

The Fate of PCI for Multi-Vessel Disease From COURAGE to Syntax,

PCI vs. CABG Is The Game Over ?

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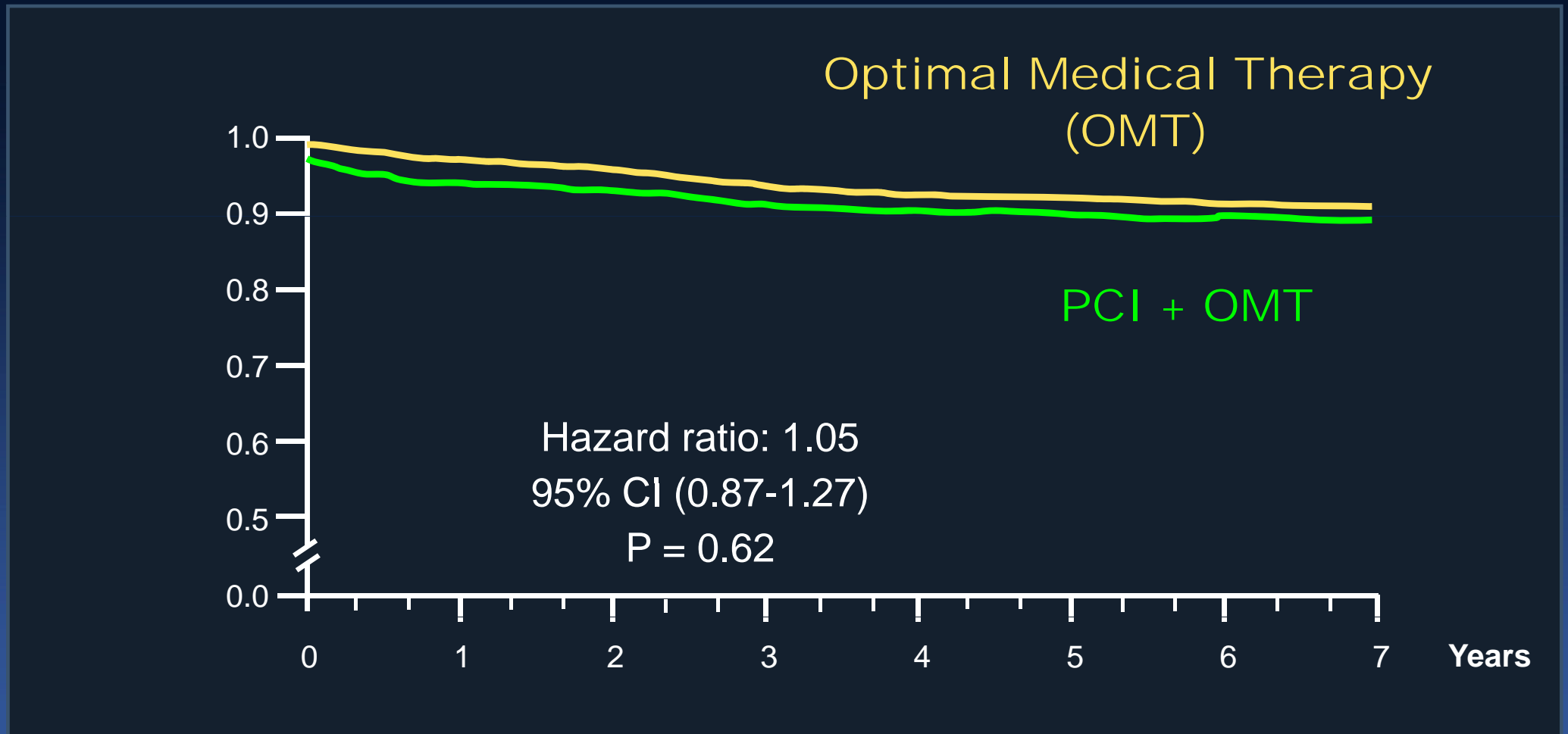
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What We Know,

Medical treatment, PCI and/or CABG for Stable Angina

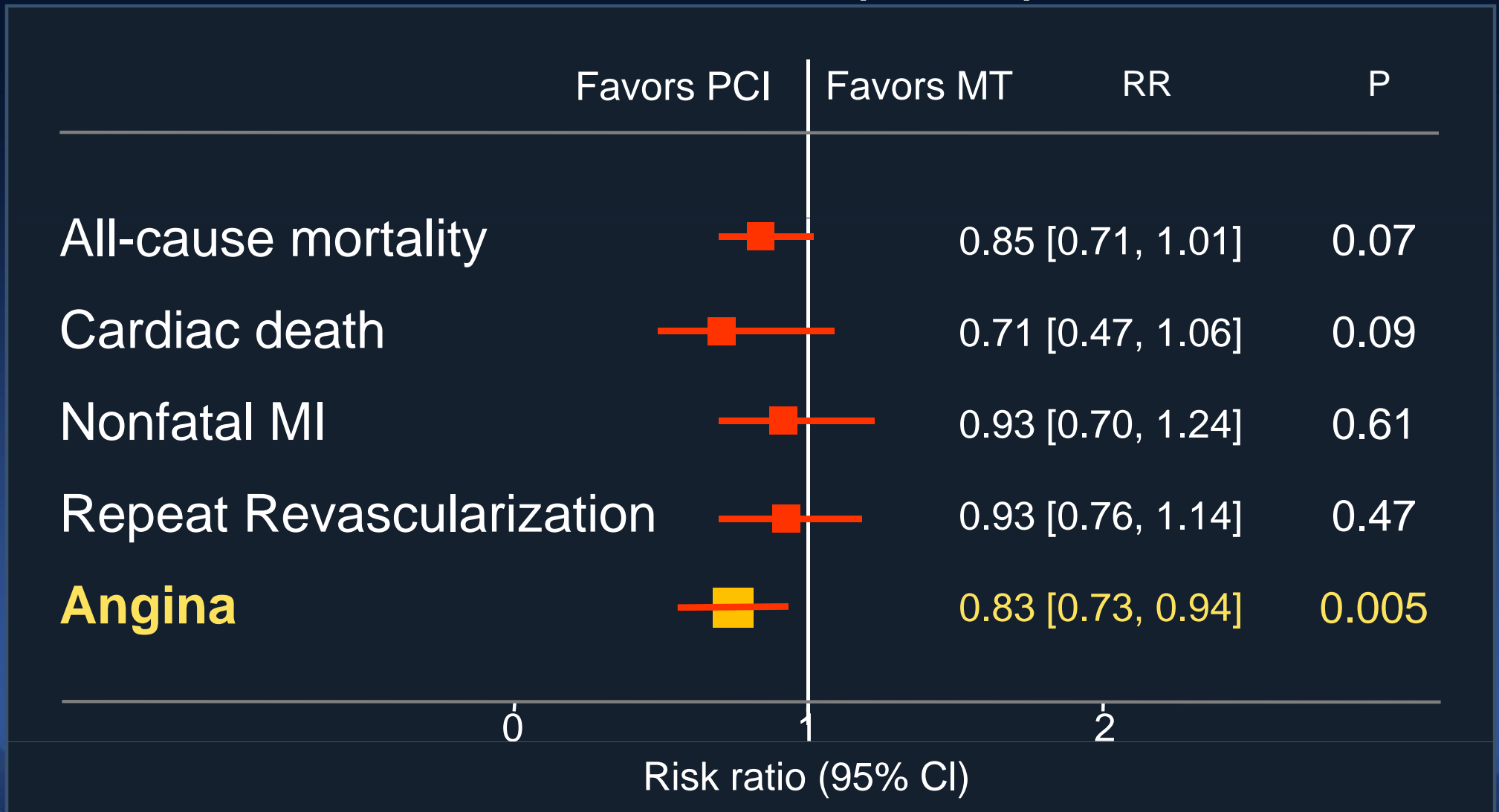
Benefit of Stents Over Medications in Stable Disease

Survival Free From Death and MI (COURAGE, n=2,287)



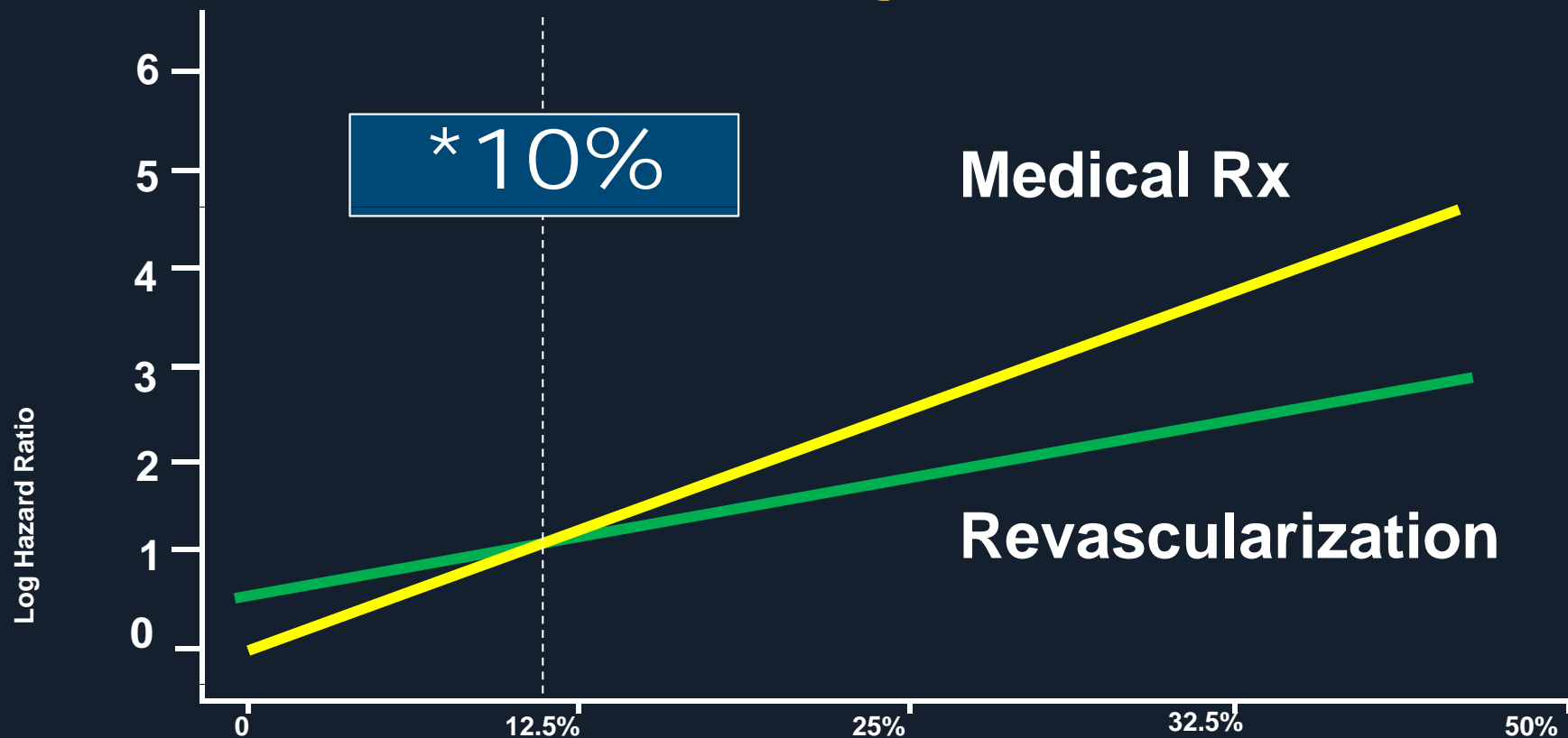
Benefit of Stents Over Medications in Stable Disease

