

FFR, It is Standard

Jung-Min Ahn, MD

Heart Institute, University of Ulsan College of Medicine
Asan Medical Center, Seoul, Korea

Guidelines

ESC Guideline 2018

Recommendations	Class ^a	Level ^b
When evidence of ischaemia is not available, FFR or iwFR are recommended to assess the haemodynamic relevance of intermediate-grade stenosis. ^{15,17,18,39}	I	A
FFR-guided PCI should be considered in patients with multivessel disease undergoing PCI. ^{29,31}	IIa	B
IVUS should be considered to assess the severity of unprotected left main lesions. ^{35–37}	IIa	B

ACC/AHA Guideline 2021

Recommendations for the Use of Coronary Physiology to Guide Revascularization With PCI		
Referenced studies that support the recommendations are summarized in Online Data Supplement 5 .		
COR	LOE	Recommendations
1	A	1. In patients with angina or an anginal equivalent, undocumented ischemia, and angiographically intermediate stenoses, the use of fractional flow reserve (FFR) or instantaneous wave-free ratio (iFR) is recommended to guide the decision to proceed with PCI. ^{1–6}
3: No benefit	B-R	2. In stable patients with angiographically intermediate stenoses and FFR >0.80 or iFR >0.89, PCI should not be performed. ^{7–10}

Initial Studies

1356 *Circulation* Vol 86, No 4 April 1993

$P_a - P_v$ R_c

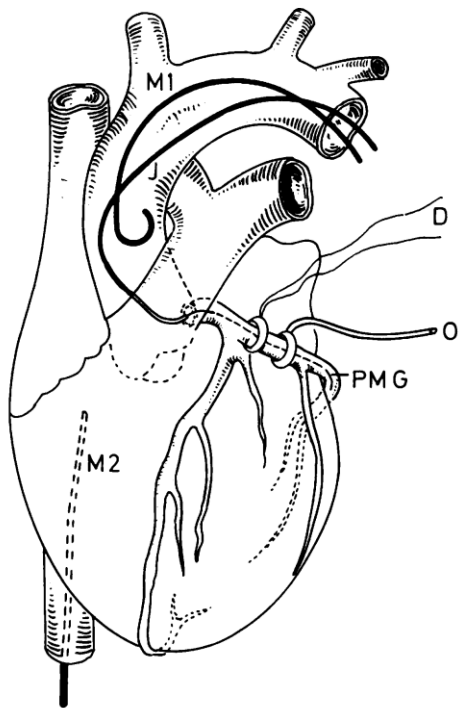


FIGURE 2. Schematic of animal instrumentation. D, Doppler probe; J, 6F left Judkins catheter; M₁, Millar catheter in ascending aorta; M₂, Millar catheter in right atrium; O, balloon occluder; PMG, pressure-monitoring guide wire with its tip 3–5 cm distal to the balloon occluder.

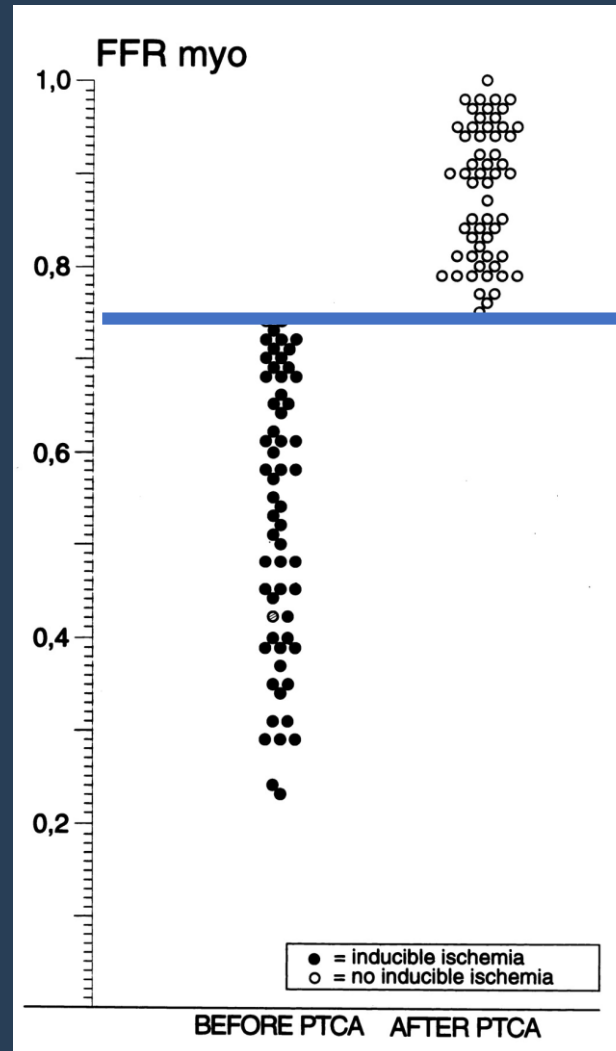
Nico H.J. Pijls et al. *Circulation* 1993;86:1354-67.

num
ood
sing
d

cir-
ary
the
ood
R,
the

dimensions,
ow capacity
w, however,
nimal) as
asurements

he coronary
ctional flow
roportional
lated from
n arteriolar
ary Doppler
monitoring



