Role of Quantitative Flow Ratio in Guiding PCI

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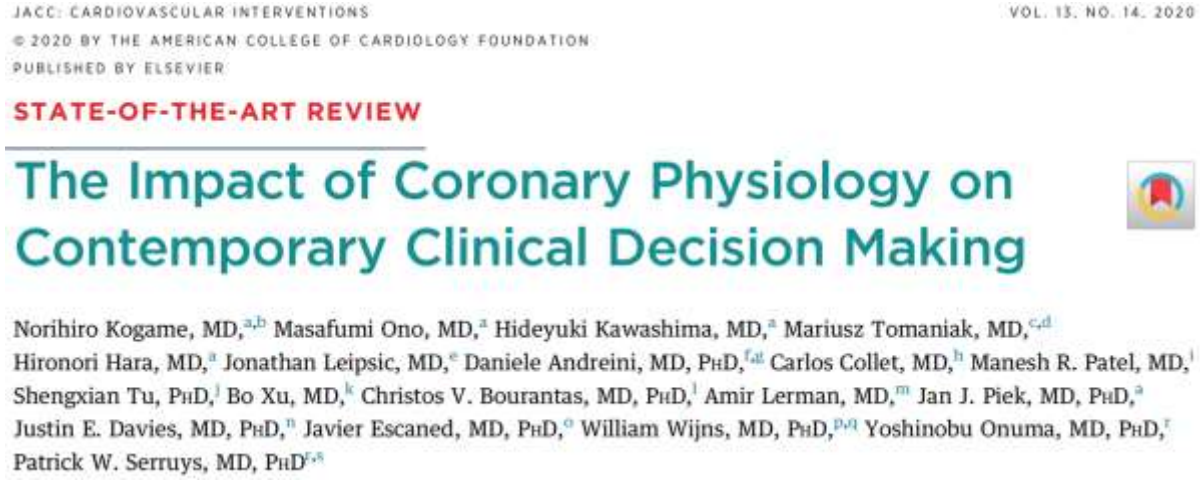
Disclosure

- I, (Bo Xu) DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Background

- Wire-based physiological assessments are recommended in the Guidelines (IA, IIA)
- Physiological modalities should be appropriately selected in the entire revascularization processes to obtain optimal results, including choices of strategies (PCI or CABG), identification of treated vessels, and optimization during the procedure
- Computed coronary physiology indexes (e.g. quantitative flow ratio [QFR]) were currently well-validated against wire-based FFR as the reference standard; moreover, its simplicity, shorter assessment times, fewer complications, and lower costs may further promote the use of physiology-guided decisions in the catheterization laboratory



Tu S, et al. *Eur Heart J* 2019; Kogame N, et al. *JACC Cardiovasc Interv* 2020

Quantitative Flow Ratio (QFR)

FAVOR Series of QFR Studies

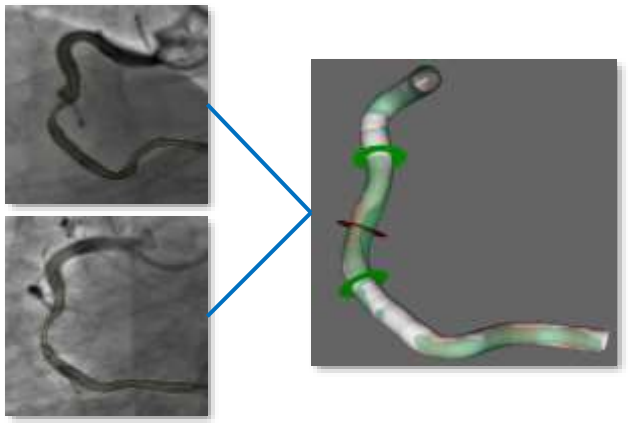
Standard Angiogram

Data Transmission System

Two image runs with angle difference ≥25°

AngioPlus System

3D Reconstruction



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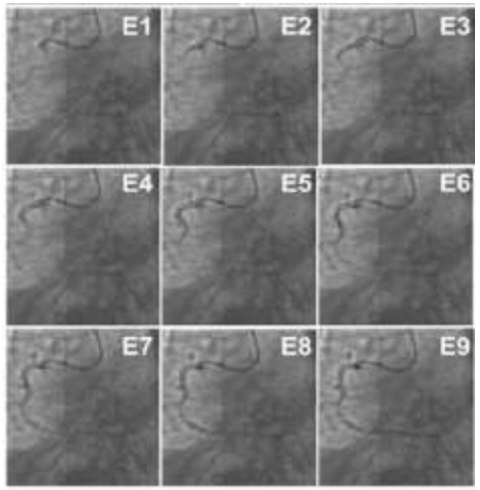
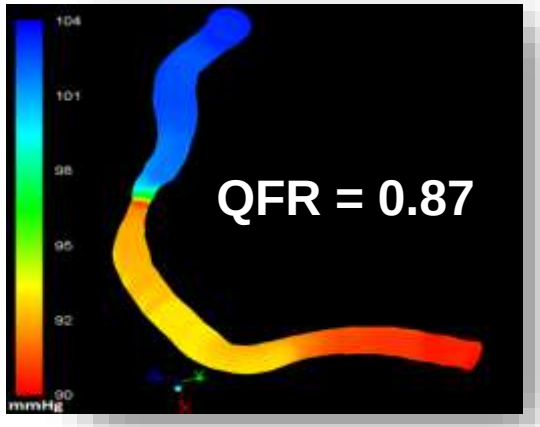


QFR

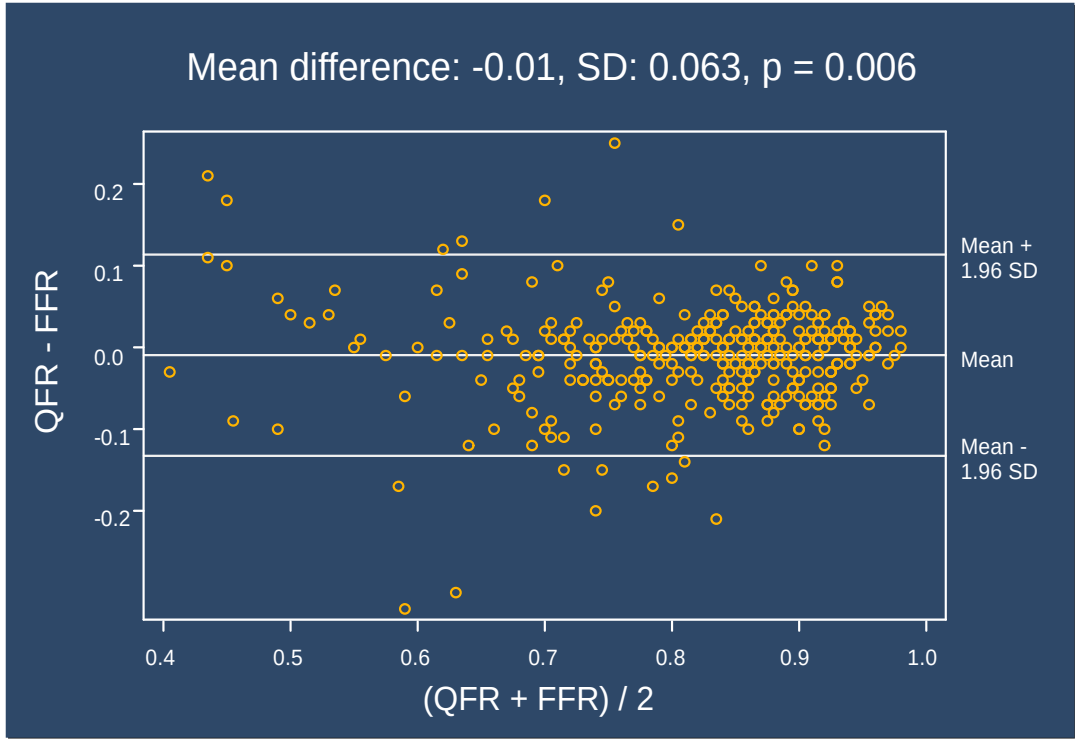


Without Inducing Hyperemia

Tu S, et al. *JACC Cardiovasc Interv* 2016; Xu B, et al. *J Am Coll Cardiol* 2017

Diagnostic Performance FAVOR II China

Agreement between QFR and FFR (Online Analysis)



