

FRR or Resting Gradients: Rationale and Clinical Data



Allen Jeremias, MD, MSc

*Division of Cardiovascular Medicine
Director, Cardiac Intensive Care
Associate Professor of Medicine
Stony Brook University Medical Center*

Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship

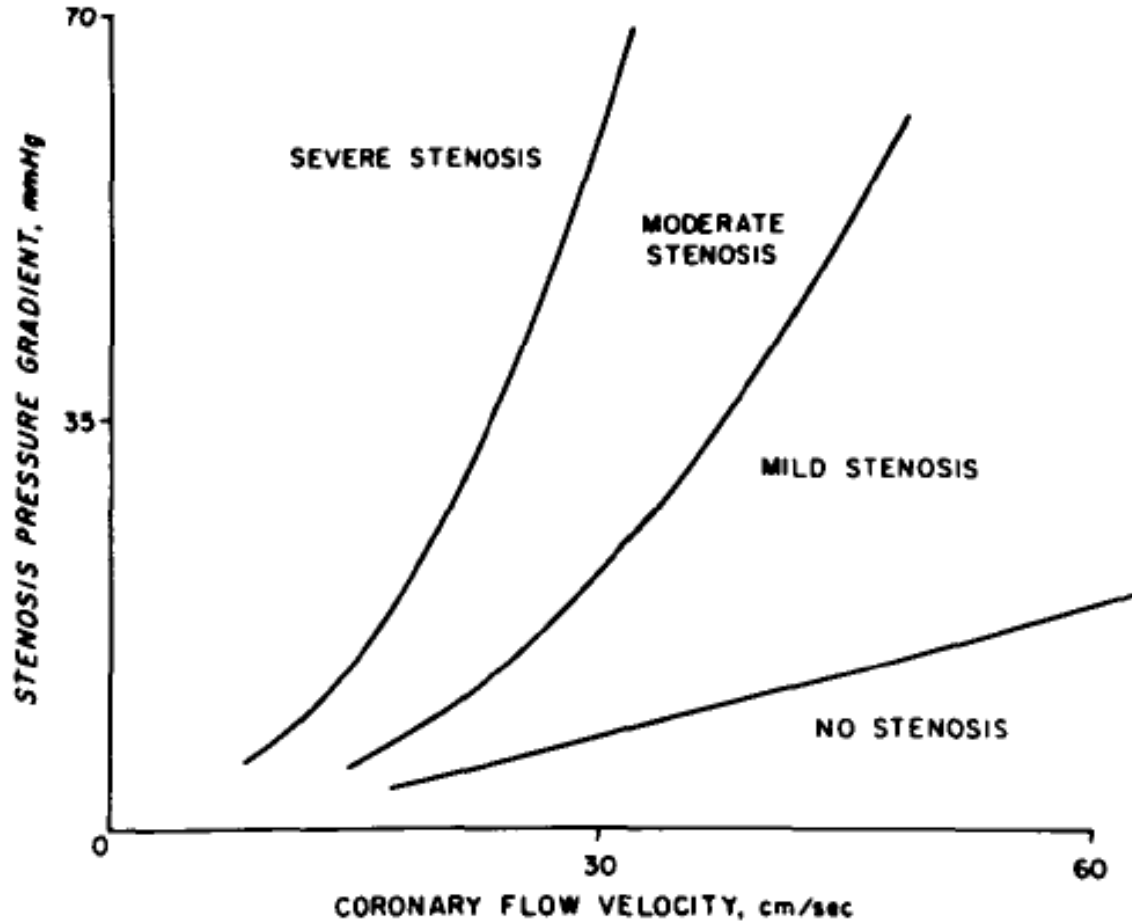
- Consulting Fees/Honoraria

Company

- Abbott Vascular
- Astra Zeneca
- The Medicines Company
- Volcano Inc.

Pressure drop *increases* with *stenosis severity*

Pressure drop across stenosis

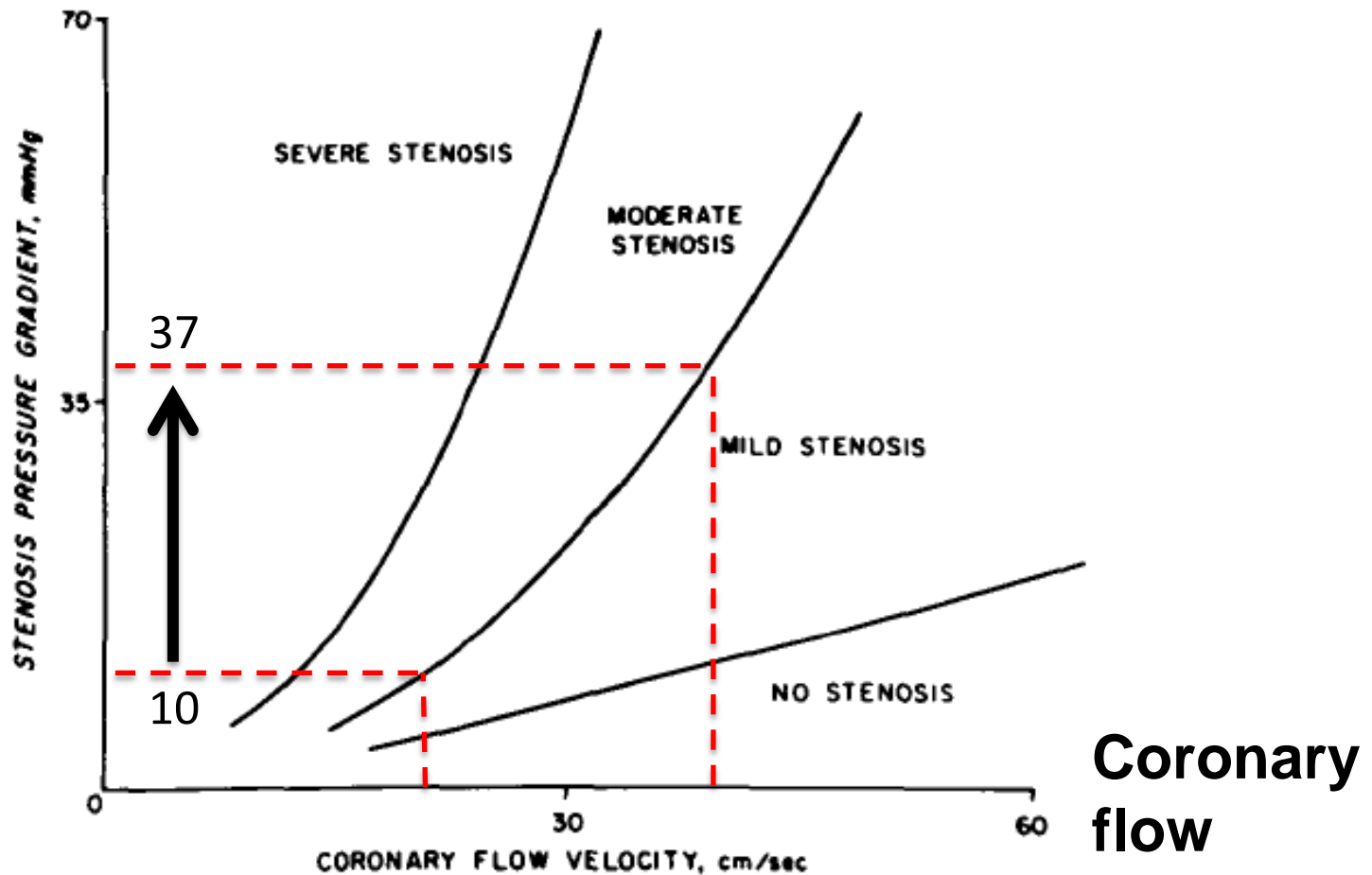


Coronary flow

Basic Principle of FFR

'Unmask' trans-coronary gradients by increase in flow

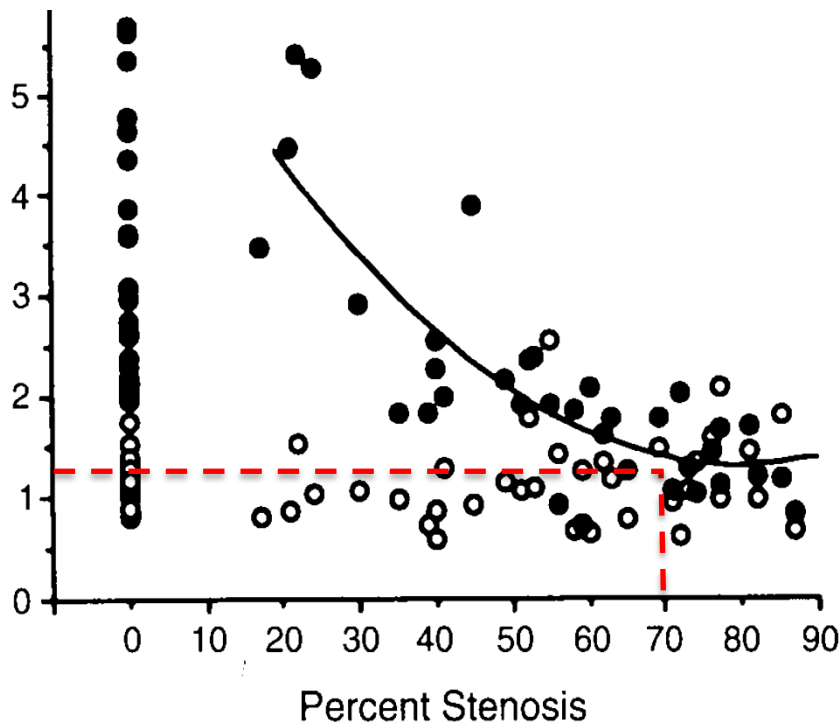
Pressure drop across stenosis



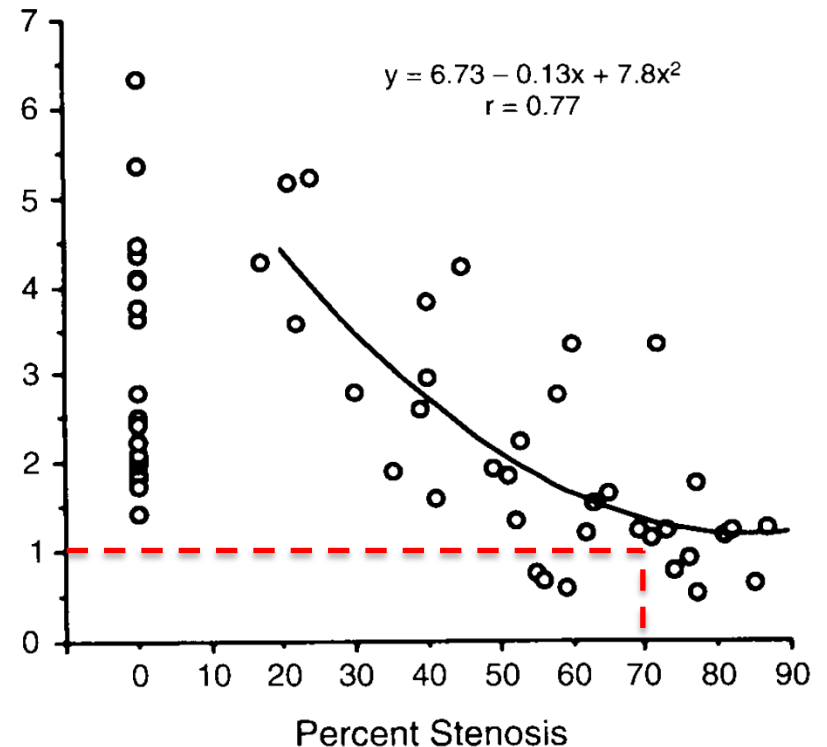
Relationship btw. Myocardial Blood Flow and CAD Severity

