FACULTY OF HEALTH SCIENCES
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Diagnostic performance of non-invasive fractional flow reserve derived from coronary CT angiography in suspected coronary artery disease: The NXT trial

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For the NXT Investigators

Disclosures

- Study funding provided by HeartFlow which had no involvement in the data analysis, abstract planning or preparation
- No study investigator had any financial interest related to the study sponsor

Background

- **Coronary CT Angiography:**
  - High diagnostic accuracy for anatomic stenosis detection
  - Cannot determine physiologic significance of lesions[1]

[1]Min et al. J Am Coll Cardiol 2010; 55: 957

Background

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- **Invasive Fractional Flow Reserve (FFR):**
  - Gold standard for diagnosis of lesion-specific ischemia[2]
  - Improves event-free survival and cost effectiveness[3,4]

[1]Min et al. J Am Coll Cardiol 2010; 55: 957; [2]Piljs et al. Cath Cardiovasc Interv 2000;49:1; [3]Tonino et al. N Engl J Med 2009;360:213; [4]Berger et al. J Am Coll Cardiol 2005;46:438

Background

- **Coronary CT Angiography:**
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- **Invasive Fractional Flow Reserve (FFR):**
  - Gold standard for diagnosis of lesion-specific ischemia[2]
  - Improves event-free survival and cost effectiveness[3,4]
- **FFR computed from standard acquired coronary CT angiography images (FFR_{CT})** [5,6]

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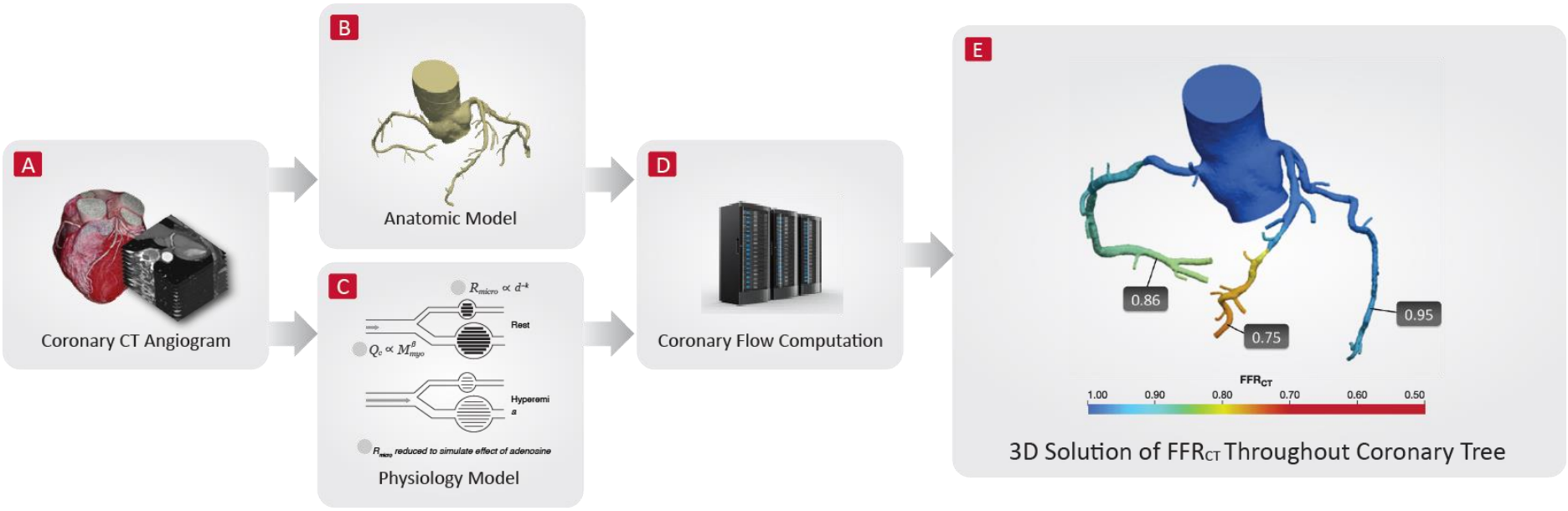
FFR_{CT} Technology