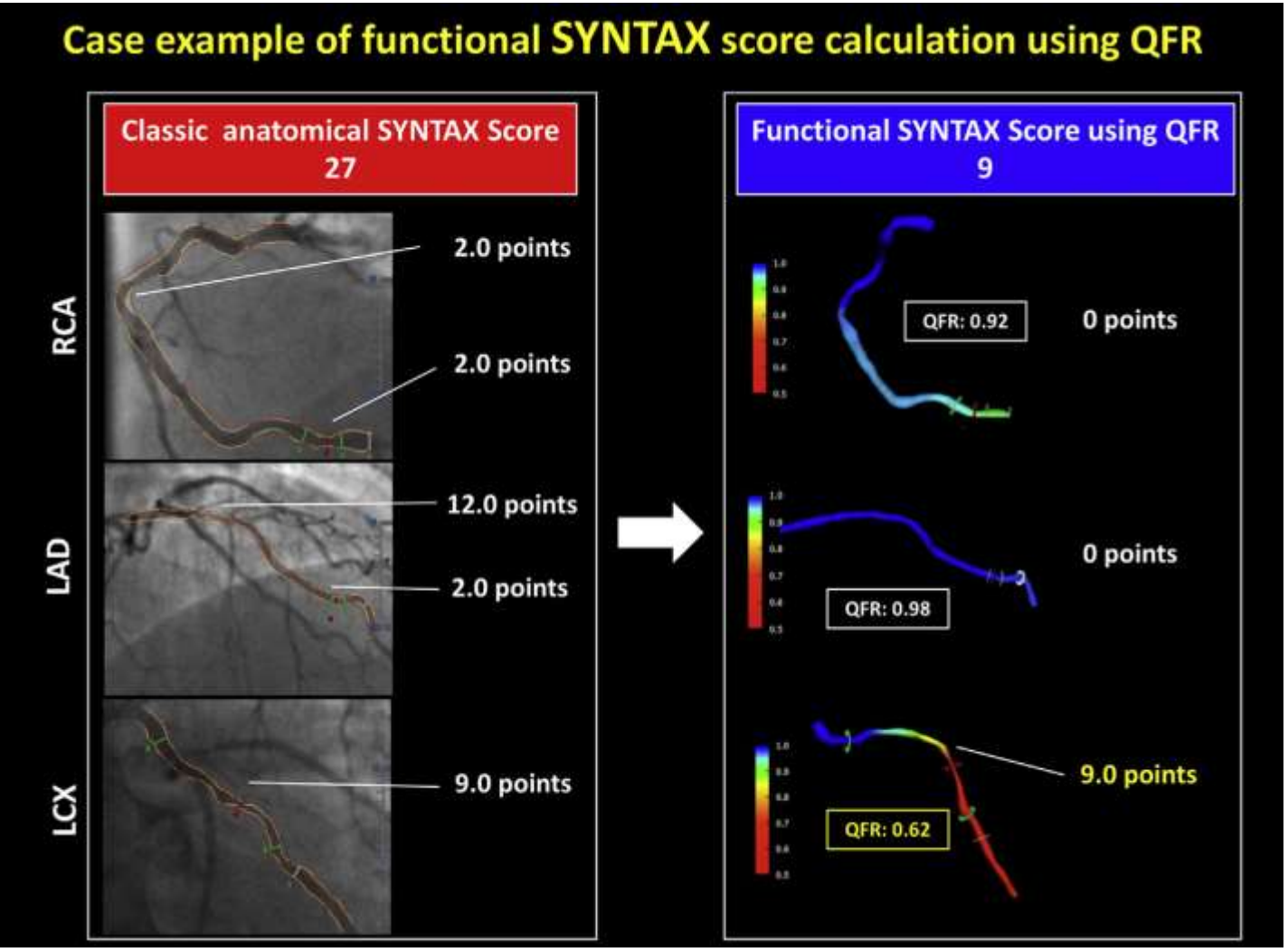
Diagnostic Performance of QFR and QCA (Online Analysis)

	QFR ≤ 0.80	Diameter Stenosis by QCA ≥ 50%	Difference (95% CI)	P value
Accuracy, %	**92.7 (89.3, 95.3)**	59.6 (54.1, 65.0)	34.9 (28.3, 41.5)	<0.001
Sensitivity, %	**94.6 (88.7, 98.0)**	62.5 (52.9, 71.5)	32.0 (21.0, 43.1)	<0.001
Specificity, %	**91.7 (87.1, 95.0)**	58.1 (51.2, 64.8)	36.1 (27.9, 44.3)	<0.001
PPV, %	85.5 (78.0, 91.2)	43.8 (35.9, 51.8)	42.0 (31.4, 52.7)	<0.001
NPV, %	97.1 (93.7, 98.9)	74.9 (67.6, 81.2)	24.4 (15.6, 33.2)	<0.001
+ LR	11.4 (7.1, 17.0)	1.49 (1.21, 1.85)	-	-
- LR	0.06 (0.03, 0.13)	0.65 (0.50, 0.84)	-	-

Xu B, et al. *J Am Coll Cardiol* 2017

Pre-PCI Assessment

QFR-based Functional SYNTAX Score (FSS_{QFR})



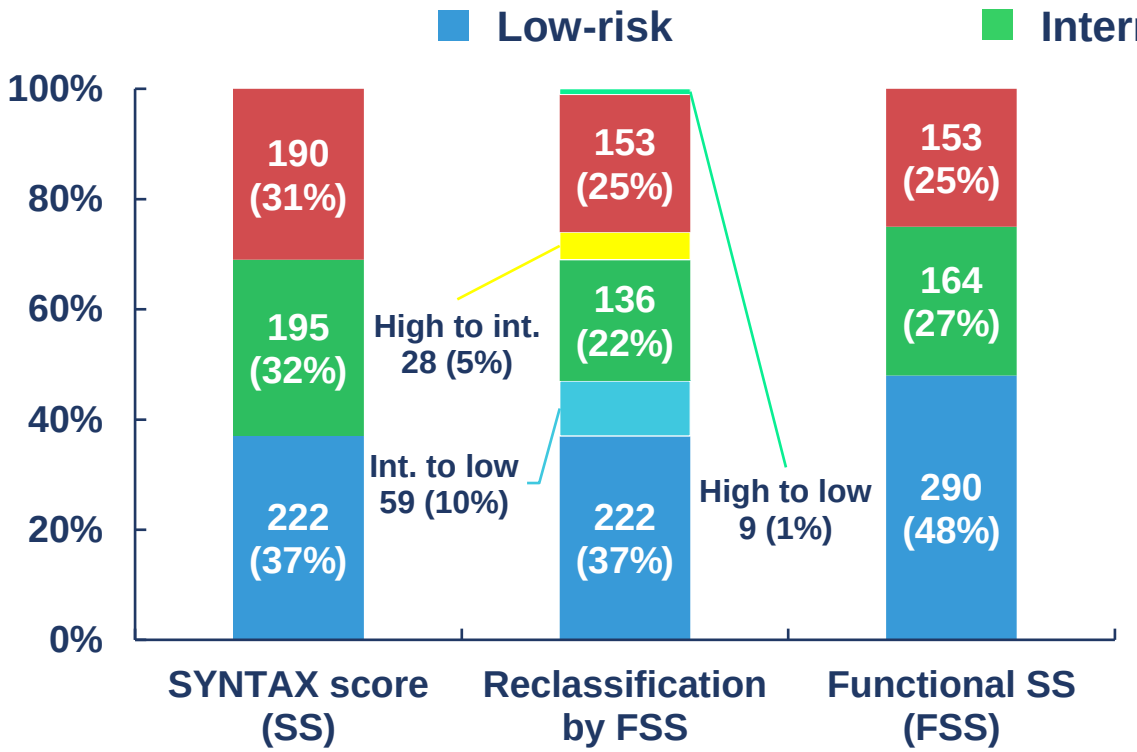
- FSS_{QFR} was calculated by summing the individual scores only in vessels with low vessel QFR (QFR ≤0.80) and ignoring lesions with vessel QFR >0.80
- FSS_{QFR}-based **Risk Stratification**
- FSS_{QFR}-based **Strategy Selection**

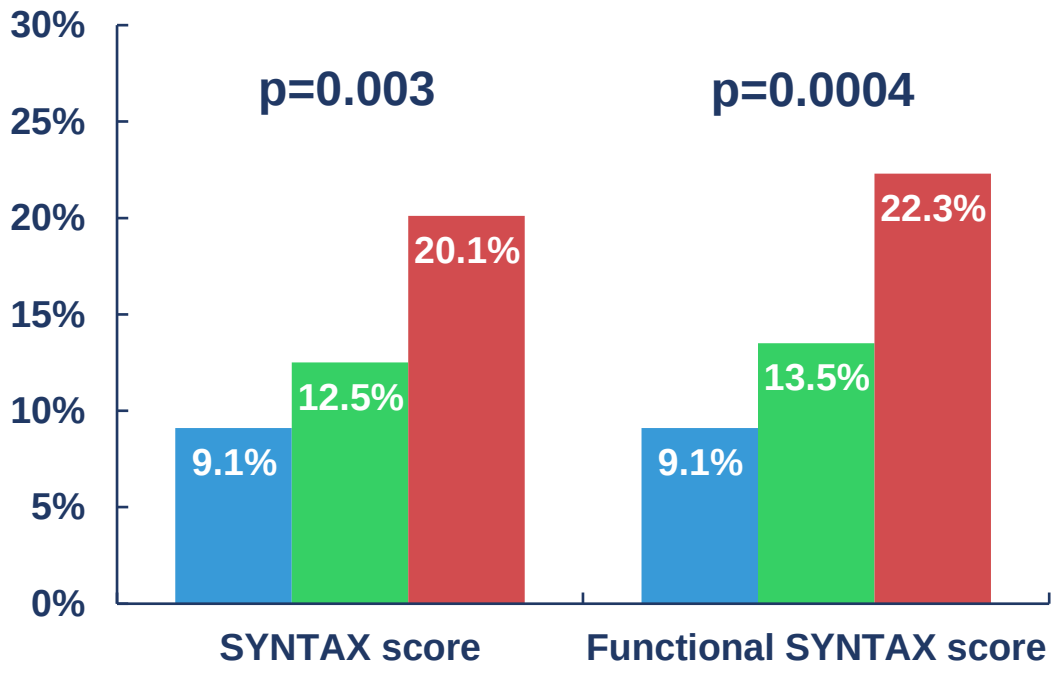
Asano T, et al. *JACC Cardiovasc Interv* 2019

Zhang R, et al. *Circ Cardiovasc Interv* 2020

FSS_{QFR}-based Risk Stratification

- After calculating the FSS_{QFR}, **16%** of study patients moved from higher-risk group (by SS) to lower-risk group
- FSS_{QFR} appropriately reclassified patients from higher-risk groups to lower-risk groups, while better discriminating risk for MACE than SS

