PCI Today: Best Practices, Optimal Outcomes, and Limitations

When Do I Prefer CABG for MVD?

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CABG vs. PCI for MVD

What really matters?

Most important outcome metrics

- Death/stroke/MI: Death > stroke > MI

Also should be considered

- Invasiveness
- Recovery and return to work
- Angina status and repeat revascularization
- Quality of life and cost-effectiveness
- Other adverse events: atrial fibrillation, renal failure, bleeding and transfusion, infection, etc.

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Revascularization eras

1. CABG vs PCI with balloon angioplasty and bare metal stents

2. CABG vs PCI with bare metal stents only

3. CABG vs PCI with DES

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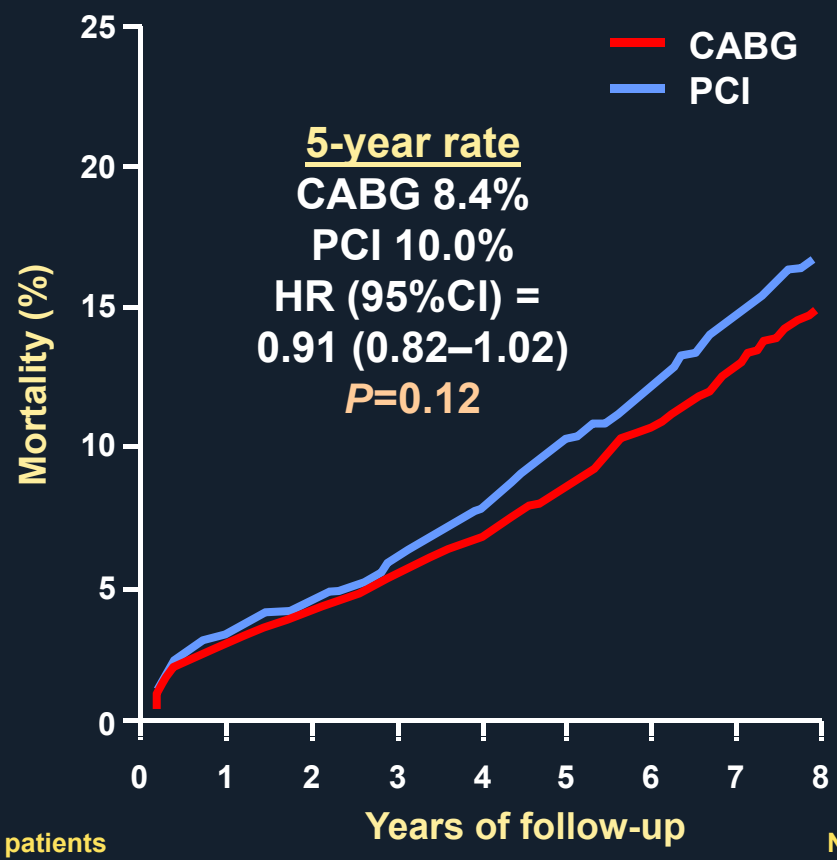
CABG vs PCI for MVD (10 RCTs, n=7,812)

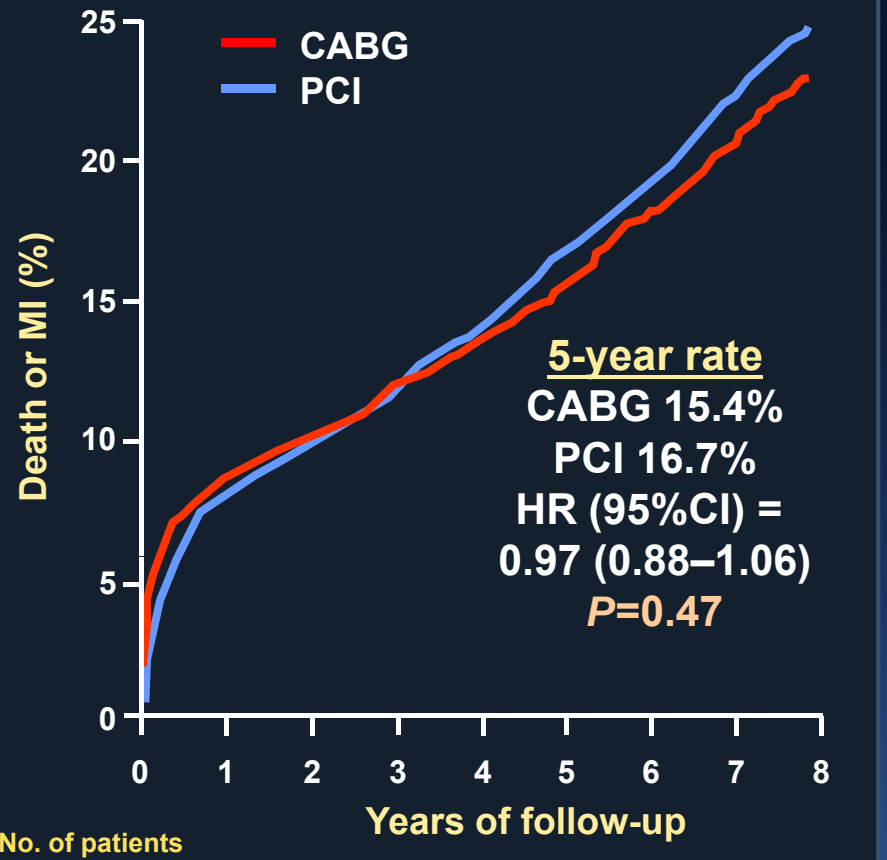
- 37% stents (PTCA only in 6/10 studies), 83% IMA -

median FU 5.9 years



No. of patients

CABG	3889	3767	3675	3415	3180	2693	1853	1609	1477
PCI	3923	3798	3709	3431	3205	2658	1828	1576	1452



No. of patients

CABG	3695	3369	3269	3001	2763	2294	1501	1269	1161
PCI	3725	3419	3310	3023	2797	2267	1491	1253	1150

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Hlatky ML et al. Lancet 2009;373:1190-7.

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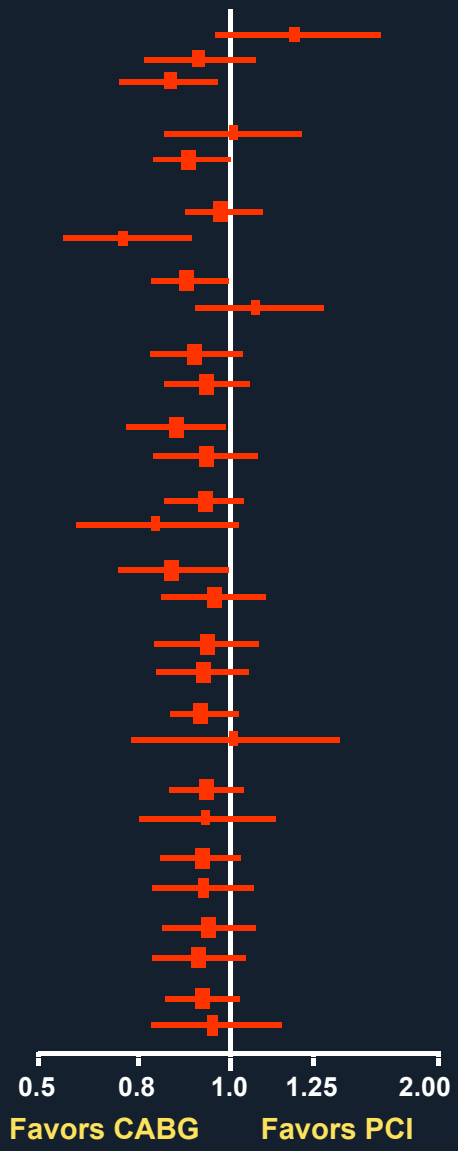
CABG vs PCI for MVD (10 RCTs, n=7,812): 5-yr mortality

	Total mortality		5-year mortality (%)		HR (95% CI)	P value for interaction
	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)	0.01
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)	0.07
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 (0·79–1·08)	
Normal cholesterol	236/1599	273/1588	9.0%	11.0%	0·84 (0·71–1·00)	0.46
Hypercholesterolaemia	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)	
Stable symptoms	205/1840	256/1900	8.2%	10.2%	0·83 (0·69–0·99)	0.30
Unstable symptoms	262/1347	266/1306	9.6%	11.1%	0·95 (0·80–1·12)	
No previous MI	263/2123	286/2132	7.4%	9.3%	0·92 (0·78–1·09)	0.92
Previous MI	308/1742	334/1764	9.5%	10.8%	0·91 (0·78–1·07)	
No heart failure	513/3756	566/3800	7.5%	9.2%	0·91 (0·80–1·02)	0.46
Heart failure	59/126	58/119	30.1%	32.1%	1·01 (0·70–1·46)	
Normal LV function	375/2789	398/2791	7.6%	9.1%	0·92 (0·80–1·06)	0.87
Abnormal LV function	126/551	151/615	12.4%	14.4%	0·93 (0·73–1·18)	
1 or 2 vessel disease	325/2386	371/2523	7.7%	8.8%	0·91 (0·78–1·06)	0.98
3-vessel disease	248/1477	253/1376	9.5%	12.1%	0·91 (0·77–1·09)	
No proximal LAD	278/1567	310/1636	8.2%	10.2%	0·92 (0·79–1·09)	0.77
Proximal LAD	249/1707	268/1684	8.8%	10.5%	0·90 (0·75–1·07)	
Balloon angioplasty trials	436/2356	481/2405	8.5%	10.9%	0·91 (0·80–1·03)	0.19
Bare-metal stent trials	139/1533	147/1518	8.2%	8.6%	0·94 (0·74–1·18)	