12 RCTs, 7182 participants



Survival Benefit of Revascularization (CABG and/or PCI) Over Medications

Large Ischemic Burden



* % Total Myocardium Ischemic Burden

Survival Benefit of Revascularization (CABG and/or PCI) Over Medications

Large Ischemic Burden

1. Left Main Disease
2. 3 Vessel Disease
with Moderate LV dysfunction (EF>35%)

Velazquez EJ, et al. NEJM 2011;364:1607-16

Caracciolo E A et al. Circulation 1995;91:2325-2334

CASS Investigators, Circulation 1983;68:939-950

What We Know,

Any revascularization (CABG and/or Stent) treatment **have no survival benefit** over medical treatment especially in low risk patients with small ischemic burden (<10%).

PCI vs CABG

Multi-Vessel Disease

Meta-Analysis of RCTs
BARI 2D
FREEDOM
SYNTAX

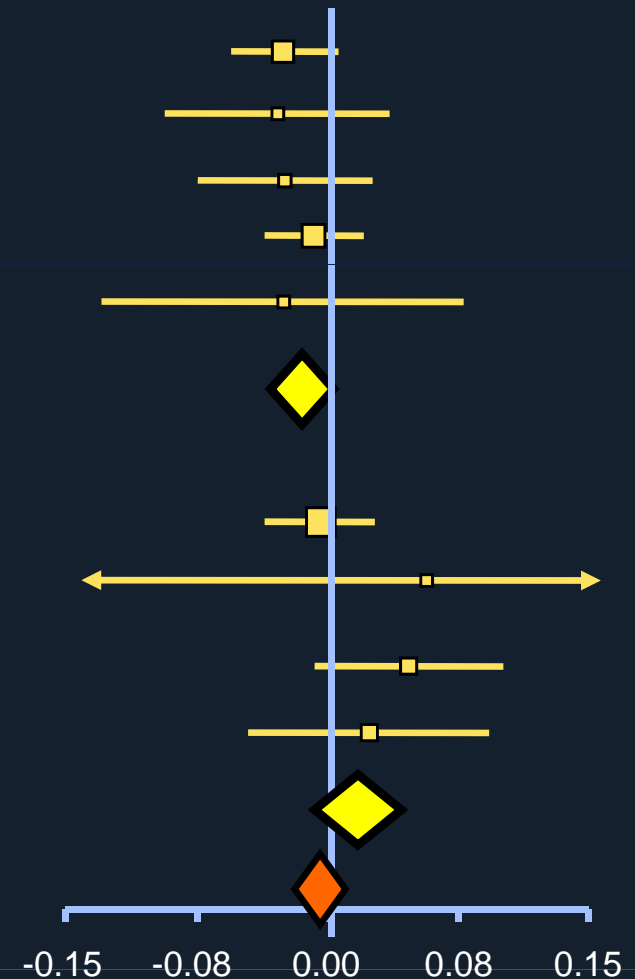
5 Year Survival

Meta-analysis of 23 RCTS, 9,963 patients treated with PTCA or BMS vs CABG

Surviving patients/all patients

Study, year	PCI	CABG
BARI, 1996	790/915	816/914
EAST, 2000	153/174	161/177
GABI, 2005	164/177	157/165
RITA, 1998	483/510	474/501
French Monocentric Study, 1997	66/76	68/76
Balloon overall	1,656/1,852	1,676/1,833
ARTS, 2005	542/590	538/584
AWESOME, 2001	30/38	19/26
ERACI II, 2005	209/225	199/225
MASS II, 2006	177/205	171/203
BMS overall	958/1,058	927/1,038
MVD overall	2,614/2,910	2,603/2,871

Risk difference (95% CI)



P=NS

PCI better CABG better

More Strokes in CABG



Treatment Effect in Subgroups

	Total mortality* (n/N)		5-year mortality (%)†		Hazard ratio (95% CI)*	P value‡
	CABG	PCI	CABG	PCI		
Age <55 years	107/1063	88/1122	5.5%	5.0%	1.25 (0.94/1.66)	0.002
Age 55-64 years	201/1477	220/1456	8.0%	9.4%	0.90 (0.75-1.09)	
Age >65 years	267/1347	319/1341	11.0%	14.7%	0.82 (0.70-0.97)	
Women	162/909	164/922	9.6%	12.0%	1.02 (0.82-1.27)	0.25
Men	413/2980	464/3001	8.0%	9.4%	0.88 (0.77-1.00)	
No diabetes	432/3263	448/3298	7.6%	8.1%	0.98 (0.86-1.12)	0.014
Diabetes	143/615	179/618	12.3%	20.0%	0.70 (0.56-0.87)	
Not smoking	393/2558	440/2526	7.9%	9.5%	0.87 (0.76-1.00)	0.073
Smoking	158/816	149/849	10.4%	10.9%	1.11 (0.89-1.39)	
No hypertension	268/2128	299/2167	7.1%	8.7%	0.90 (0.76-1.06)	0.73
Hypertension	306/1750	329/1753	9.9%	11.5%	0.93 (0.79-1.11)	
Normal cholesterol	236/1559	273/1588	9.0	11.0%	0.84 (0.71-1.00)	0.46
hypercholeserolaemia	221/1667	247/1719	8.4	9.8%	0.93 (0.77-1.11)	
No PVD	374/2841	408/2872	8.1%	9.1%	0.92 (0.80-1.06)	0.33
PVD	91/334	110/331	15.0%	22.1%	0.78 (0.59-1.03)	

CABG better

PCI better

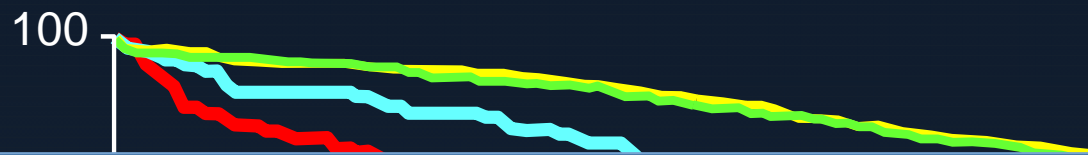
PCI (Balloon PTCA and BMS) vs. CABG In Multi-Vessel Disease

1. No Difference in Mortality and Death or MI between the two group.
2. TVR is Higher in PCI group.
3. Stroke is Higher in CABG group.
4. Better Survival,
in **Diabetics and Older Age (>65year)**
in CABG group.

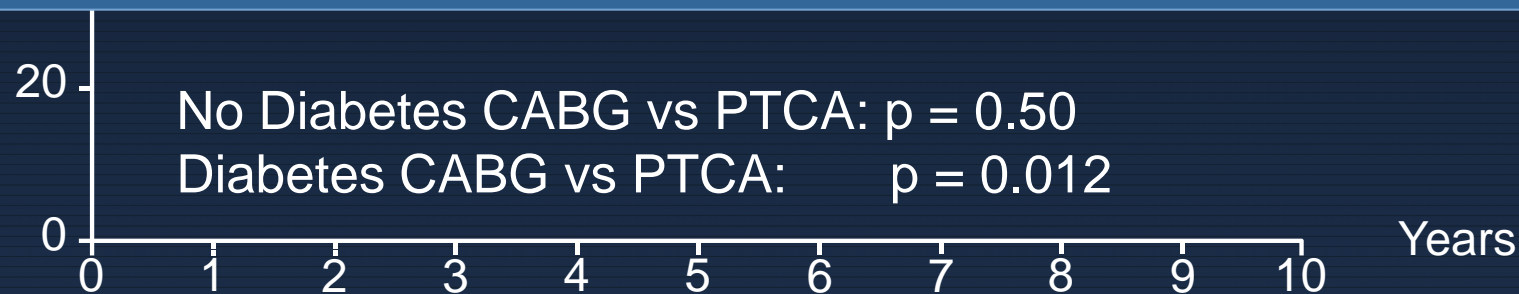
Diabetic Concerns,

BARI 10-Year Survival

PTCA vs. CABG in Multi-Vessel Disease
From 1988 to 1991



“**Unsuspected**” Finding
in Patients with Diabetes



— Diabetes CABG (n=180)
— No diabetes CABG (n=734)

— Diabetes PTCA (n=173)
— No diabetes PTCA (n=742)

Syntax, Diabetic Subgroup

	No Diabetes n=1348	Diabetes* n=452	P value
Age, yrs	65.0 ± 9.9	65.4 ± 9.2	0.41
Male, %	79.9	71.0	<0.001

Clinical Baseline Risk Increased

Current smoker, %	21.7	15.8	0.006
Congestive heart failure, %	3.7	7.4	0.001
Peripheral vascular disease, %	8.2	14.6	<0.001
Prior stroke, %	3.8	6.0	0.046
Creatinine >200 µmol/L	1.0	2.9	0.003
EuroSCORE	3.7 + 2.6	4.0 + 2.7	<0.03
Parsonnet score	7.5 + 6.8	11.3 + 6.4	<0.001