Patient-Specific Coronary Flow and Pressure:

- Using a standard CT dataset a quantitative model is built
- A physiological model is developed using LV and coronary anatomy and established form-function principles
- A fluid model calculates flow and pressure under simulated hyperemic conditions

Taylor et al, JACC 2013; 61: 2233-41

Study Objectives

- To determine the diagnostic performance of non-invasive FFR_{CT} using invasive FFR as the reference standard

- To compare the diagnostic performance of FFR_{CT} vs. anatomic testing (coronary CTA or invasive coronary angiography)

Incorporates learnings from previous FFR_{CT} trials:

- Newest generation of FFR_{CT} analysis software
- CT acquisition according to societal guidelines[1]

[1]Abbara S et al. J Cardiovasc Comput Tomography 2009;3:190;

Study Endpoints

Primary Endpoint:

- Per-patient diagnostic performance as assessed by the area under the receiver operating characteristic curve (AUC) of FFR_{CT} vs. coronary CTA for the diagnosis of ischemia.
  (Reference standard: FFR ≤ 0.80)

Secondary Endpoints:

- Diagnostic performance (accuracy, sensitivity, specificity, PPV and NPV) of FFR_{CT}, coronary CTA, and invasive coronary angiography

Subject Inclusion / Exclusion Criteria

Inclusion Criteria:

- Underwent ≥64-row CT and ICA scheduled
- < 60 days between CT and ICA

Exclusion Criteria:

- Prior CABG or PCI
- Suspected ACS
- Recent MI within 30 days of CT
- Contraindication to nitrates, beta blockade or adenosine

ICA = Invasive coronary angiography; CABG = coronary artery bypass surgery; ACS = acute coronary syndrome; MI = myocardial infarction; PCI = percutaneous coronary intervention