Hlatky et al, *The Lancet* 2009;373:1190-1197

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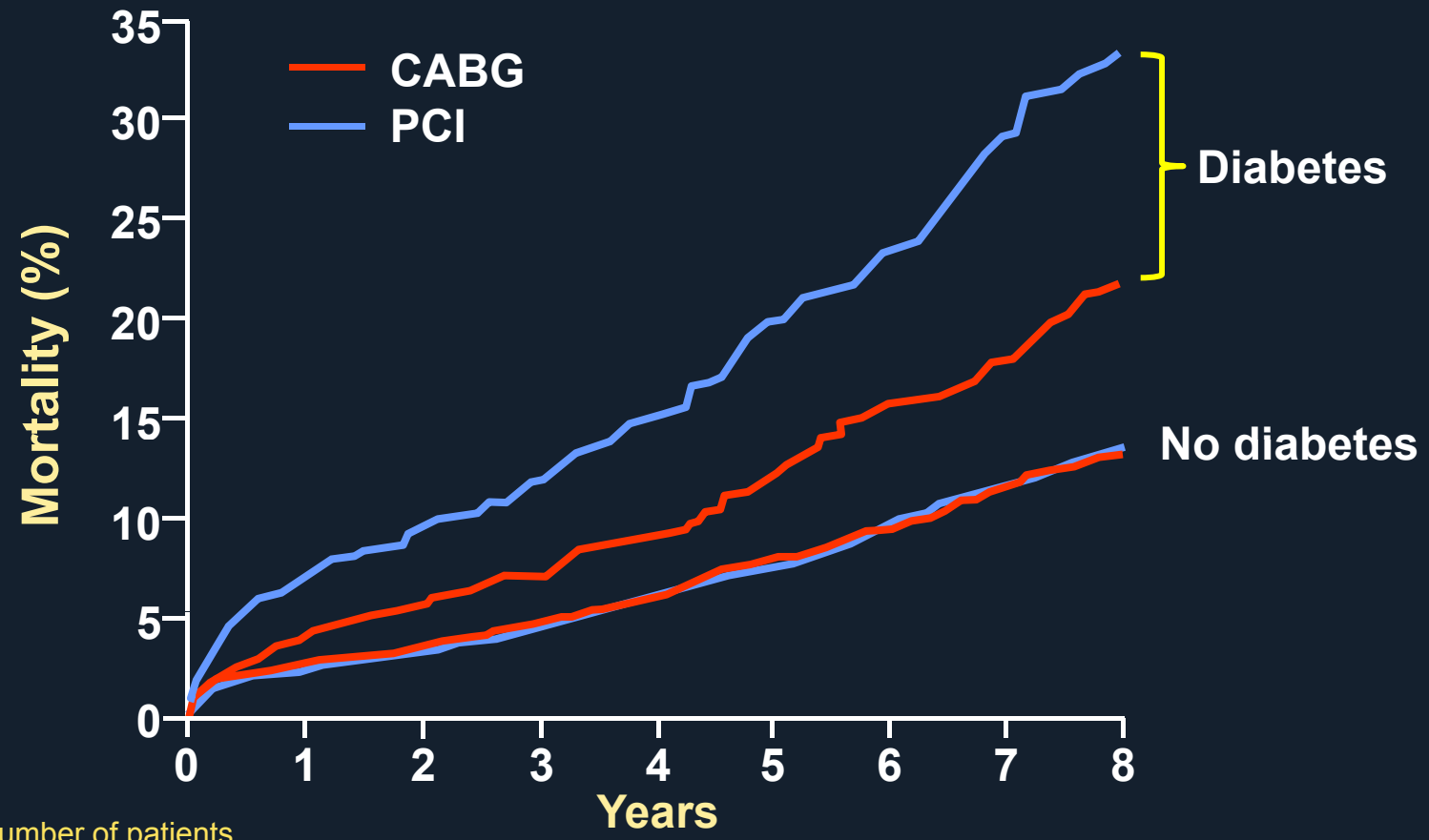
CABG vs PCI for MVD (10 RCTs, n=7,812)

- Impact of diabetes on mortality -



Number of patients									
CABG no diabetes	3263	3169	3089	2877	2677	2267	1592	1380	1274
CABG diabetes	615	587	575	532	498	421	257	225	200
PCI no diabetes	3298	3217	3148	2918	2725	2281	1608	1393	128
PCI diabetes	618	574	555	508	475	373	218	179	160

Hlatky et al, *The Lancet* 2009;373:1190-1197

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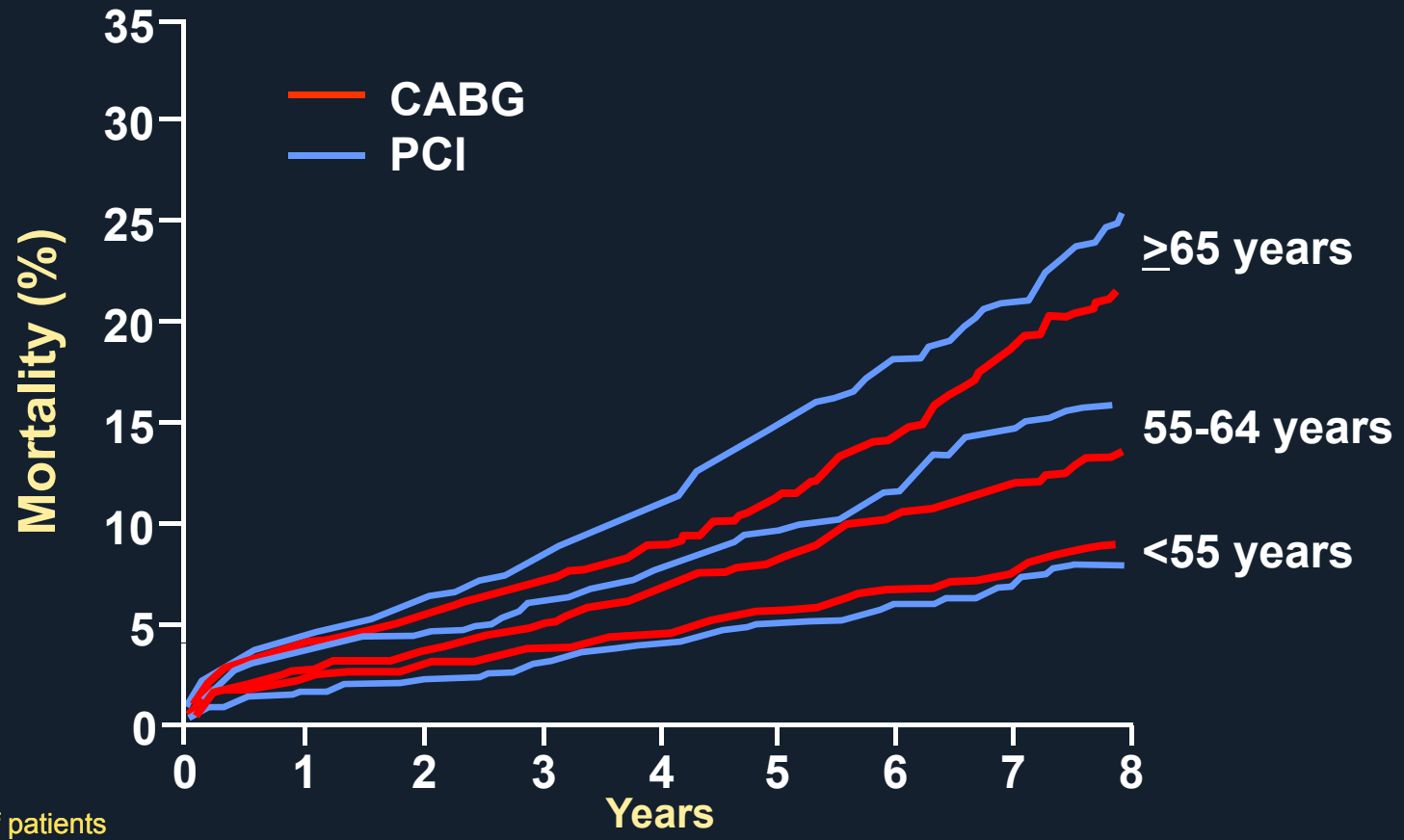

Number of patients									
CABG <55 years	1063	1039	1016	938	891	774	556	507	468
CABG 55-64 years	1477	1434	1400	1308	1206	1017	711	634	585
CABG ≥65 years	1347	1292	1257	1167	1082	902	586	468	424
PCI <55 years	1122	1104	1087	1013	955	817	561	500	466
PCI 55-64 years	1456	1404	1371	1262	1177	989	705	614	578
PCI ≥65 years	1341	1286	1247	1154	1072	852	562	462	408

Hlatky et al, *The Lancet* 2009;373:1190-1197

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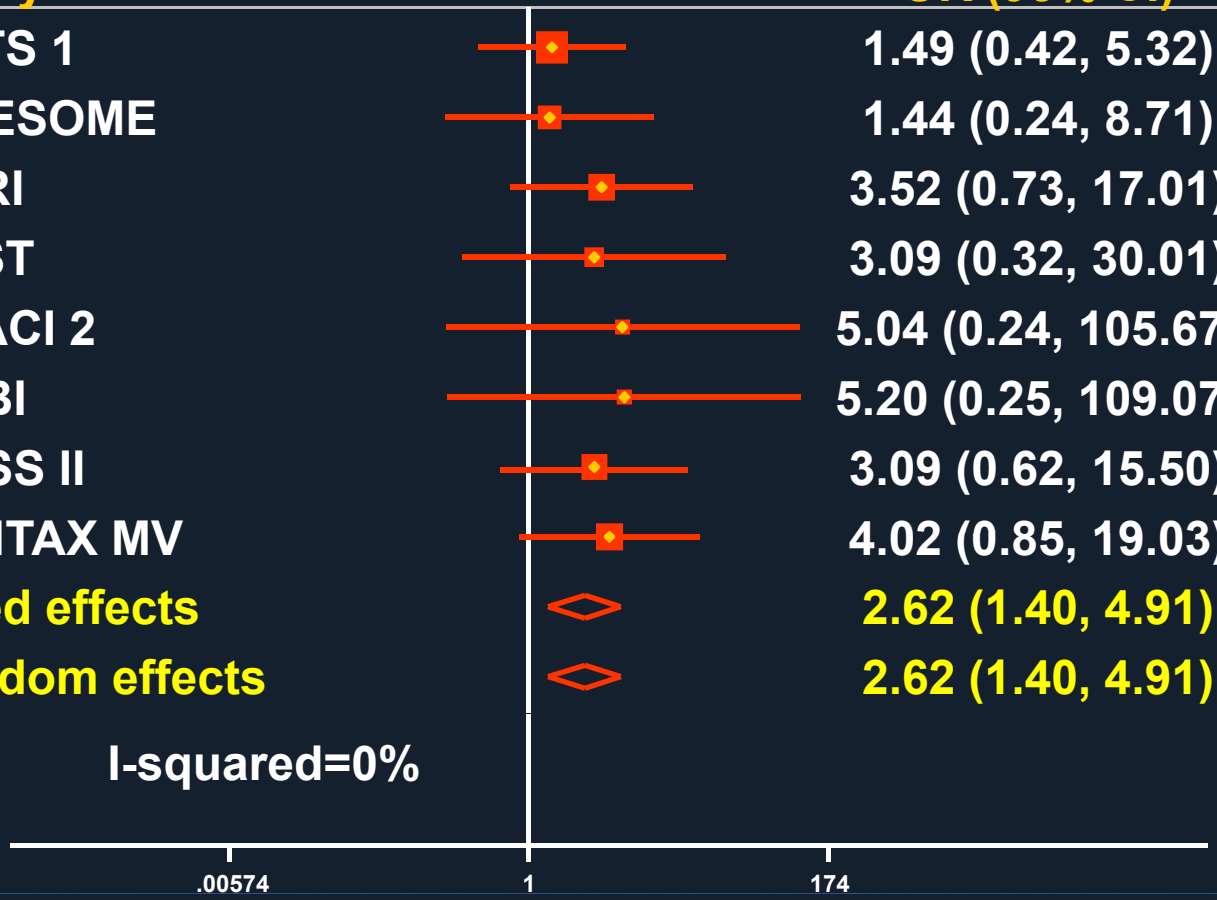
Risk of Stroke with CABG vs PCI in Multivessel Disease: Meta-analysis of 8 Randomized Trials

- 30-day Follow-up -



Study	OR (95% CI)	CABG	PCI
ARTS 1	1.49 (0.42, 5.32)	6/605	4/600
AWESOME	1.44 (0.24, 8.71)	3/232	2/222
BARI	3.52 (0.73, 17.01)	7/914	2/915
EAST	3.09 (0.32, 30.01)	3/194	1/198
ERACI 2	5.04 (0.24, 105.67)	2/225	0/225
GABI	5.20 (0.25, 109.07)	2/177	0/182
MASS II	3.09 (0.62, 15.50)	6/203	2/205
SYNTAX MV	4.02 (0.85, 19.03)	8/549	2/546
Fixed effects	2.62 (1.40, 4.91)	37/3099	13/3093
Random effects	2.62 (1.40, 4.91)	1.19%	0.42%

I-squared=0%

Δ=0.77%

Palmerini T and Stone GW. JACC in press.