Minimal Hyperemia in Presence of Stenosis >70%

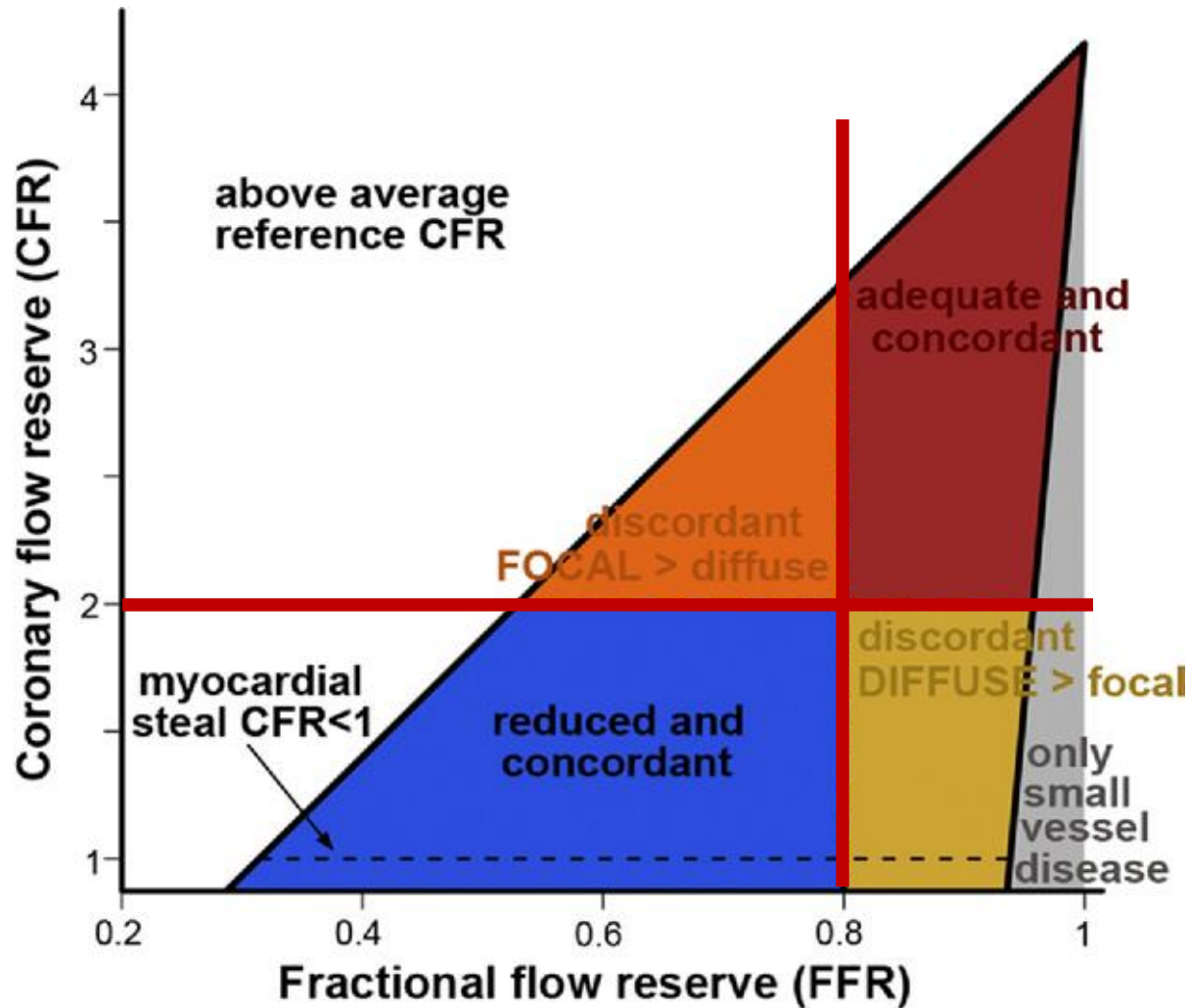
Myocardial Blood Flow



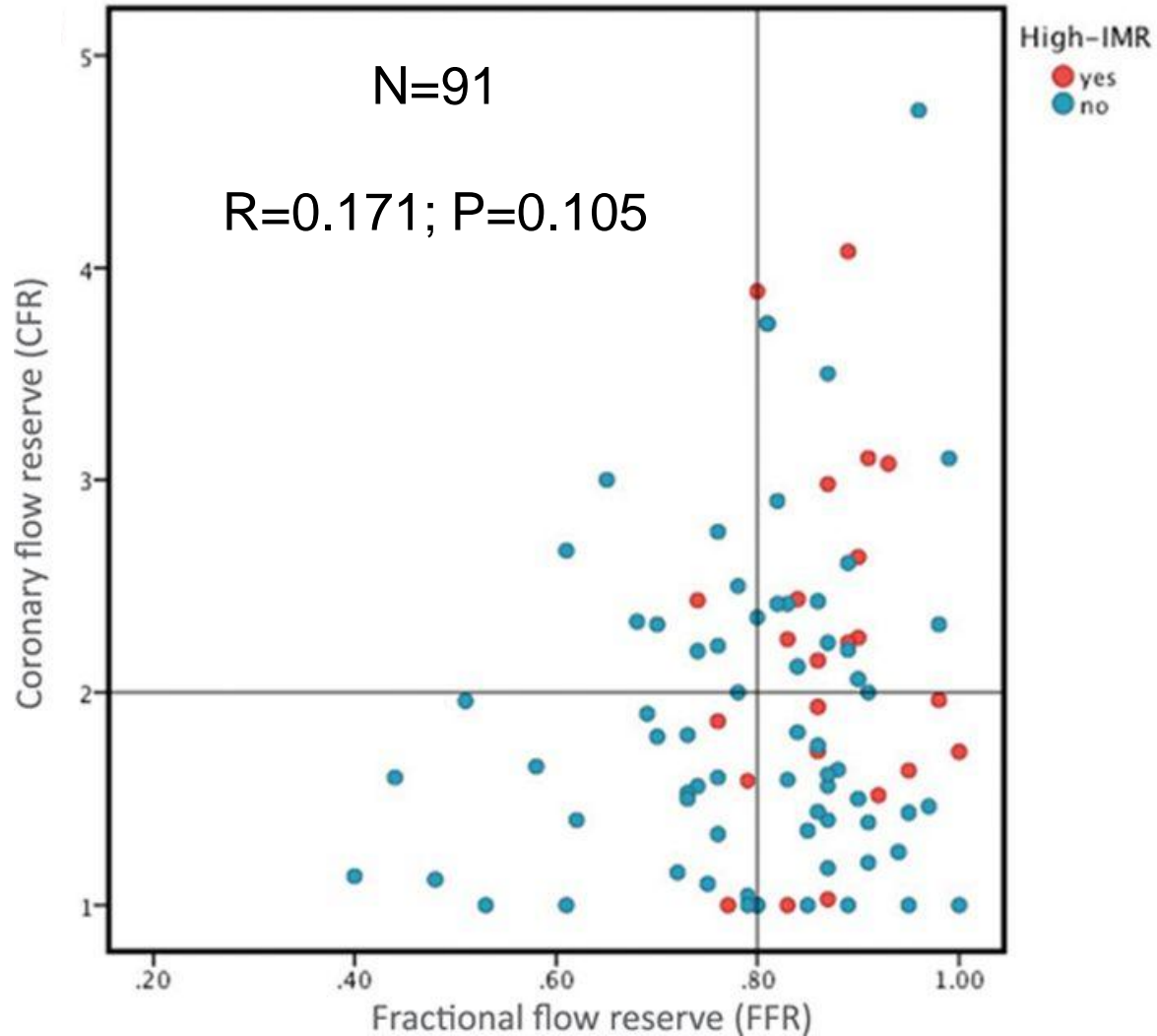
Coronary Flow Reserve



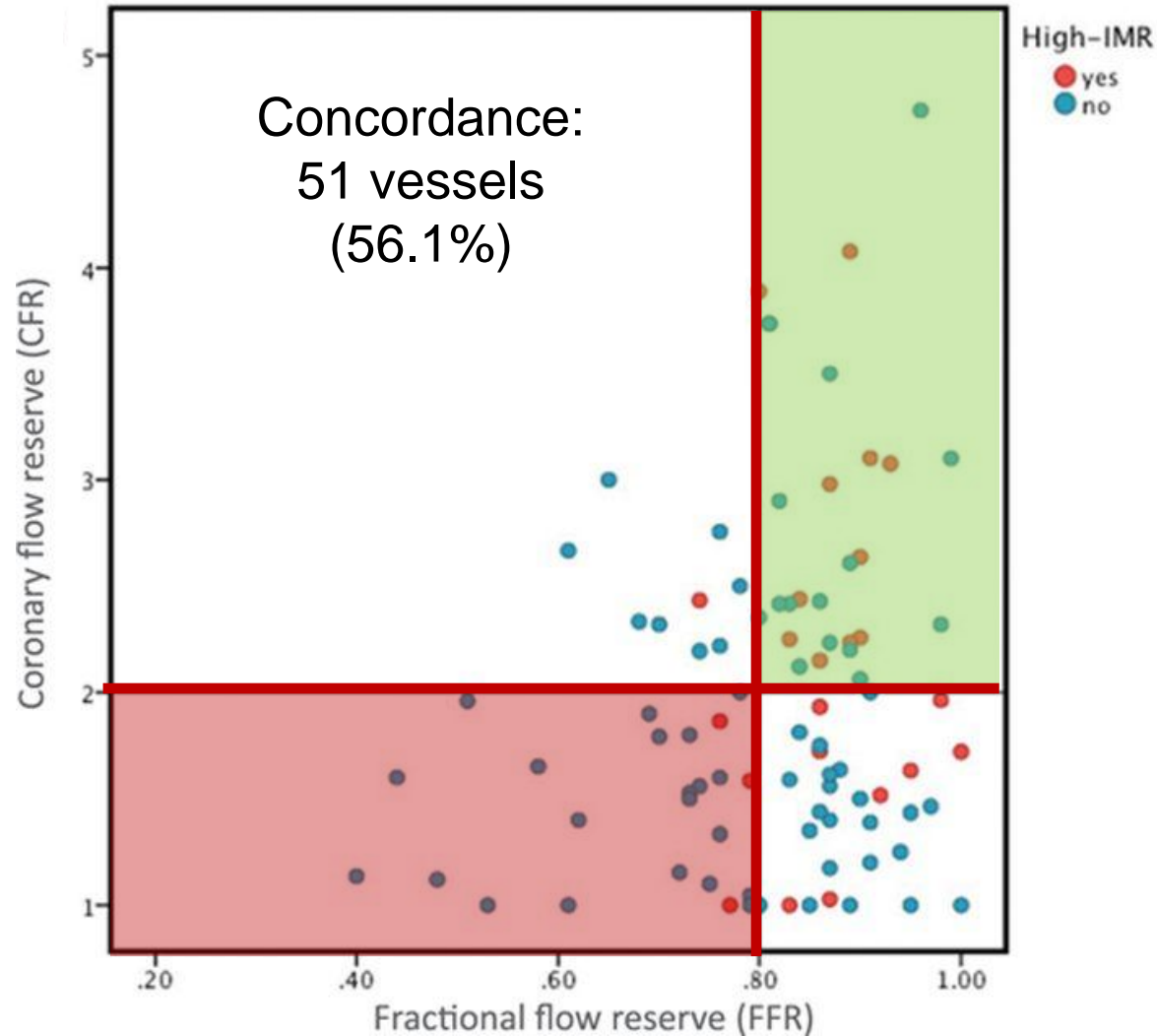
