Cost-Effectiveness of PCI with Drug Eluting Stents vs. Bypass Surgery for Patients with Diabetes and Multivessel CAD: *Results from the FREEDOM Trial*

Elizabeth A. Magnuson, Valentin Fuster, Michael E. Farkouh, Kaijun Wang, Katherine Vilain, Haiyan Li, Jaime Appelwick, Victoria Muratov, Lynn A. Sleeper, Mouin Abdullah, David J. Cohen

Saint Luke's Mid America Heart Institute
University of Missouri-Kansas City
Kansas City, Missouri

Disclosures

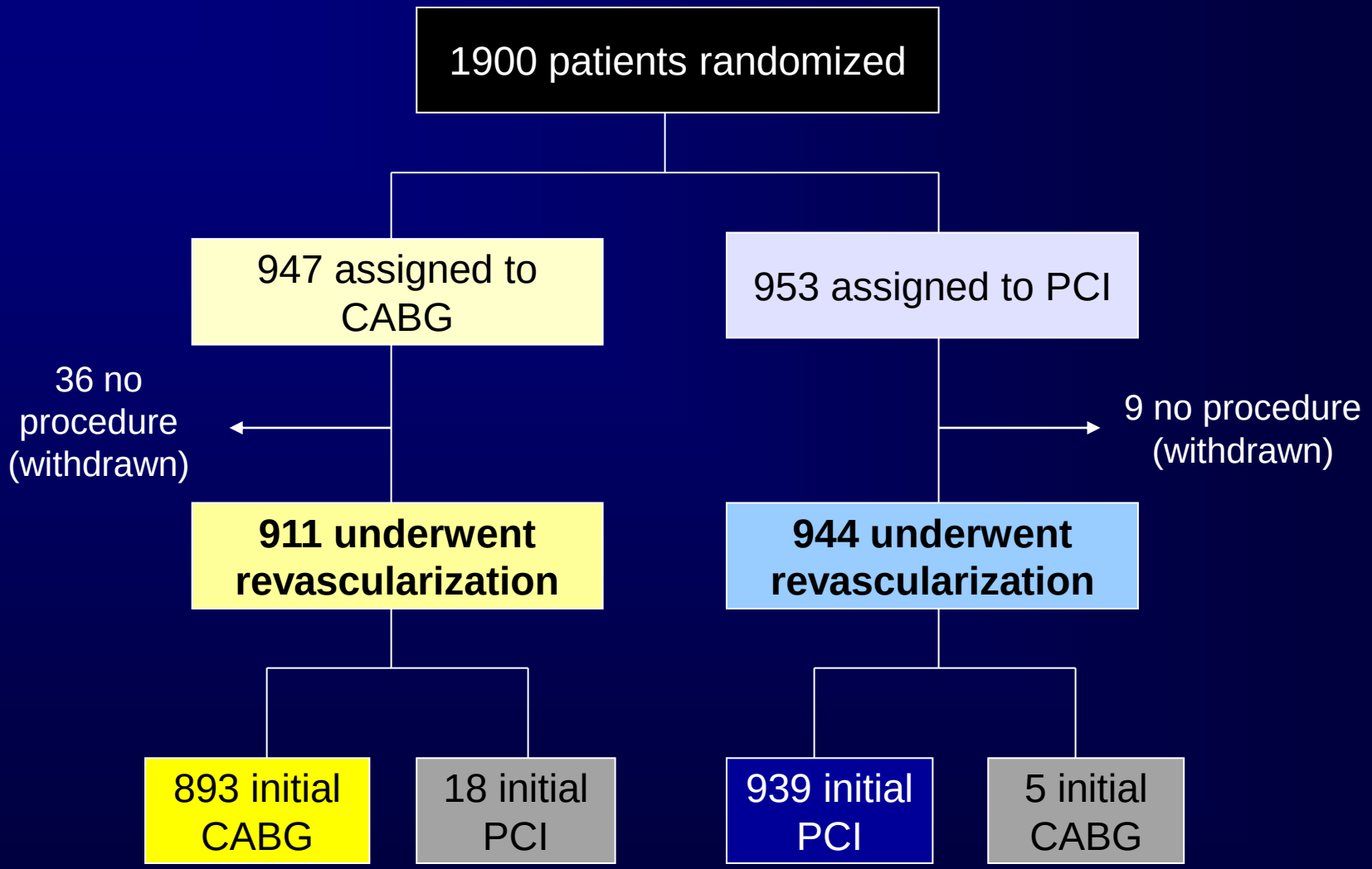
- FREEDOM was supported by U01 grants #01HL071988 and #01HL092989 from the National Heart Lung and Blood Institute
- Drug eluting stents were provided by Cordis, Johnson and Johnson and Boston Scientific
- Abciximab and an unrestricted research grant were provided by Eli Lilly and Copany
- Clopidogrel was provided by Sanofi Aventis and Bristol-Myers Squibb

Background

- Clinical results from the FREEDOM Trial showed that for patients with diabetes and multivessel CAD, CABG compared with PCI using drug-eluting stents (DES-PCI) was associated with significantly lower rates of death, MI, or stroke, with the benefit driven by significant reductions in both death and MI

- A prospective economic evaluation was carried out alongside the FREEDOM trial to provide additional insight into the relative value of CABG vs. PCI in the drug-eluting stent era.