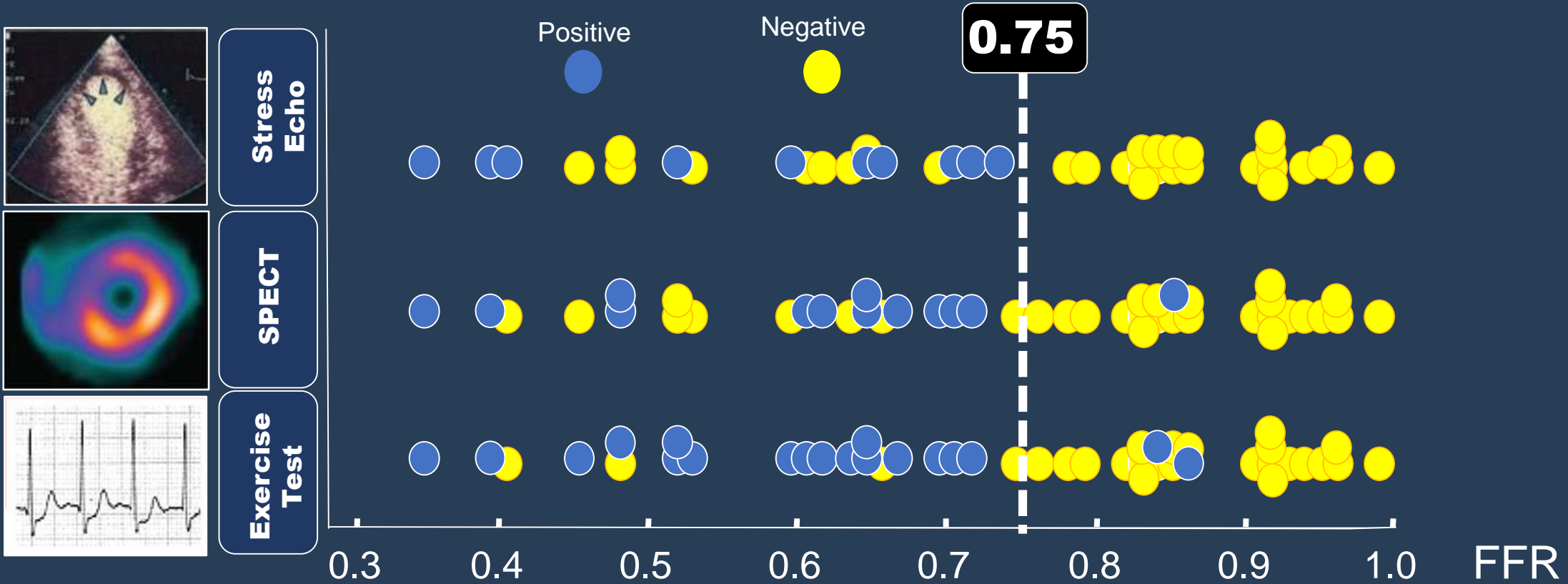
FFR 0.74

Nico H.J. Pijls et al. *Circulation* 1995;92:3183-3193



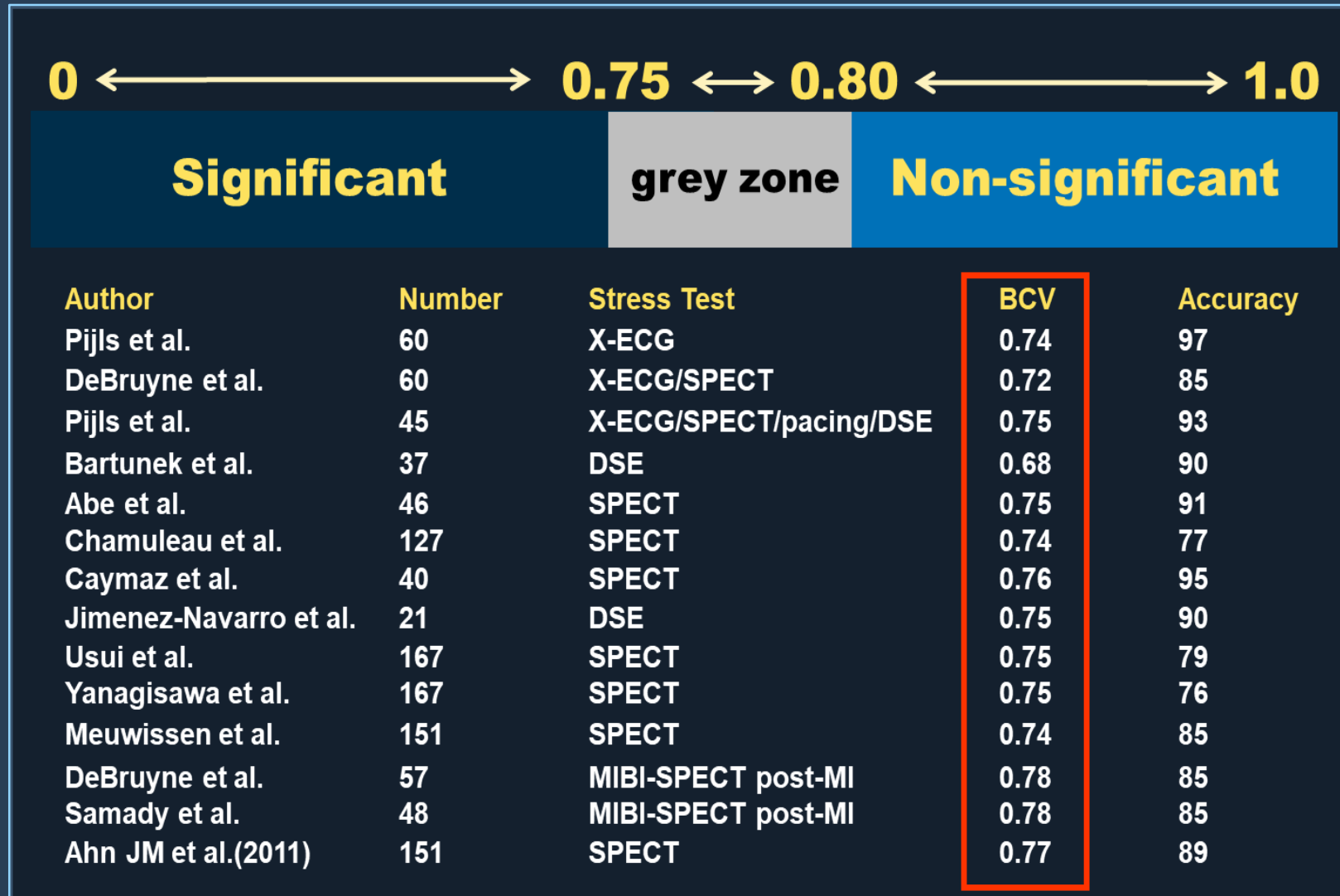
FFR: Physiologic Index To Detect Myocardial Ischemia

Comparison with 3 Non-Invasive Functional Studies



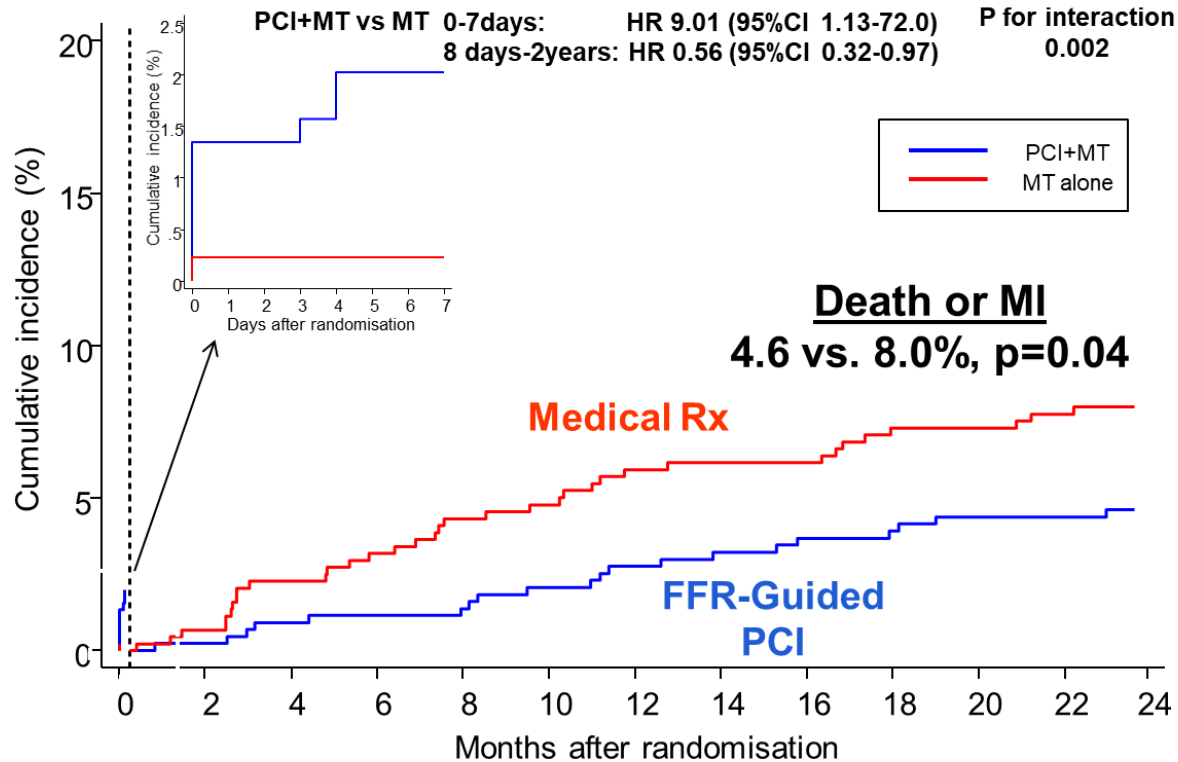
- N = 45 patients
- Sensitivity 88%, Specificity 100%, **PPV 100%**, NPV 88%

Current Cut-off Value of FFR: 0.80



FFR \leq 0.80: Stenting Justified

FAME 2



De Bruyne, et al. New Engl J Med 2014;371:1208-17.