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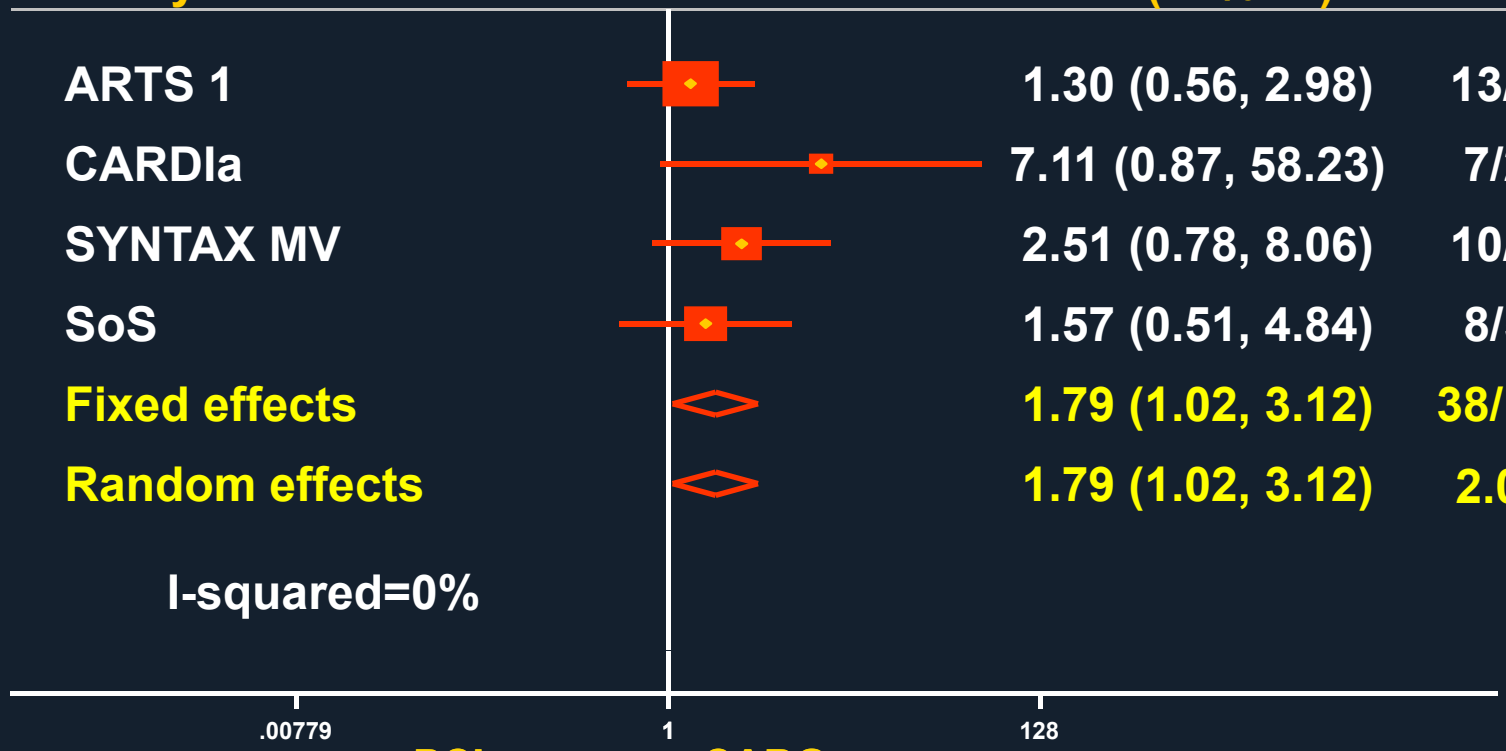
Risk of Stroke with CABG vs PCI in Multivessel Disease: Meta-analysis of 4 Randomized Trials

- Median 12.1 Month Follow-up -



Study	OR (95% CI)	CABG	PCI
ARTS 1	1.30 (0.56, 2.98)	13/605	10/600
CARDIa	7.11 (0.87, 58.23)	7/256	1/254
SYNTAX MV	2.51 (0.78, 8.06)	10/549	4/546
SoS	1.57 (0.51, 4.84)	8/500	5/488
Fixed effects	1.79 (1.02, 3.12)	38/1910	20/1888
Random effects	1.79 (1.02, 3.12)	2.00%	1.06%

I-squared=0%

Δ=0.94%

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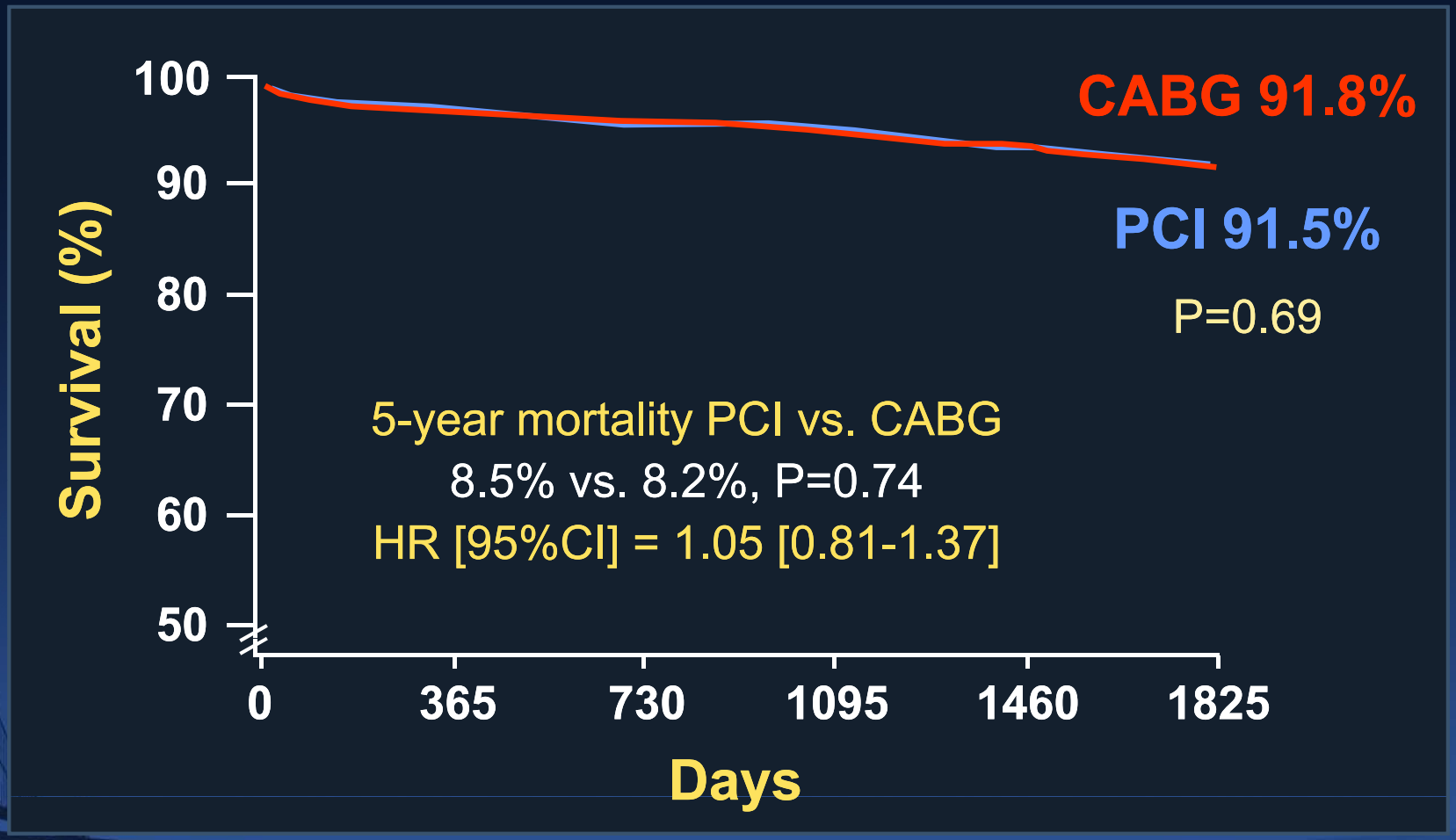
Bare Metal Stents vs. CABG