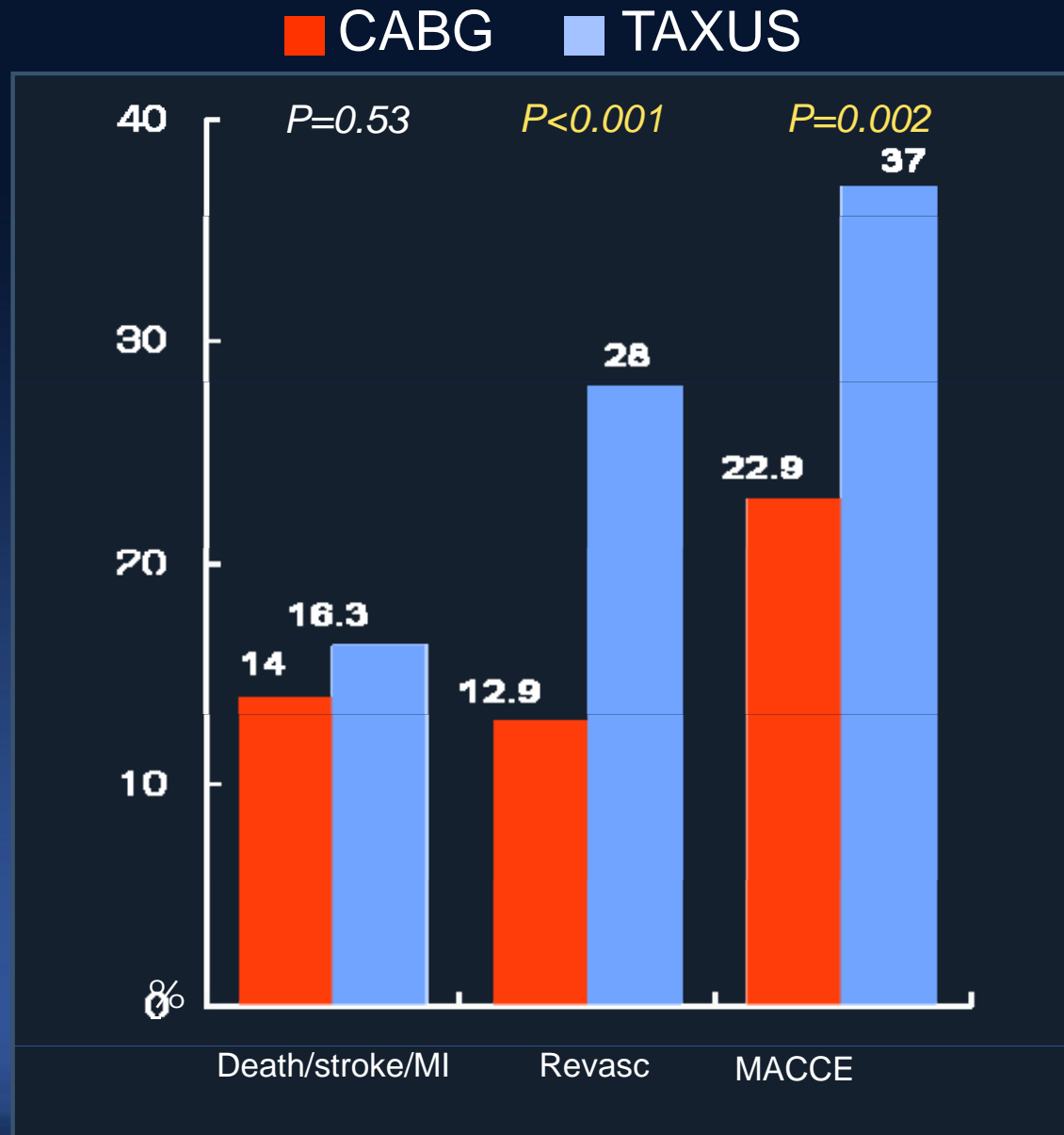
Syntax, Diabetic Subgroup

	No Diabetes n=1348	Diabetes* n=452	P value
Lesion Complexity			

Angiographic Baseline Risk Increased

SYNTAX score	28.6 + 11.5	29.0 + 11.2	0.52
Number of lesions	4.3 + 1.8	4.6 + 1.8	0.003
Left main, any %	35.9	29	0.007
3 vessel disease only	64.1	71	0.007

Syntax, Diabetic Subgroup (n=452), 3 Year Outcomes



Diabetes, Why Problem ?

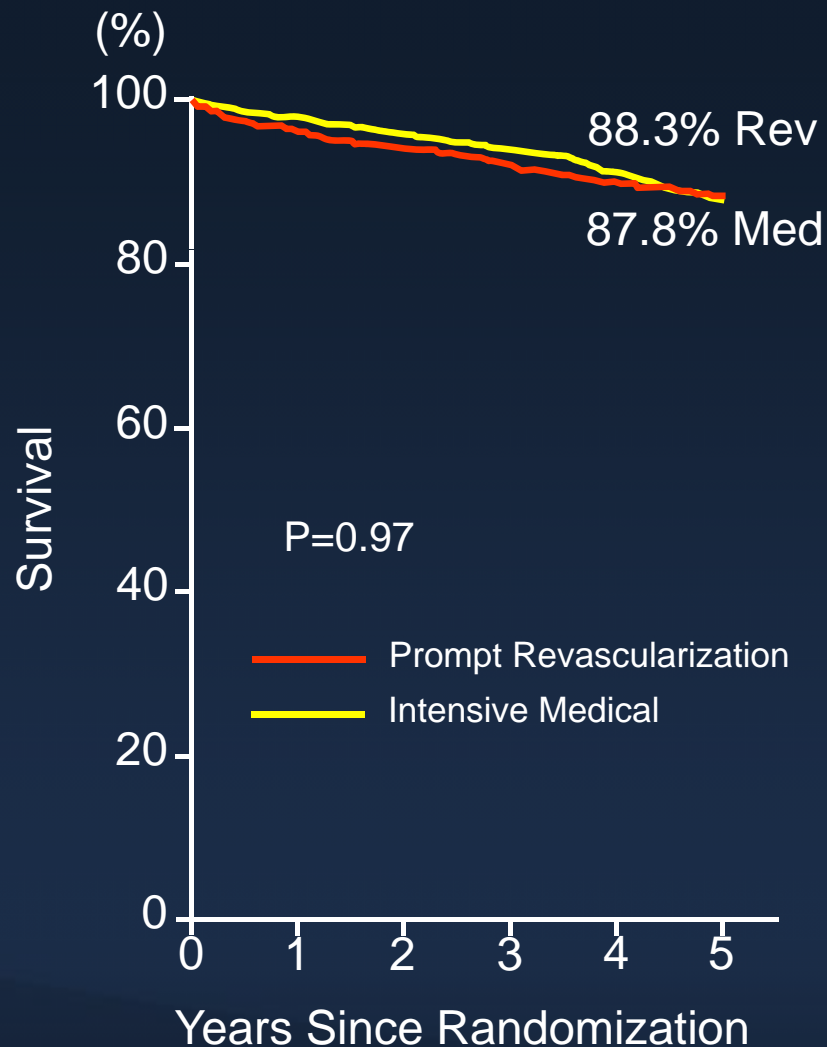
1. Diabetes was associated with more metabolic risk factors and more co-morbidities status.
2. Diabetes was associated more complex coronary lesion morphology which tended to have **increased repeat revascularization rates** with PCI.
3. Diabetic injury responses of stented segment should be more exaggerated with accelerated atherogenesis and active inflammatory process, which may be related with higher rate of MACE.

BARI 2D

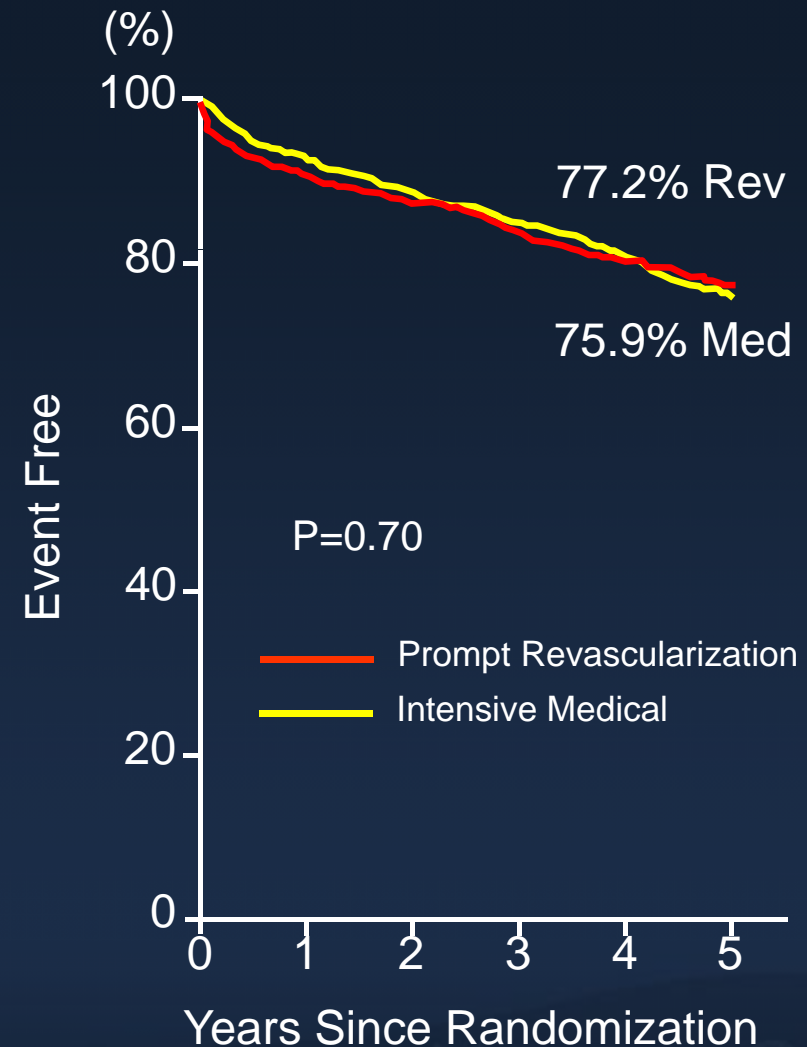
Bypass Angioplasty Revascularization
Investigation 2 Diabetes ;
Focused on the Diabetes