Relationship of Coronary Flow Reserve and Fractional Flow Reserve



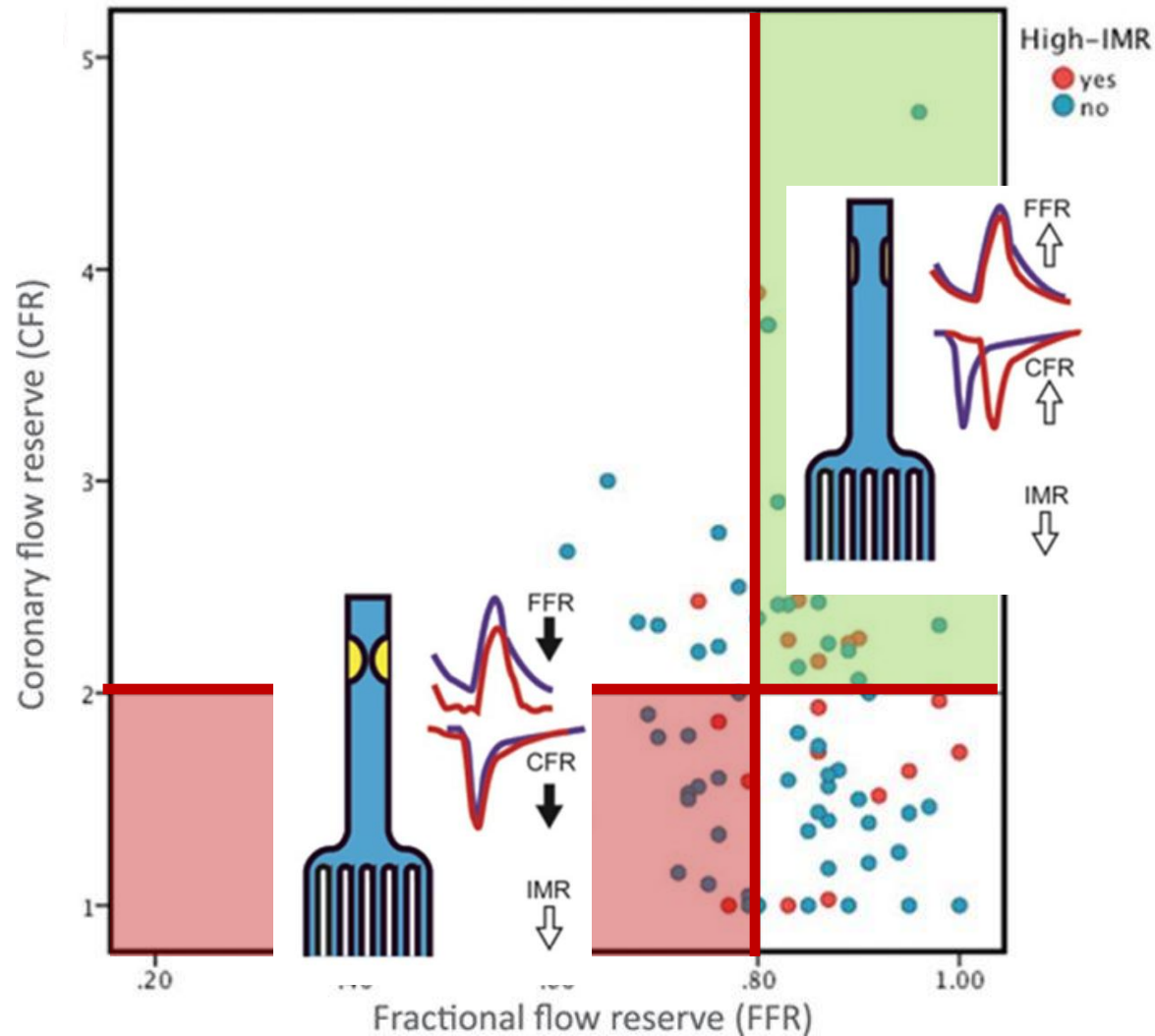
Relationship of Coronary Flow Reserve and Fractional Flow Reserve



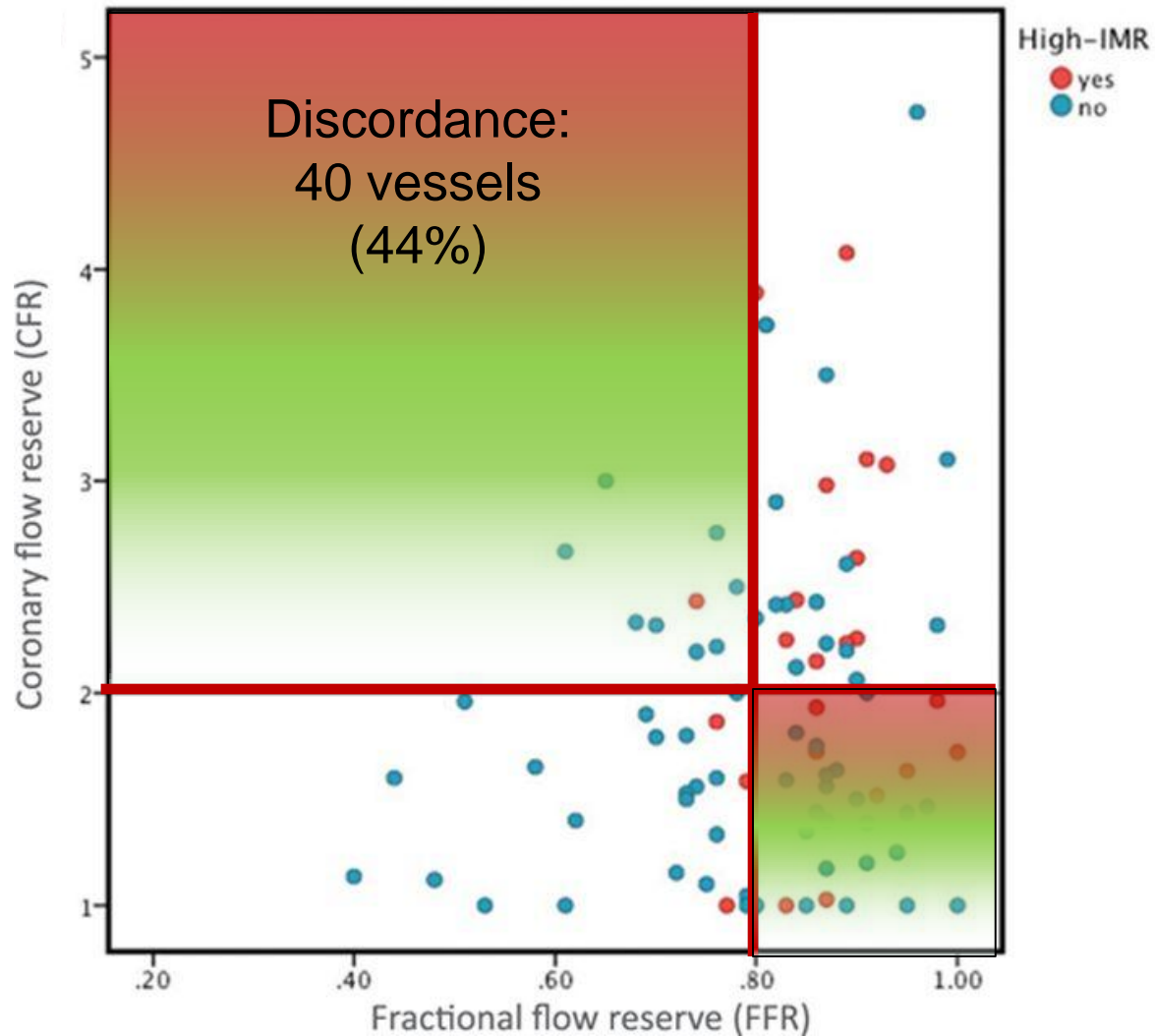
Concordance of Coronary Flow Reserve and Fractional Flow Reserve