FFR $>$ 0.80: Defer

DEFER

Cardiac Death and MI

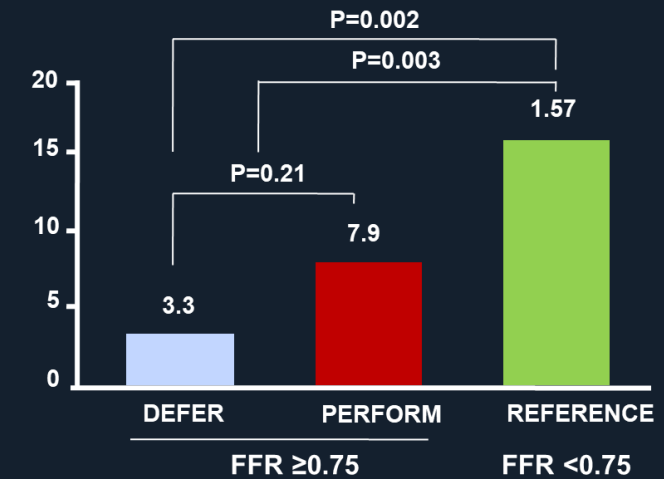
In 325 patients

• FFR \geq 0.75

DEFER (n=91)
 PERFORMANCE (N=90)

• FFR $<$ 0.75

REFERENCE (N=144)



• The risk of CD or MI related to this stenosis is $<$ 1%/year and not decreased by stenting.

J Am Coll Cardiol 2007;49:2105-11.

Outcome Derived Revascularization Threshold

ORIGINAL RESEARCH ARTICLE

Fractional Flow Reserve and Cardiac Events in Coronary Artery Disease

Data From a Prospective IRIS-FFR Registry (Interventional Cardiology Research Incooperation Society Fractional Flow Reserve)

Editorial, see p 2252

BACKGROUND: We evaluated the prognosis of deferred and revascularized coronary stenoses after fractional flow reserve (FFR) measurement to assess its revascularization threshold in clinical practice.

METHODS: The IRIS-FFR registry (Interventional Cardiology Research Incooperation Society Fractional Flow Reserve) prospectively enrolled 5846 patients with ≥ 1 coronary lesion with FFR measurement. Revascularization was deferred in 6468 lesions and performed in 2165 lesions after FFR assessment. The primary end point was major adverse cardiac events (cardiac death, myocardial infarction, and repeat revascularization) at a median follow-up of 1.9 years and analyzed on a per-lesion basis. A marginal Cox model accounted for correlated data in patients with multiple lesions, and a model to predict per-lesion outcomes was adjusted for confounding factors.

RESULTS: For deferred lesions, the risk of major adverse cardiac events demonstrated a significant, inverse relationship with FFR (adjusted hazard ratio, 1.06; 95% confidence interval, 1.05–1.08; $P < 0.001$). However, this relationship was not observed in revascularized lesions (adjusted hazard ratio, 1.00; 95% confidence interval, 0.98–1.02; $P = 0.70$). For lesions with $FFR \geq 0.76$, the risk of major adverse cardiac events was not significantly different between deferred and revascularized lesions. Conversely, in lesions with $FFR \leq 0.75$, the risk of major adverse cardiac events was significantly lower in revascularized lesions than in deferred lesions (for $FFR 0.71-0.75$, adjusted hazard ratio, 0.47; 95% confidence interval, 0.24–0.89; $P = 0.021$; for $FFR \leq 0.70$, adjusted hazard ratio 0.47; 95% confidence interval, 0.26–0.84; $P = 0.012$).

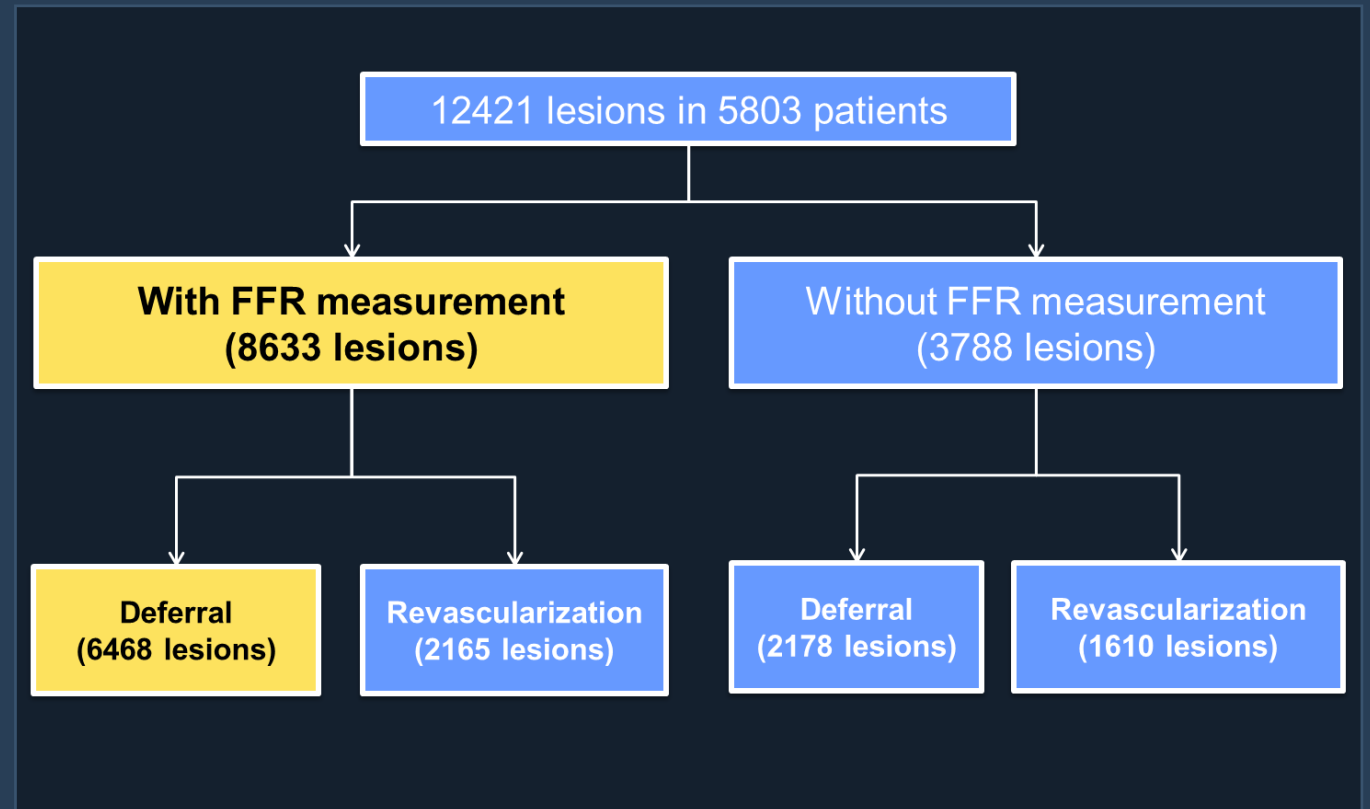
CONCLUSIONS: This large, prospective registry showed that the FFR value was linearly associated with the risk of cardiac events in deferred lesions. In addition, revascularization for coronary artery stenosis with a low FFR (≤ 0.75) was associated with better outcomes than the deferral, whereas for a stenosis with a high FFR (≥ 0.76), medical treatment would be a reasonable and safe treatment strategy.

CLINICAL TRIAL REGISTRATION: URL: <http://www.clinicaltrials.gov>. Unique identifier: NCT01366404.

Key Words: coronary disease ■ coronary stent ■ fractional flow reserve ■ revascularization
© 2017 American Heart Association, Inc.

