Panel II. *Circulation*. 1994;89:1333-1435.  
2. Kannel WB. *J Cardiovasc Risk*. 1994;1:333-339.  
3. Wilterdink JI, Easton JD. *Arch Neurol*. 1992;49:857-863.  
4. Criqui MH et al. *N Engl J Med*. 1992;326:381-386.

\*Versus the general population

†Sudden death defined as death occurring within 1 hour and attributed to coronary heart disease.



# Cardiovascular Complications of Diabetes

A 62 year-old male with hypertension, hyperlipidemia , and tobacco use suffered and acute myocardial infarction requiring stent placement

What is this patients risk of having a SECOND heart attack?

- A) 10%
- B) 20%
- C) 30%



# Cardiovascular Complications of Diabetes

A 62 year old man with the diabetes

What is this patients risk of having his FIRST heart attack?

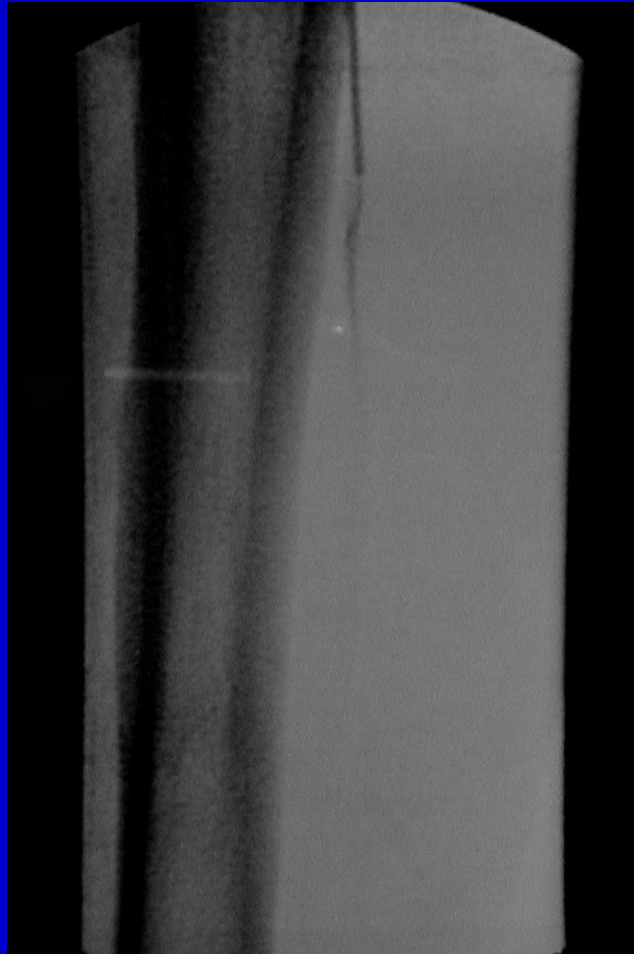
- A) 10%
- B) 20%
- C) 30%



# Diabetes

## Case Study

# Infrapopliteal Disease



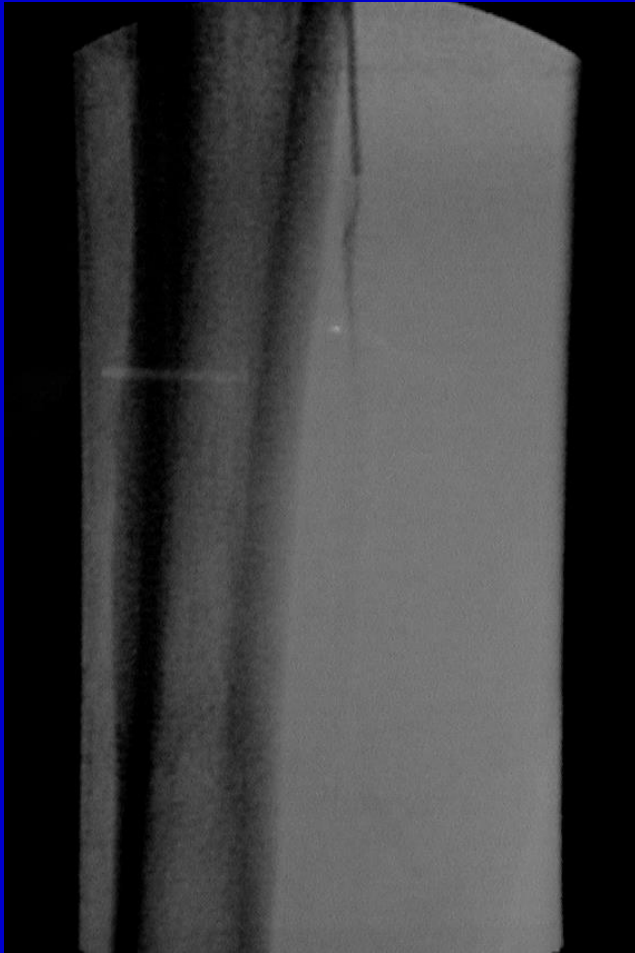


# Actual Operative Report

**Date of Procedure:  
08/24/04**

RECOMMENDATIONS: Based upon this angiogram, a revascularization procedure is not an option in this patient. Certainly, if he has progressive pain or tissue loss, he would best be served with a below knee amputation.

# Infrapopliteal Disease





# Diabetes

59 year old with a 10 year history of type 2 DM, well controlled hypertension, 120/76 mmHg, hemoglobin A1c 6.0 %.



# Diabetes

Suffered a stroke. Aphasia and left sided weakness.

Received TPA and fully recovered in two hours. No residual at follow at f/u in three months.

## ROLE of the PRIMARY CARE PROVIDER



# CAD

## ASA – Primary prevention

- USPSTF -against initiation for adults  $\geq$  60 yrs
  - ACC/AHA - not routinely recommended  $\geq$
- ADA not recommended if high bleeding risk



# Diabetes

If metformin is the appetizer,  
then GLP-1 and SGLT 2  
are the entre'e

AND

They come with free CV benefits