Prompt Revascularization (PCI or CABG) vs. Medical Therapy (n=1,185)

All-cause Mortality

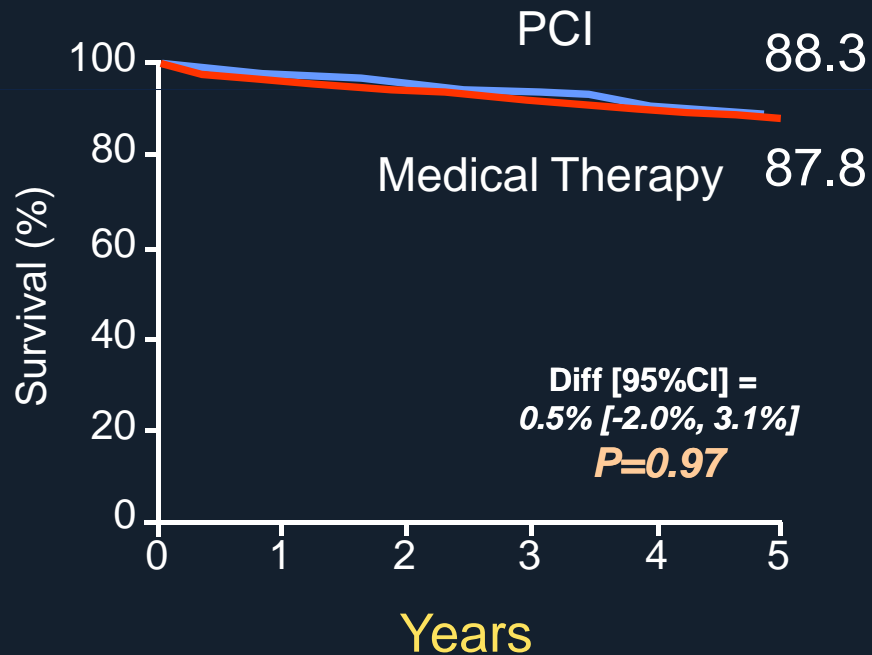


Death/MI/Stroke

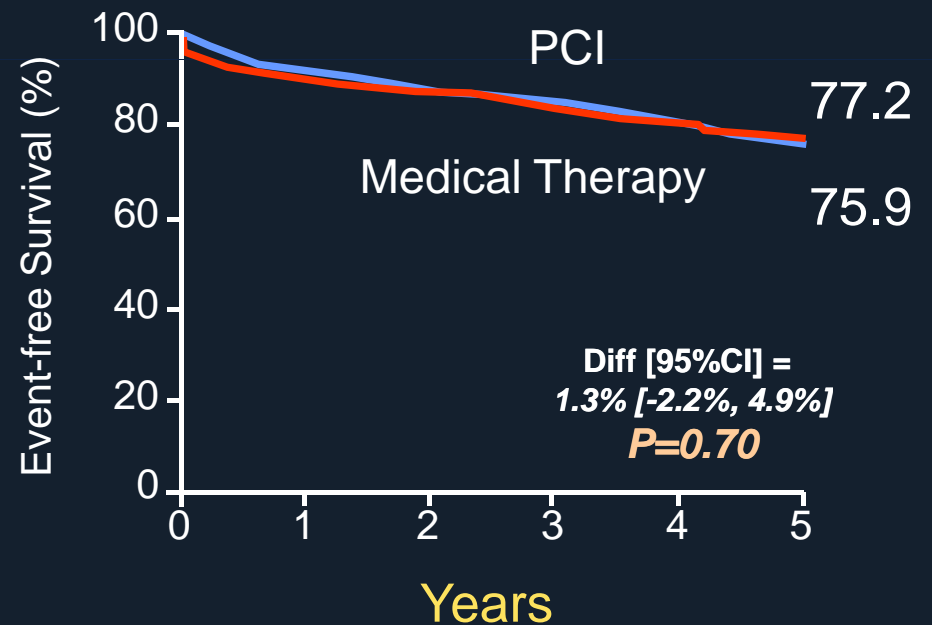


BARI 2D: PCI vs. Medical Treatment (Lower Risk Patients)

Survival



Freedom from MACE (death, MI, or stroke)

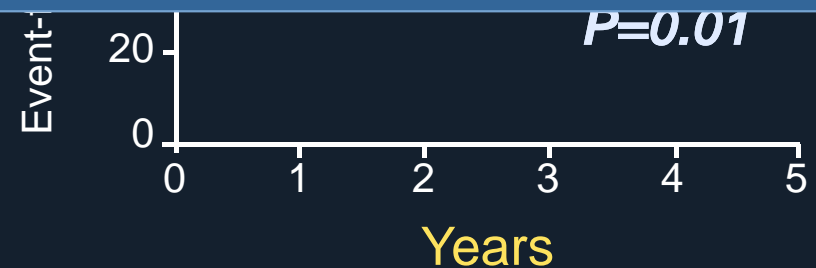
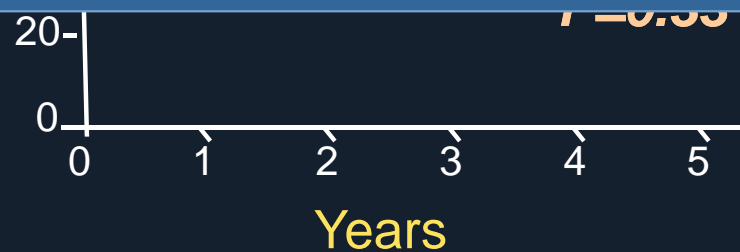


BARI 2D: CABG vs. Medical Treatment (Higher Risk Patients)

Survival

**Freedom from MACE
(death, MI, or stroke)**

Among high risk patients, CABG reduces MACE compared with medical therapy, mainly related with lower rate of myocardial infarction.



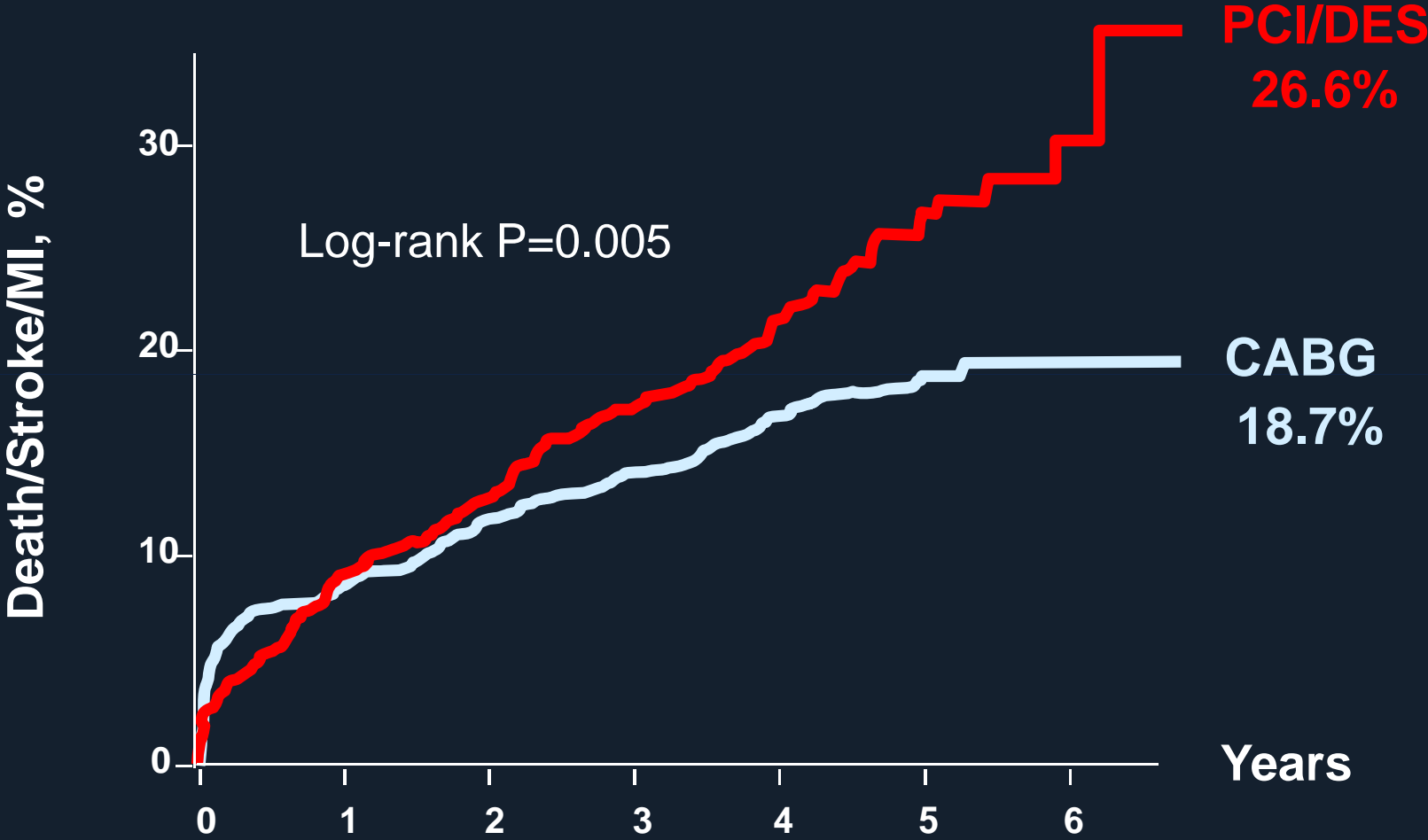
FREEDOM

Future REvascularization Evaluation in Patients with Diabetes Mellitus: Optimal Management of Multivessel Disease