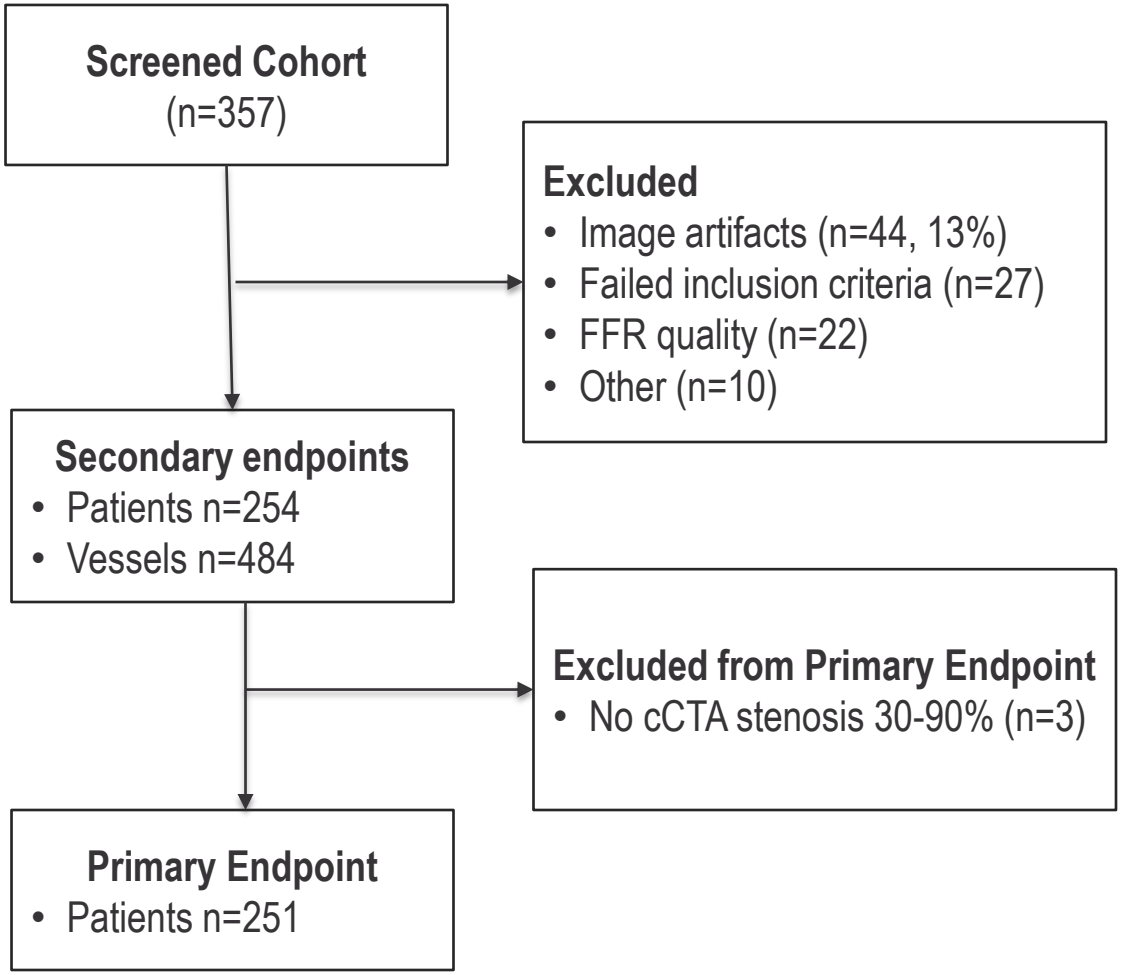
Study Procedures

- **Blinded core laboratories for FFR and FFR_{CT}**
- **CT:**
  - Acquisition protocols according to societal guidelines[1]
  - Image quality independently evaluated via predefined scoring system[2]
  - Positive: Site-read stenosis severity >50%[3]
- **ICA:**
  - Positive: Site-read stenosis severity >50%
- **FFR:**
  - At maximum hyperemia during ICA
  - Adenosine 140 – 180 mcg/kg/min IV
  - Positive: ≤ 0.80[4]

[1]Abbara S et al. J Cardiovasc Comput Tomography 2009;3:190; [2]Gaur S et al Cardiovasc Comput Tomogr 2013, in press; [3]Raff GL et al. J Cardiovasc Comp Tomogr 2009; 3: 122-36; [4]Tonino PA et al. N Engl J Med 2009; 360: 213-24;