4 RCTs (ARTS, ERACI-II, MASS-II, SoS), 3,051 pts, 94% IMA, 5-year follow-up (pt level pooled analysis)



Daemon J et al. Circulation 2008;118:1146-1154

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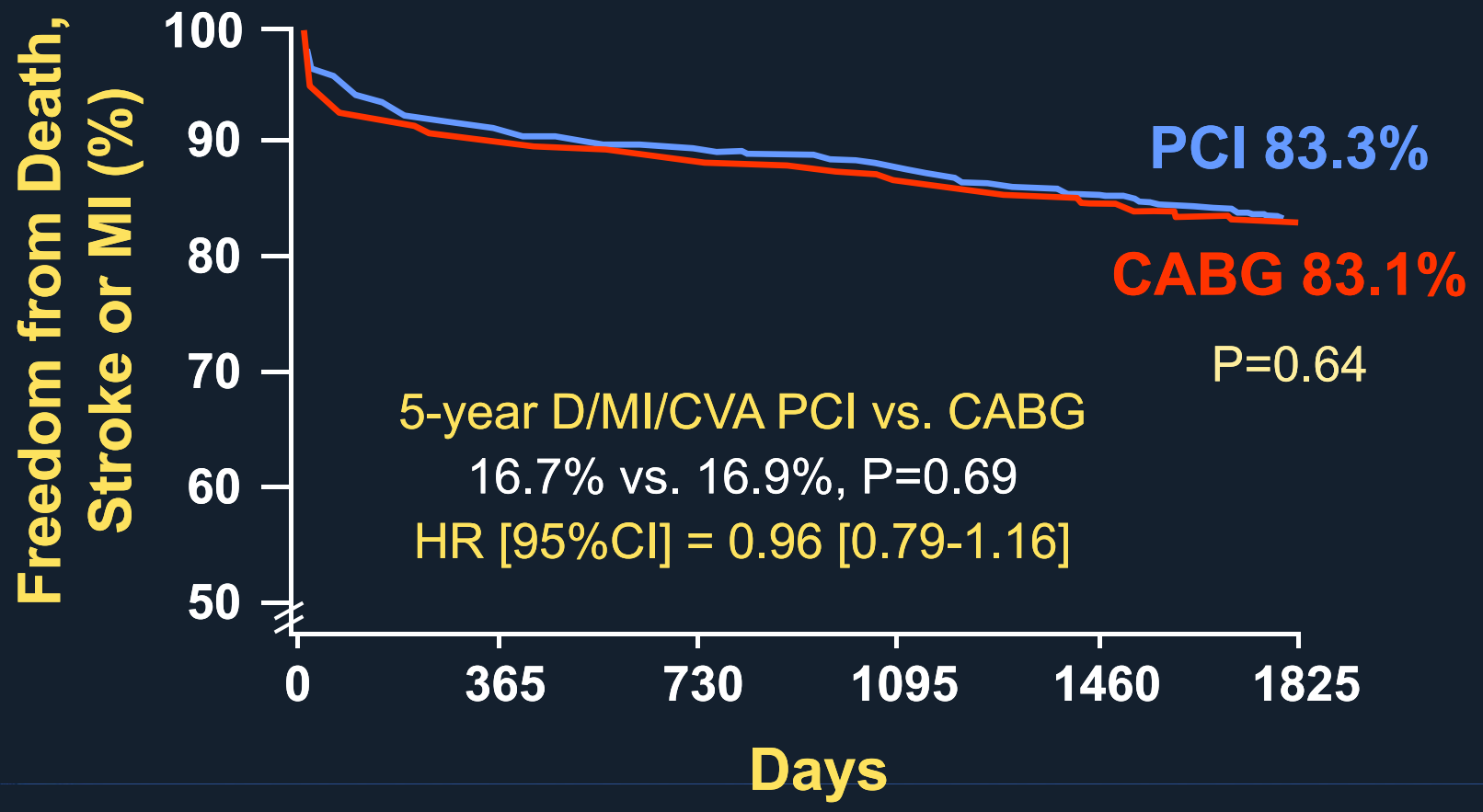

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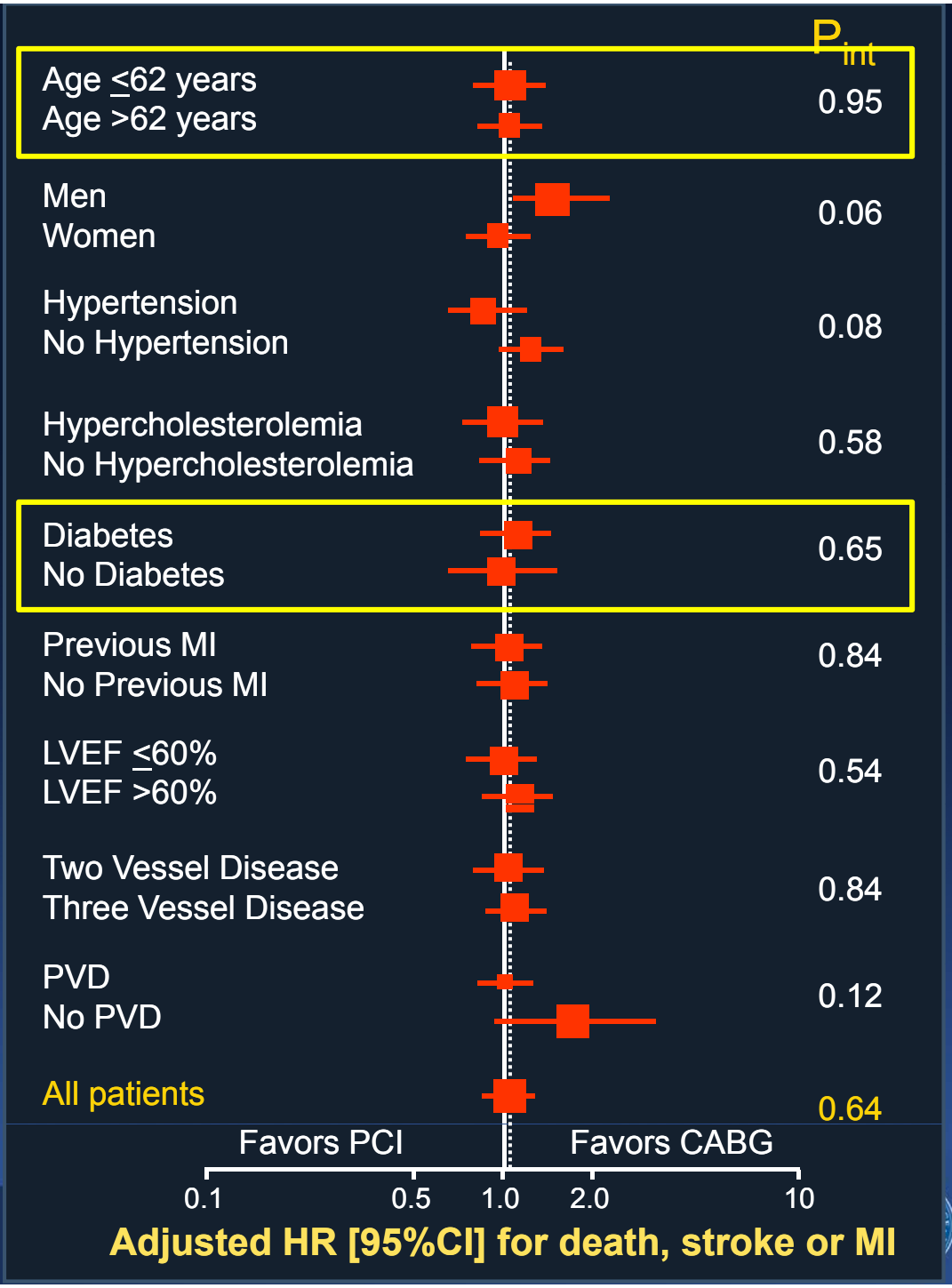
Bare Metal Stents vs. CABG

4 RCTs, 3,051 randomized pts, 5-year follow-up

Death, stroke or MI

Daemon J et al.
Circulation 2008;118:1146-1154



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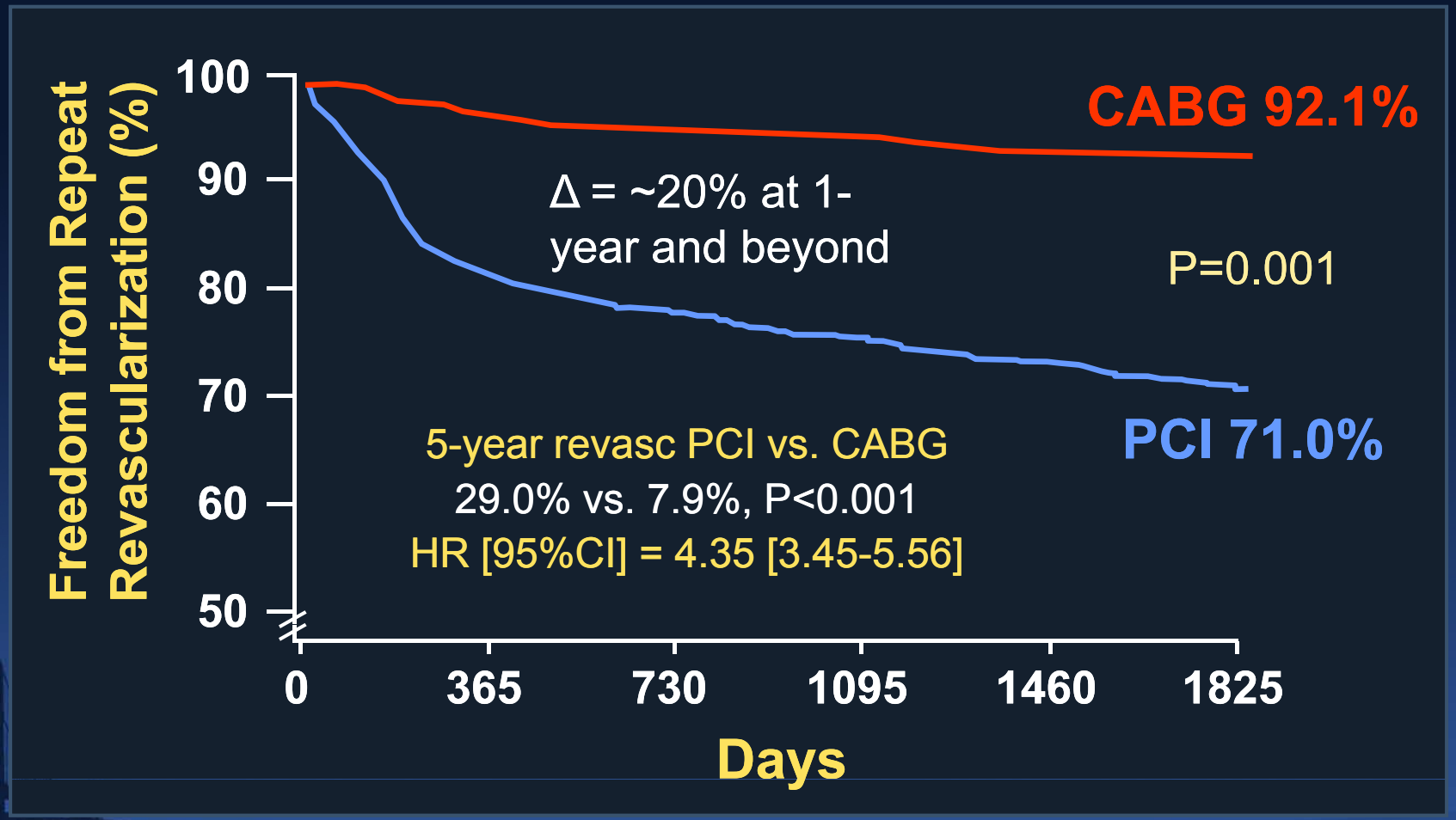