BASELINE CHARACTERISTICS

	PCI	CABG	P value
No. of Patients	953	947	
Age, yrs	63.2 ± 8.9	63.1 ± 9.2	0.78
Male, %	73	70	0.08
Body Mass Index (Kg/m ²)	29.7 ± 5.4	29.8 ± 5.3	0.08
Hypertension, %	85%	85%	0.75
Hyperlipidemia, %	84%	83%	0.66
Current smoker, %	15%	17%	0.31
Congestive heart failure, %	26%	28%	0.25
Prior Stroke	4%	3%	0.31
LV EF <40%	3%	2%	0.07
EuroScore	2.7 ± 2.4	2.8 ± 2.5	0.52
Syntax Score	26.2 ± 8.4	26.1 ± 8.8	0.77
Three vessel disease	82.3	84.5	0.22
No.of lesion	5.7 ± 2.2	5.7 ± 2.2	0.33
No.of stented lesion or graft vessel	3.5 ± 1.4	2.9 ± 0.8	NA
CTO lesion	6%	6%	0.99
Bifurcation lesion	22%	21%	0.06

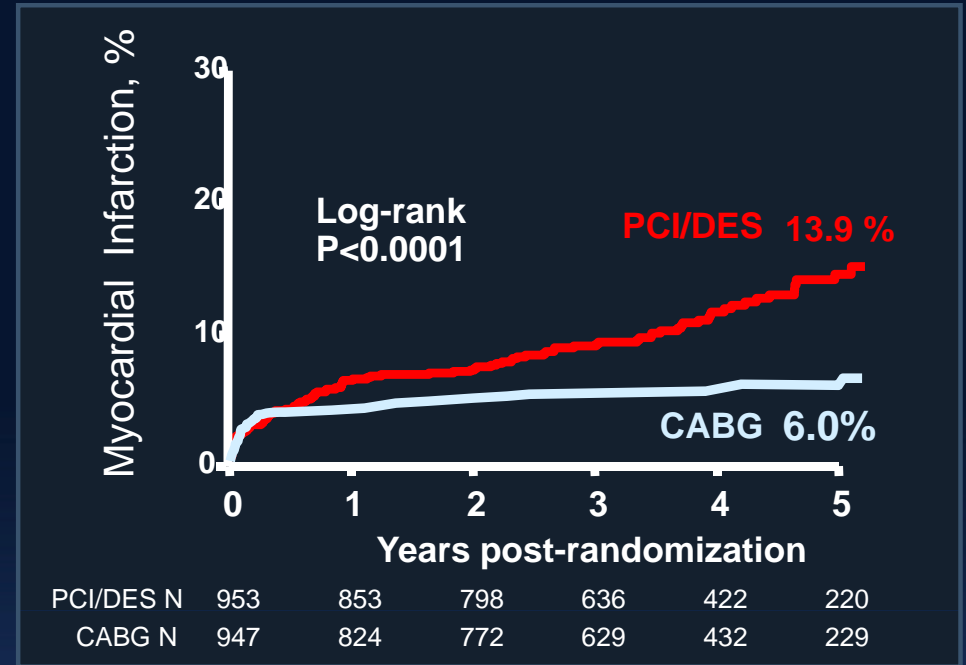
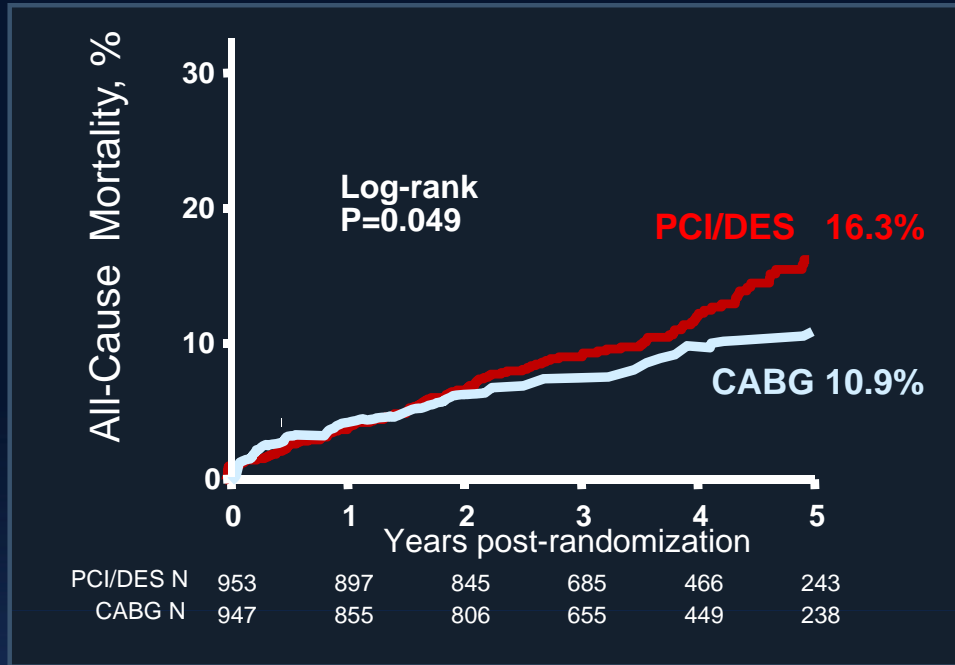
Primary Endpoint, **Death / MI / Stroke**



PCI/DES N	953	848	788	625	416	219	40
CABG N	943	814	758	613	422	221	44

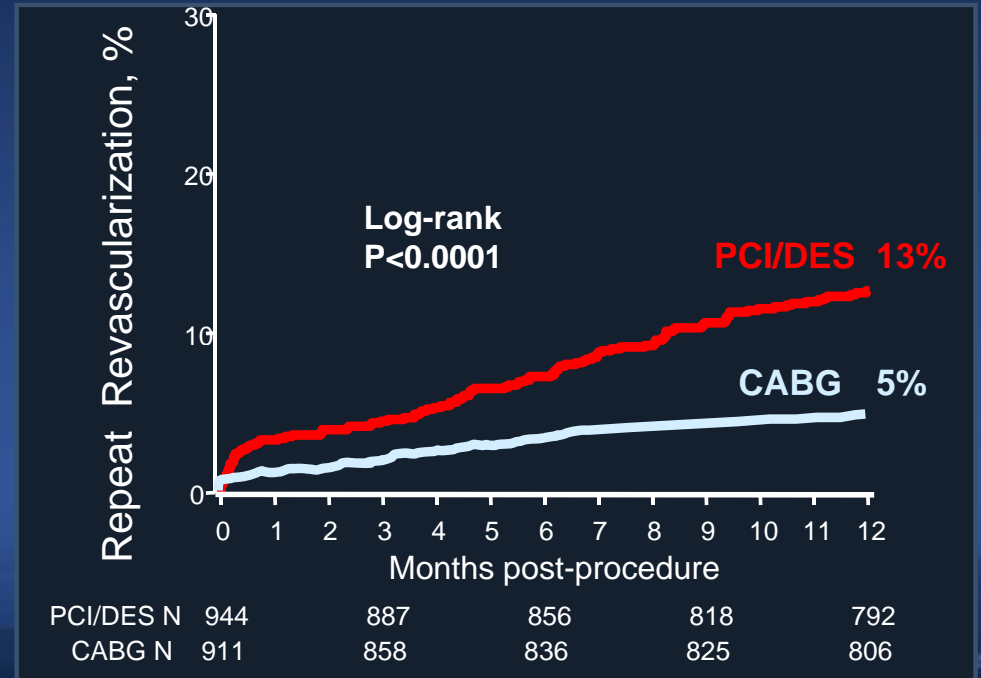
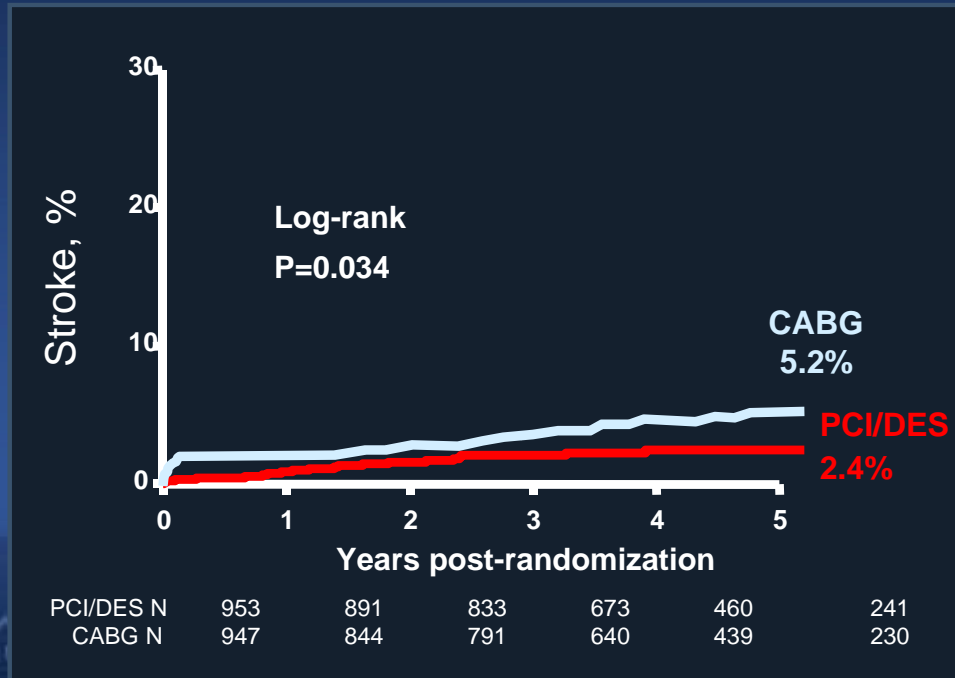
Death

MI



Stroke

Repeat Revascularization



Clinical Outcomes at 2 and 5 Years, **FREEDOM**

CABG was superior to PCI with DESs

In patients with diabetes and advanced CAD
(predominantly, 3 vessel).