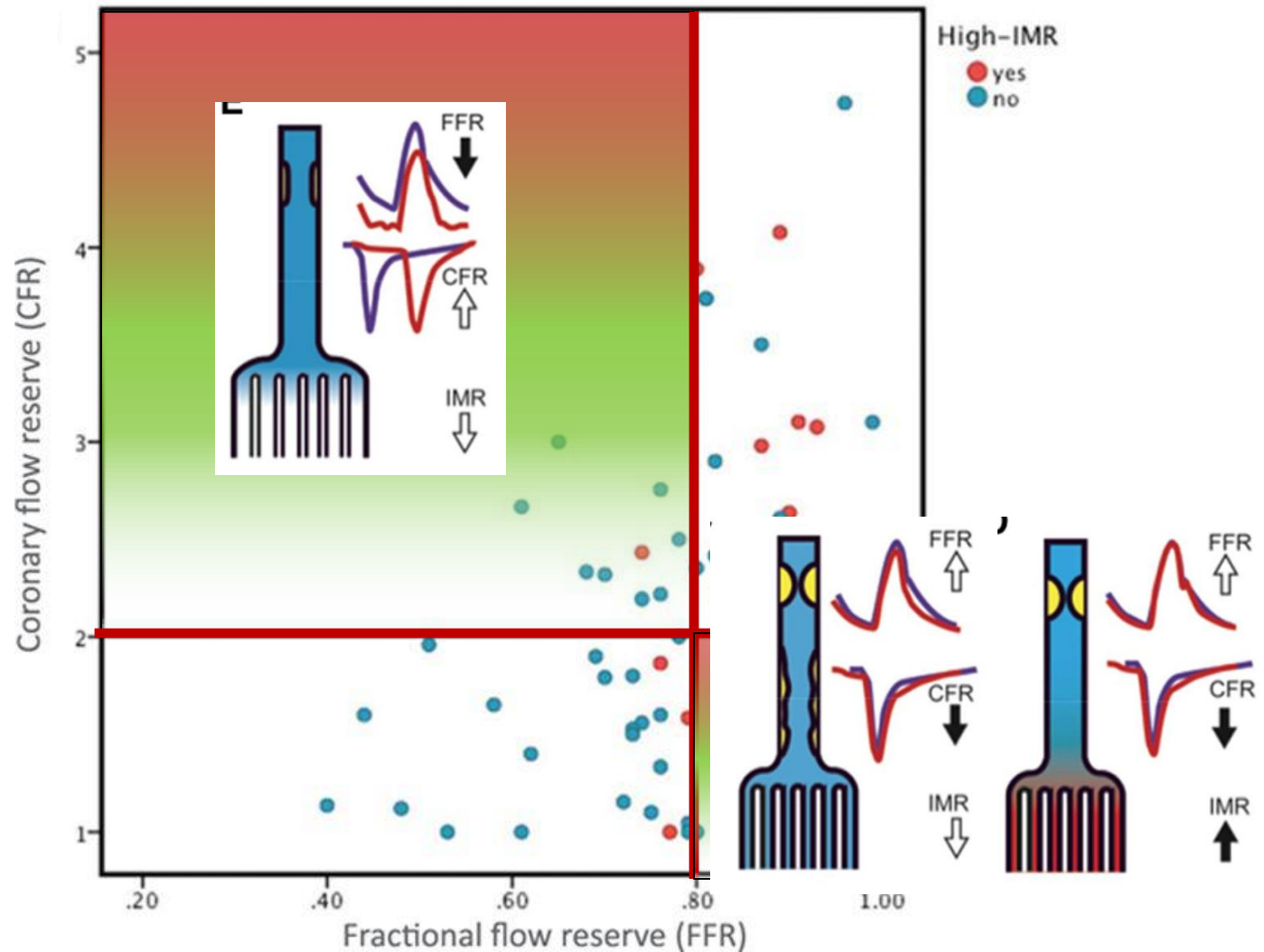
Concordance of Coronary Flow Reserve and Fractional Flow Reserve



Discordance of Coronary Flow Reserve and Fractional Flow Reserve



Discordance of Coronary Flow Reserve and Fractional Flow Reserve



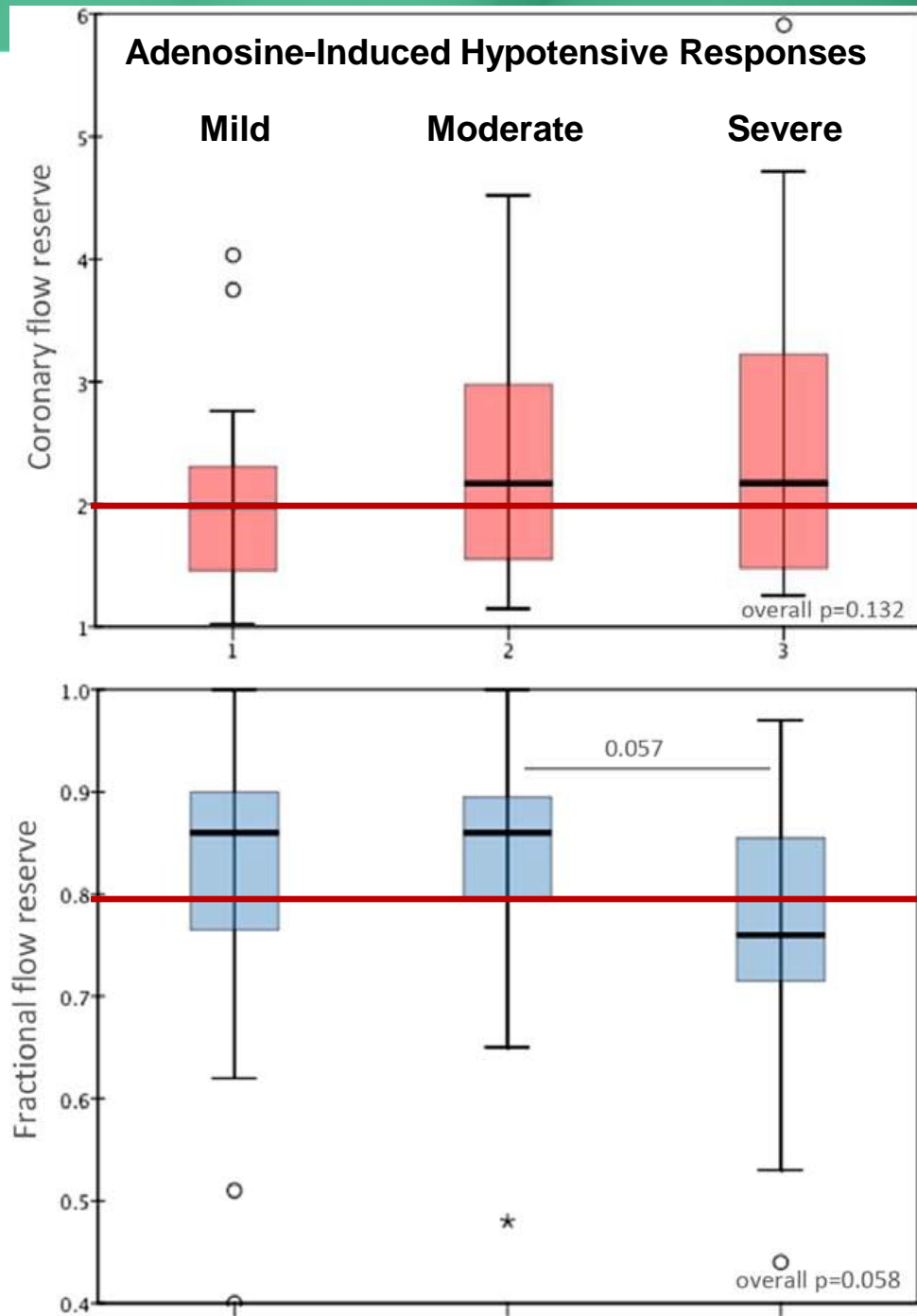
Variability in BP Response to Adenosine

Prevalence of vessels with FFR ≤ 0.80 and CFR >2 was higher (35.5% vs. 14.5%) in severe hypotensive response group

OR: 3.24

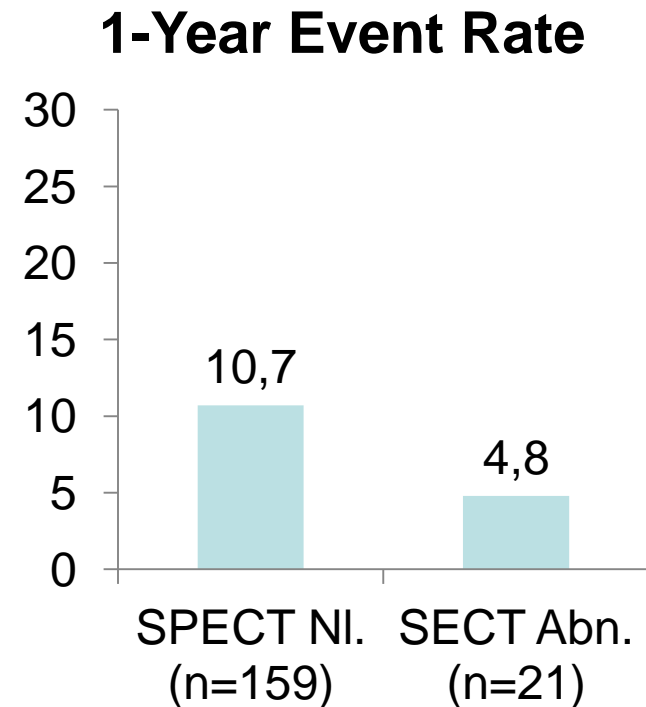
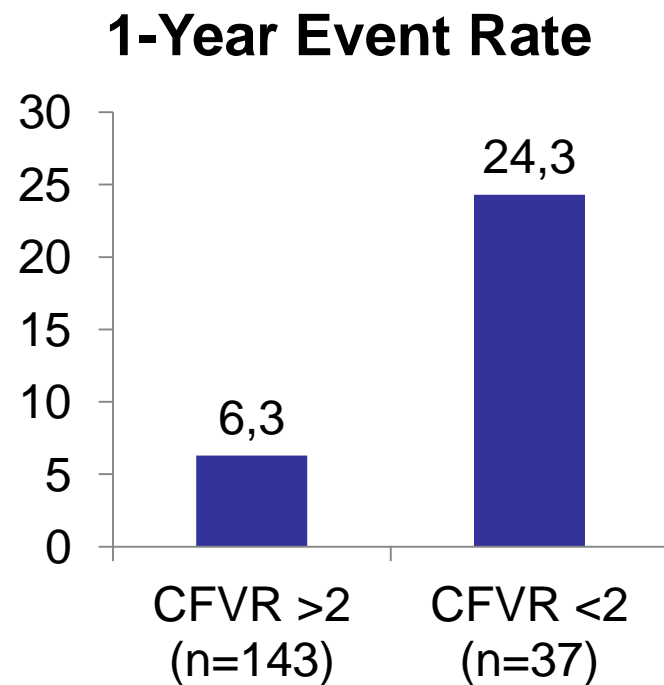
95% CI: 1.17-8.99

P=0.023



Prognostic Value of CFR and SPECT in Intermediate Coronary Lesions

PCI deferred in 182 intermediate lesions based on CFR and SPECT and pt. followed for death/MI/PCI for 1 year