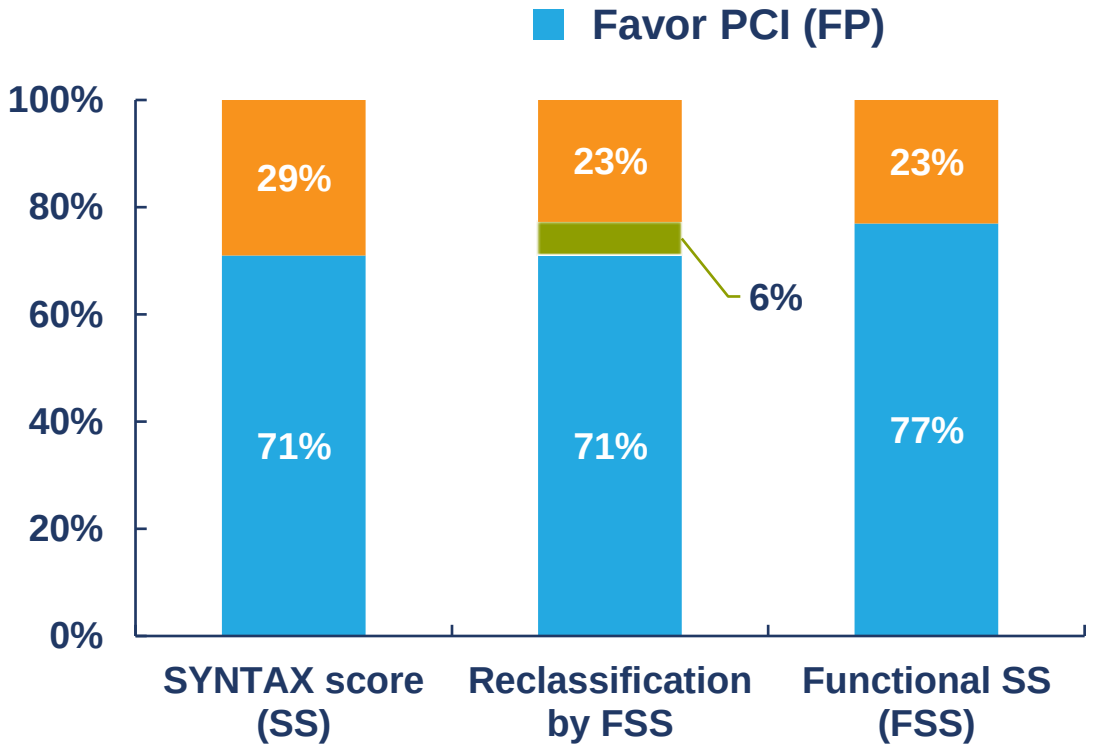


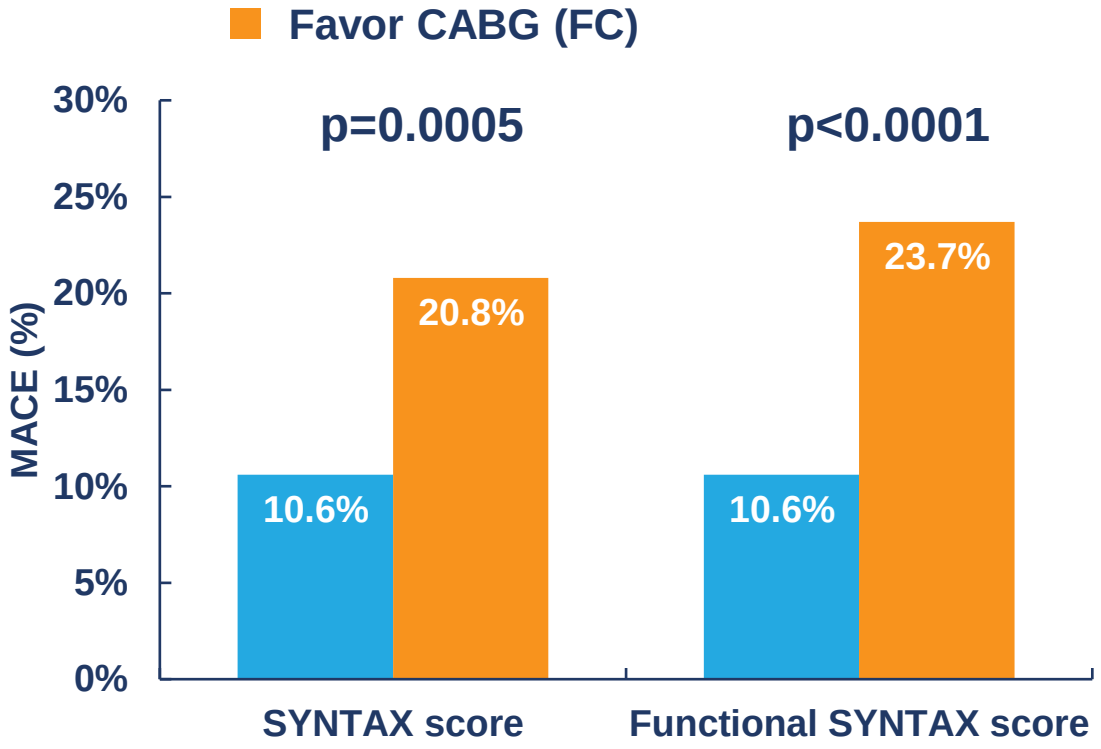


Zhang R, et al. *Circ Cardiovasc Interv* 2020

FSS_{QFR}-based Strategy Selection

- **6%** of patients, for whom CABG would be recommended by SS converted to a lower-risk group and therefore another treatment option may be preferred
- Compared with SS, FSS_{QFR} increased the risk of adverse events in “Favor CABG” group but not in “Favor PCI” group



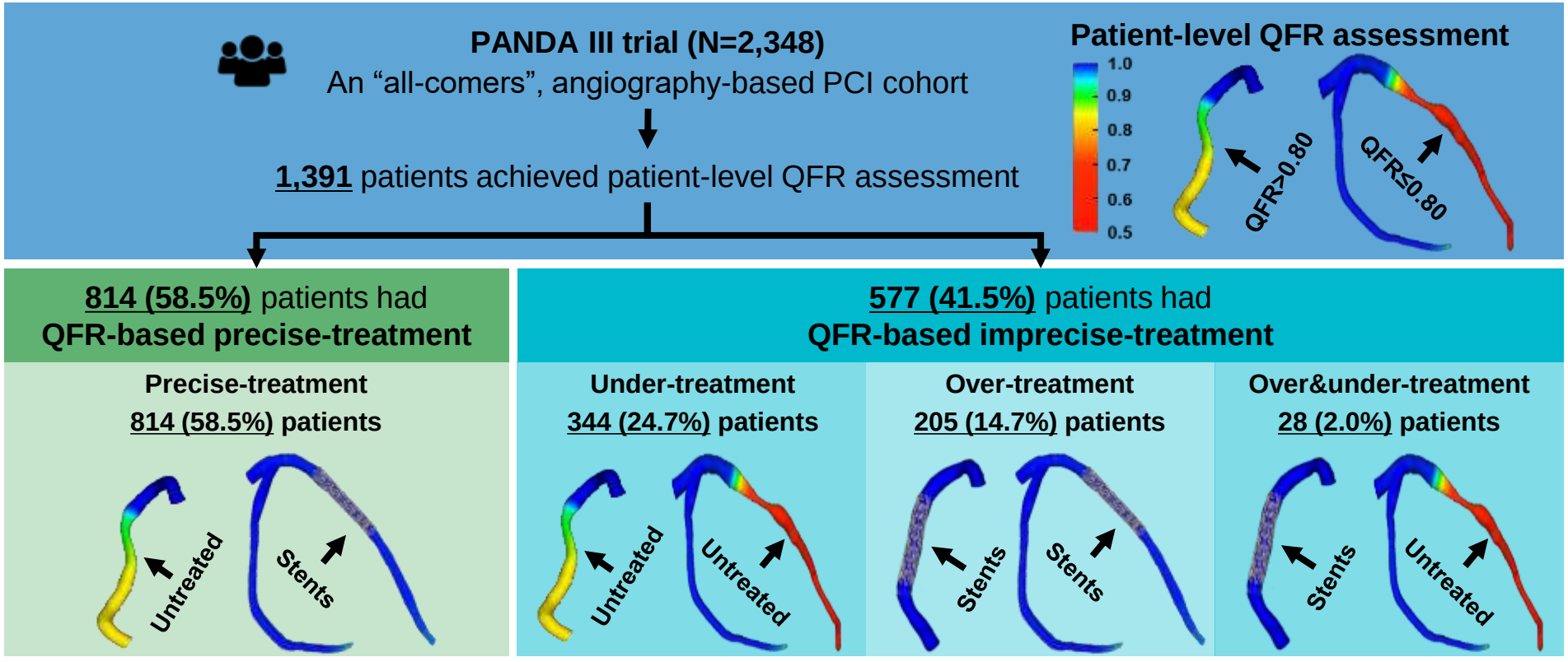


Zhang R, et al. *Circ Cardiovasc Interv* 2020

Procedural Guidance

QFR-based Precise PCI

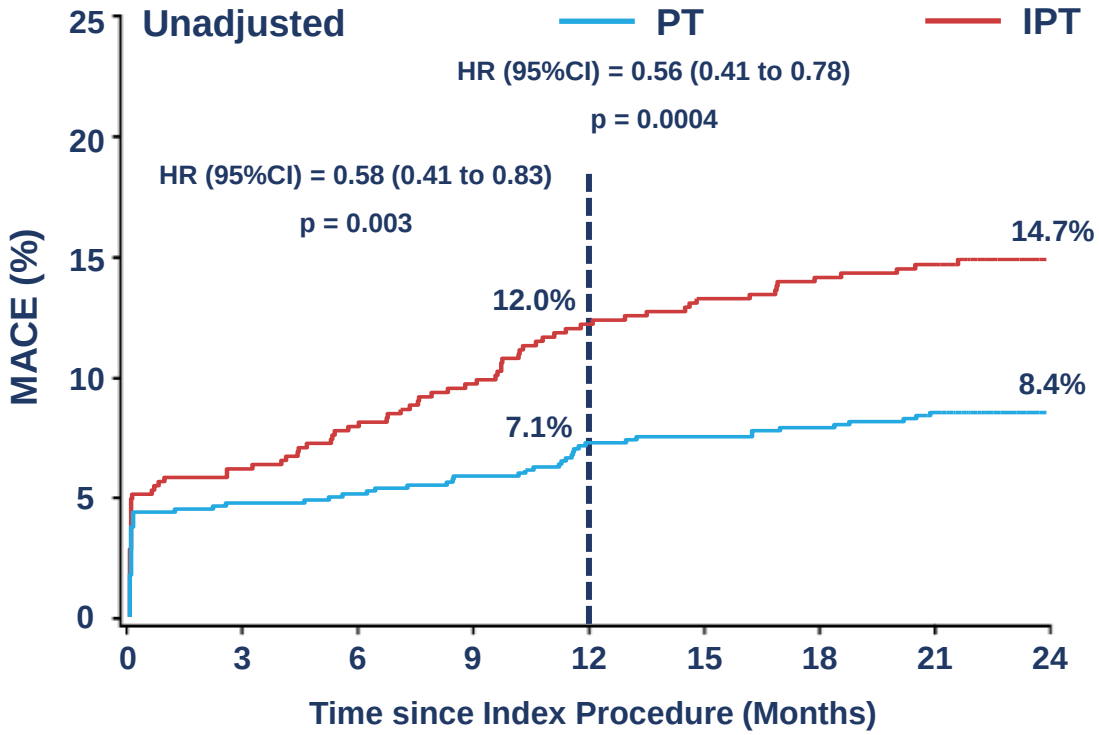
- **QFR-based precise-treatment (PT):** patients in whom all physiologically significant ischemic vessels were treated by PCI and in whom all vessels with QFR >0.80 were deferred; otherwise, they were termed to have had **QFR-based imprecise-treatment (IPT)**
- The imprecise-treatment (IPT) group was further stratified into 3 subgroups: 1) **under-treatment (UT);** 2) **over-treatment (OT);** and 3) **over- and under-treatment (OUT)**