MI	62 (6.7)	42 (4.7)	98 (13.9) >	48 (6.0)	<0.001
Stroke	14 (1.5)	24 (2.7)	20 (2.4) <	37 (5.2)	0.03
CV Death	9 (0.9)	12 (1.3)	73 (10.9)	52 (6.8)	0.12

SYNTAX

5 Year Outcomes

Patient Characteristics

	CABG RCT N=897	PCI RCT N=903	P value
Age* (y)	65.0 ± 9.8	65.2 ± 9.7	0.55
Male, %	78.9	76.4	0.20
Diabetes*†, %	24.6	25.6	0.64
Additive euroSCORE*	3.8 ± 2.7	3.8 ± 2.6	0.78
Total Parsonnet score*	8.4 ± 6.8	8.5 ± 7.0	0.76
Total SYNTAX Score	29.1 ± 11.4	28.4 ± 11.5	0.19
Mean # of lesions	4.4 ± 1.8	4.3 ± 1.8	0.44
3VD only, %	66.3	65.4	0.70
Left main, any, %	33.7	34.6	0.70
Total occlusion, %	22.2	24.2	0.33
Complete revasc, %	63.2	56.7	0.005

Values are mean ± SD or %. Core laboratory reported unless *Site-reported †Medically treated

SYNTAX 3 VD, 5 Year Outcomes

	CABG	PCI	P value
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Is the Game Over ?

Death/CVA/MI	14.0%	22.0%	<0.001
Repeat revascularization	12.6%	25.4%	<0.001
CVA	3.4%	3.04%	0.66

SYNTAX Trial

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

MARCH 5, 2009

VOL. 360 NO. 10

Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease

Patrick W.
Antonio C.
Ted E. Feldman, M.D.
Keith D.

D.,
D.,
dley, M.D.,
*

**Complete Revascularization,
Small Vessel Included (<1.5 mm)**

Average Number of Stents

4.6 ± 2.3

Message from SYNTAX, 5 Year Outcomes

Syntax Concept of PCI is
Outdated from Current Practice !

What is Changing Now ? 2013

1. Smart “New DES”

2. Better Concept of PCI,

Does More Stents Mean More Care ?

Is Complete Revascularization Necessary ?

Reasonable Incomplete Revascularization.

Ischemia Guided PCI is Better,

FFR Guided PCI is Better,

Integrated Use of FFR and IVUS

Past Story,

BARI 2D

FREEDOM

SYNTAX

Old DES,

DES 35%, BMS 56%, Others 9%

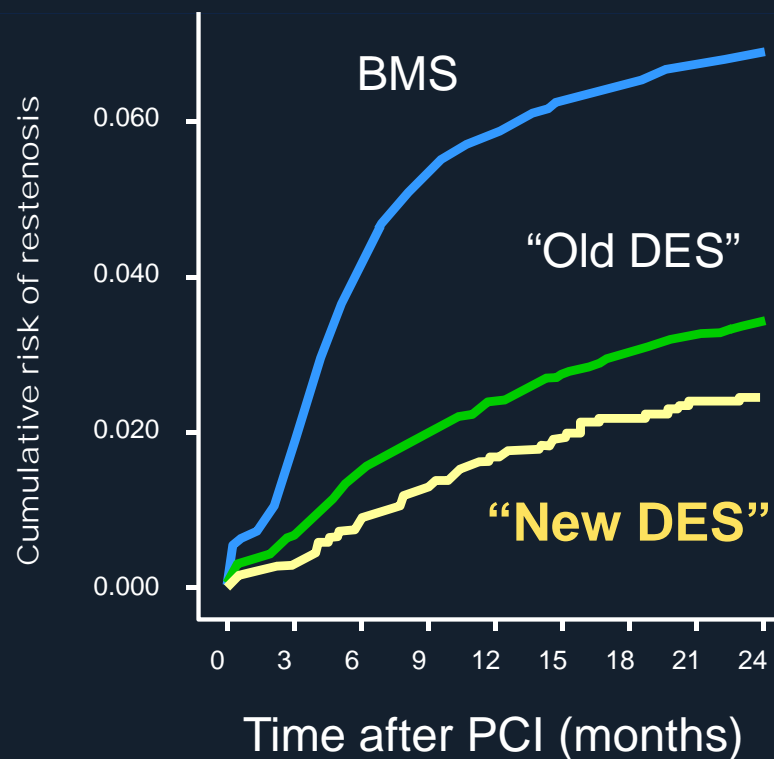
SES 49%, PES 41%, Others 10%

PES 100%,

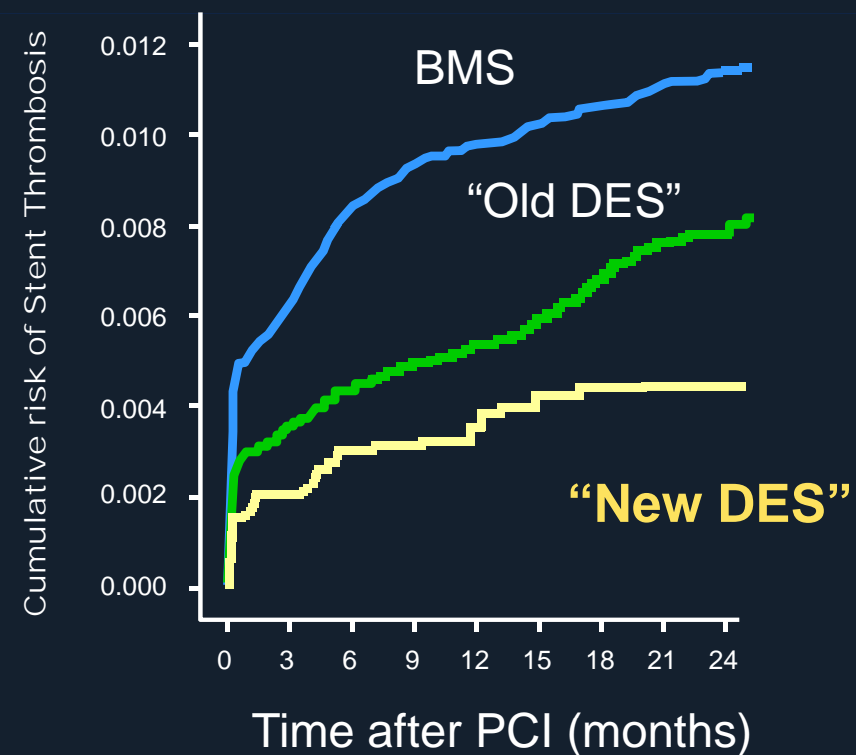
New DES is Clearly Better !

SCAAR Registry (94,384 pts)

Restenosis



Definite ST



Better Concept of PCI,

Does More Stents Mean More Care ?

Is Complete Revascularization Necessary ?

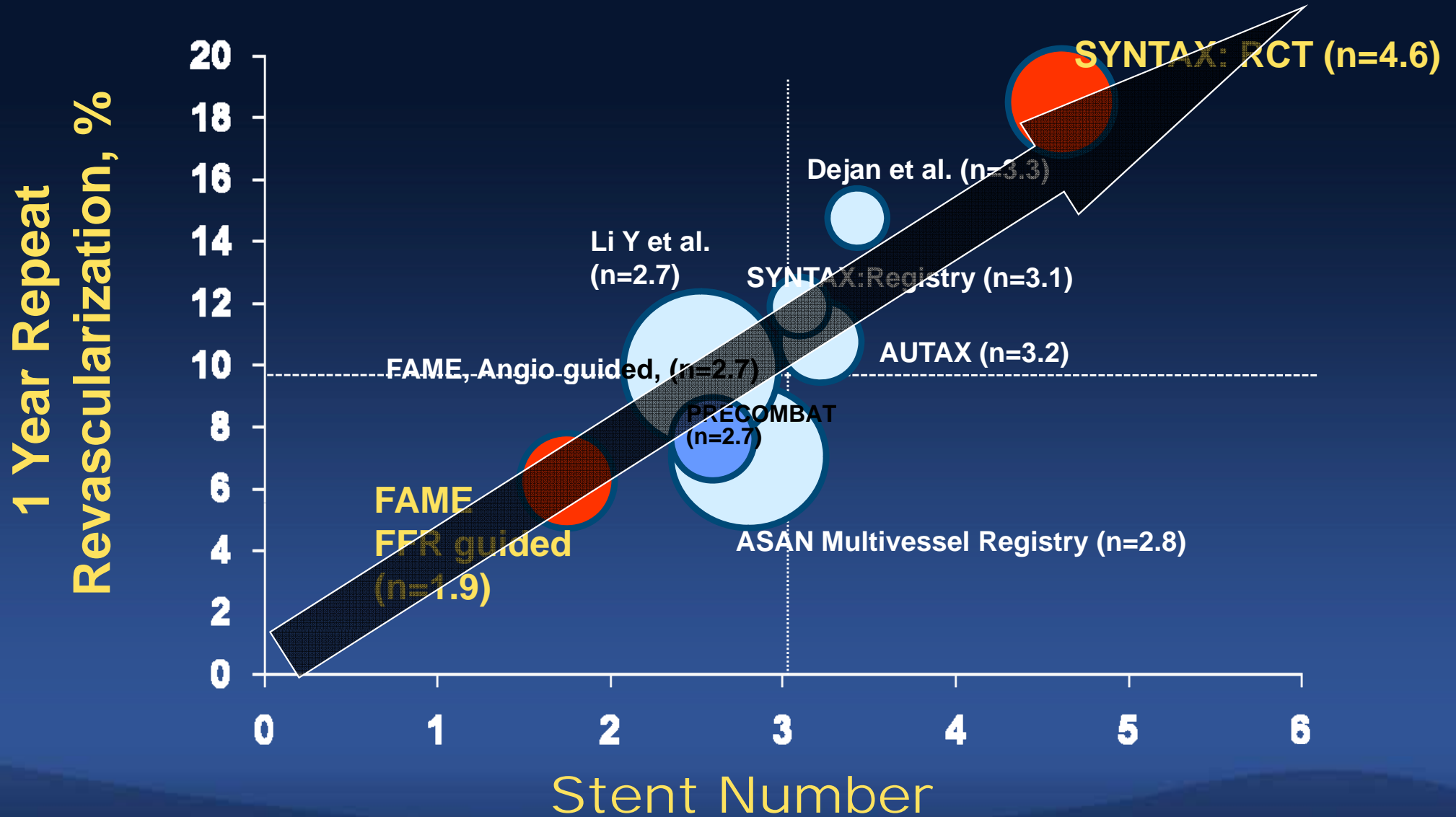
Reasonable Incomplete Revascularization.