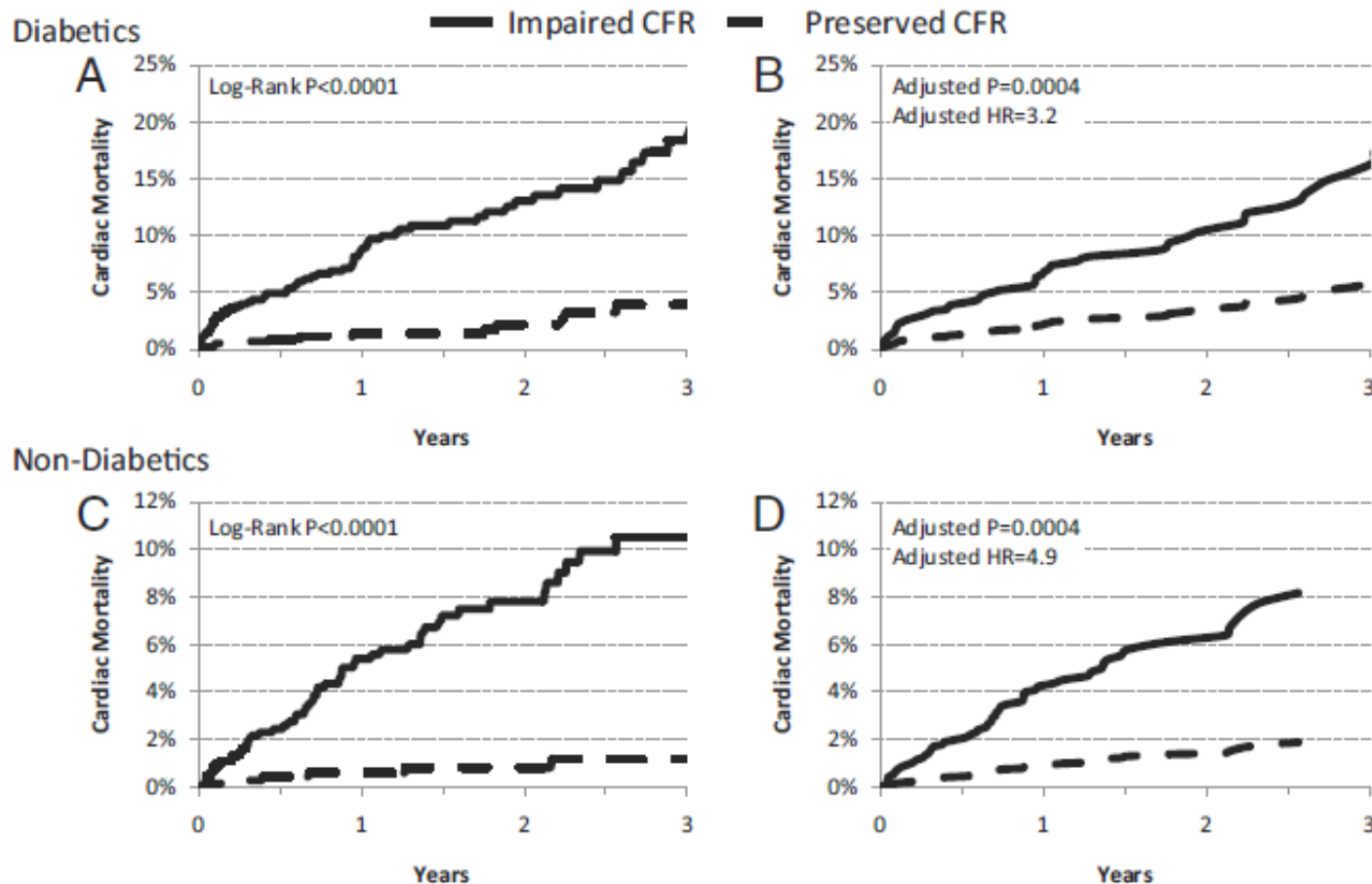
Multivariate analysis revealed CFVR as the only significant predictor for cardiac events

CFVR RR: 3.9 (1.7 to 9.1), $p < 0.05$

SPECT RR: 0.5 (0.1 to 3.2), $p = NS$

Association Between Coronary Vascular Dysfunction and Cardiac Mortality

A total of 2783 consecutive patients underwent quantification of CFR by PET and were followed for a median of 1.4 years

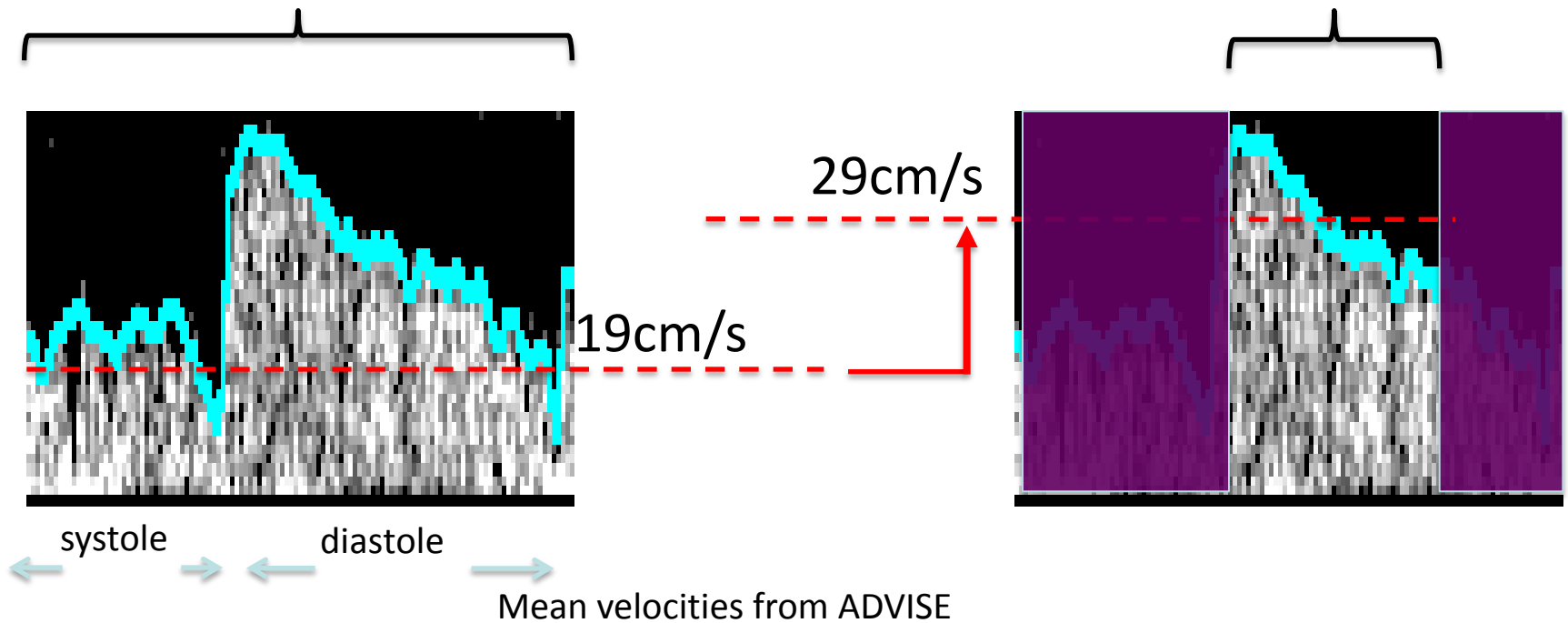


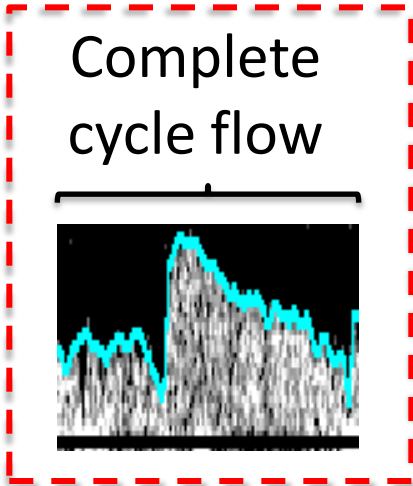
Instant wave-free ratio (iFR)

Detect trans-coronary gradients by using physiologically increased flow during diastole

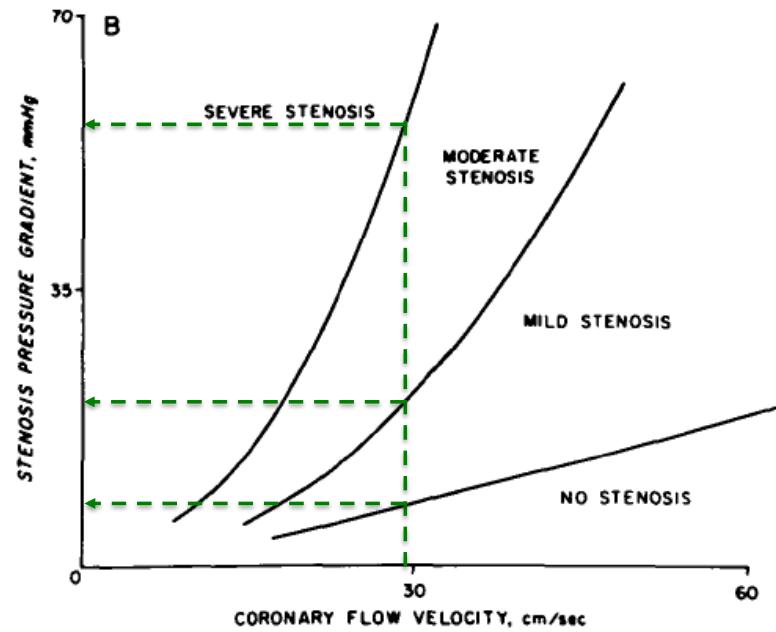
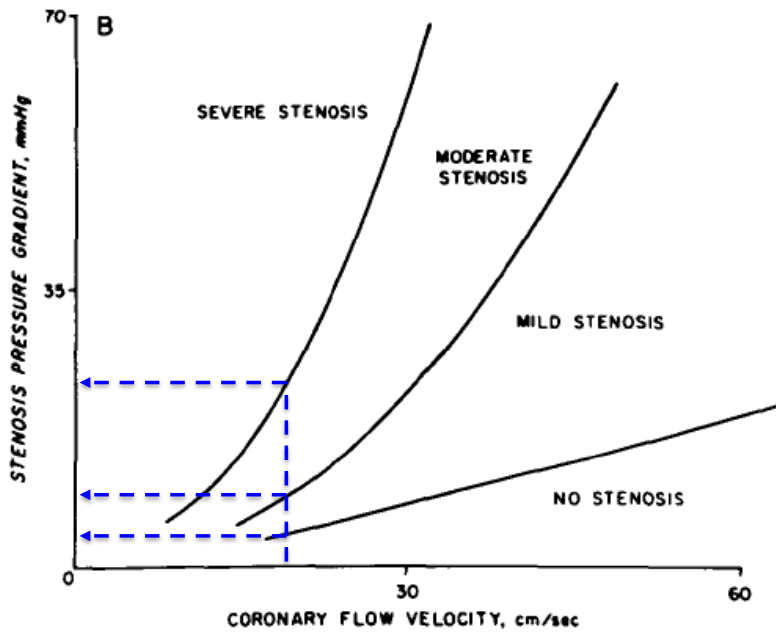
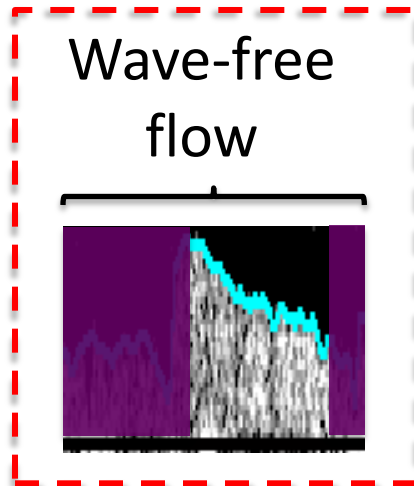
Complete cycle flow