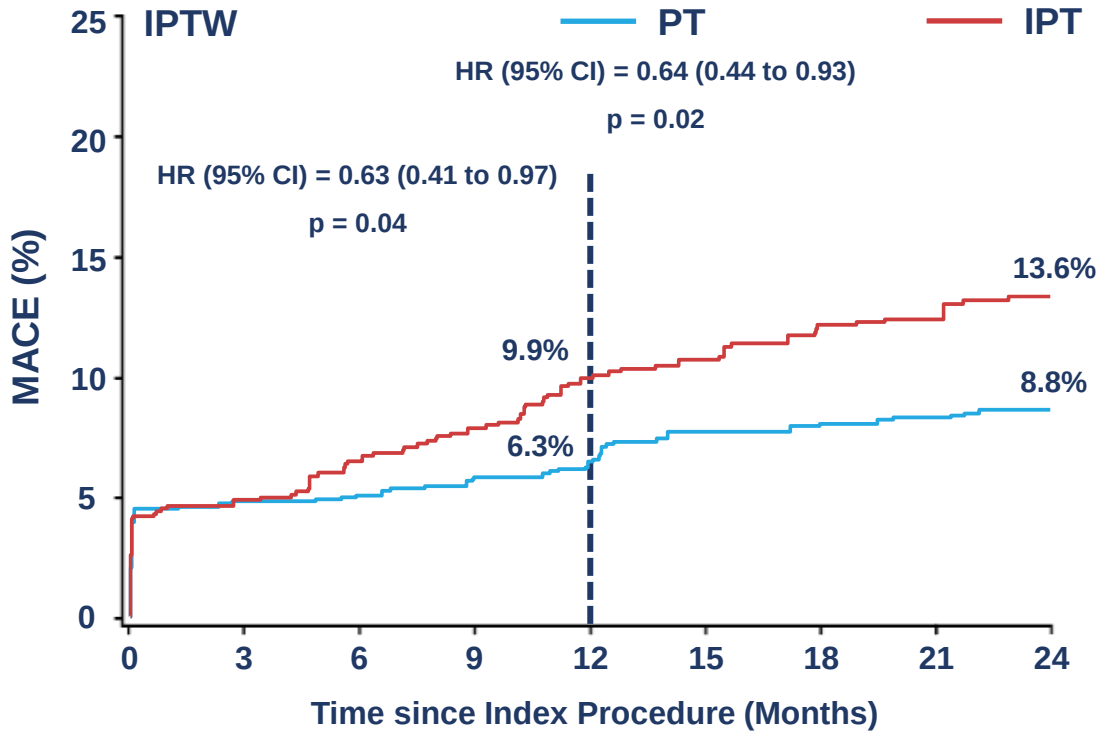


Zhang R, et al. Submitted

QFR-based Precise PCI

- The achievement of QFR-based precise PCI was associated with improved 2-year clinical outcomes, both in unadjusted and IPTW analysis





Number at Risk:

PT	814	776	774	770	759	747	745	742	740
IPT	577	541	532	521	507	501	497	492	489

Number at Risk:

PT	859	817	815	811	799	783	781	778	777
IPT	507	481	473	465	454	449	444	440	436

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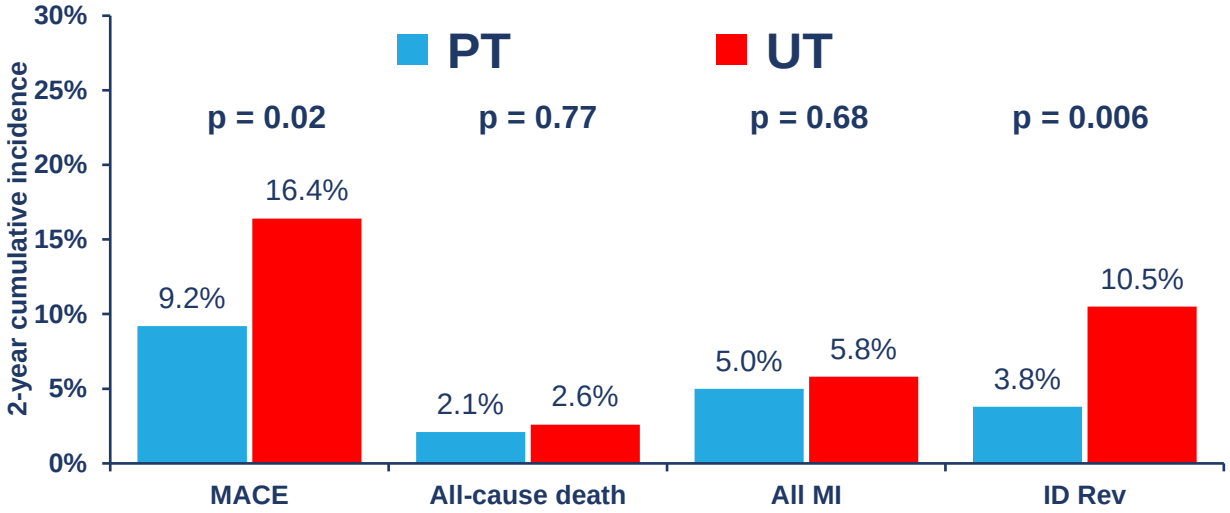
QFR-based Precise PCI

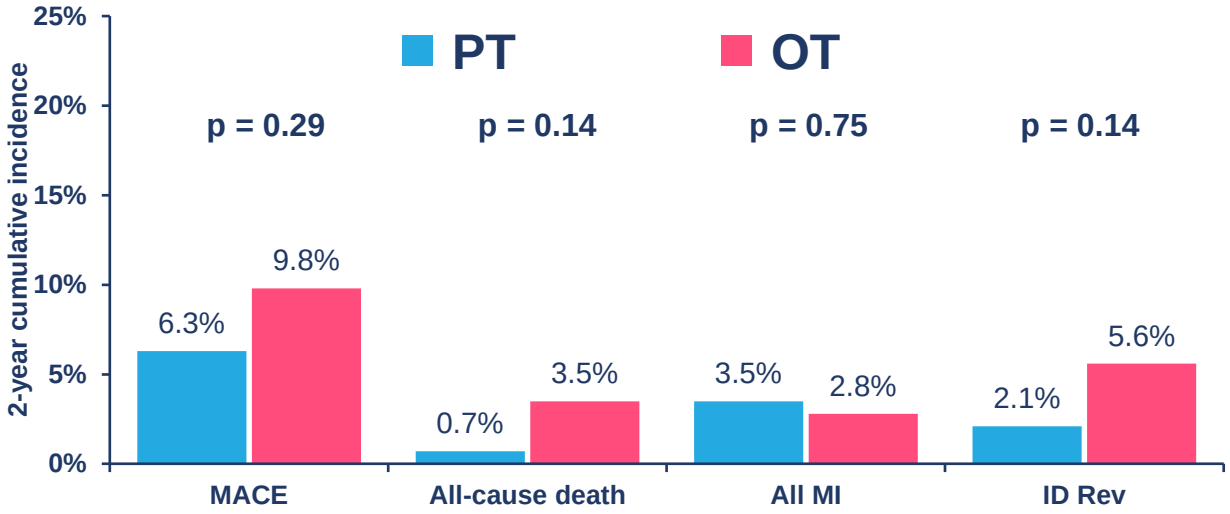
PT vs. UT Propensity 1:1 Matching (N=482)



Rationale between Treated and Untreated Vessels

	Vessels with QFR ≤0.80 (N_V=1,932)			Vessels with QFR >0.80 (N_V=611)		
	Treated (N_V=1,471)	Untreated (N_V=461)	*P* value	Treated (N_V=246)	Untreated (N_V=365)	*P* value
Vessel SS	8.59 ± 5.82	6.94 ± 5.55	<0.01	4.61 ± 3.37	3.37 ± 2.42	<0.01
LAD	51.0%	38.8%	<0.01	34.6%	24.1%	<0.01
RVD, mm	2.65 ± 0.46	2.40 ± 0.51	<0.01	2.67 ± 0.53	2.37 ± 0.58	<0.01
DS%	75.4 ± 16.2	69.1 ± 16.6	<0.01	50.6 ± 10.2	51.5 ± 10.0	0.28

PT vs. OT Propensity 1:1 Matching (N=286)