Ischemia Guided PCI is Better,

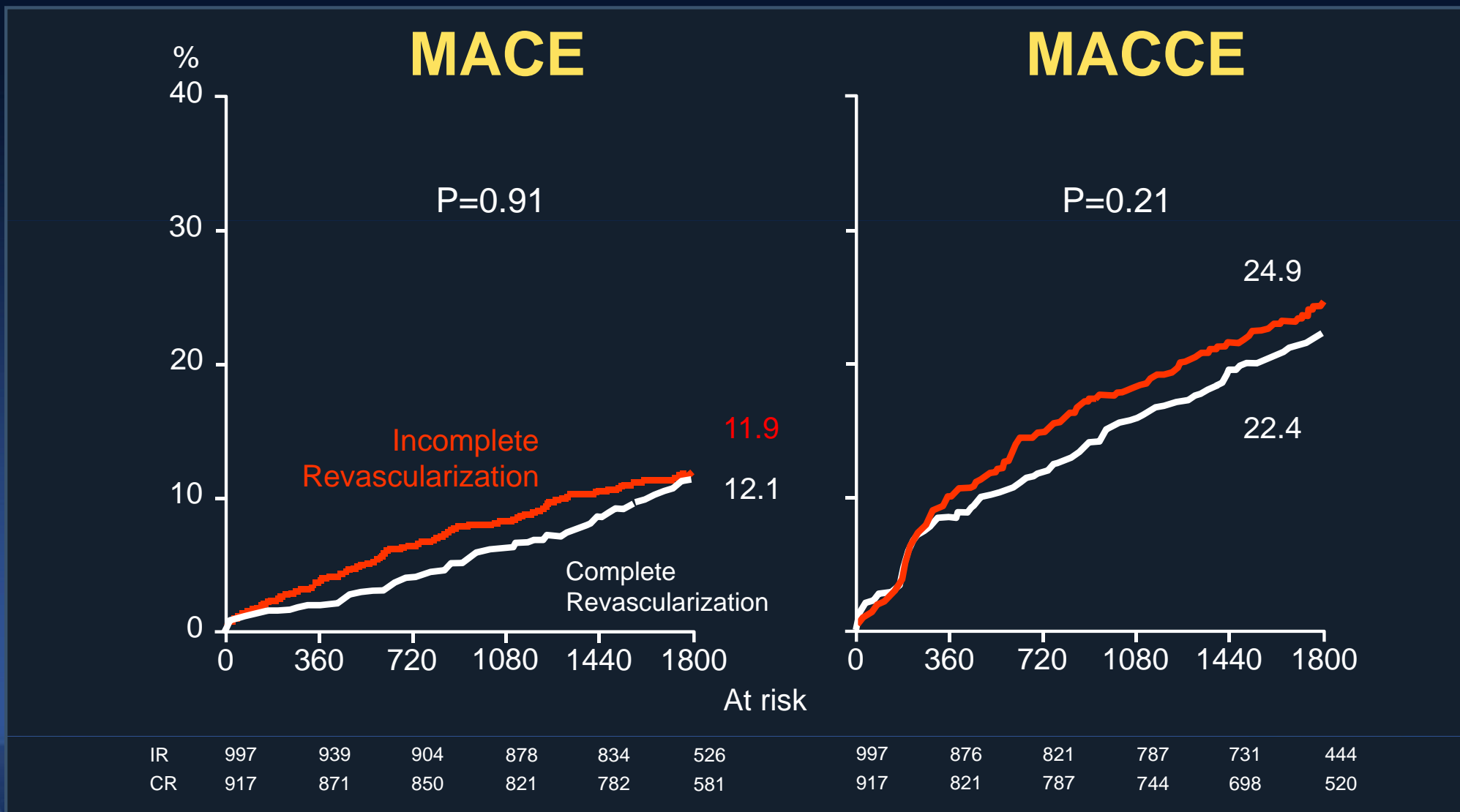
FFR Guided PCI is Better,

Integrated Use of FFR and IVUS

More Stents Means Just **More MACCE** !



Impact of Complete Revascularization Unadjusted Outcomes of MACCE



Impact of Complete Revascularization

Adjusted Outcomes of MACCE

No Different Clinical Outcomes

Between Complete vs. Incomplete Revascularization
in DES era with Optimal Medical Treatment

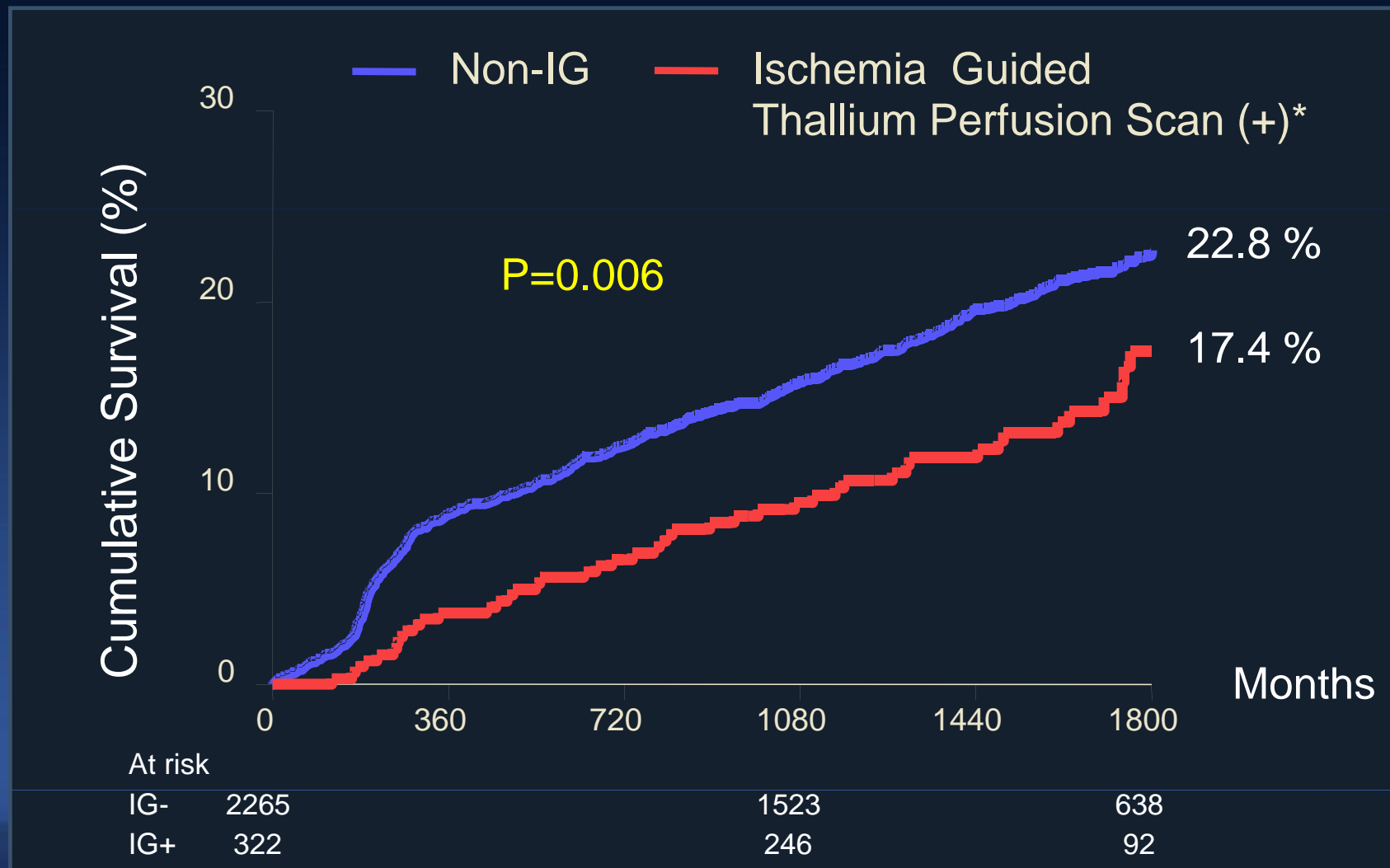
	Angiographic CR-1	0.95	0.78	1.18	0.82	0.94	0.75	1.18	0.81
PCI	Angiographic CR-2	0.99	0.80	1.22	0.90	1.00	0.81	1.25	0.99
	Proximal CR	1.01	0.82	1.26	0.90	1.04	0.83	1.30	0.73

Reasonable Incomplete Revascularization With Optimal Medical Treatment

These Are **Cosmetic Angioplasty** !
Optimal Medical Treatment is Very Enough.

Ischemia* Guided PCI Has Better Clinical Outcomes

MACCE at 5 Years



FFR Guided PCI is Better,

Meta-Analysis

FFR vs. CAG Guided PCI

A total of 9,301 patients

(1 randomized trial and 4 observational studies)

Park SJ, Ahn JM, Unpublished Data, 2013

FFR vs. Angio-Guided PCI

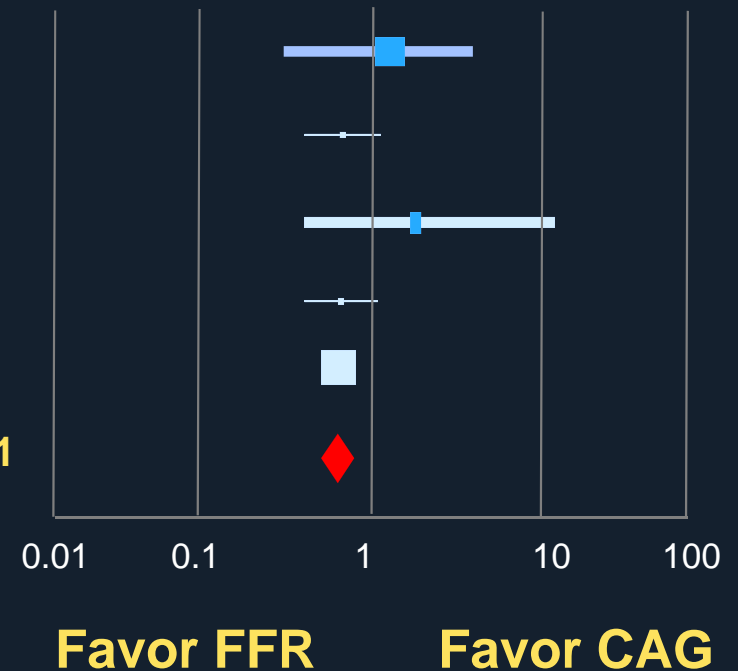
(Meta-analysis n=9,301)