Circulation. 2017;135:2241–2251. DOI: 10.1161/CIRCULATIONAHA.116.024433 June 6, 2017 2241

IRIS FFR Registry (2009.8-2015.8)

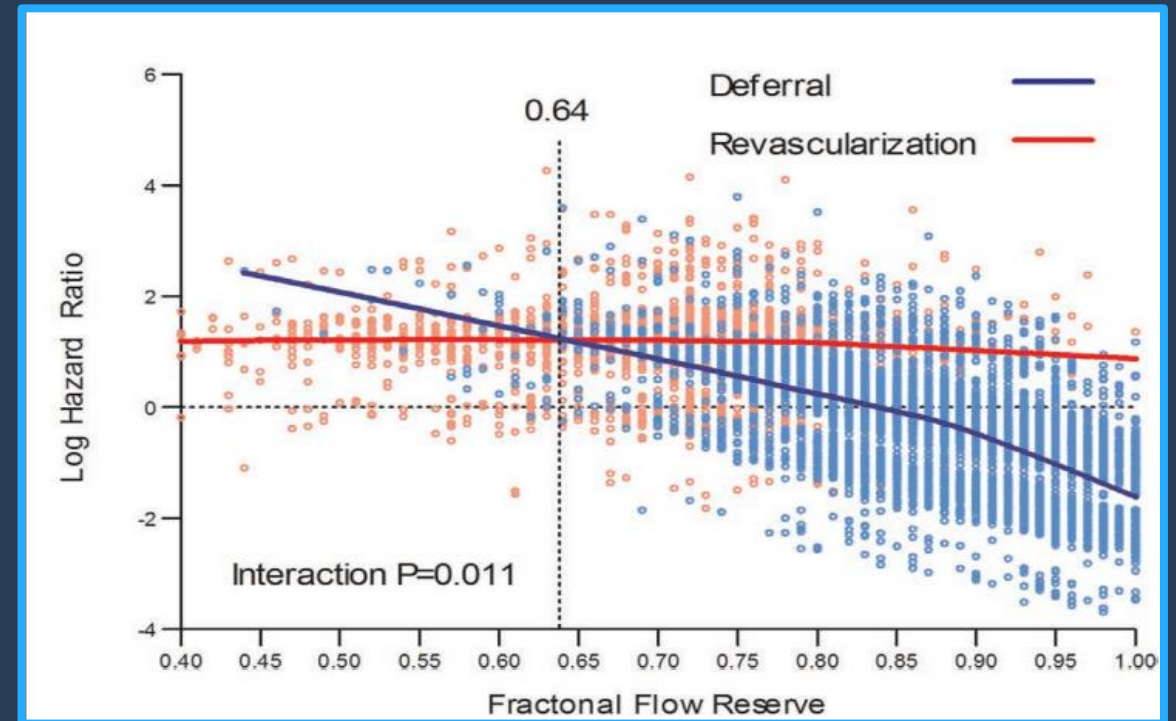
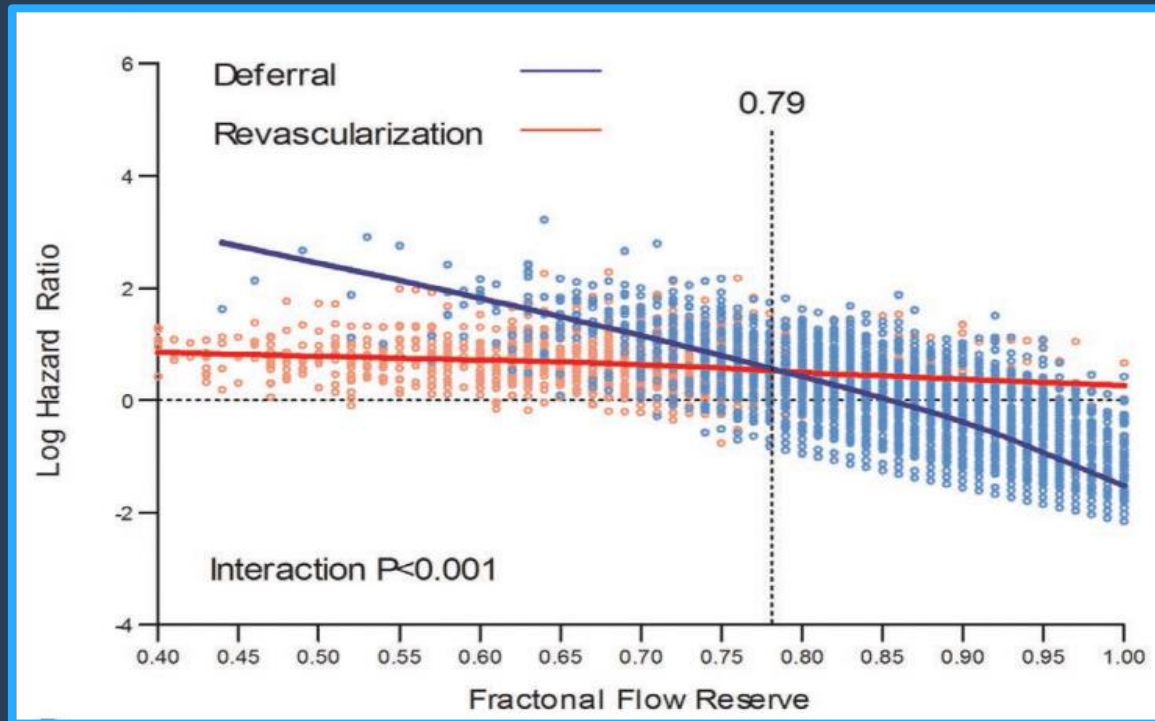