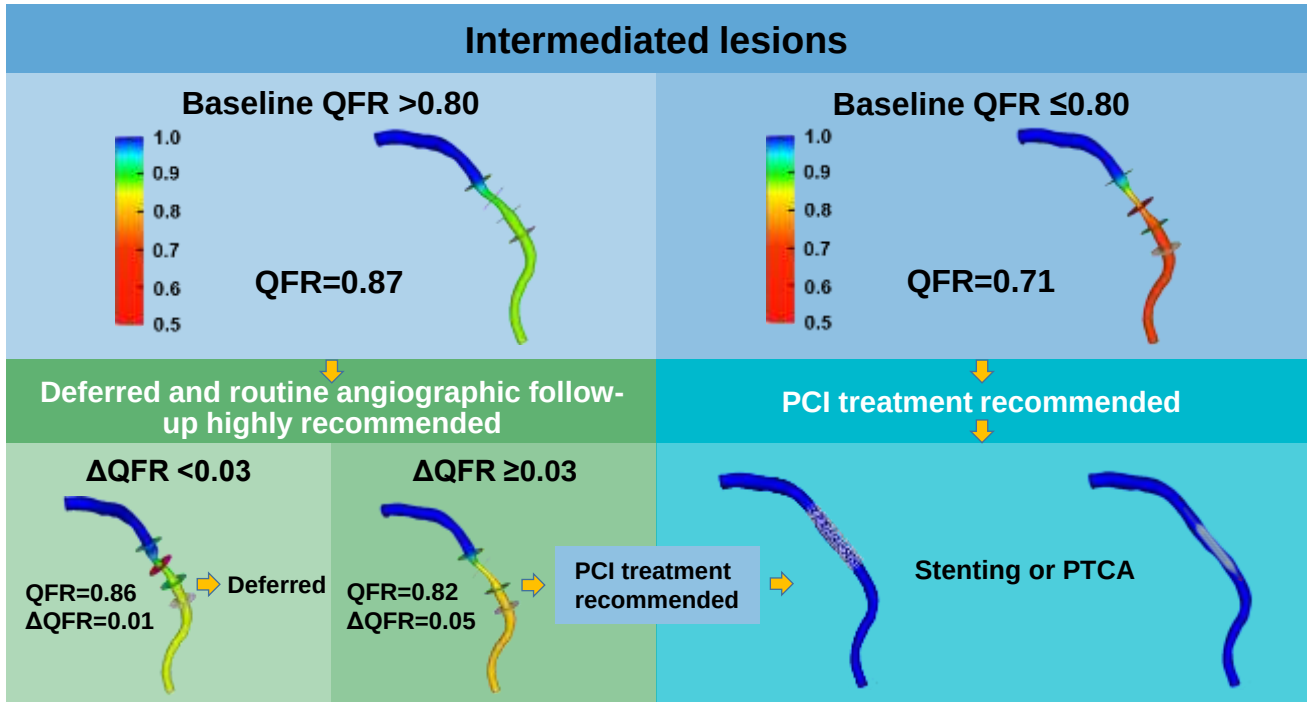
Uses of Interventional Devices (PT vs. OT)

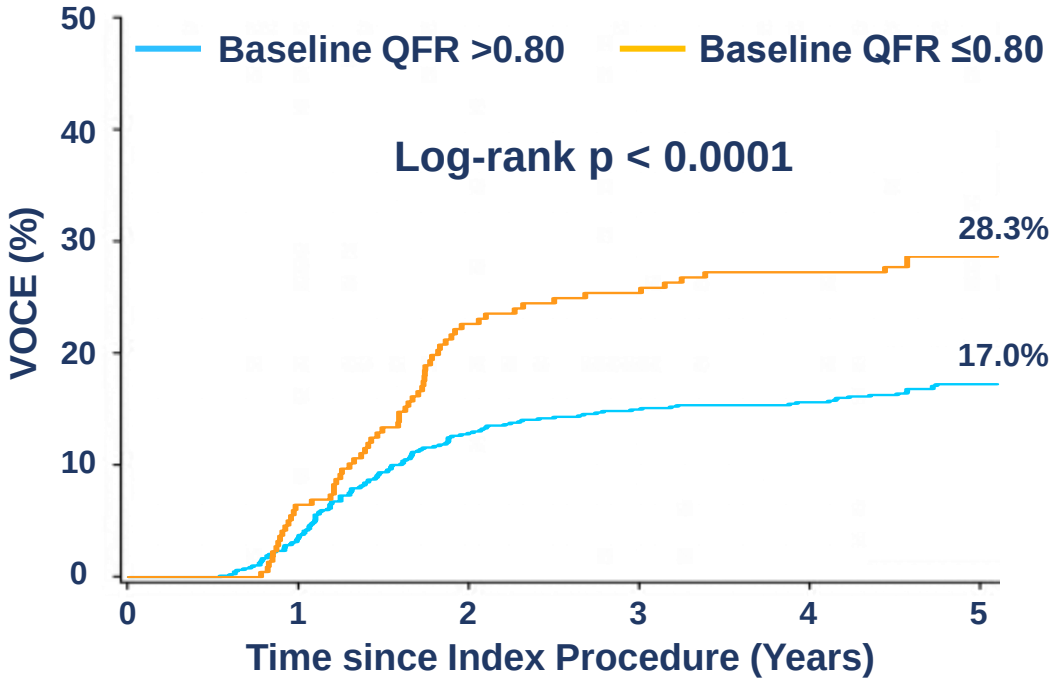
	Unweighted Sample			Propensity 1:1 Matching		
	PT (N=814)	OT (N=205)	*P* value	PT (N=143)	OT (N=143)	*P* value
Treated vessels per patient	1.18 ± 0.44	1.36 ± 0.54	<0.01	1.12 ± 0.35	1.45 ± 0.58	<0.01
Stents per patient	1.57 ± 0.85	1.63 ± 0.91	0.41	1.52 ± 0.72	1.75 ± 0.99	0.02
Balloons per patient	2.05 ± 1.34	2.11 ± 1.52	0.38	2.02 ± 1.13	2.37 ± 1.47	0.02

Procedural Guidance

Intermediate Coronary Lesion

- ✓ Retrospective QFR assessment was available in **820 patients (996 intermediate *de novo* coronary vessels)**
- ✓ It appears **safe to defer** treatment of vessels with **functional insignificant intermediate lesion** at baseline angiography (baseline QFR>0.80) during long-term follow-up



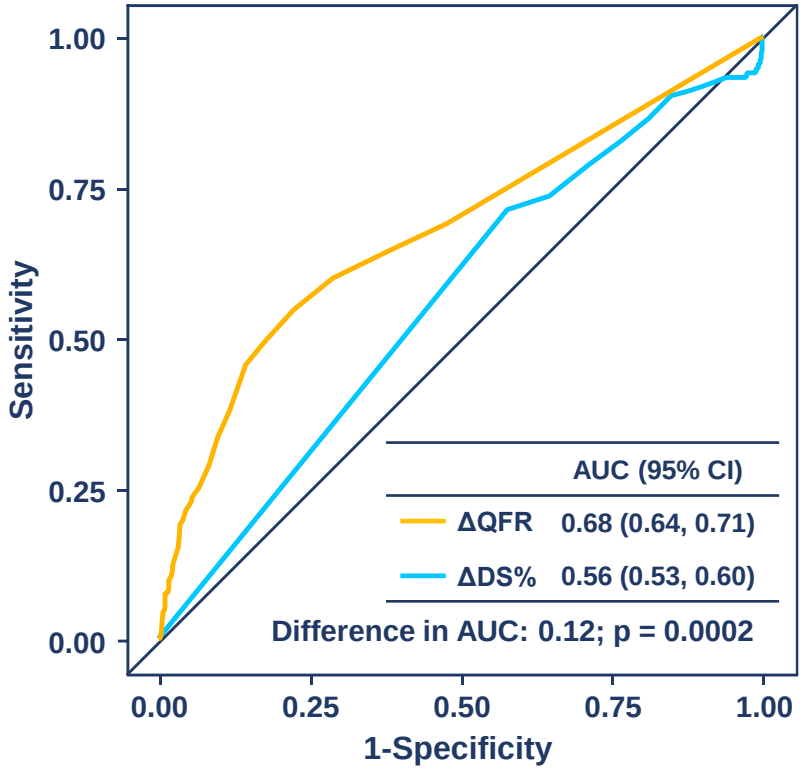


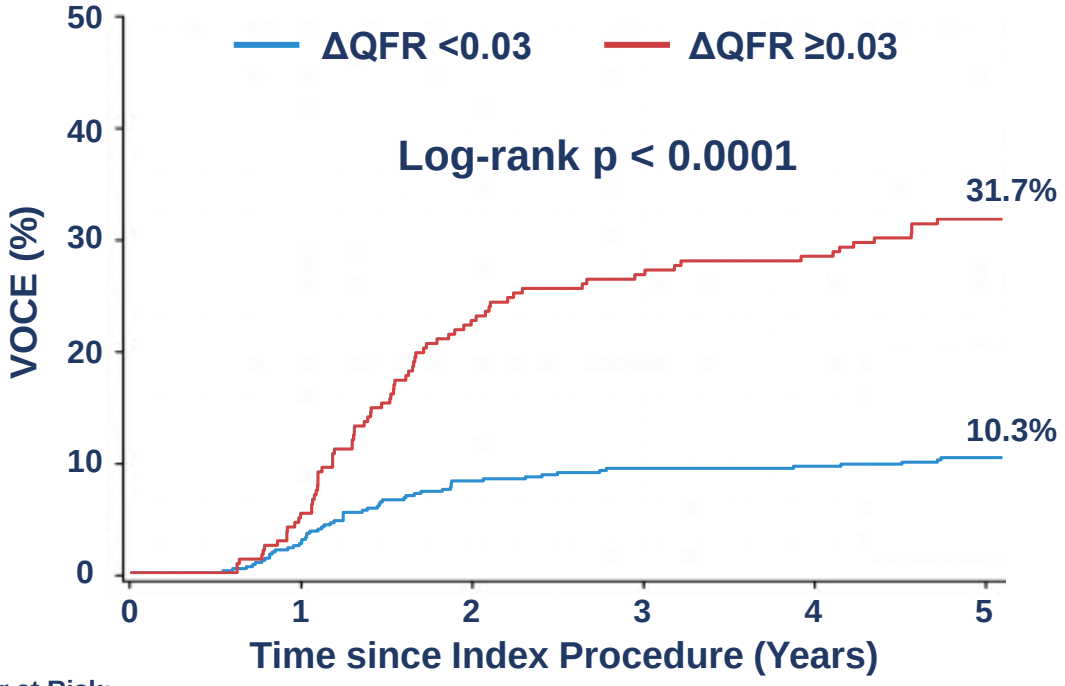
Guan C, et al. Submitted

Procedural Guidance

Intermediate Coronary Lesion

- ✓ **ΔQFR,** [baseline QFR – follow-up QFR] / years
  - A useful tool to annually evaluate dynamic functional change of deferred intermediate lesions, which demonstrated **having good prognostic value**