Diastolic flow





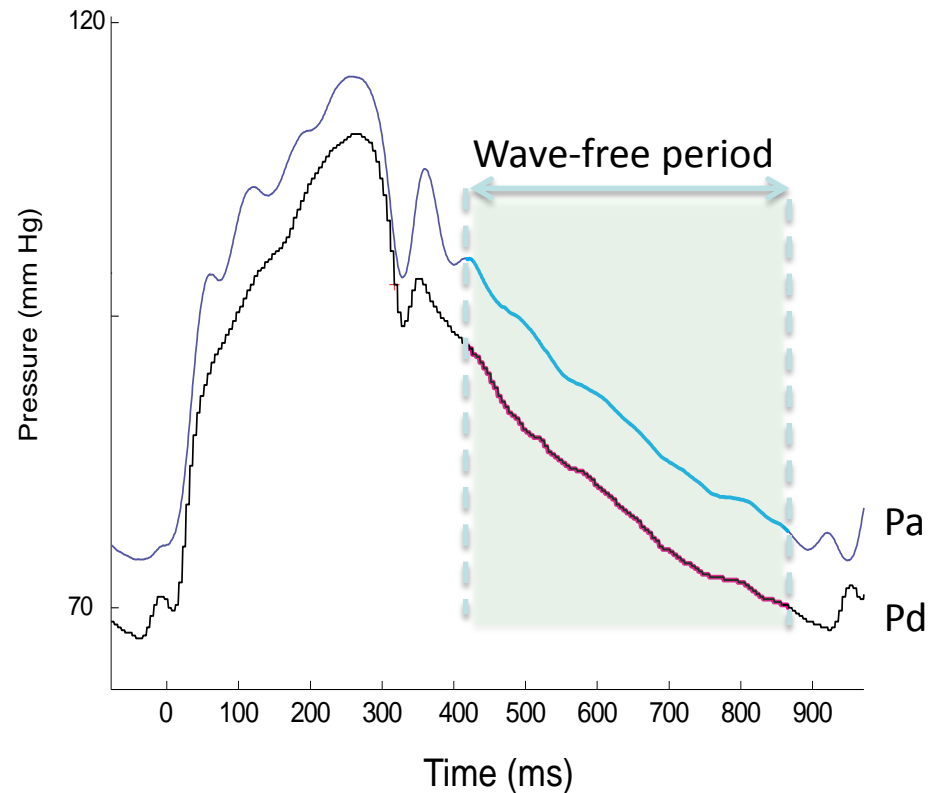
Increased sensitivity



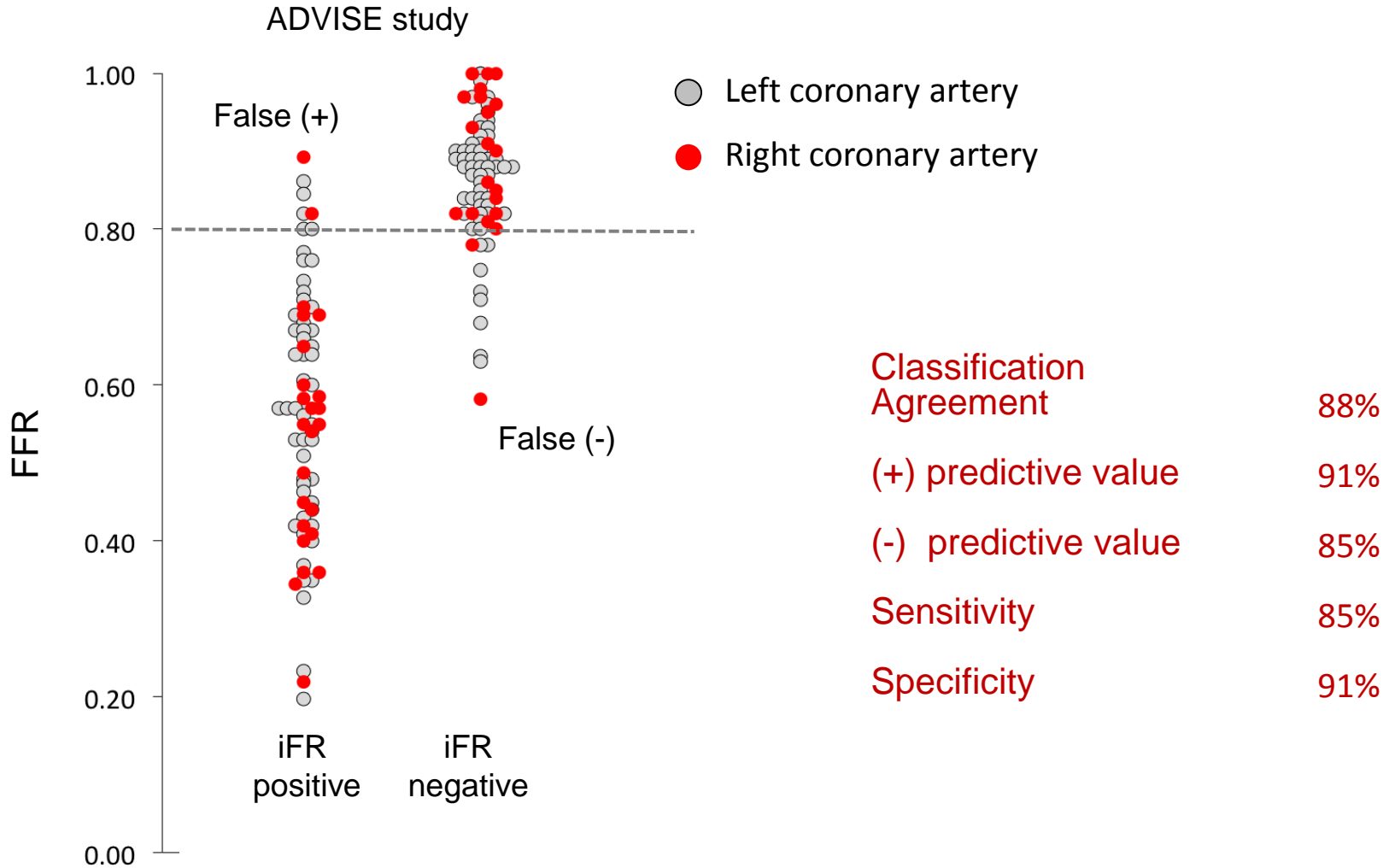
iFR = instantaneous wave-free ratio

Definition:

Instantaneous pressure ratio, across a stenosis during the wave-free period, when resistance is naturally constant and minimised in the cardiac cycle