Patient Flow



Median follow-up duration: 47 months

Cost-Effectiveness Analysis

Analytic Perspective:

- US healthcare system

Patient Population:

- All randomized patients who underwent an initial revascularization procedure

General Approach:

- Multiply counts of resources derived from trial population by price weights derived from a comparable US population

Costing Methods

- Cath lab and CABG-related procedure costs based on measured utilization (procedure duration, balloons, stents, wires, etc.) and current unit costs
  - *DES cost = $1500/stent*
- Ancillary hospital costs based on event-based (rather than resource-based) regression models of FREEDOM-eligible US patients using 2010 MedPAR data
  - *Avoids distortions due to marked differences in LOS across different health care systems*
- Costs also included for other CV and non-CV hospitalizations, MD fees, outpatient CV care/testing, cardiac rehabilitation, and outpatient medications

Economic Study Analysis Plan

Primary Endpoint:

- Incremental cost-effectiveness ratio (ICER) expressed as cost per quality-adjusted life year (QALY) gained

General Approach

- In-trial analysis based on observed survival, health state utility (EQ-5D), and costs derived from observed health care resource use through 5 years
- Lifetime analysis based on projections of survival, quality-adjusted survival and costs beyond 5 years

Planned Analyses

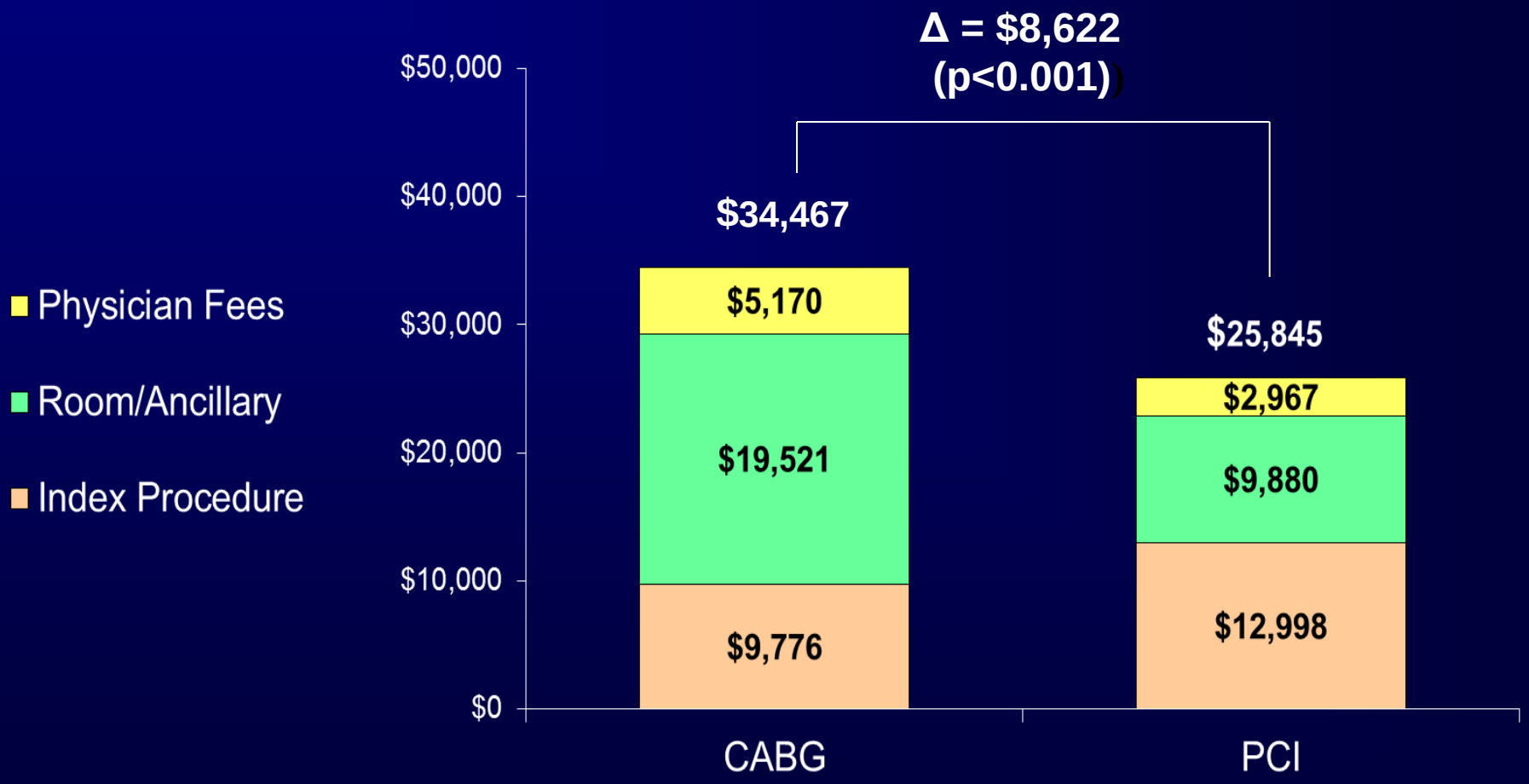
- In-trial costs and cost-effectiveness
- Stratified analyses – including by SYNTAX score