Number at Risk:

ΔQFR <0.03	534	522	489	483	483	439
ΔQFR ≥0.03	243	233	190	179	175	155

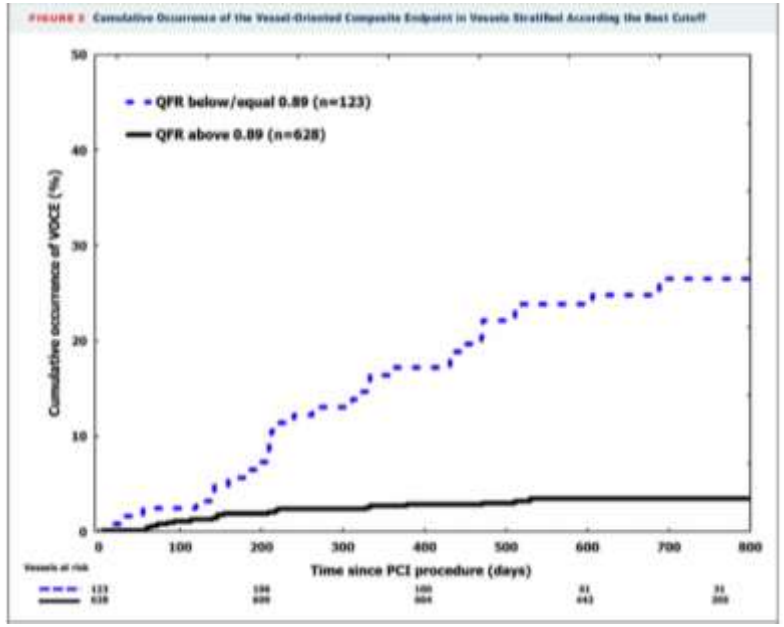
Guan C, et al. Submitted

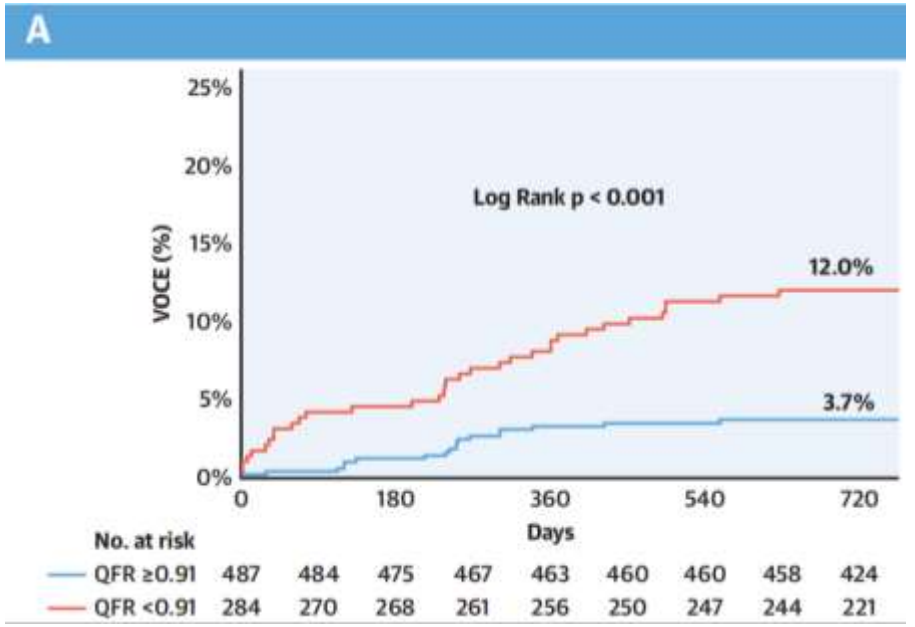
Post-PCI Assessment

Prognostic Value of Post-PCI QFR

✓ Post-PCI QFR value was strongly associated with long-term prognosis

- **HAWKEYE study:** vessels with post-PCI QFR **≤0.89** were associated with a higher risk of VOCE
- **SYNTAX II substudy:** vessels with post-PCI QFR **<0.91** were more likely to suffer VOCE



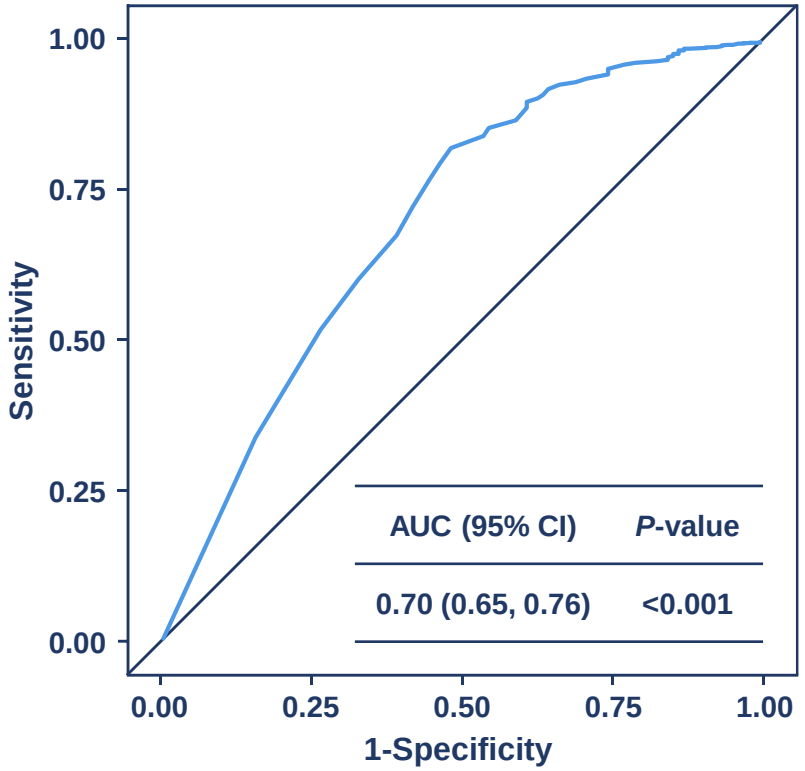


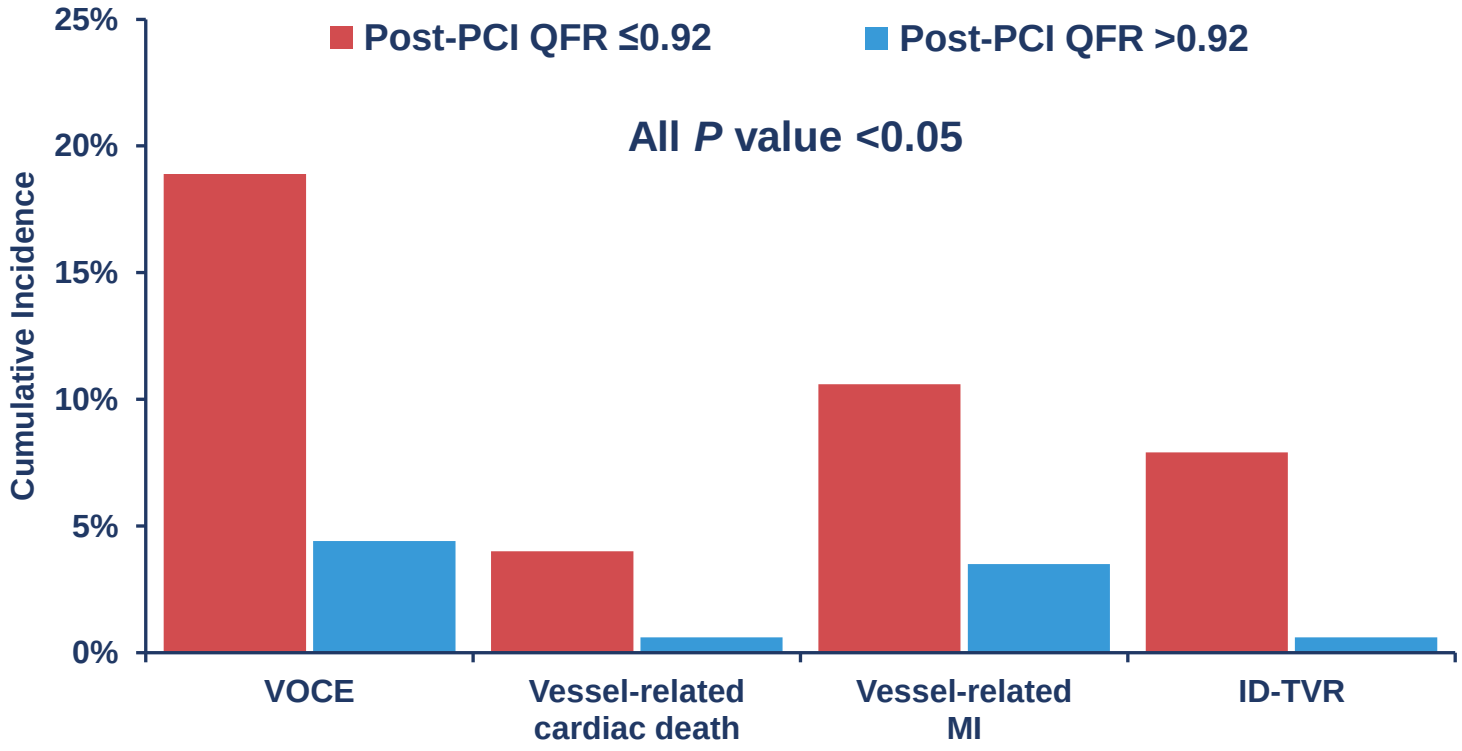
Biscaglia S, et al. *JACC Cardiovasc Interv* 2019
Kogame N, et al. *JACC Cardiovasc Interv* 2019