iFR closely correlated to FFR in some studies



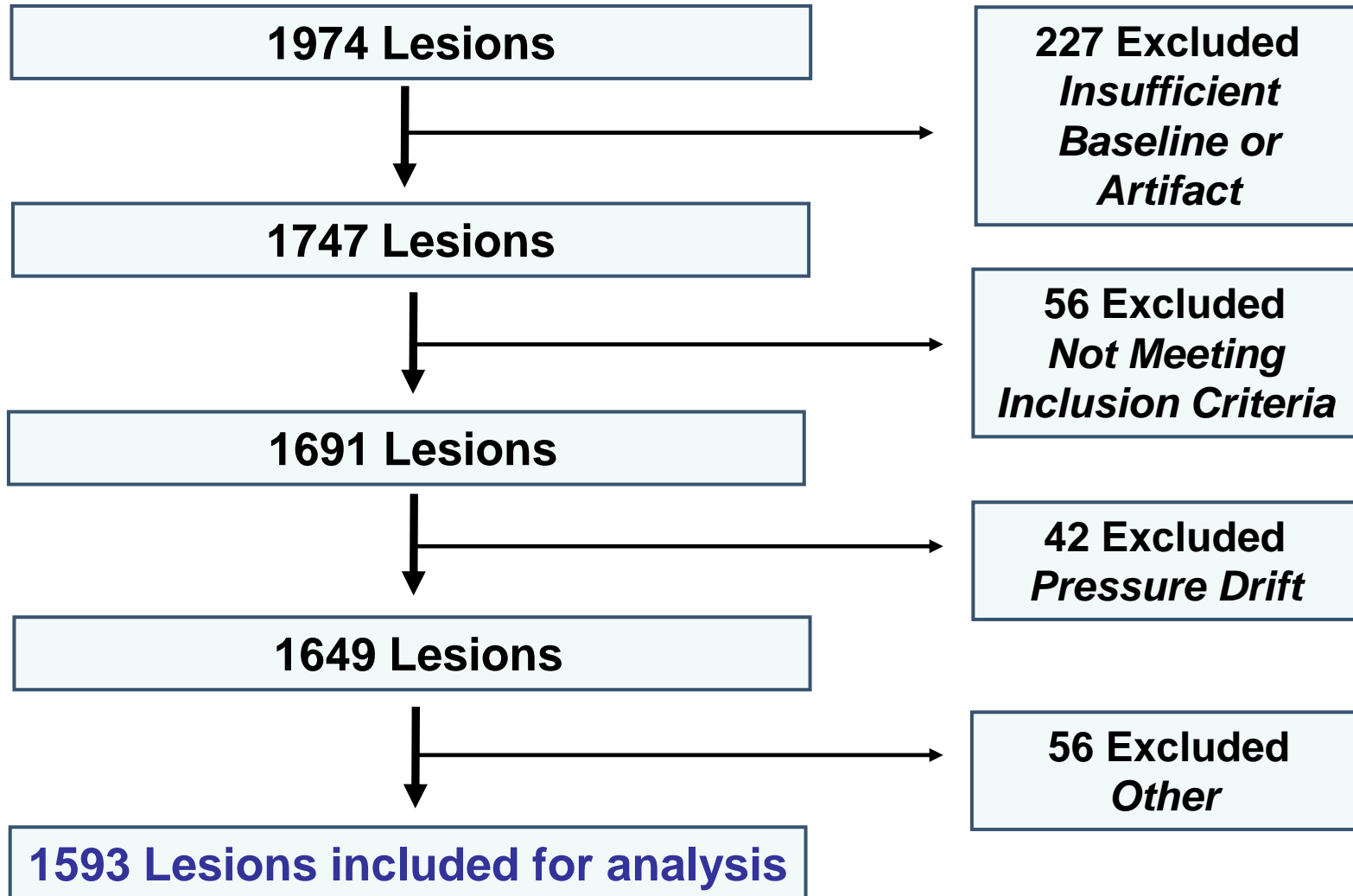
Sen et al. J Am Coll Cardiol. 2012

Petraco et al. Eurointervention. 2012

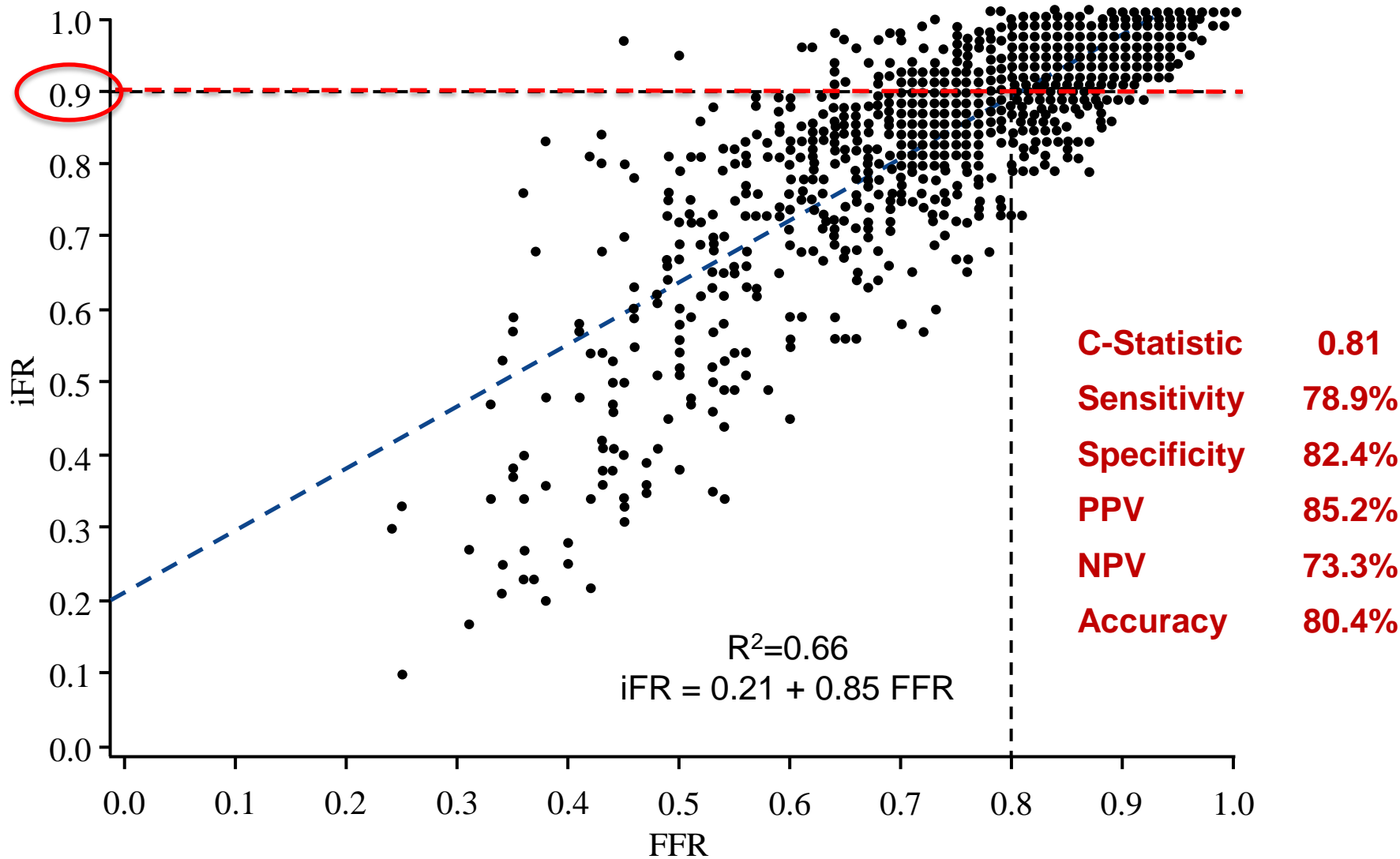
RESOLVE Study

- Given conflicting reports, we have formed a collaborative group of independent investigators to perform a large-scale analysis of the diagnostic agreement between iFR and FFR
- Core lab analysis by the Cardiovascular Research Foundation of all published iFR studies as well as consecutive cases from select sites
- Volcano supplied proprietary iFR algorithm to CRF core laboratory