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CARDia Trial

510 pts <80 yo **with diabetes** and complex 1, 2, or 3 VD (no LM) were randomized to stents vs. CABG

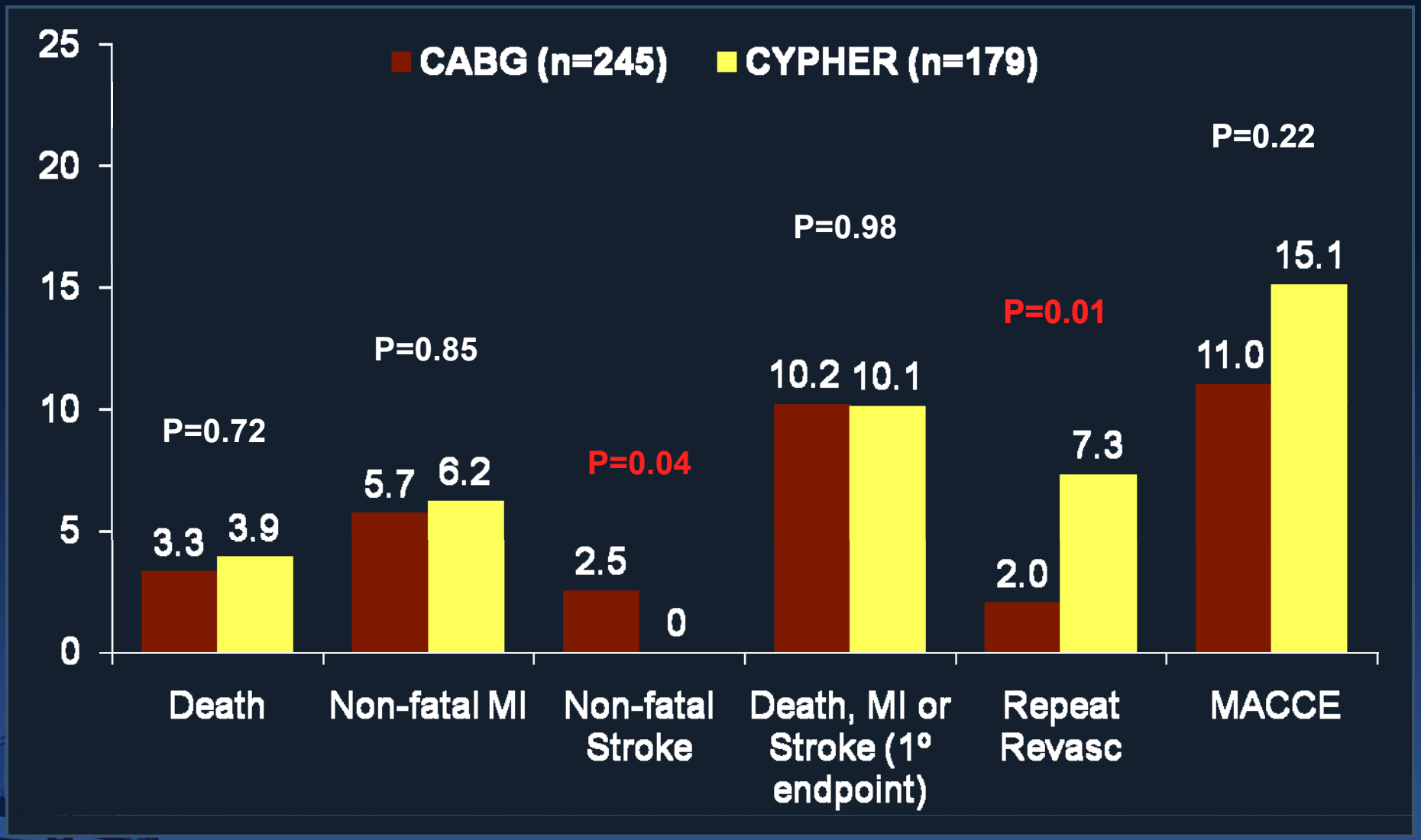
Primary endpoint: 1 yr death/MI/stroke (NI)

31% insulin-treated, 6% 1VD, 33% 2VD, 61% 3VD, mean LVEF 60%

CABG pts		PCI pts	
LIMA	89%	DES (Cypher)	71%
≥2 arterial grafts	17%	BMS	29%
Mean # of grafts	2.8	Mean # stents	3.5
Off pump	31%	Mean stent length (mm)	71

Kapur A et al. JACC 2010;55:432–40

1-Year MACCE: DES group (n=424)



Kapur A et al. JACC 2010;55:432–40

SYNTAX Eligible Patients

SYNTAX

De novo disease (n=1800)

Limited Exclusion Criteria
- Previous interventions
- Acute MI with CPK>2x
- Concomitant cardiac surgery

Left Main Disease
(isolated, +1, +2 or +3 vessels)