Patient Enrollment

- Study enrollment 9/2012 – 8/2013
- 10 sites in Europe, Asia, and Australia



Study Population

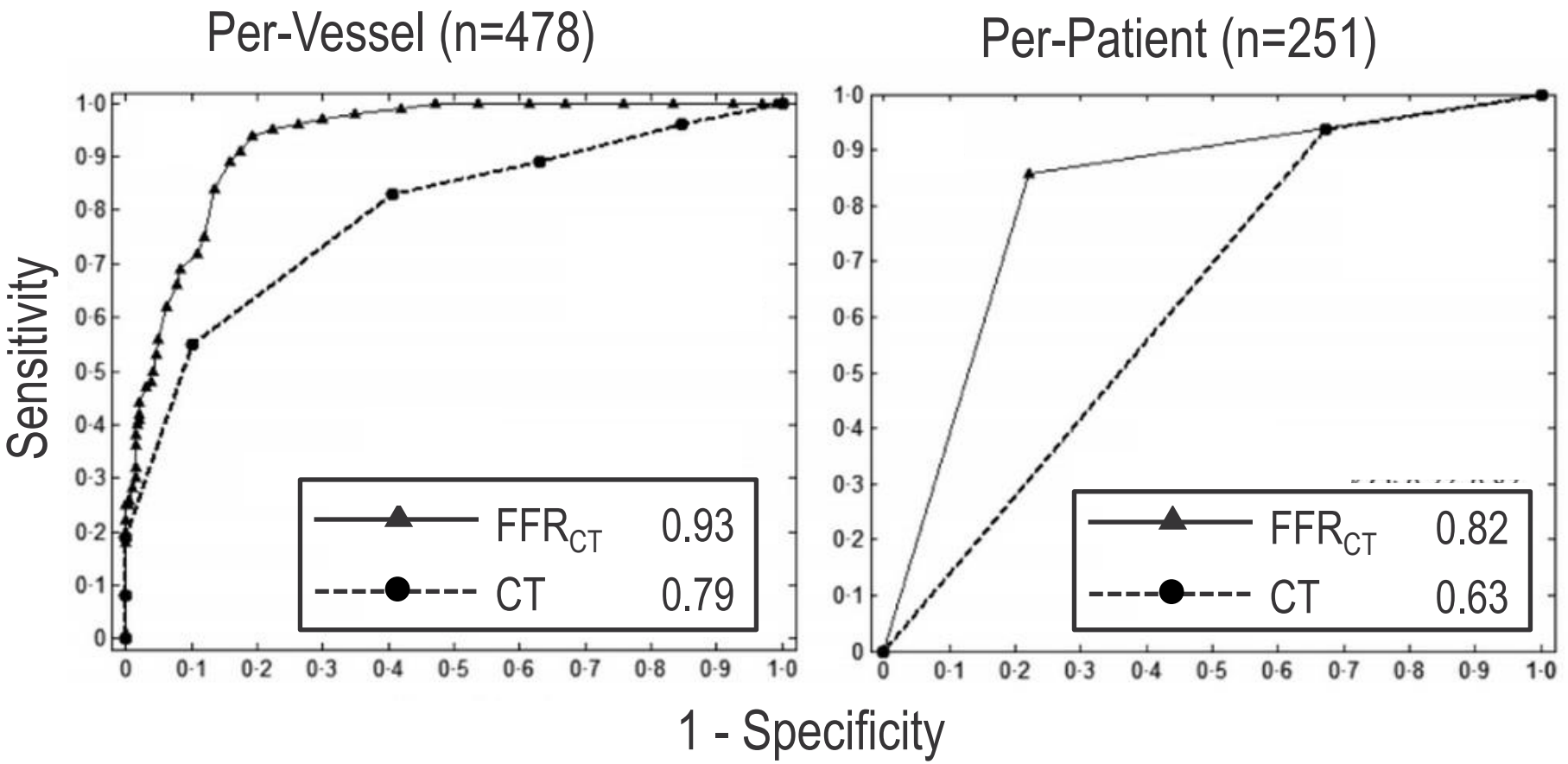
Patient Characteristics	
Age (years) [mean ± SD]	64 ± 10
Male gender	64%
Prior MI	2%
Diabetes mellitus	23%
Hypertension	69%
Pre-test Likelihood of CAD	58%
FFR≤0.80	32%

CT Characteristics

– Nitrates	99.6%
– Beta Blockers	78%
– Heart Rate (bpm)	63
Range	37-110
– Prospective	54%
mean dose (mSv)	3
– Retrospective	46%
mean dose (mSv)	14
– Calcium score*	
Mean	302
>400	26%