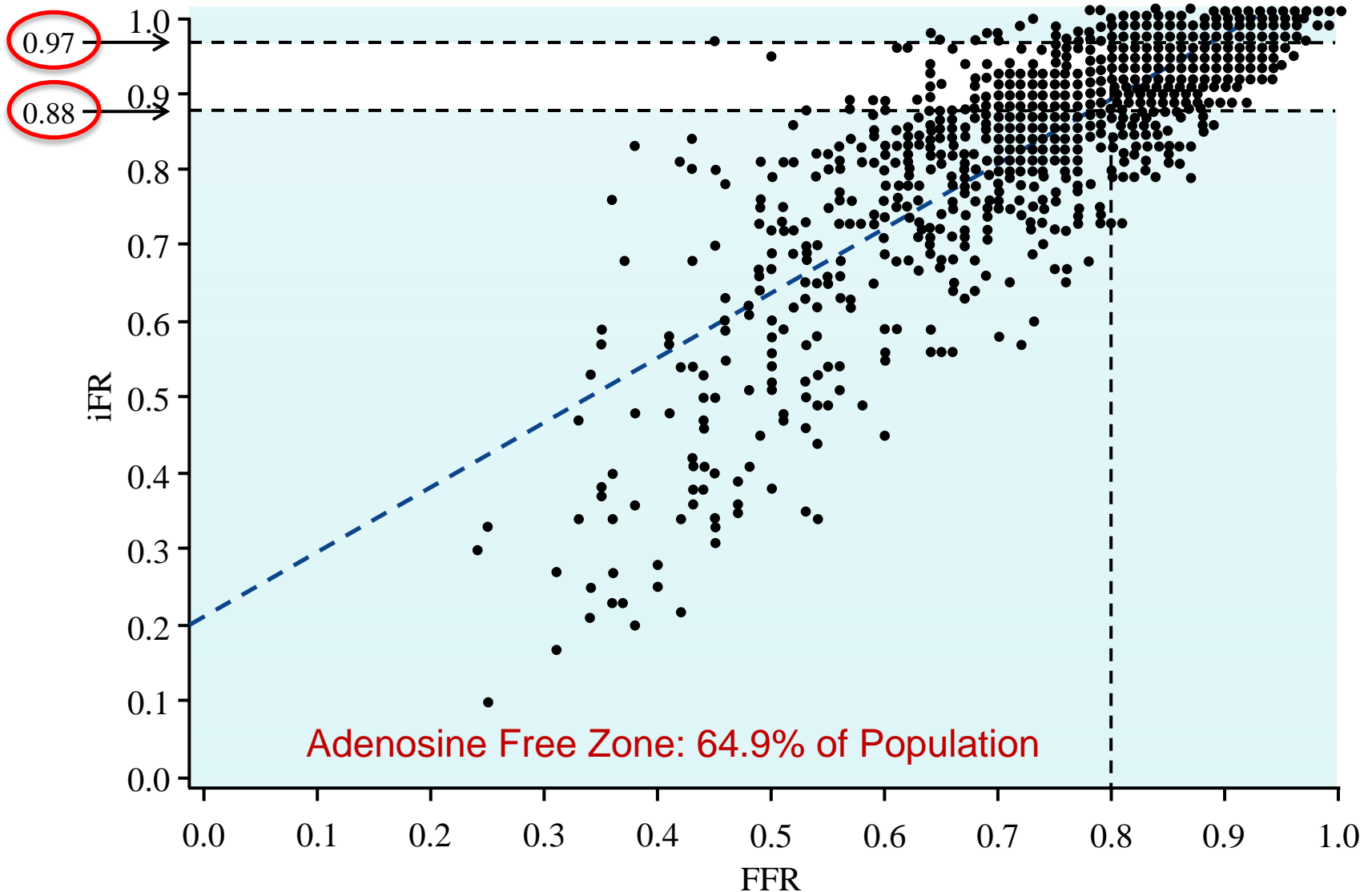
Study Flow Chart



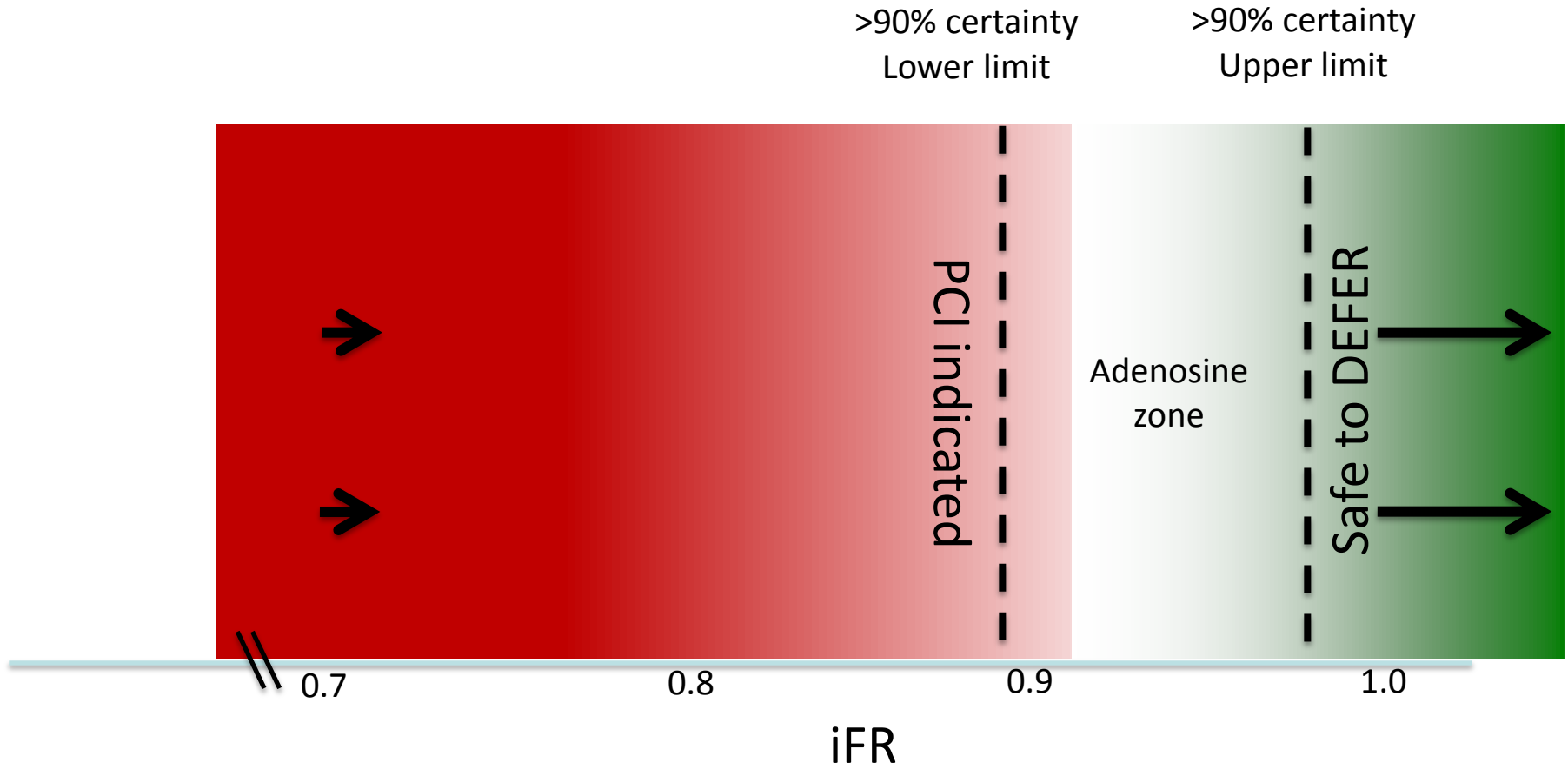
Correlation iFR vs. FFR



≥90% Diagnostic Accuracy for iFR vs. FFR

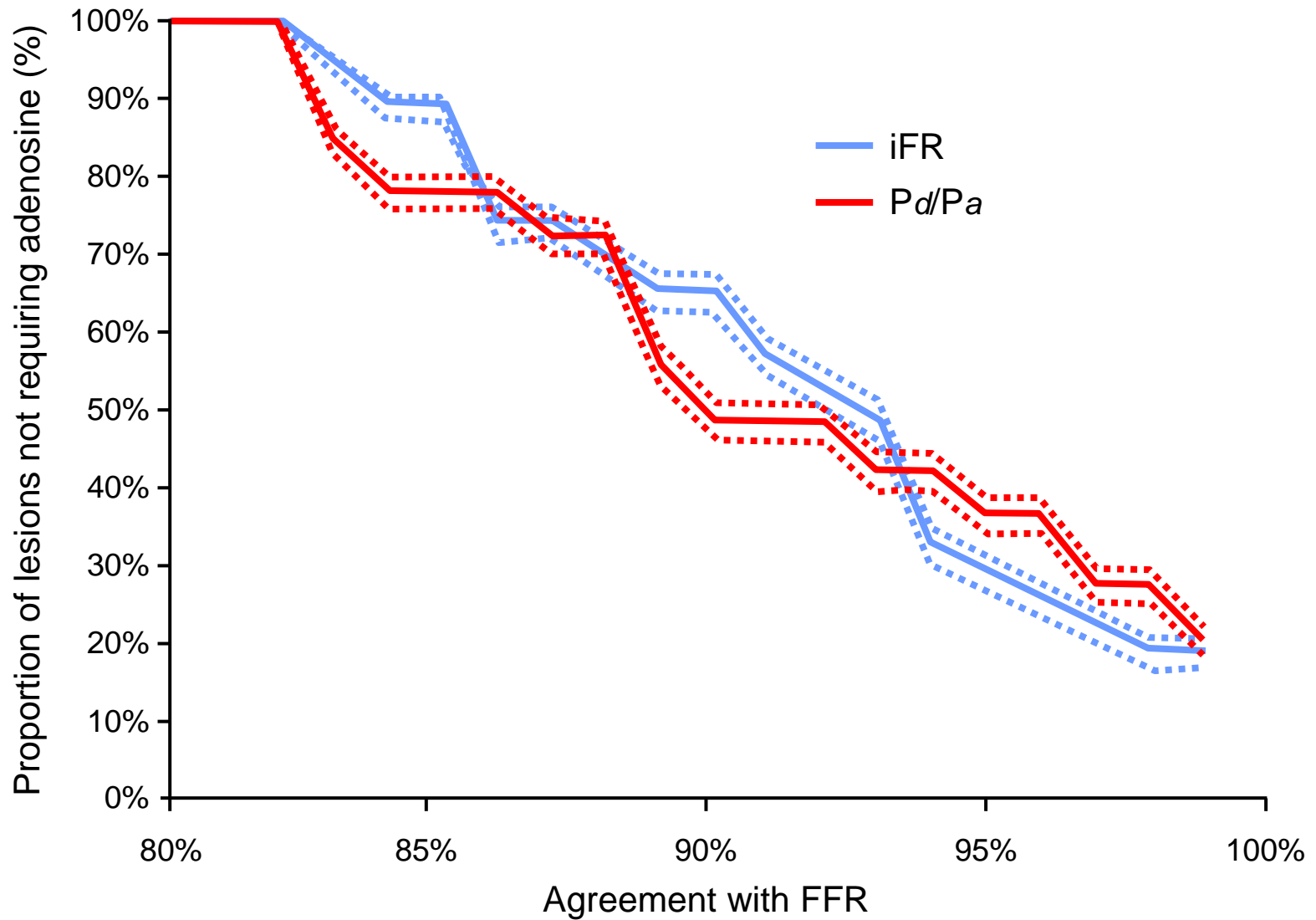


Hybrid iFR-FFR Approach

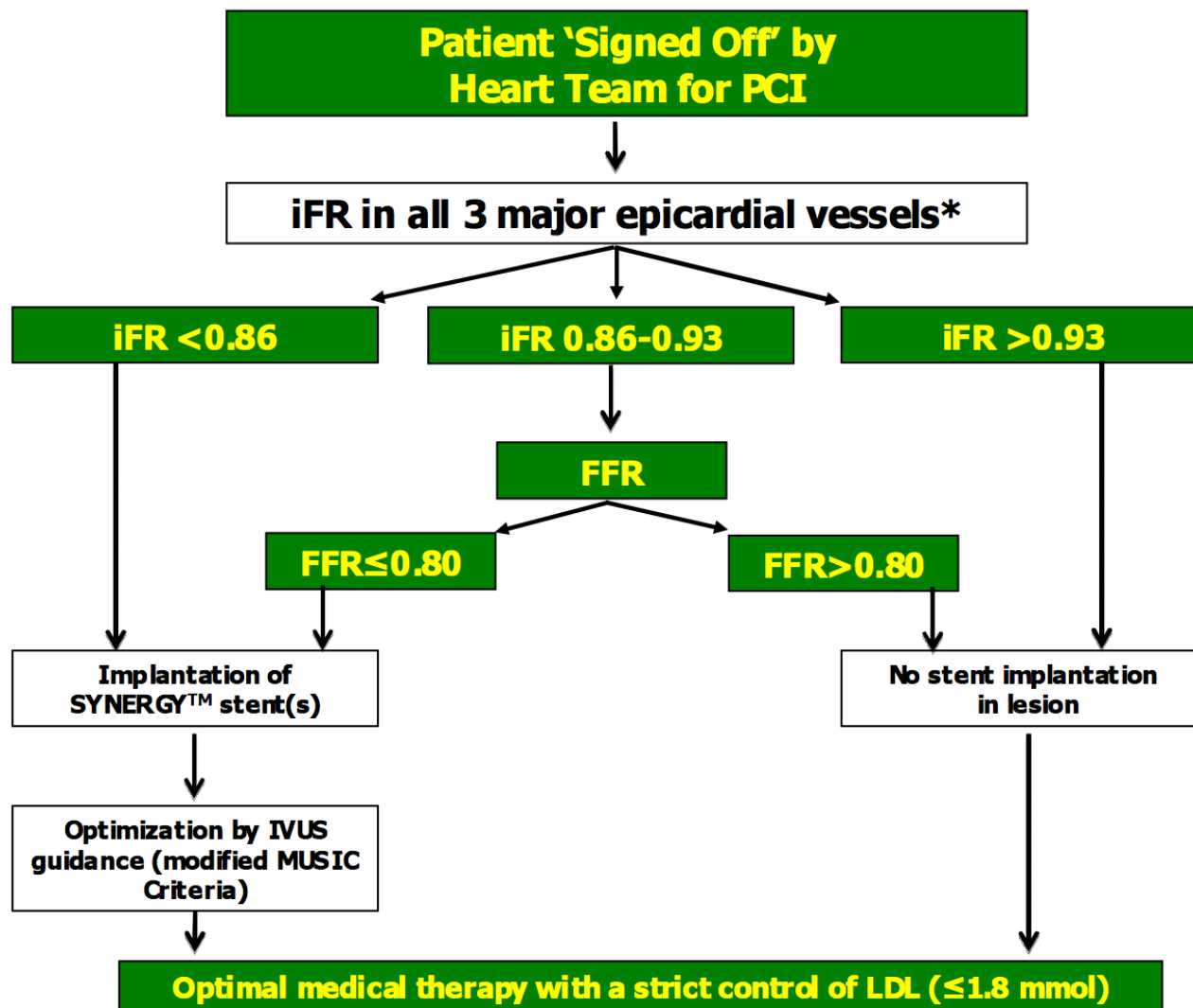


Petraco R et al., EuroIntervention 2013
Jeremias A., et al., J Am Coll Cardiol 2014

Adenosine Free Zone



iFR Clinical Implementation – SYNTAX II Trial



**FFR with adenosine, iFR/FFR in side branches, all at discretion of the operator*

Conclusions

- Despite reasonable statistical correlation with FFR, iFR and Pd/Pa accuracy is only ~80% which is insufficient for clinical decision making
- A hybrid iFR/FFR approach can increase the accuracy to $\geq 90\%$, sparing adenosine use in ~60% of the population
- Outcome studies like SYNTAX II will show if this is a clinically feasible approach
- However, given limitations of adenosine in clinical practice, iFR may prove equivalent/superior to FFR – 2 randomized trials ongoing comparing iFR and FFR directly