Outcome Derived Revascularization Threshold

FFR: **Clinical Index** To Decide Revascularization

Cardiac Death, MI, and TVR

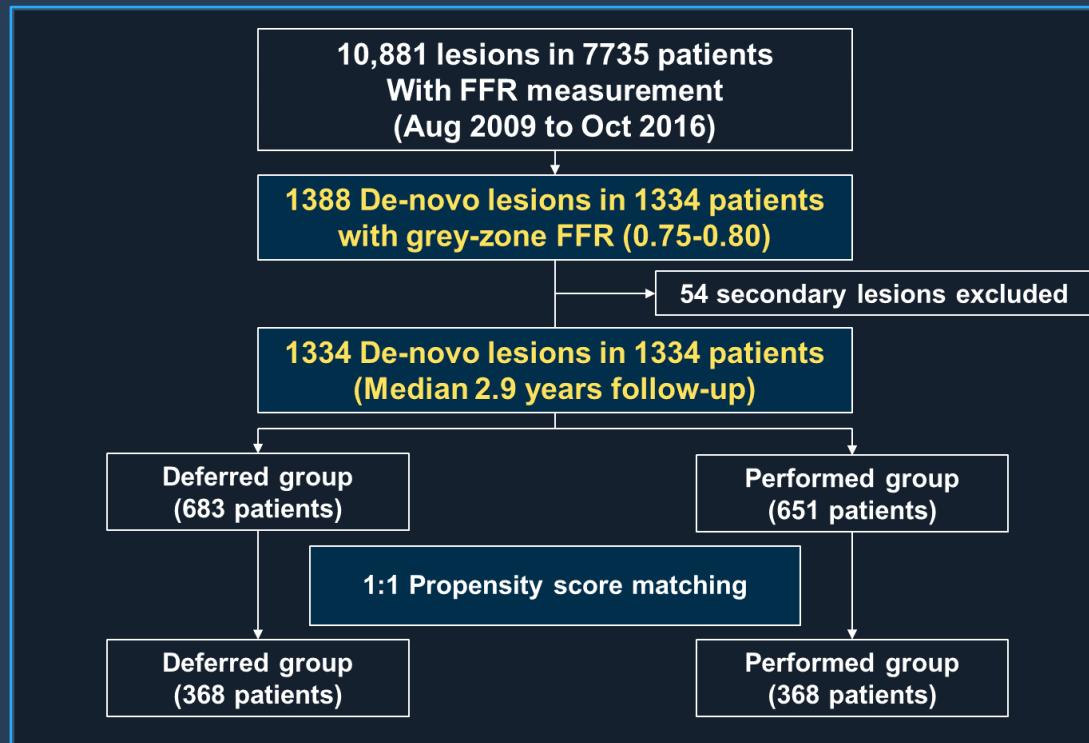
Cardiac Death, and MI



Ahn JM, Park SJ et al. Circulation 2017 Jun 6;135(23):2241-2251

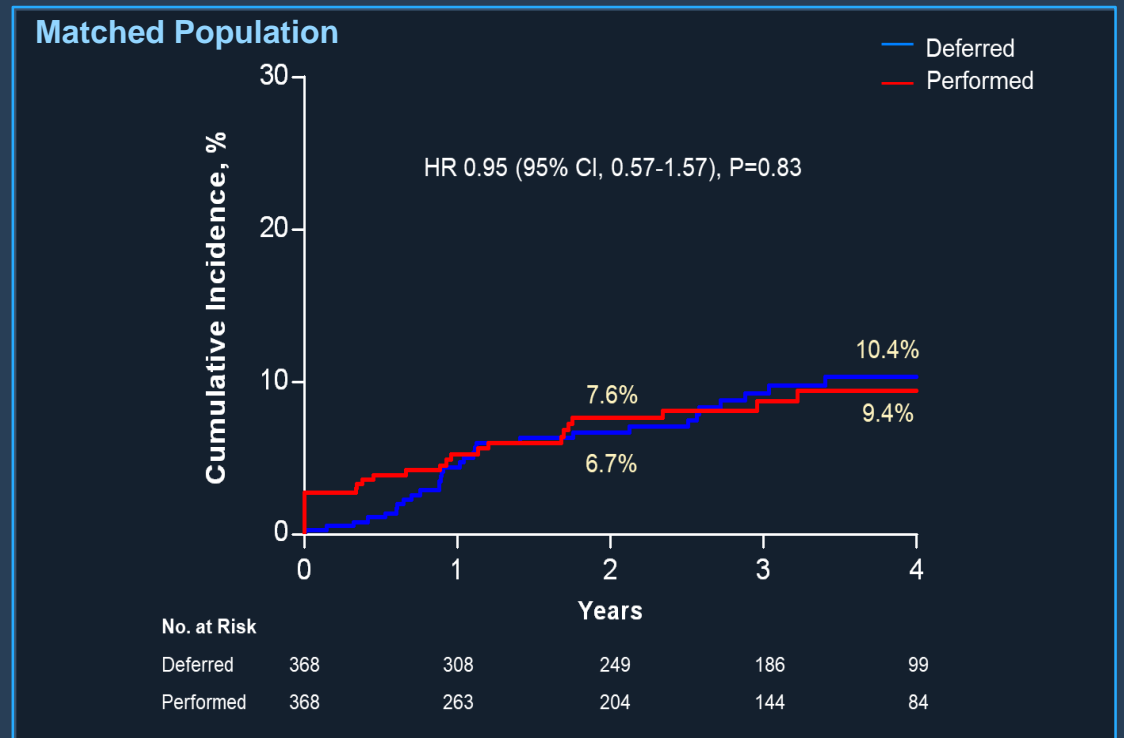
Decision Making In the Grey Zone

Grey Zone FFR From IRIS-FFR Registry

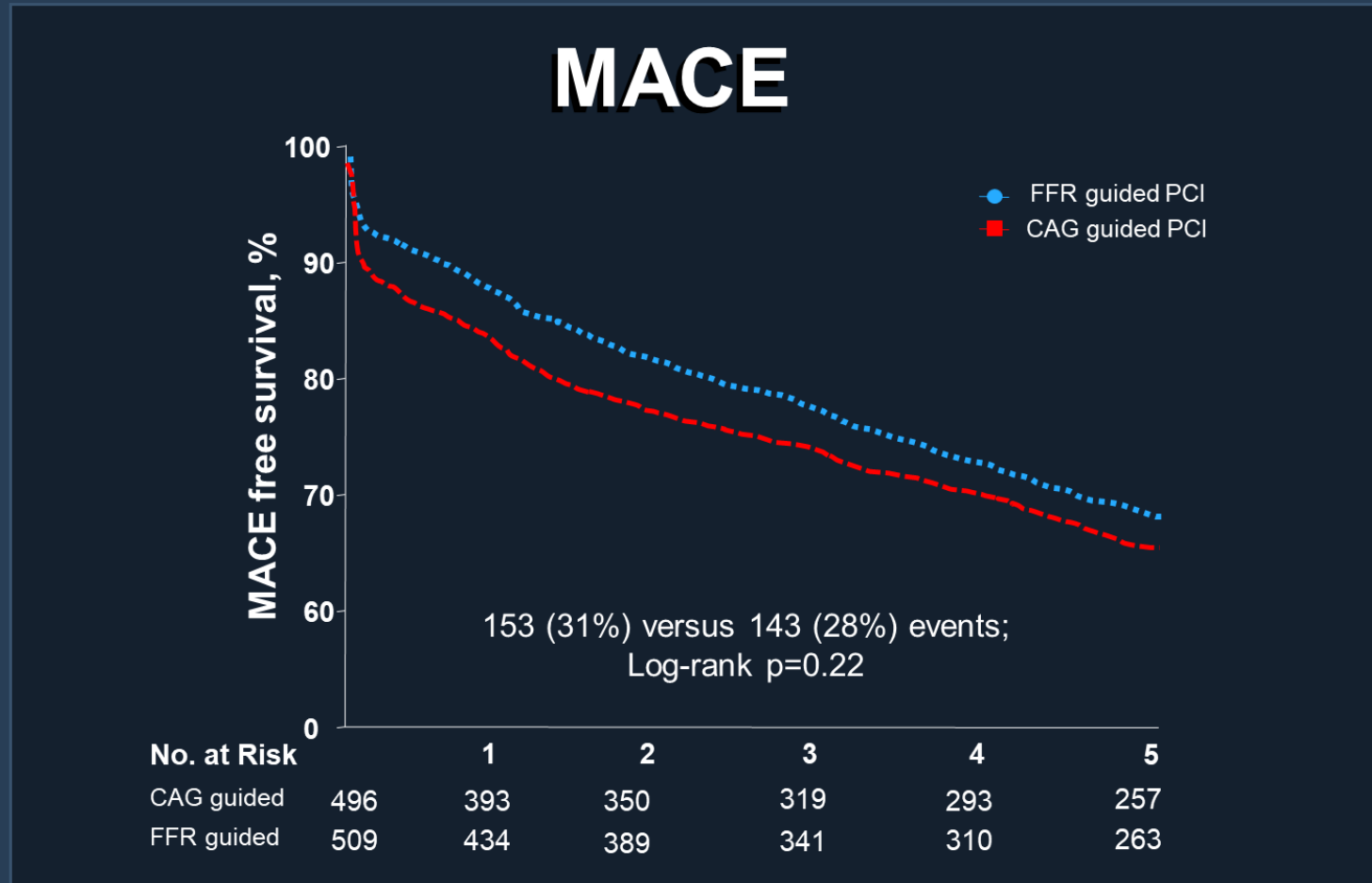


Primary End Point

(Death, TV-MI, Target Vessel Revascularization)