N=705

3 Vessel Disease
(revasc all 3 vascular territories)

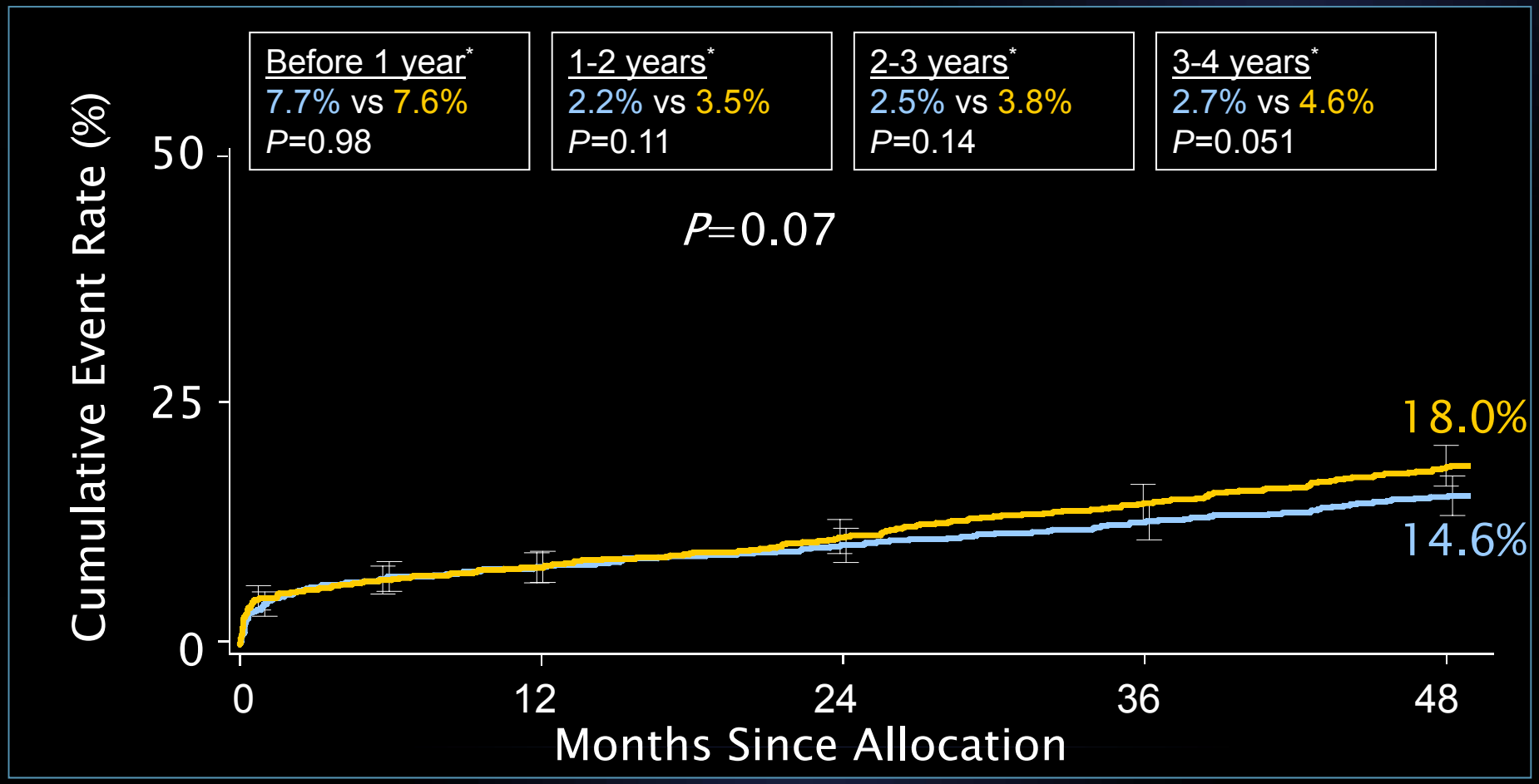
N=1095

Primary endpoint = death/MI/stroke/repeat revasc at 1 year

Serruys PW et al. NEJM 2009;360:961-72

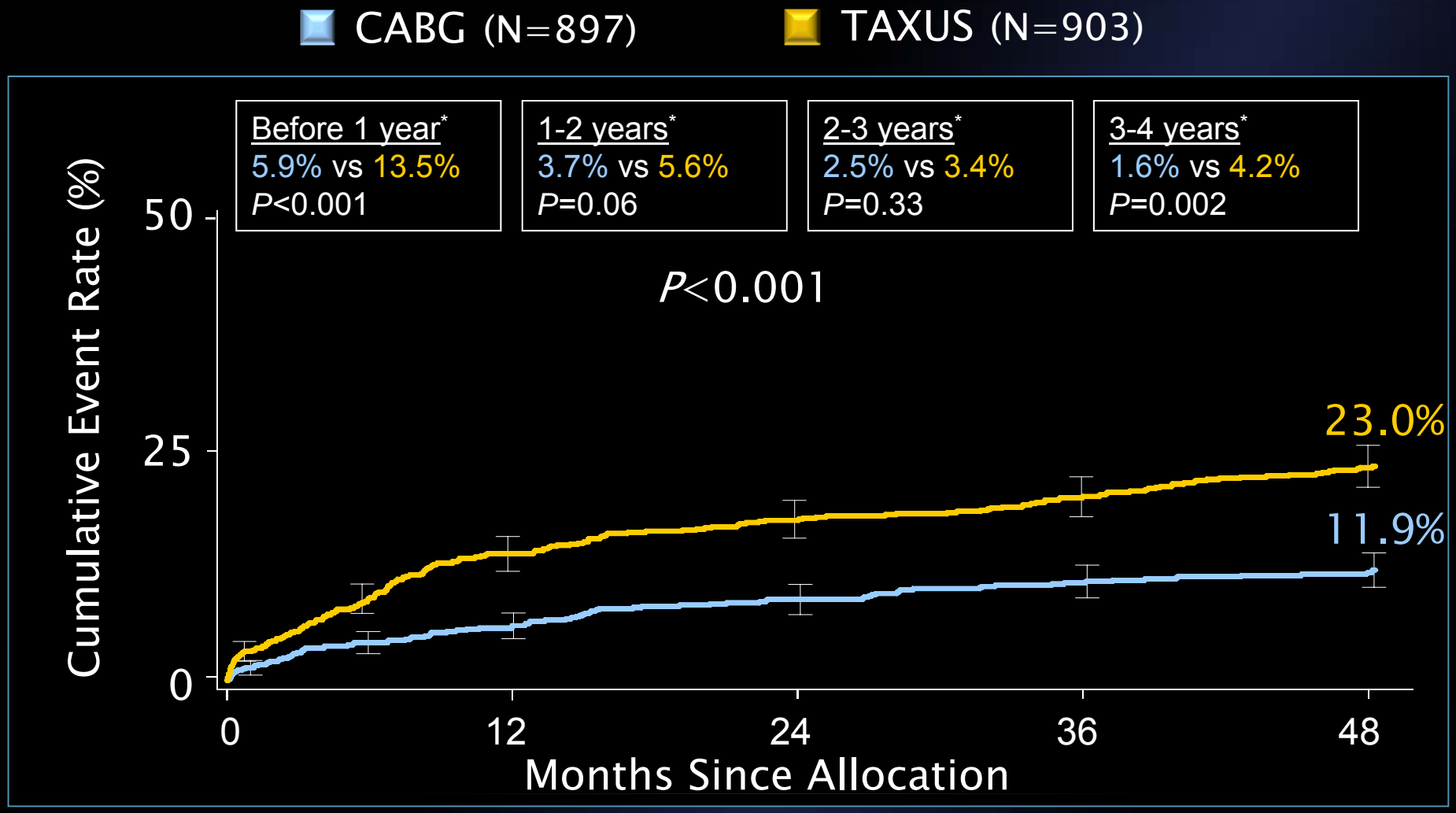
All-Cause Death/CVA/MI to 4 Years

SYNTAX



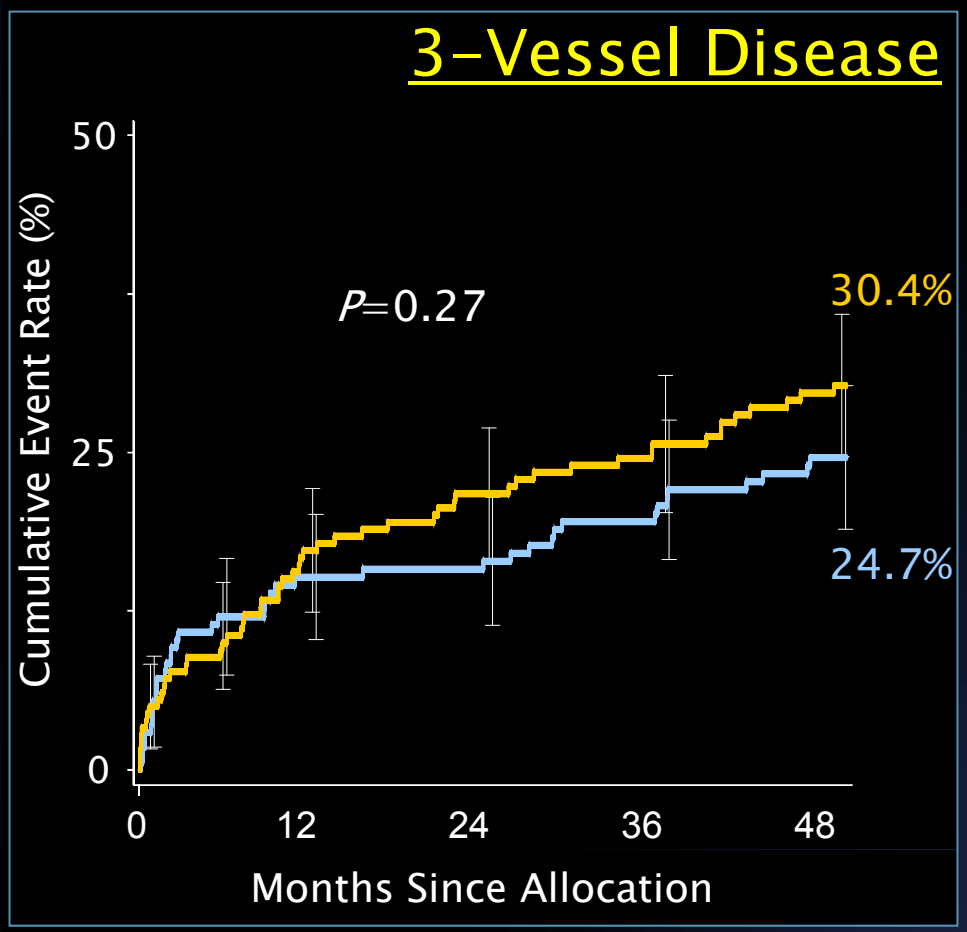
Serruys PW. TCT2011

Repeat Revascularization to 4 Years



Serruys PW. TCT2011

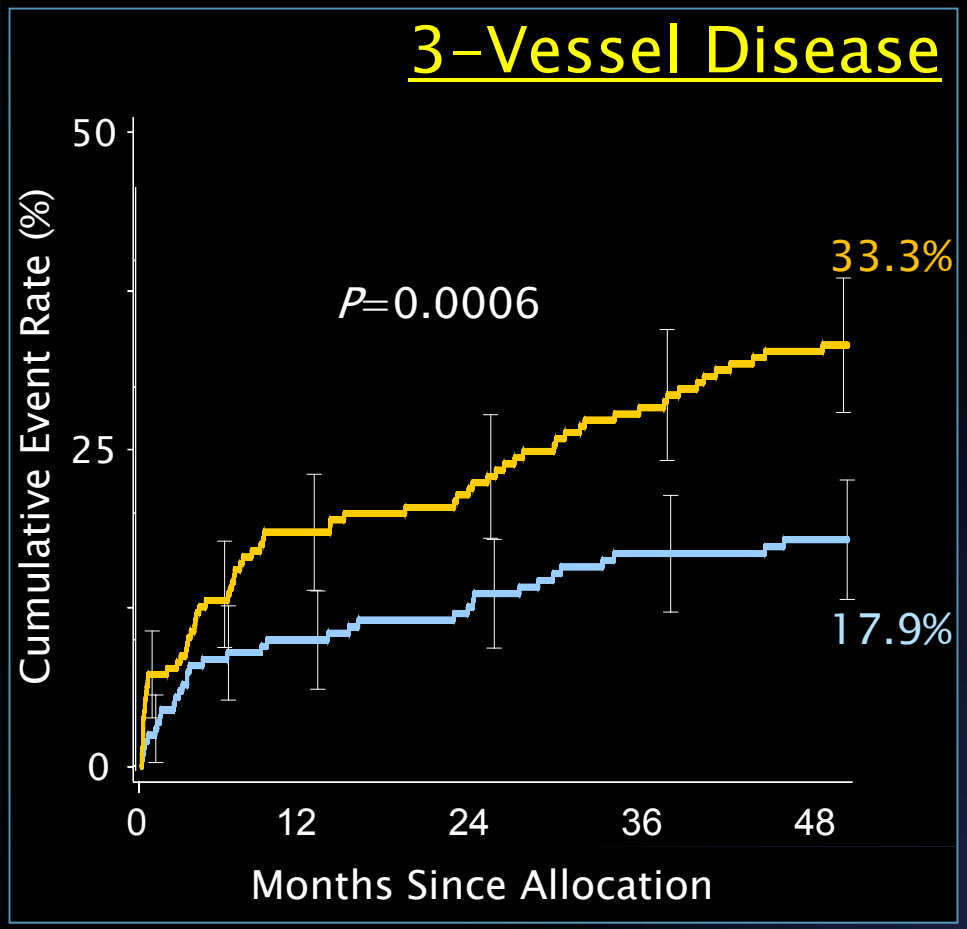
MACCE to 4 Years by SYNTAX Score Tercile *Low Scores (0–22)*



	CABG	PCI	*P* value
Death	8.7%	9.0%	0.92
CVA	3.9% >	1.2%	0.12
MI	4.9%	8.2%	0.27
Death, CVA or MI	14.8%	15.8%	0.84
Revasc.	11.6% <	21.2%	0.02

Serruys PW. TCT2011

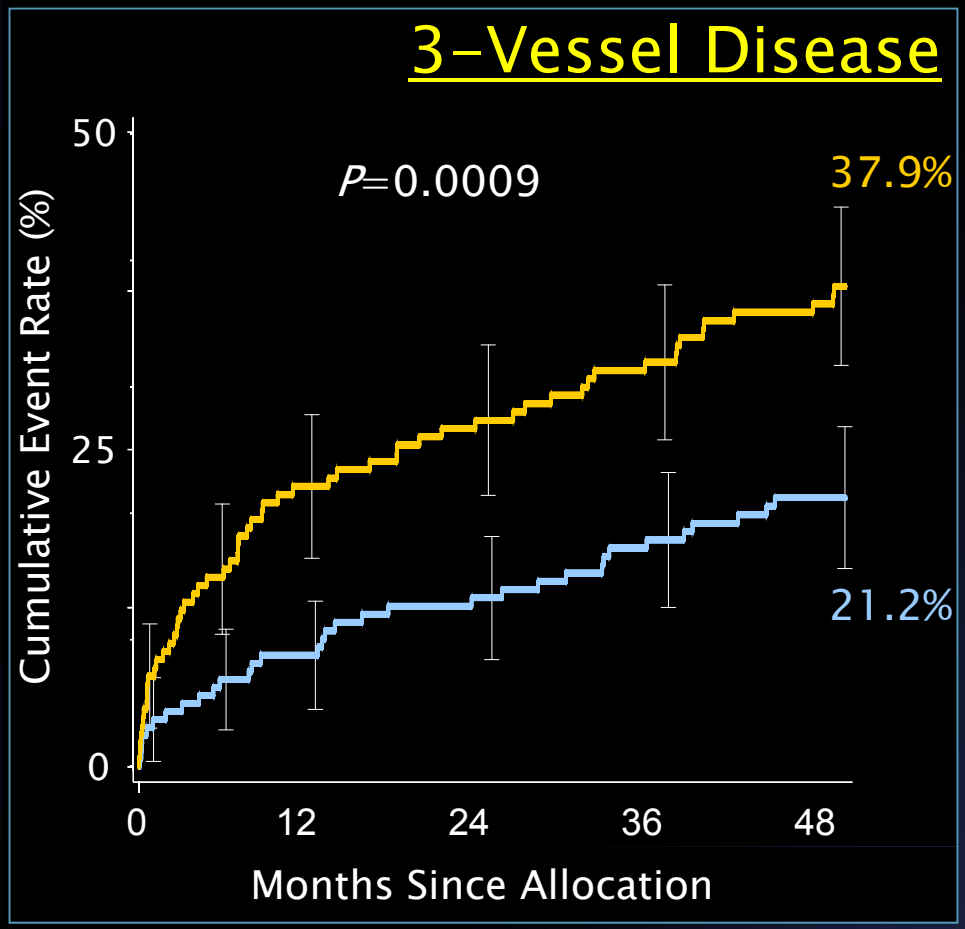
MACCE to 4 Years by SYNTAX Score Tercile *Intermediate Scores (23–32)*