Index Procedure Resource Use*

	CABG	PCI
PCI procedures		
1		66.6%
2		30.9%
3-4		2.3%
Procedure duration (mins)	248 ± 78	107 ± 6.7
Drug-eluting stents		4.1 ± 1.9
Paclitaxel-eluting		45.6%
Sirolimus-eluting		51.7%
Other drug-eluting stents		2.7%
Total Procedure Cost	**$9,739 ± $2,453**	**$13,014 ± $5,173**

* Per protocol population (includes planned staged procedures)

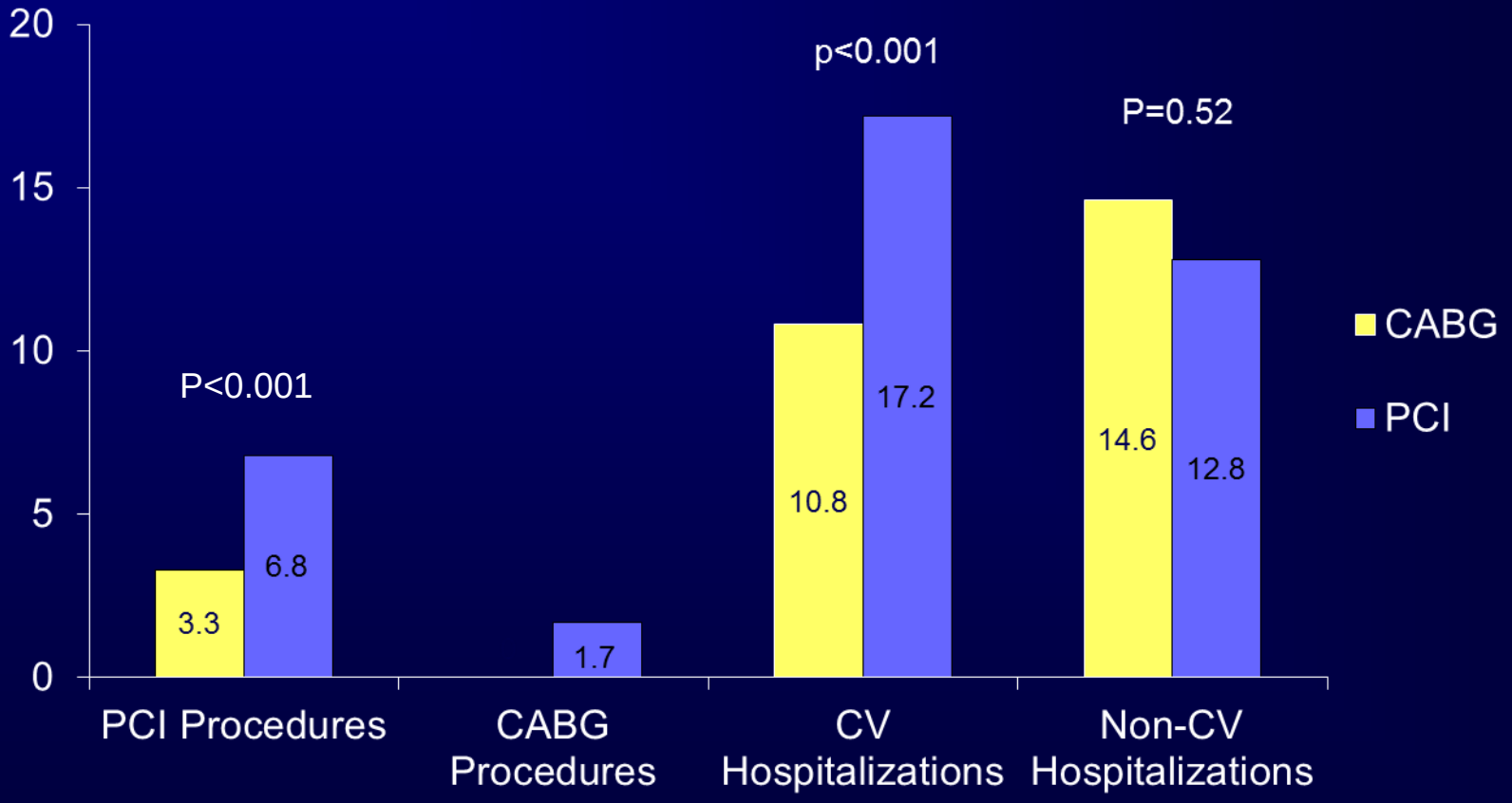
Index Hospitalization Costs



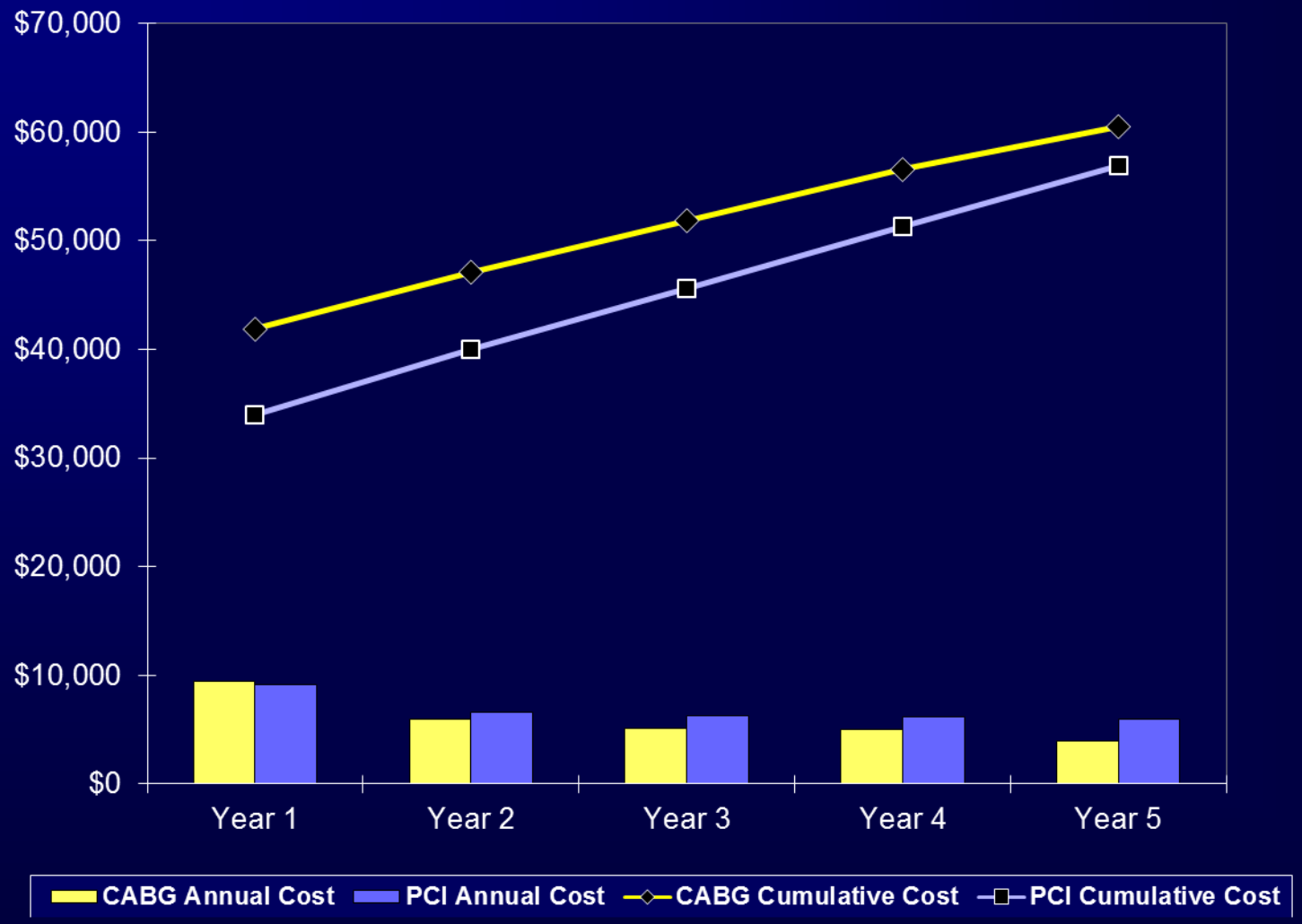
* ITT population (includes planned staged procedures)