Prognostic Value of Post-PCI QFR

✓ Our data further confirmed this finding

- A total of **1,503 vessels** in the PANDA III trial were retrospectively analyzed for post-PCI QFR
- The AUC was **0.70 (p<0.001)** for post-PCI QFR to predict 2-year VOCE, and the best cutoff value was **0.92 (≤0.92)**



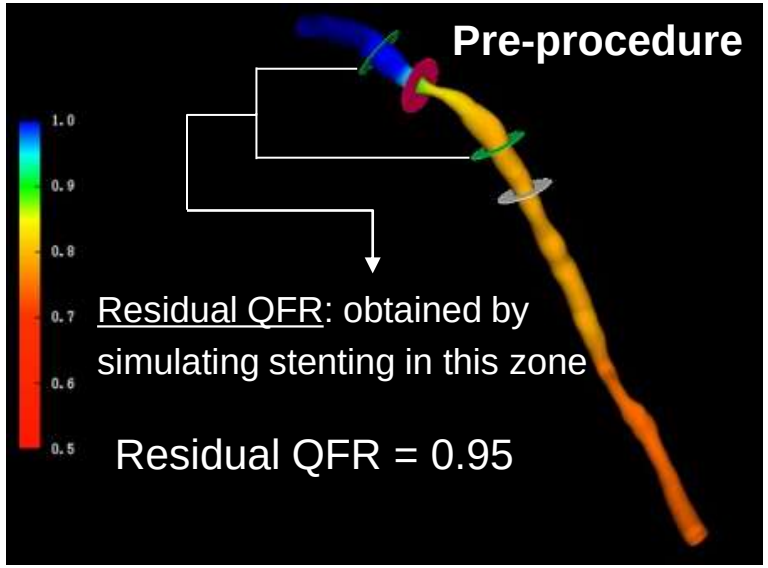


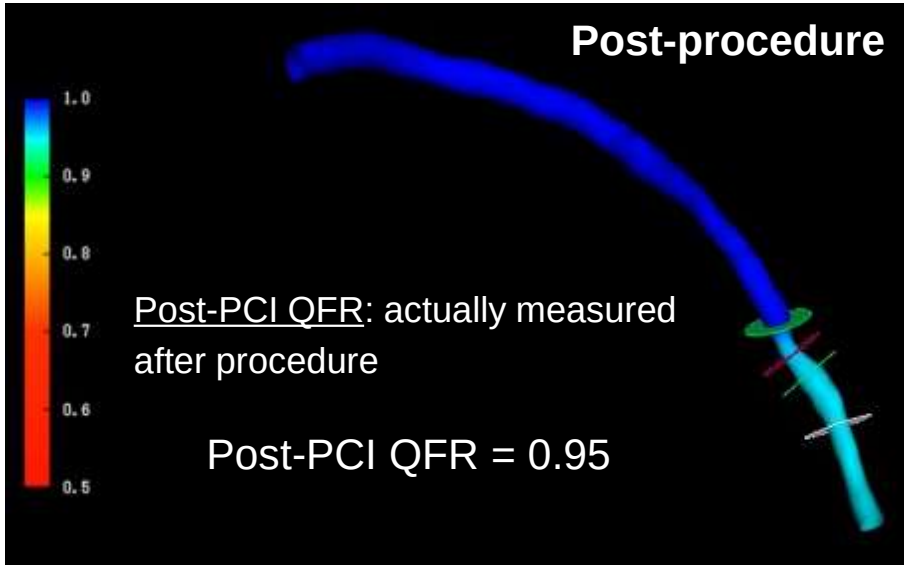
Zhang R, et al. Submitted

Pre-PCI Simulation

Simulated Residual QFR

- **Simulated residual QFR**: corresponds to the QFR value if a specified segment of the assessed vessel is successfully dilated, **which is essentially predictive of actually post-PCI QFR**
- By advancing the time point of post-procedural functional assessment, this would help physicians to **develop the best strategies while planning the procedure**

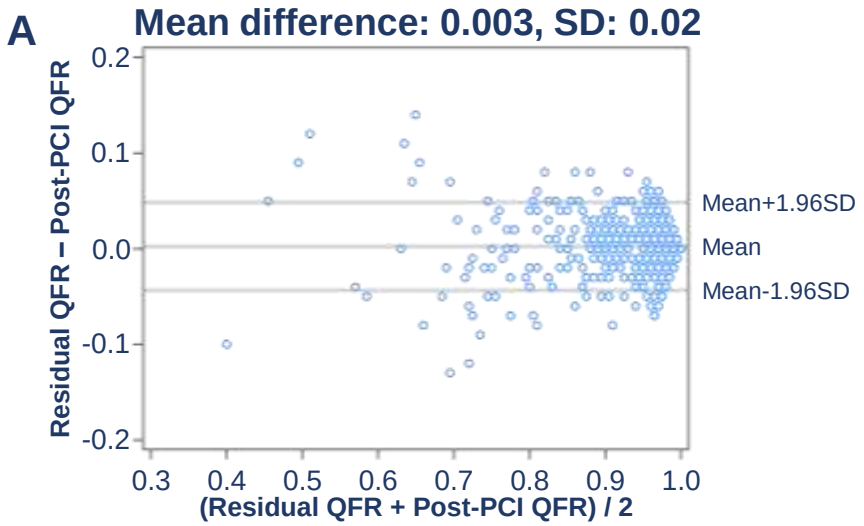


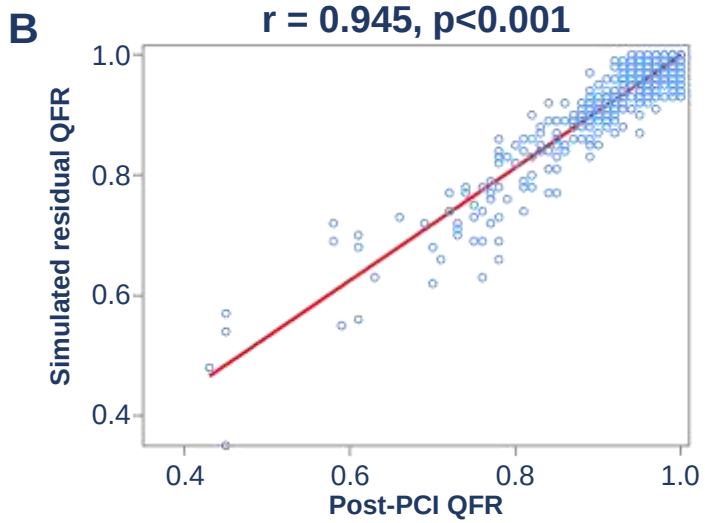


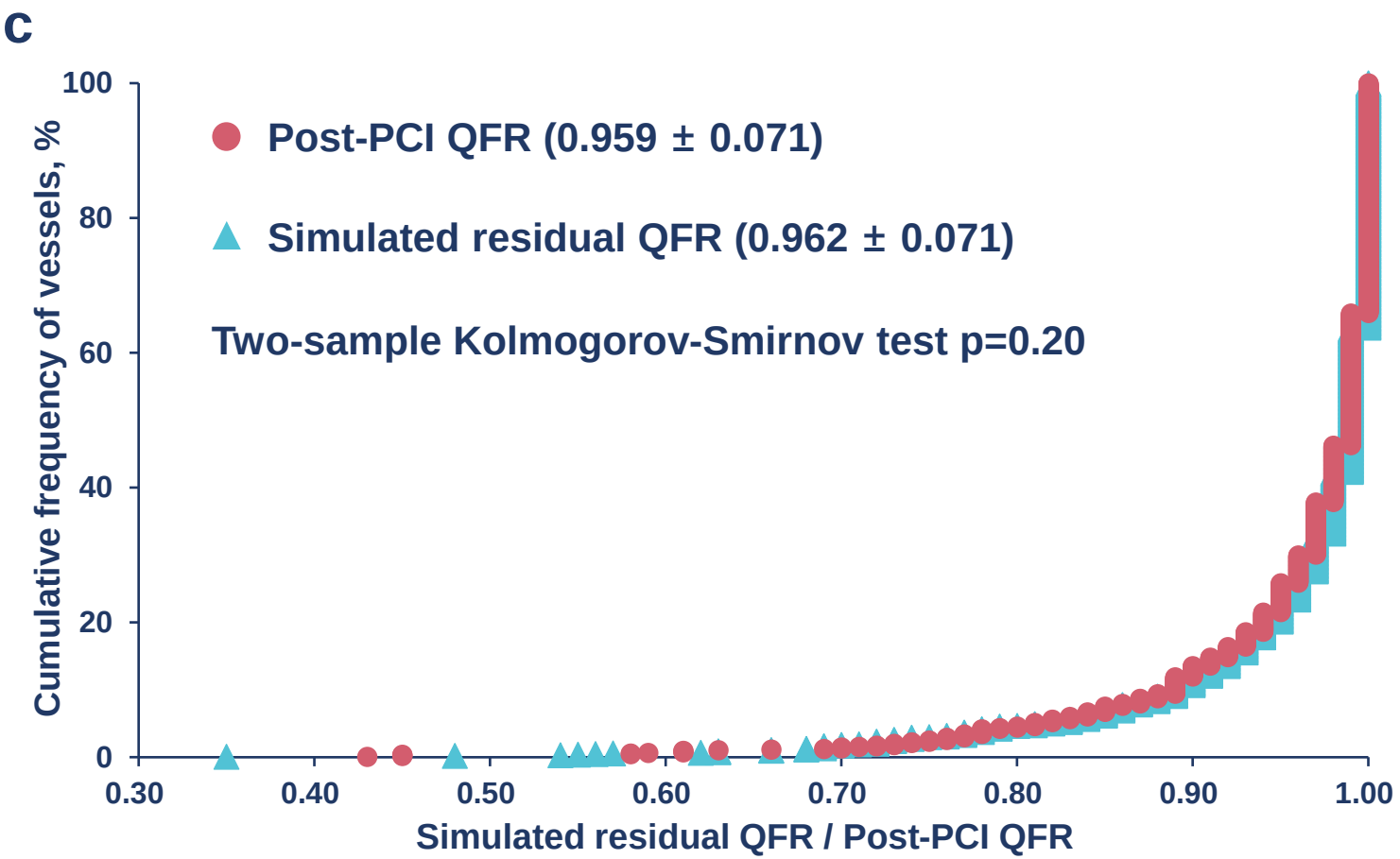
Zhang R, et al. Submitted
Rubimbura, et al. *Catheter Cardiovasc Interv* 2020