*Available for 214 patients

Discrimination of Ischemia*

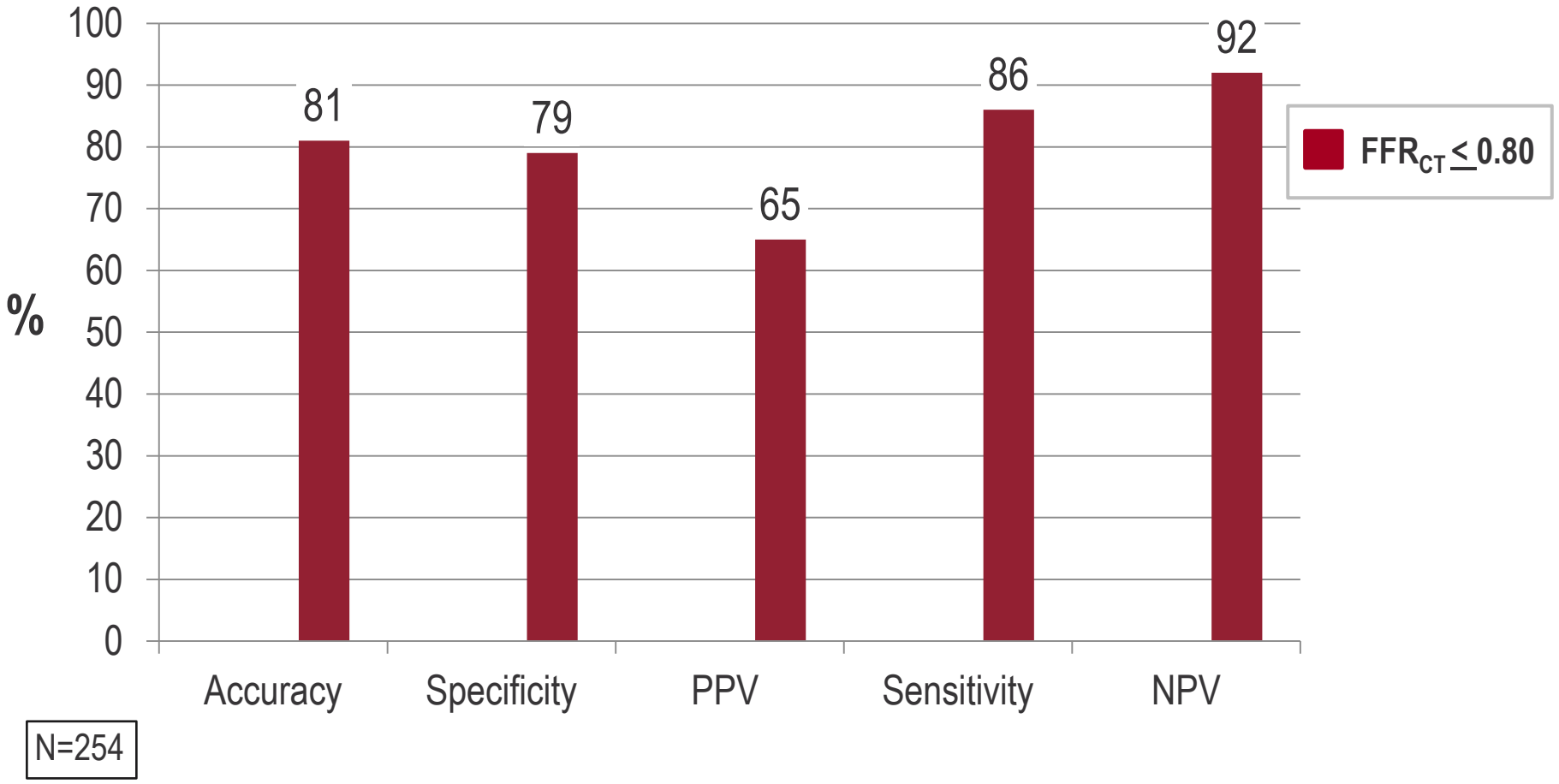


Greater discriminatory power