5-Year Follow-up Resource Utilization

Rates per 100 person-years



Annual and Cumulative Costs: Years 1- 5



In-Trial Cost-Effectiveness

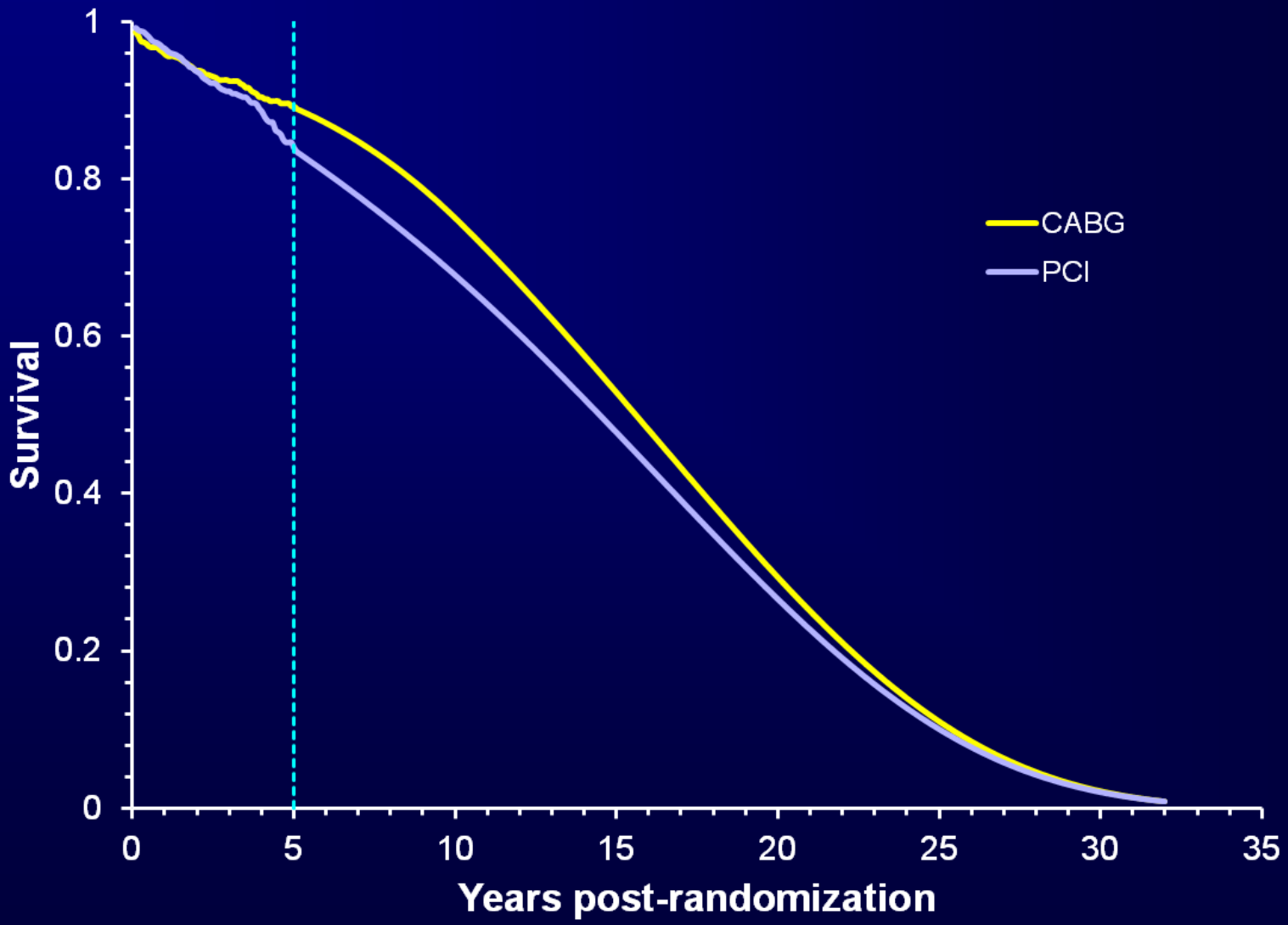
Time Since Randomization (Years)	Δ Costs (CABG-PCI)	Δ QALYs (CABG-PCI)	ICER
1	$7,878	-0.033	PCI dominant
2	$7,086	-0.034	PCI dominant
3	$6,251	-0.029	PCI dominant
4	$5,235	-0.004	PCI dominant
5	$3,641	0.031	$116,699/QALY