FFR Guided PCI in Multivessel Disease: FAME I



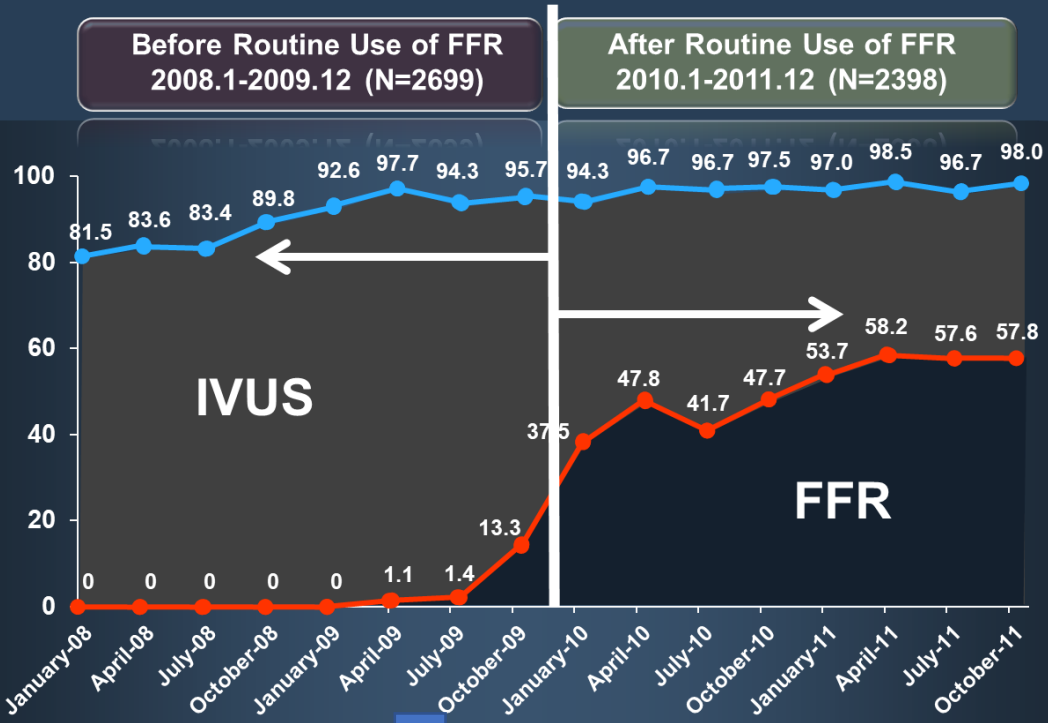
Stent Number

29.6%



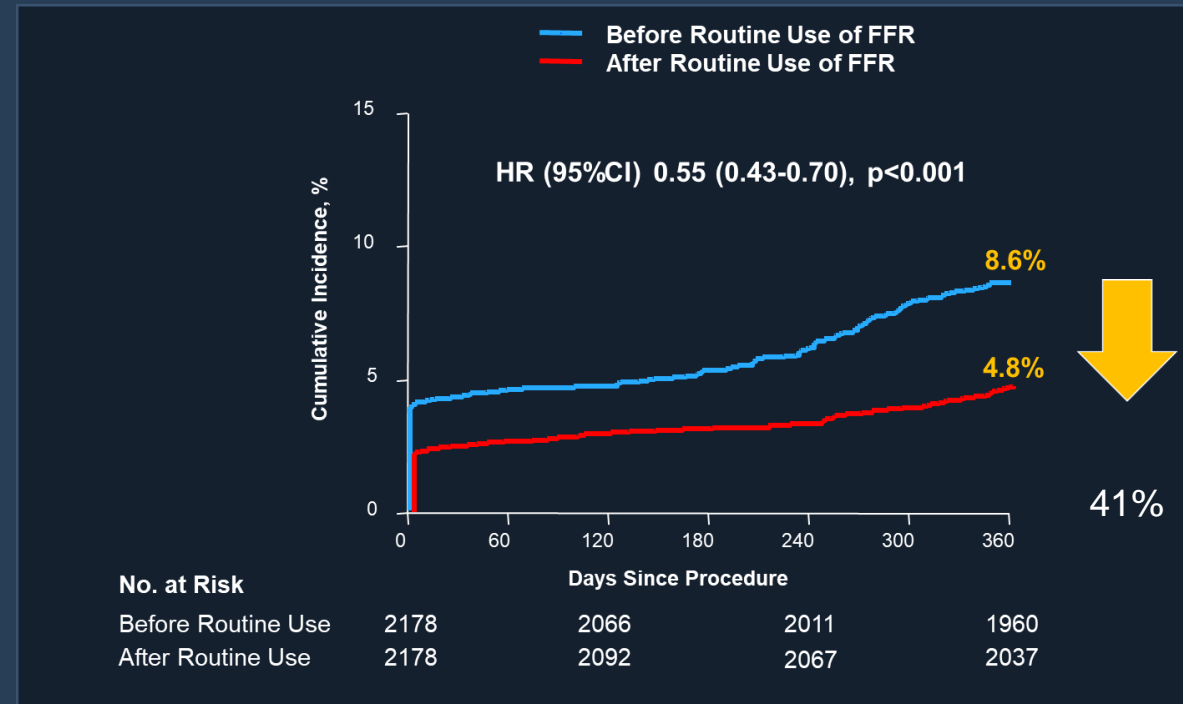
FFR Guided PCI Improves PCI Outcomes: ASAN PCI Registry

FFR Use in Asan Medical Center

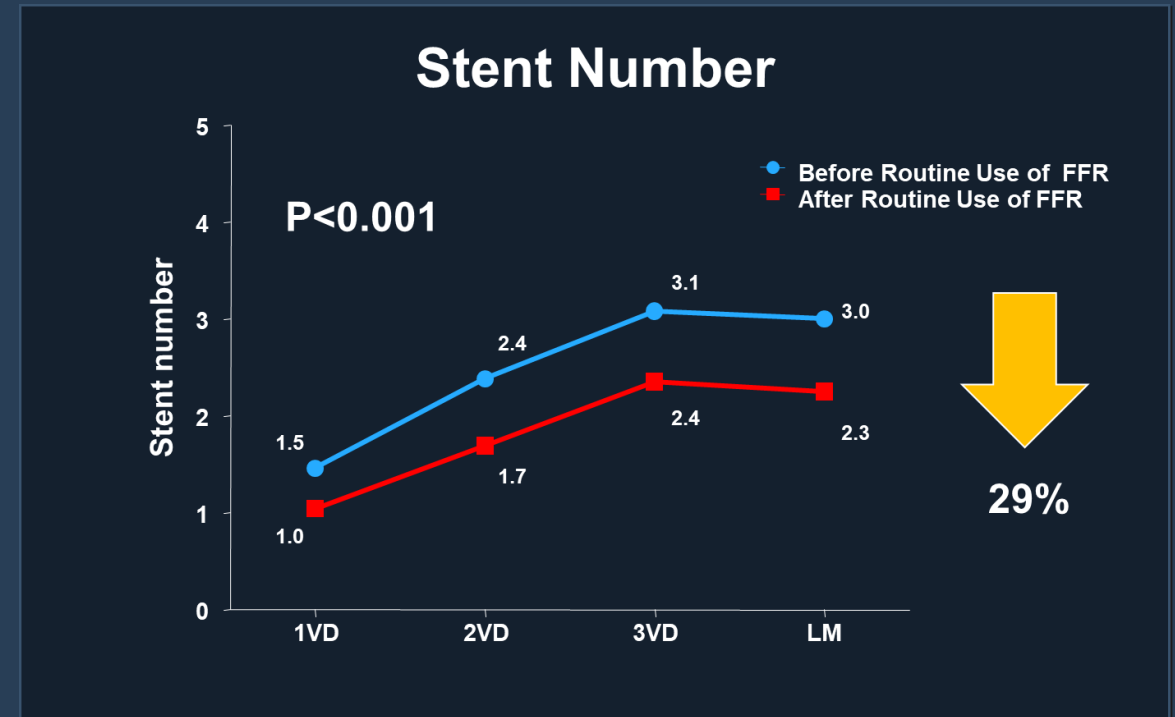
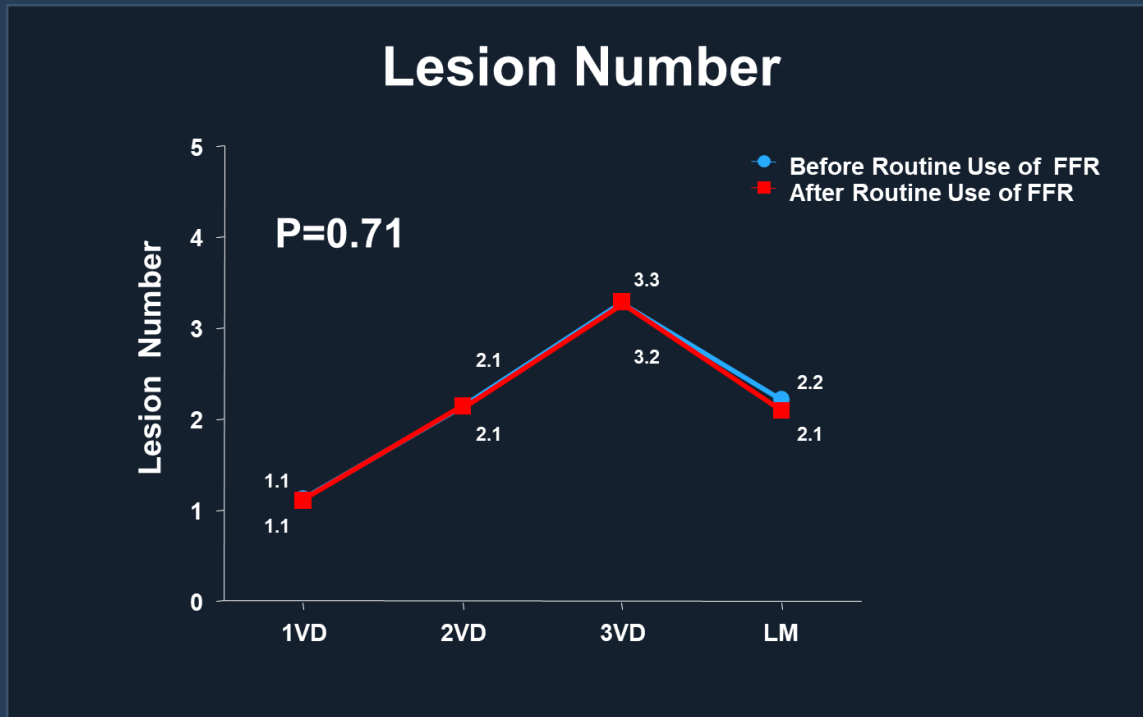