	CABG	PCI	*P* value
Death	12.4% <	18.6%	0.048
CVA	3.6% >	2.5%	0.53
MI	3.1% <	10.5%	0.004
Death, CVA or MI	12.4% <	18.6%	0.09
Revasc.	8.3% <	21.0%	0.0005

Serruys PW. TCT2011

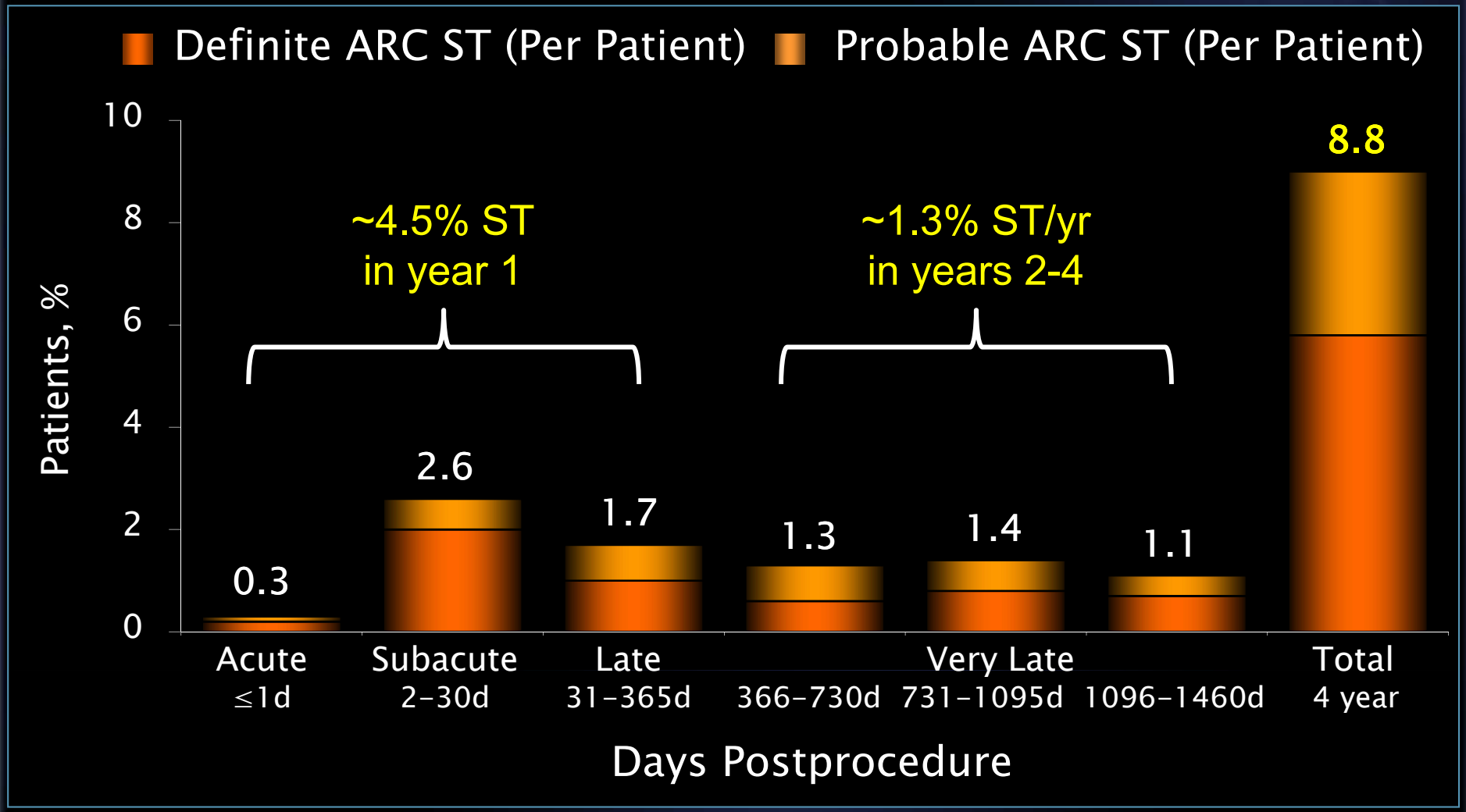
MACCE to 4 Years by SYNTAX Score Tercile *High Scores (≥33)*



	CABG	PCI	*P* value
Death	6.5% <	14.5%	0.02
CVA	2.6% <	5.1%	0.31
MI	1.9% <	7.9%	0.01
Death, CVA or MI	11.0% <	22.3%	0.008
Revasc.	11.2% <	26.7%	0.0005

Serruys PW. TCT2011

SYNTAX: ARC Stent Thrombosis



1 patient had an ST 1d and 6d post-procedure; therefore, counted in the ≤1d and 2-30d intervals but only once in the total.

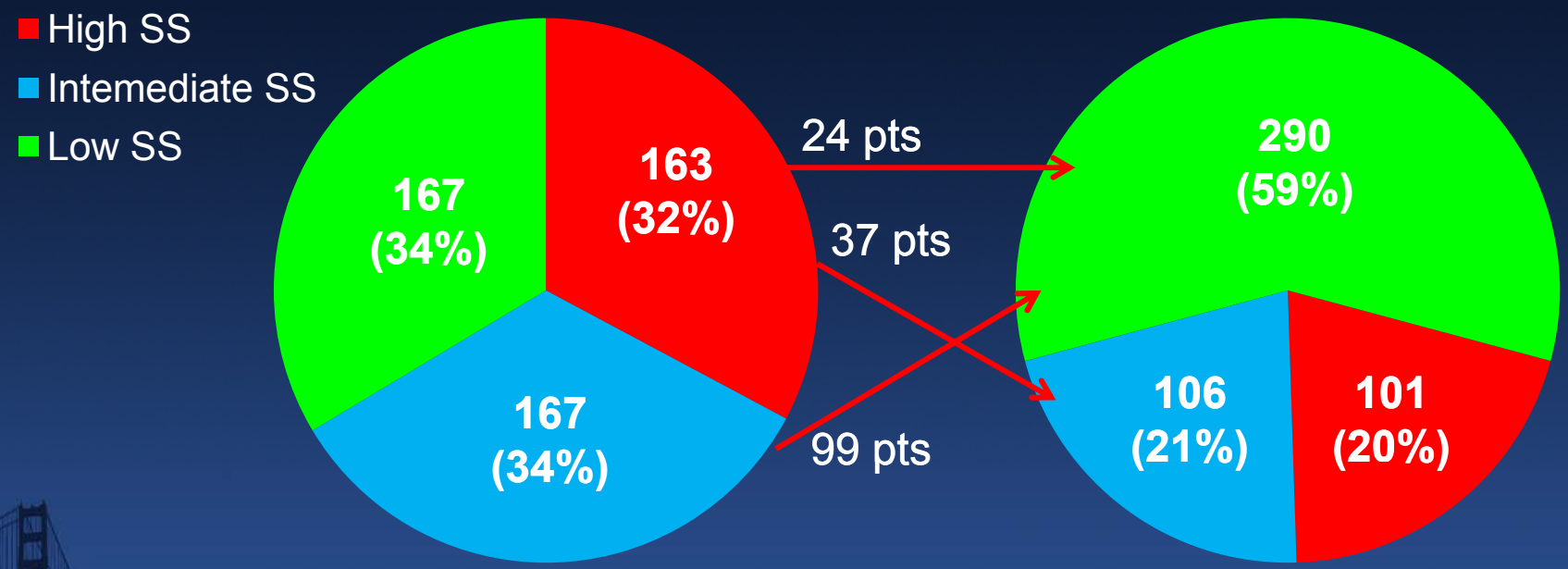
Serruys PW. TCT2011

Functional SYNTAX Score (FFR ≤0.80)

SS and FSS calculated in 497 pts with MVD in FAME

Angiographic SS tertiles —FFR→ **Functional SS**

Angiographic SS tertiles	Functional SS
Median 13.8	Median 10.5
Mean 14.8 ± 6.0	Mean 11.3 ± 6.9
Range 4 to 43	Range 0 to 43



In total, 32% of pts moved from a higher-risk to a lower-risk group

Chang-Wook N et al. JACC 2011;58:1211–8

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Functional SYNTAX Score (FFR ≤0.80)