Markov Model

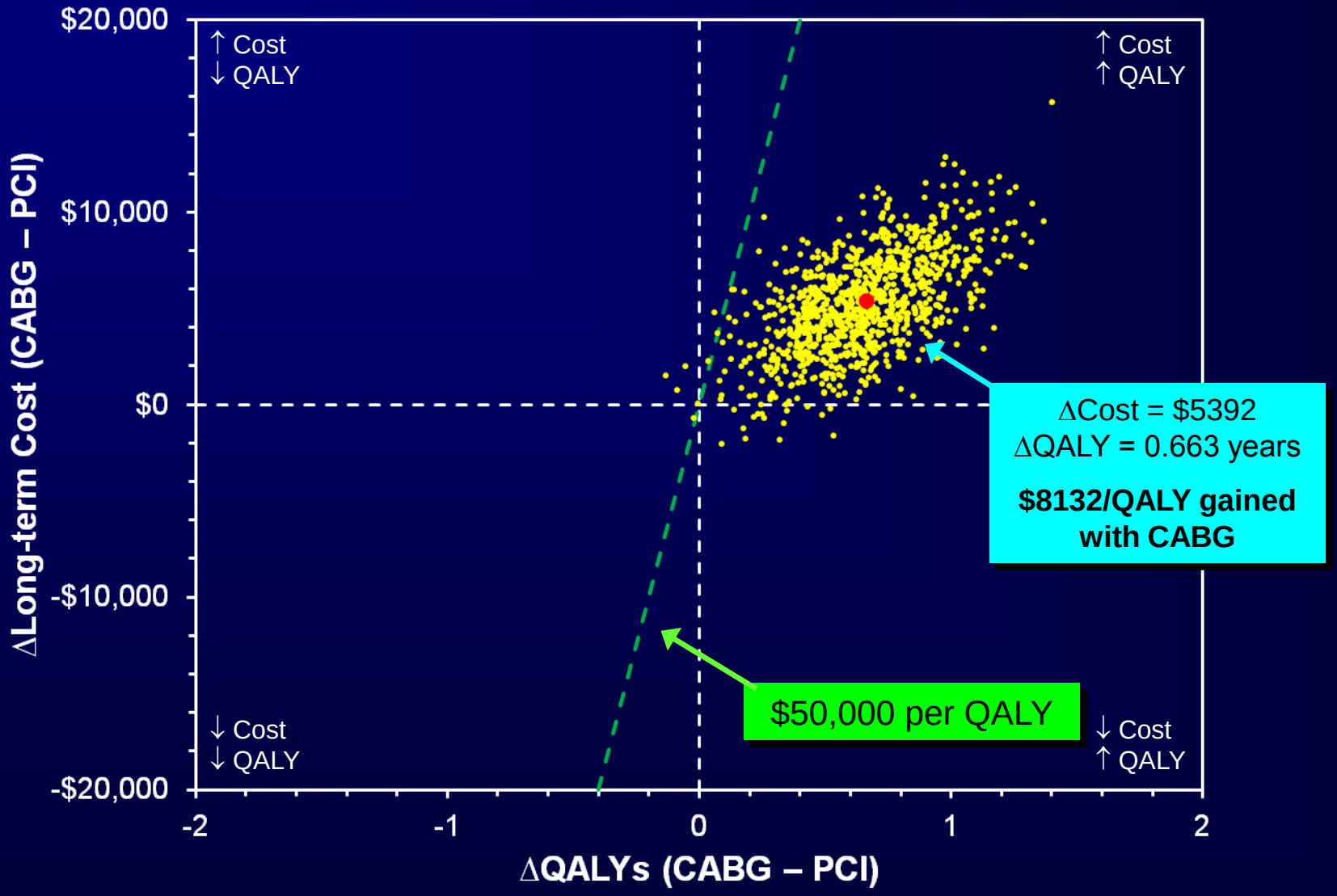
For the Projection of Post-Trial Costs and QALYS

- Monthly risk of death based on age, sex and race-matched data from US life tables calibrated to the observed 5 year mortality for the PCI population
  - *Modeled CABG effect based on a landmark analysis for years 1-5: mortality hazard ratio for CABG vs. PCI = 0.60*
- Long-term costs and utility weights based on regression models developed from trial data
- Base case: Gradual attenuation of CABG effect
  - *Mortality hazard ratio increases from 0.60 to 1 in a linear fashion between 5 and 10 years; no impact of CABG beyond 10 years*