for FFR$_{CT}$ versus CT stenosis

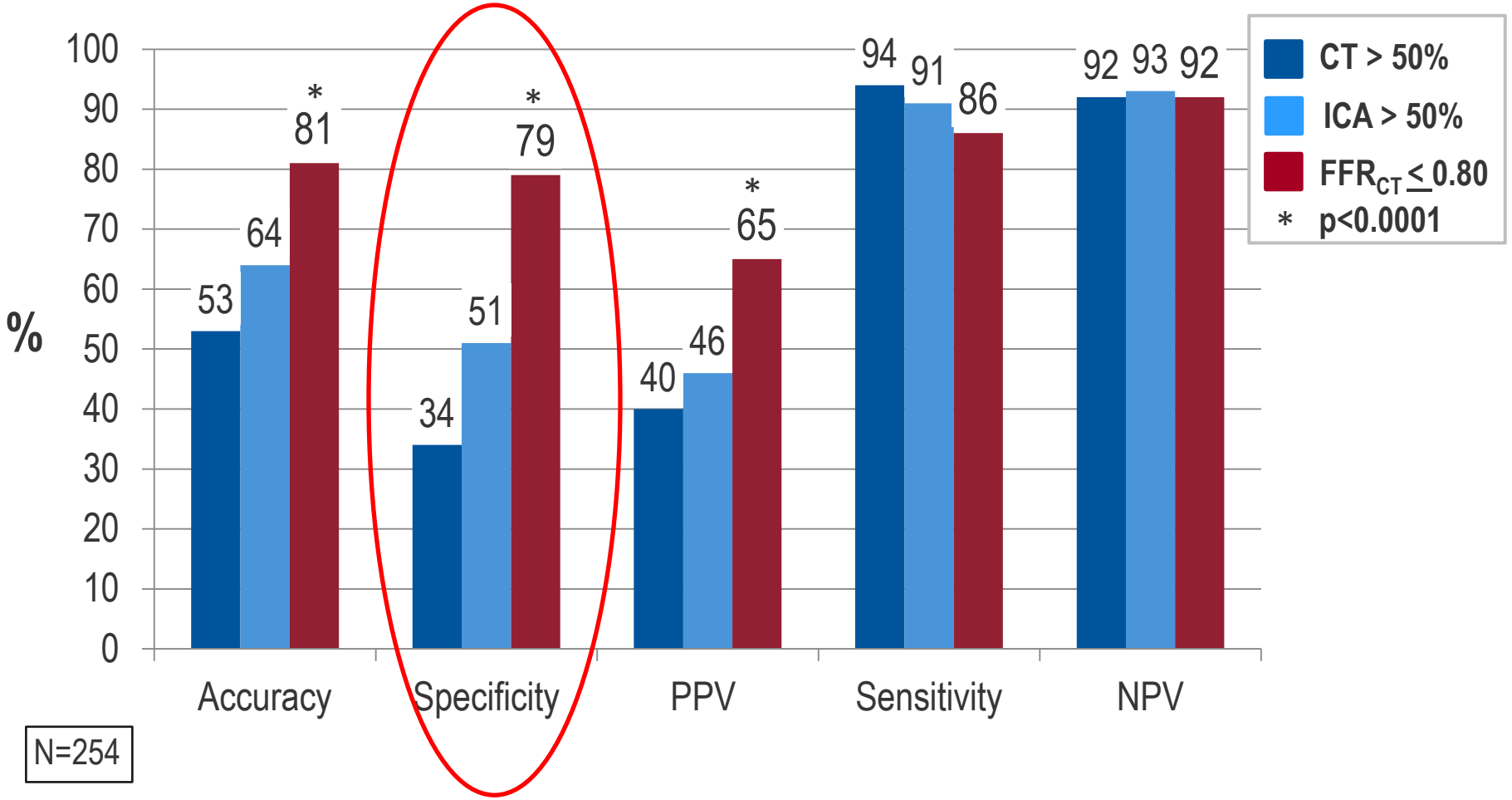
Vessel (Δ 0.14, p<0.001) Patient (Δ 0.19, p<0.001)