FAME was published in NEJM

Cardiac Death, MI, TVR

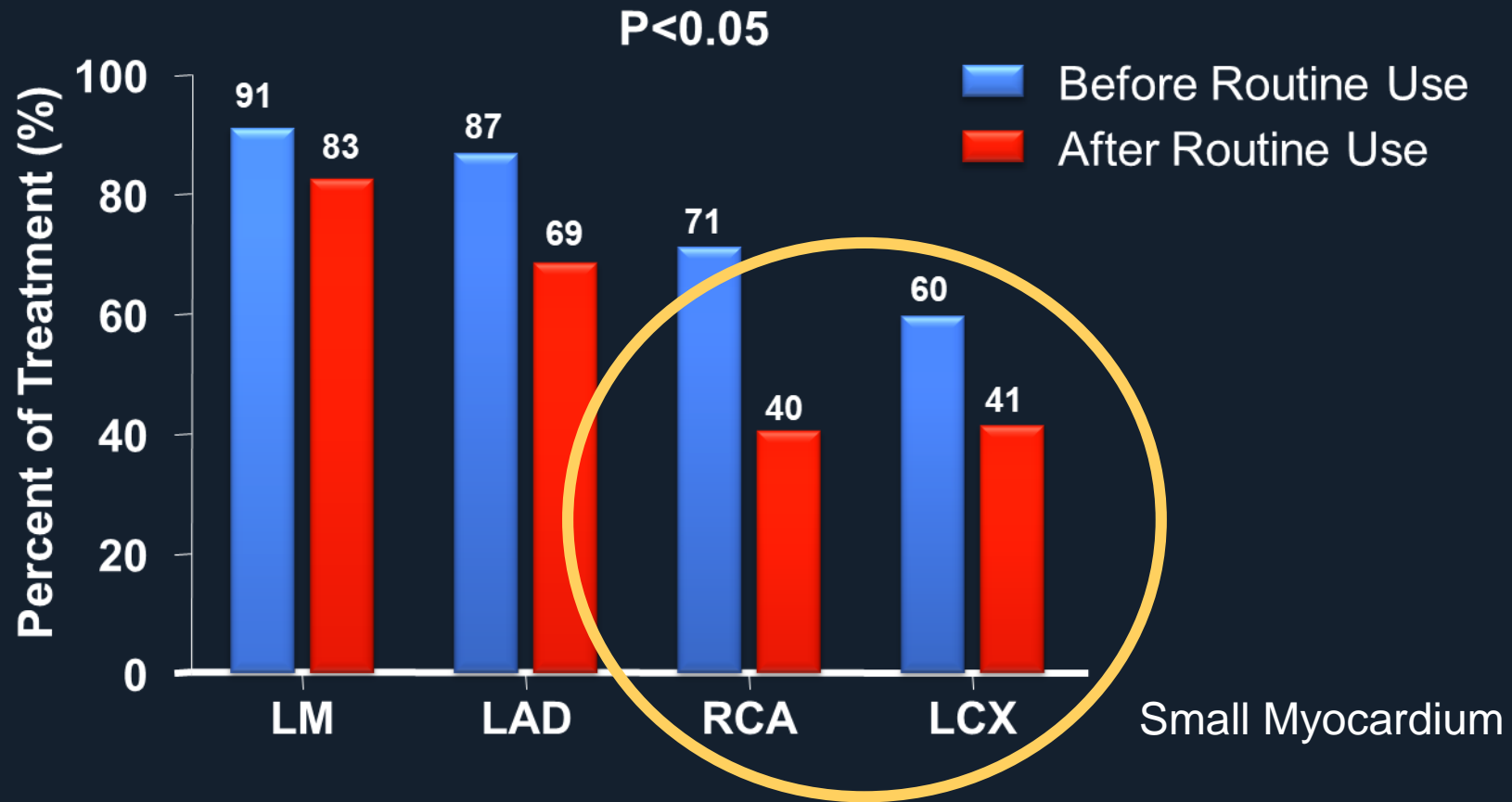


FFR Guided PCI Improves PCI Outcomes: ASAN PCI Registry



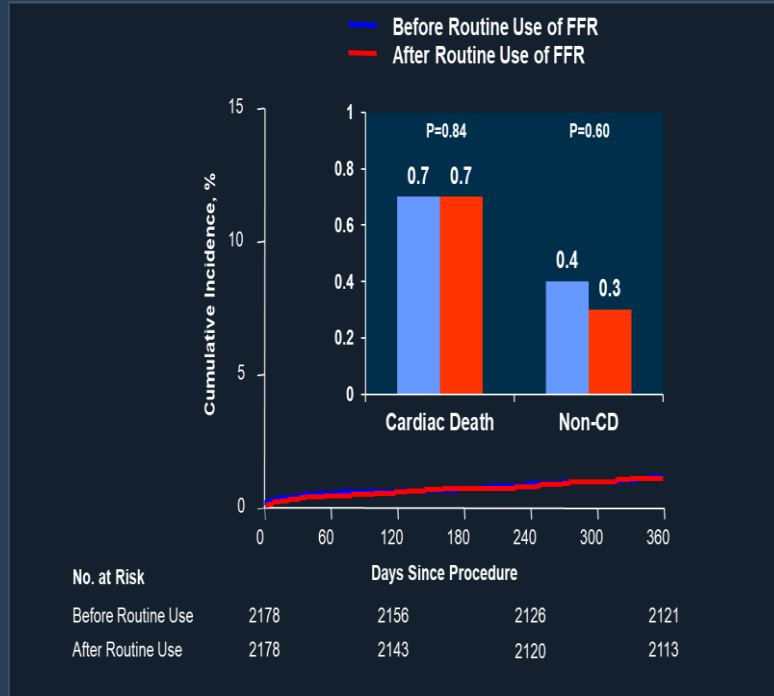
Changes in PCI procedure

Diseased Vessel Territory

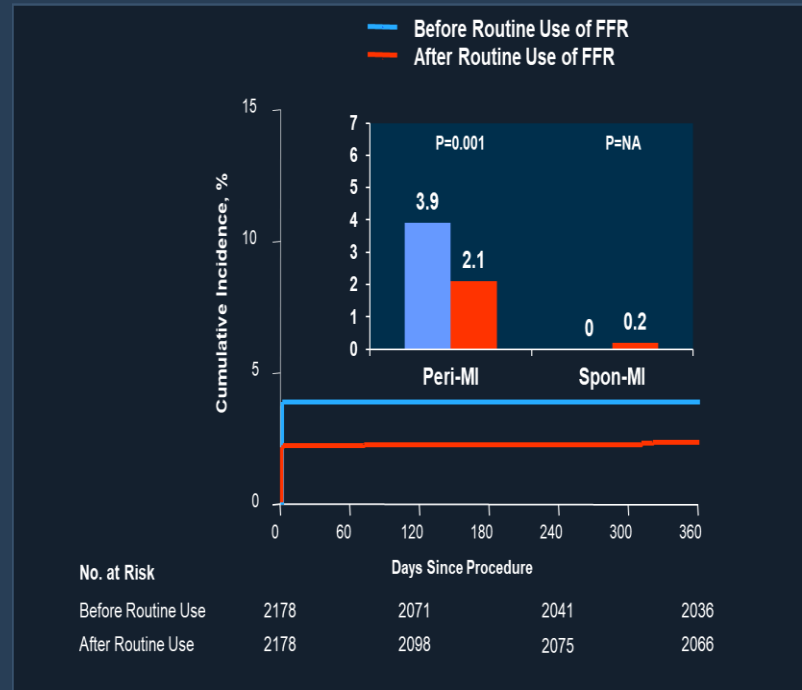


FFR Guided PCI Improves PCI Outcomes: ASAN PCI Registry

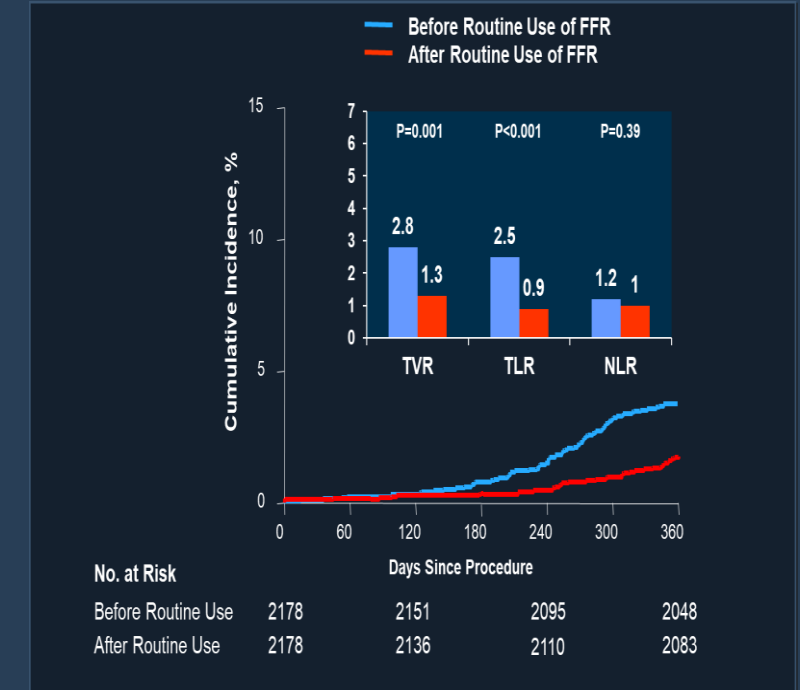
Death



Myocardial Infarction



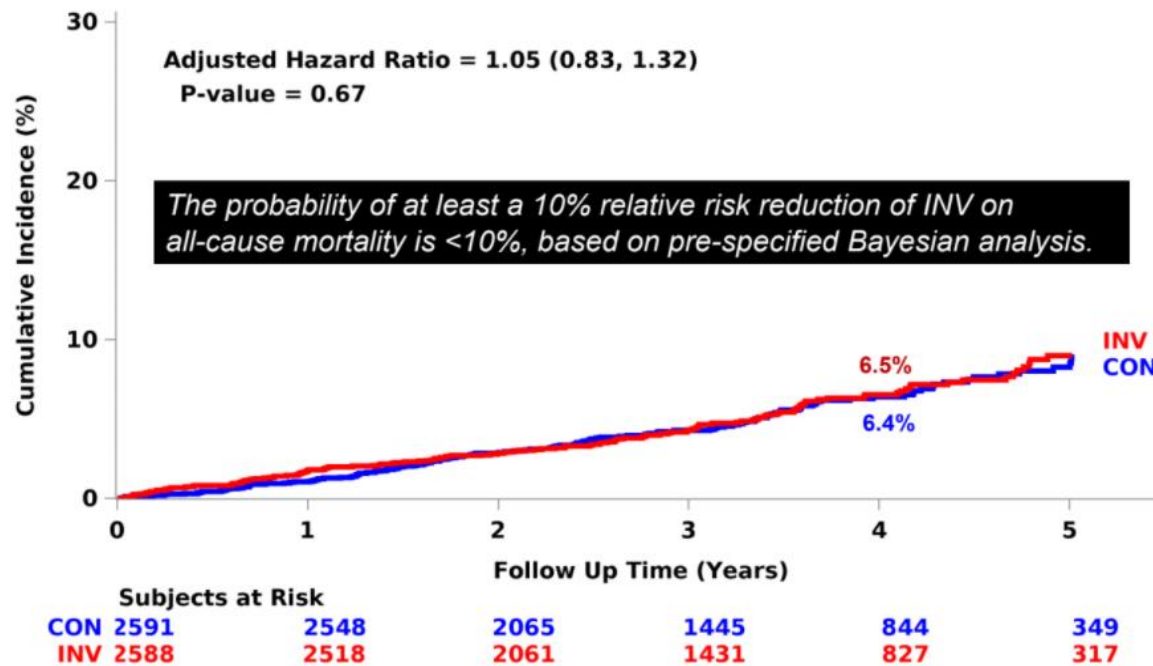
Repeat Revascularization



- The benefit of FFR guided PCI is primarily due to
 - 1) The reduced number of stents used per patients
 - 2) The subsequent decreased risk of peri-procedural MI and repeat revascularization

The Role of FFR in Post-ISCHEMIA Era

All-Cause Death



No Ischemia, No Stenting



No FFR, No Stenting

Summary

1. Sound scientific basis.
2. Cut-off value was initially validated against *ischemia test* and *clinical outcome* thereafter. *FFR might be considered as a clinical index in revascularization decision-making rather than a simple physiologic indicator of ischemia.*
3. FFR guided PCI was validated in randomized trials and real-world registry: *favorable outcomes* with *less stent use*.
4. In the post-ISCHEMIA era, $FFR \leq 0.80$ would be a minimum requirement for coronary stenting and revascularization of the stenosis with $FFR > 0.80$ is never justified.