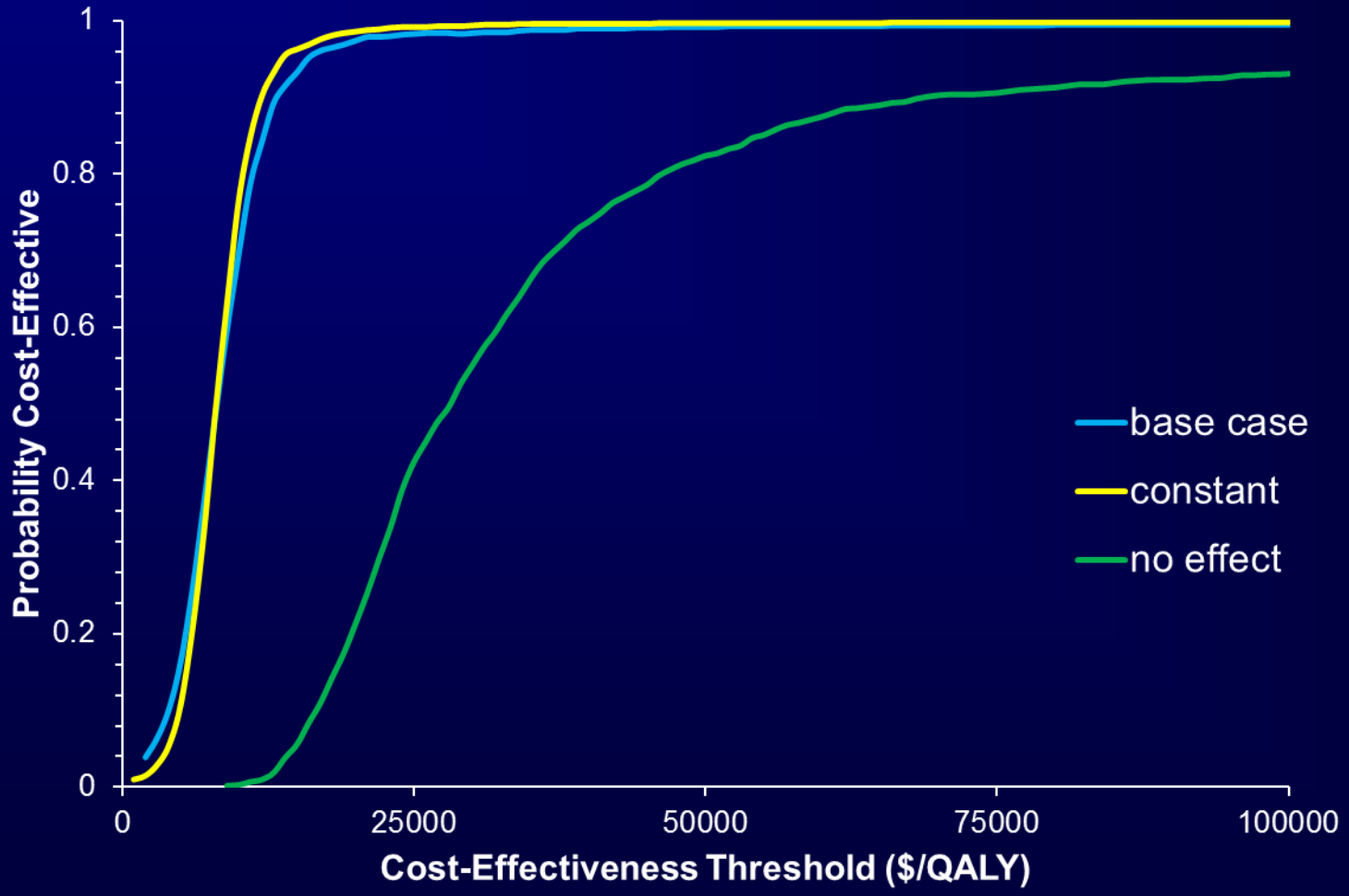
In-Trial and Projected Survival



Lifetime Cost-Effectiveness Results

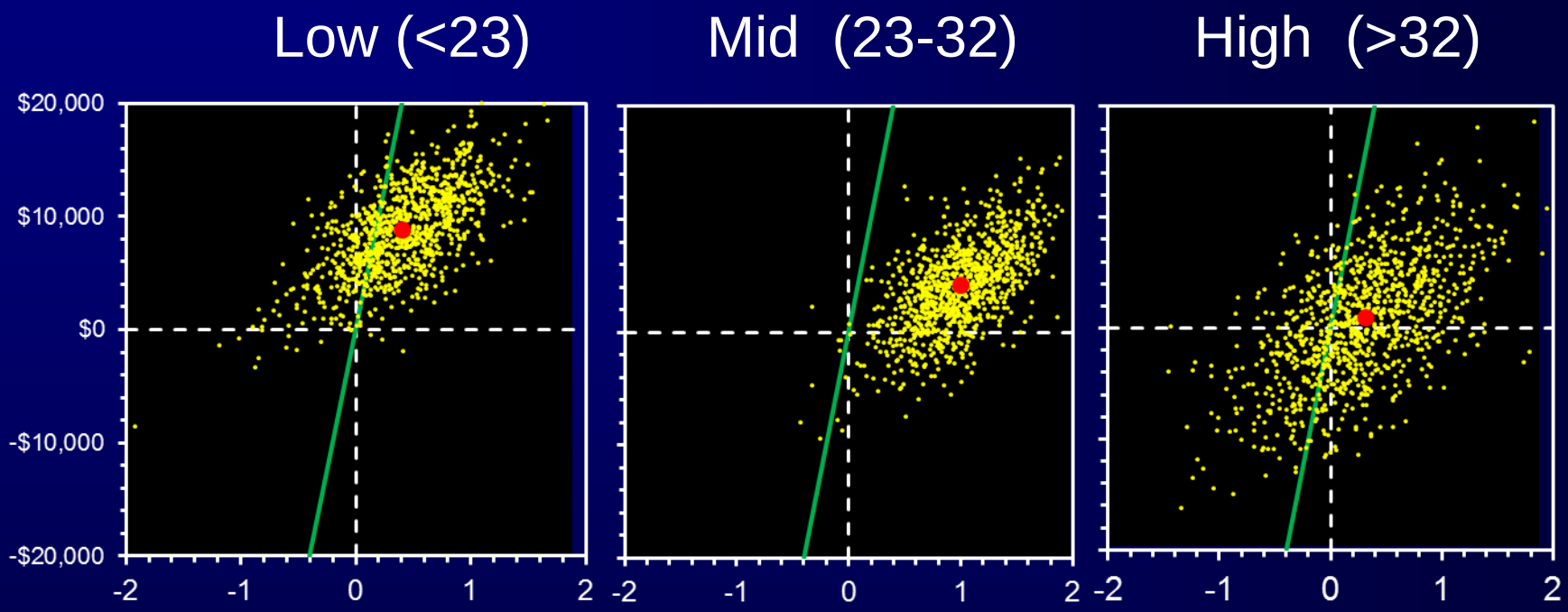


Acceptability curves: Base case and sensitivity analyses varying CABG effect beyond 5 years



Cost-Effectiveness of CABG vs. PCI

SYNTAX Score Tertiles



Δ Costs	$8,784
Δ QALYs	0.407
ICER	**$21,582**

Pr < $50K/QALY = 73.5%

Δ Costs	$4,160
Δ QALYs	0.997
ICER	**$4,172**

Pr < $50K/QALY = 99.2%

Δ Costs	$973
Δ QALYs	0.315
ICER	**$3,088**

Pr < $50K/QALY= 72.4%

Subgroups

Subgroup	Δ Costs	Δ QALYs	ICER	Prob. < $50,000
Male (n=1328)	$3,059	0.778	$3,932	99.8
Female (n=527)	$9,249	0.510	$18,135	77.3
Age <60 (n=624)	$11,190	1.160	$9,647	99.8
Age 60-69 (n=621)	-$1,765	0.276	Dominant	80.5
Age ≥70 (n=610)	$6,892	0.349	$19,748	71.9
US (n=351)	$4,701	1.120	$4,197	98.1
Non-US (n=1504)	$5,622	0.576	$9,760	96.5

Summary (1)

- CABG is associated with initial costs ≈ $9,000/patient higher than PCI
- Partially offset by lower costs associated with repeat revascularization and to a lesser extent cardiac meds
- At 5 years, CABG improved quality-adjusted life expectancy by ~ 0.03 years while increasing total costs by ~ $3,600/patient, at an incremental cost-effectiveness ratio of ~$117,000/QALY gained
- Over a lifetime horizon, CABG associated with 0.66 QALYs gained and ~$5,400/patient higher costs yielding an ICER of $8,132/QALY gained

Summary (2)

- Results were robust to a broad range of sensitivity analyses regarding the duration the CABG effect on both survival and costs
  - *ICER for CABG remained less than $50,000/QALY gained (most cases <$10,000) in all analyses except those restricted to first 5 years of follow-up*
- Results were also consistent across a wide range of subgroups

Conclusions

- For patients with diabetes and multivessel CAD, CABG provides not only better long-term clinical outcomes than DES-PCI but these benefits are achieved at an overall cost that represents an attractive use of societal health care resources
- These findings provide additional support for existing guidelines that recommend CABG for diabetic patients with multivessel CAD