*Area under the receiver operating characteristics curve

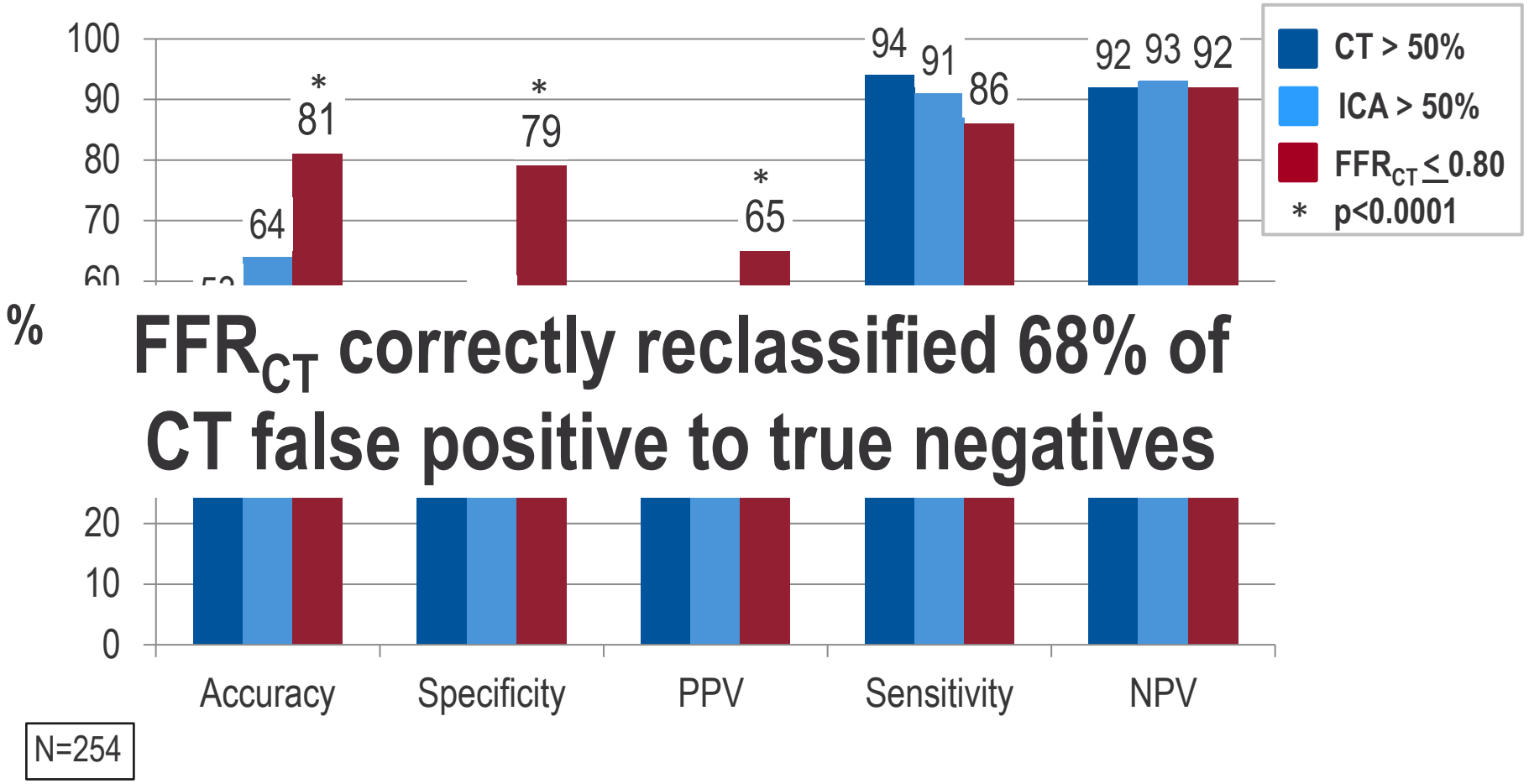
Per-Patient Diagnostic Performance



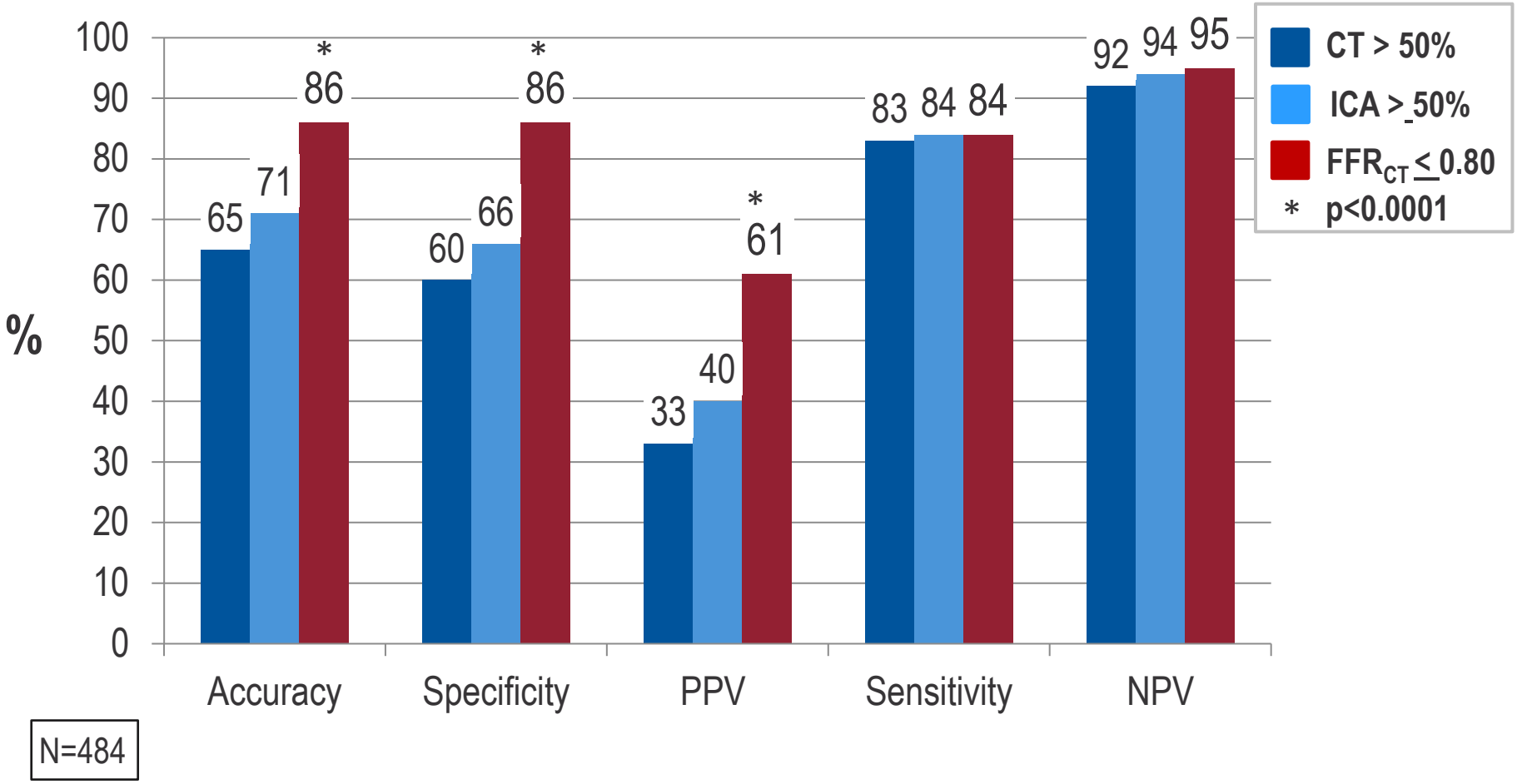