Death

		Odds Ratio	Lower Limit	Upper Limit	Z-Value	P-Value
Wongpraparut	2005	1.25	0.24	6.59	0.26	0.80
Pijls	2010	0.68	0.33	1.38	-1.08	0.28
Angkananard	2011	2.09	0.36	12.16	0.82	0.41
Puymirat	2012	0.61	0.30	1.20	-1.44	0.15
Lerman	2013	0.56	0.48	0.66	-7.22	0.00
Random pooled estimate		0.58	0.50	0.67	-7.24	<0.001

I²=0

Odds ratio and 95% CI



Favor FFR

Favor CAG

FFR vs. Angio-Guided PCI

(Meta-analysis n=9,301)

Relative

**FFR Guided PCI Has
Better Clinical Outcomes !**

MACE

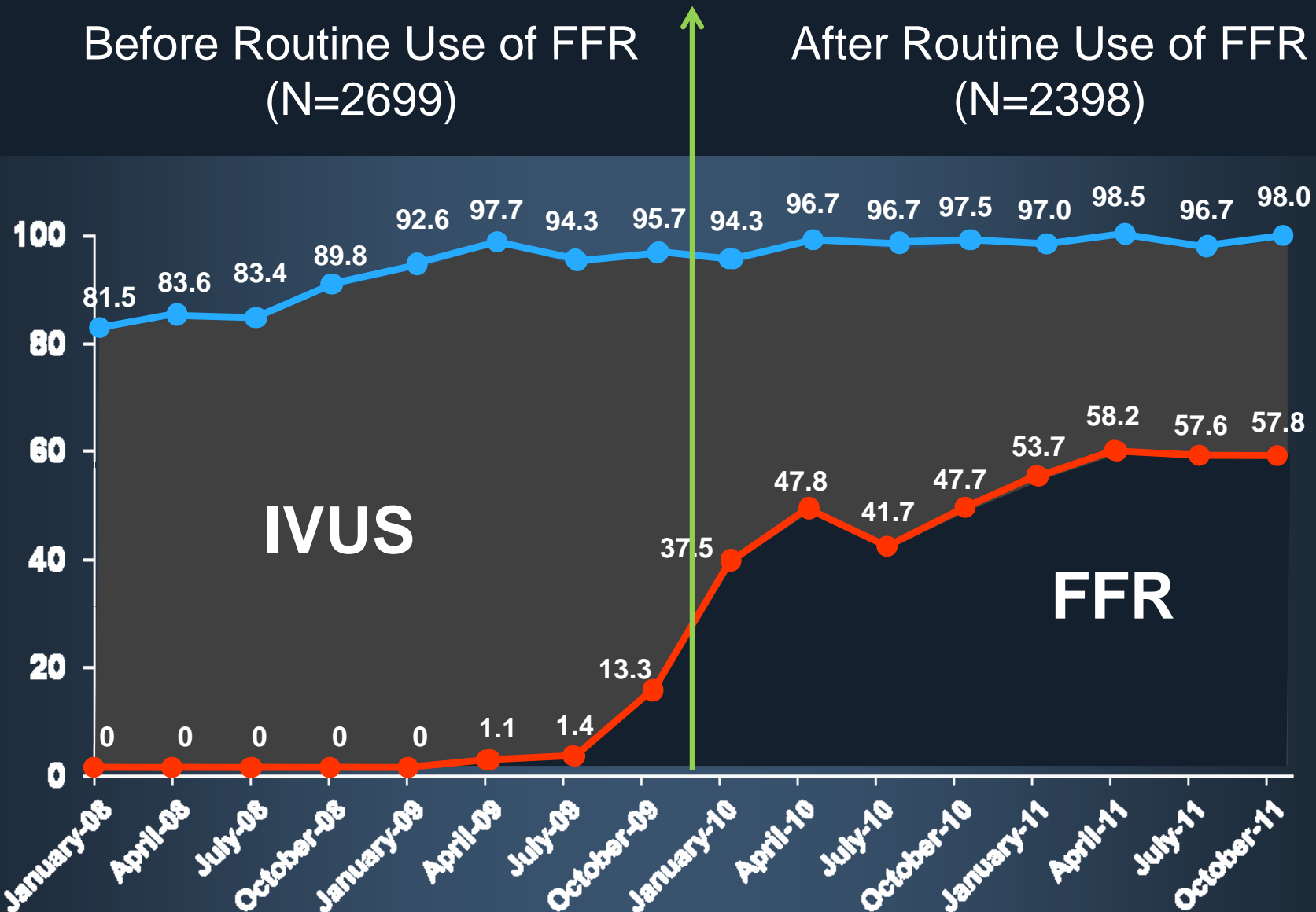
↓ 29%

<0.001

How Much **Synergetic** ? Integrated Use of **FFR** and **IVUS**

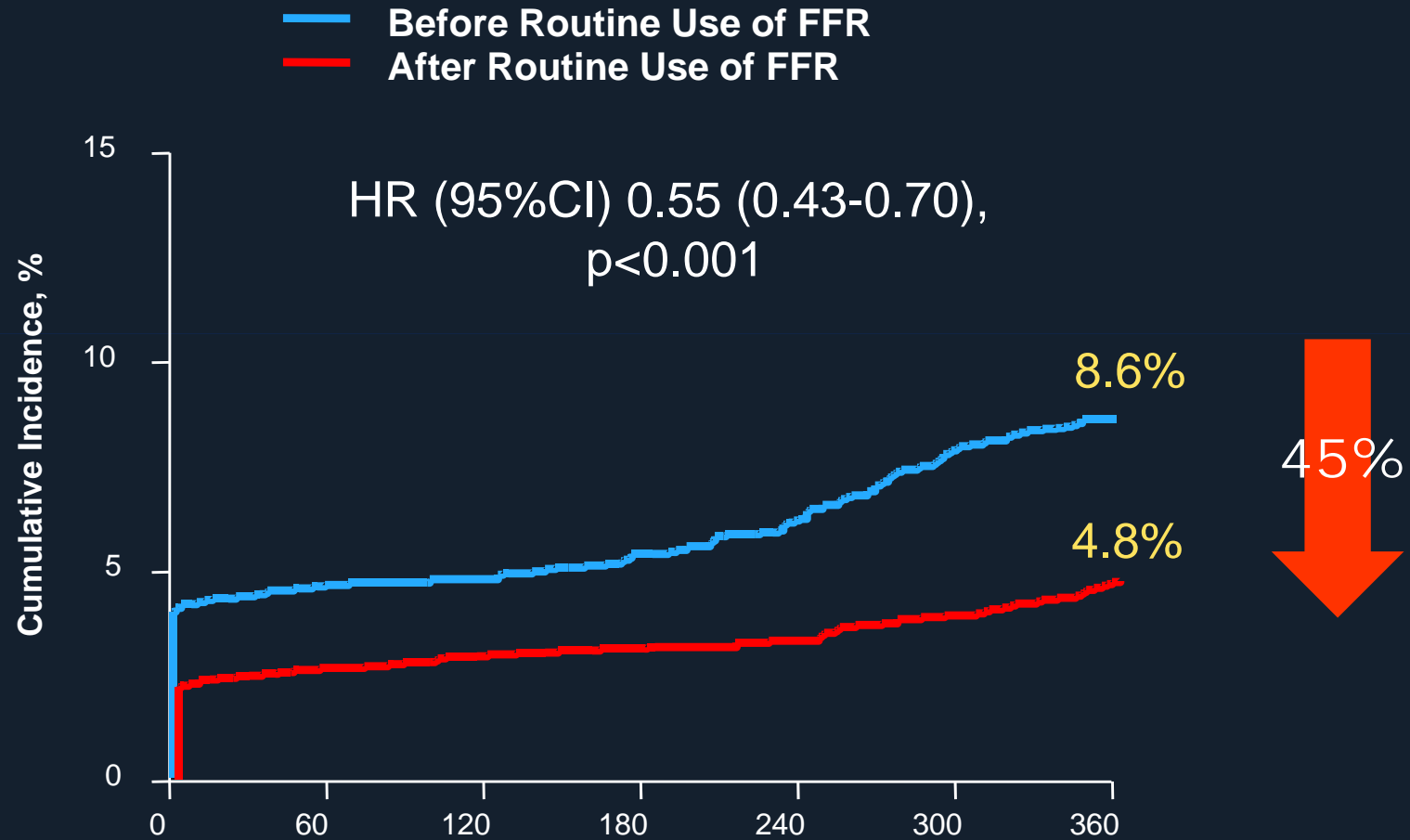
Integrated Use of FFR and IVUS

(AMC data, n=5097)



Primary End Point

(Death, MI, or Repeat Revascularization)



No. at Risk

	0	60	120	180	240	300	360
Before Routine Use	2178	2066	2011	1960			
After Routine Use	2178	2092	2067	2037			

Propensity Score Matched Population

PCI vs. CABG

in Multi-Vessel Disease, 2013

Evolving Concept of PCI ; More Functional Approach,

More Stents Means Just More MACE.

Complete Revascularization is Not Always Necessary.

Consider Reasonable Incomplete Revascularization.

Ischemia Guided PCI is Better.

FFR Guided PCI is Better,

Consider Integrated Use of FFR and IVUS.

Impact of FFR for Multi-Vessel Disease

“Totally Different World”
“Different Concept and
Different Clinical Outcomes” !

We Need New Concept of Study, **FAME 3**

Patients with
Positive FFR (<0.80), 2-3 Vessel Disease
with or without LM

R

```
graph TD; A[Patients with Positive FFR (<0.80), 2-3 Vessel Disease with or without LM] --> B((R)); B --> C[PCI + OMT]; B --> D[CABG];
```

PCI + OMT

CABG

**Primary Endpoint at 2 years:
Death + MI + Repeat R + Stroke**

PCI vs. CABG

in Multi-Vessel Disease, 2013

The Game Is Just Begun !