Concordance between QFRs

- **1,033 vessels** with paired simulated residual QFR and post-PCI QFR
- Good correlation and agreement were observed



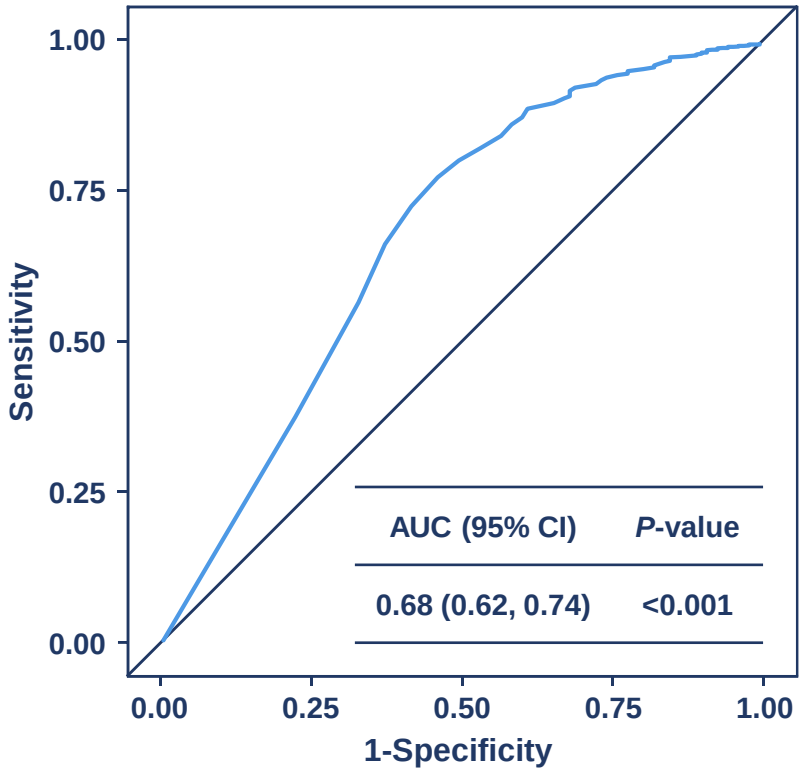


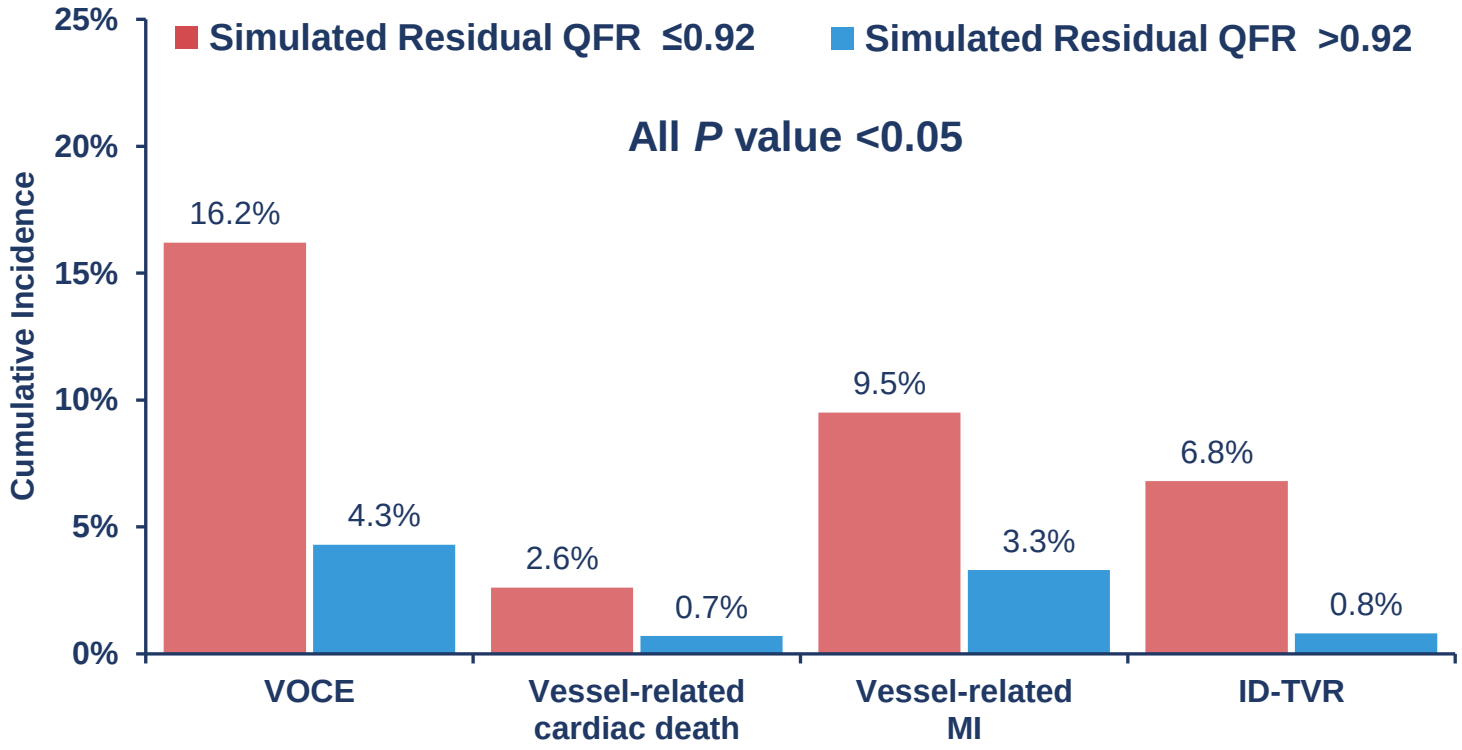


Zhang R, et al. Submitted

Prognostic Value of Simulated Residual QFR

- A total of **1,782 vessels** with available simulated residual QFR were included
- Vessels with suboptimal residual QFR (≤0.92) suffered worse 2-year VOCE **(16.2% vs. 4.3%; HR 3.87 [95% CI: 2.67-5.62], p<0.001)**





Zhang R, et al. Submitted

FAVOR III China

Investigator-initiated, Multicenter, Subjects and Clinical Assessors Blinded, Randomized, Superiority Trial

Patients with CAD scheduled for coronary angiography

Meet all general inclusion and exclusion criteria

Inclusions: age ≥ 18 years; stable, unstable angina, or post-AMI (≥72 hours). Exclusions: cardiogenic shock or severe heart failure (NYHA ≥ III).

Written informed consent

Coronary angiography

Meet all angiographic inclusion and exclusion criteria

Inclusions: patients must have at least one lesion with DS% of 50%-90% in an artery with visually estimated RVD ≥ 2.5 mm and be eligible for PCI as determined by investigators. Exclusions: patients had only one lesion with DS%>90% and TIMI grade <3; interrogated lesions are related with AMI.

Identify the vessels intended to treat

1:1 Randomization

Randomization Stratifications
- Center
- Diabetes
- SVD vs. MVD
- DS% > 90% and TIMI Flow <3

Independent Organizations
- Core Lab
- CEC
- DSMB
- Data Management
- Statistical Analysis

QFR-guided strategy
N=1,915

QFR measurements in all vessels with 50%≤DS%≤90% and the reference vessel diameter ≥2.5 mm by visual assessment
- QFR ≤0.80: PCI
- QFR >0.80: deferral
- All measured vessel QFR >0.8: OMT alone

Angiography-guided strategy
N=1,915

PCI is performed on all the vessels intended to treat identified prior to randomization, based on visual assessment of the angiogram

Imaging core lab analysis; Clinical follow-up at 1 month, 6 months,1 year, 2 years, and 3 years; EQ-5D questionnaires collected at 1, 6, and 12 months

Primary endpoint: 1-year MACE, defined as the composite of all-cause death, MI, or any ischemia-driven revascularization

Major Secondary Endpoint: 1-year MACE excluding peri-procedural MI; **Other Important Outcome**: Cost-effectiveness

ClinicalTrial.gov Identifier: NCT03656848

FAVOR III China in Perspective

- As the world's largest randomized controlled clinical trial of coronary physiological guidance for revascularization, FAVOR III China aims to effectively identify the ischemic lesions that have real intervention value and can improve the long-term prognosis of patients, so as to formulate reasonable treatment strategies.
- The study aims to answer the following questions:
  1. In the era of contemporary DES, is a QFR-guided strategy better than a conservative angiography-guided PCI strategy and, if so, to what extent and why? QFR guidance may avoid unnecessary stent implantation, reducing procedural related complications and long-term adverse events. Conversely, QFR assessment may also identify angiographic borderline lesions that are functionally significant and require treatment.
  2. Will the 3D-QCA measurement be useful to achieve more appropriate device sizing than standard angiography?
  3. Will the QFR-guided strategy prove cost-effective?

Song L, et al. *Am Heart J* 2020