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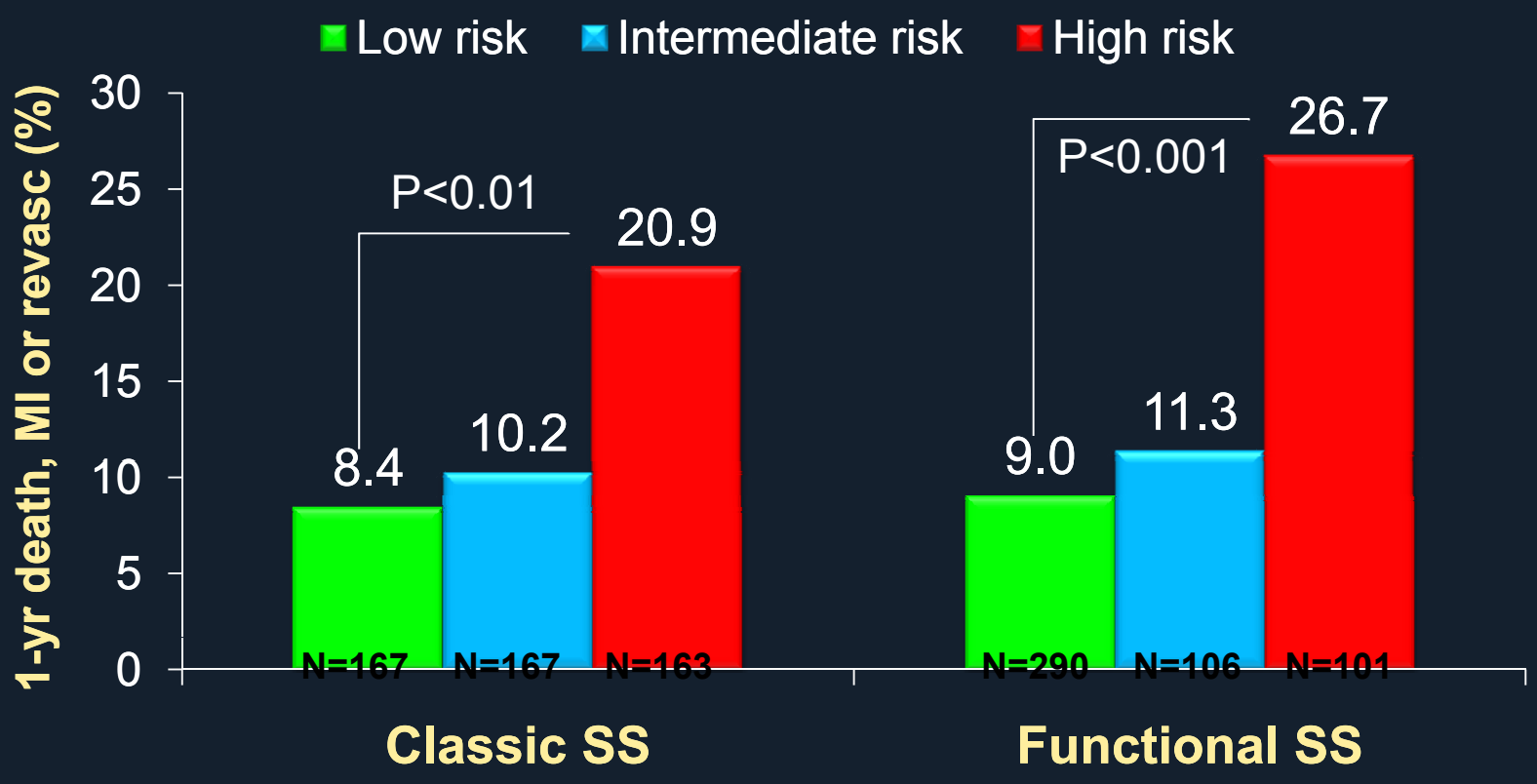
1-Year Death, MI or repeat revascularization



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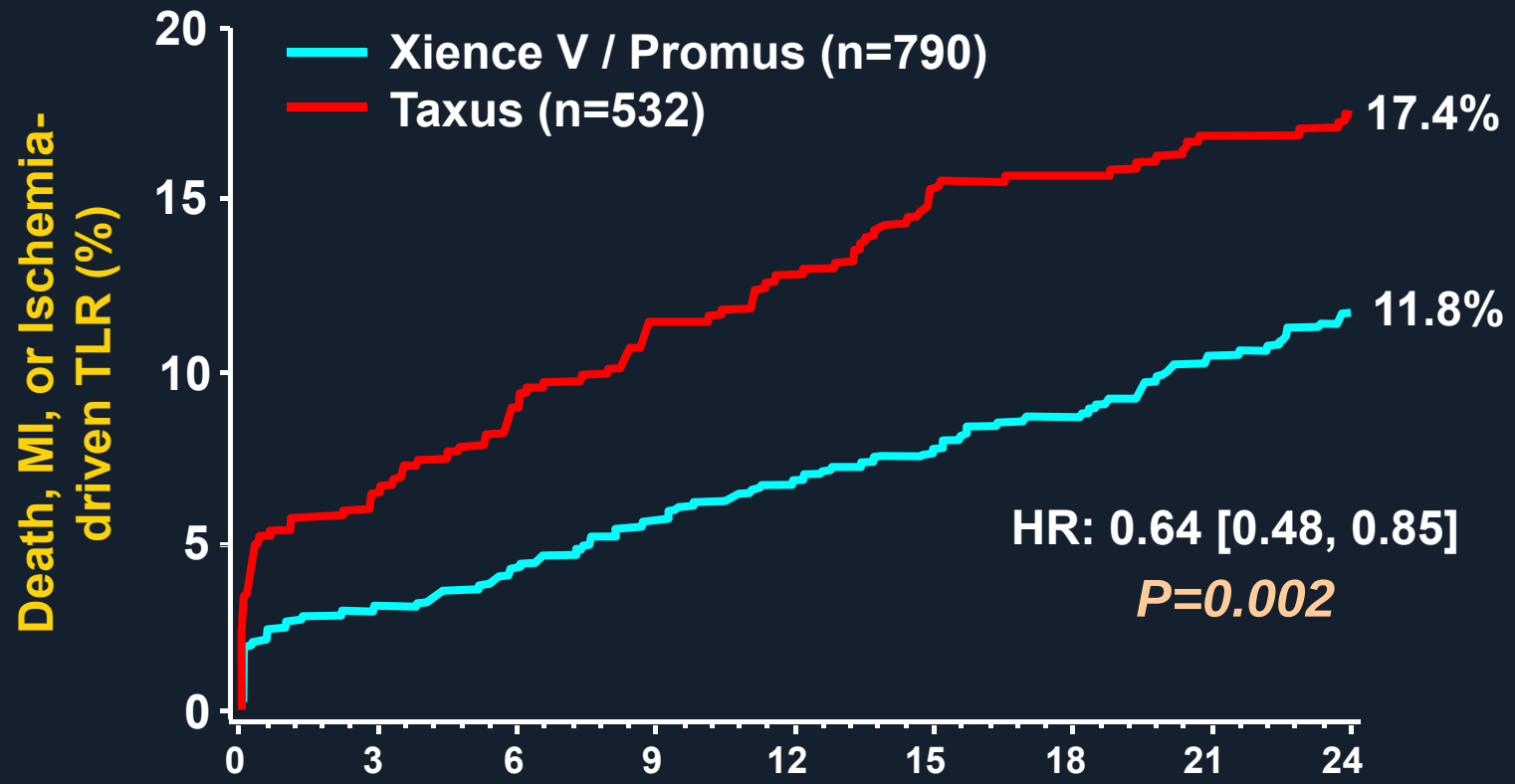
EES vs. PES: SPIRIT II, III, IV and COMPARE RCTs

Pooled database analysis – 2 year results

Patients with multivessel PCI (n=1,322)



No. at risk					
Xience V	790	752	720	969	624
Taxus	532	478	451	430	387

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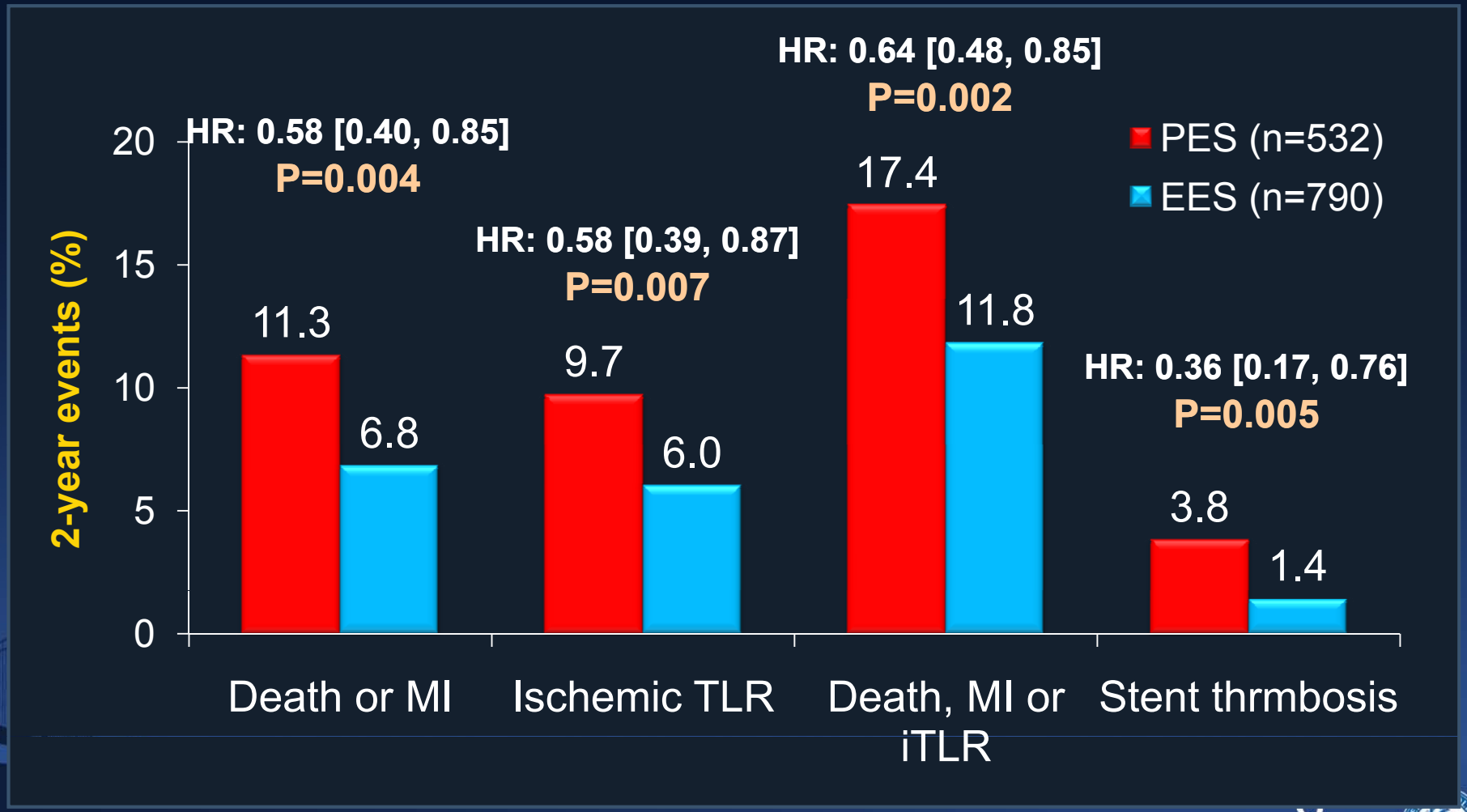

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Evidence-based Medicine

When Do I Prefer CABG for MVD?

With current DES, the benefits of PCI compared to CABG in terms of lesser invasiveness, fewer major peri-procedural complications, reduced stroke, better early QOL, more rapid return to work, etc., outweigh the greater rate of repeat revascularization, as long as mortality is not increased. Thus, I currently prefer CABG in:

1. Most patients with SYNTAX score ≥33
2. Select patients with SYNTAX score 22 – 33 (e.g. non-revascularizable LAD supplying viable myocardium)

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AMERICAN COLLEGE OF CARDIOLOGY

Evidence-based Medicine

When Do I Prefer CABG for MVD?

Other factors which must be considered:

- Likelihood to completely revascularize all major ischemic segments
- Operator expertise (interventionalist and surgeon)
- Expected patient compliance with follow-up medications and procedures

Diabetes, LVEF, and 2VD vs 3VD do not independently weigh into this equation!

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