Per-Patient Diagnostic Performance



Per-Patient Diagnostic Performance

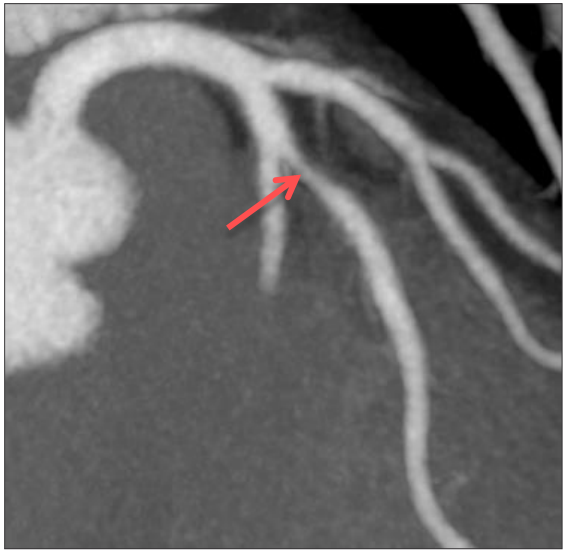


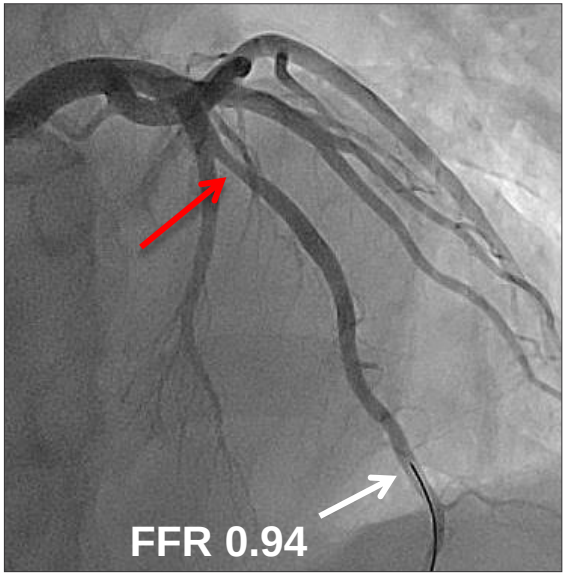
Per-Vessel Diagnostic Performance

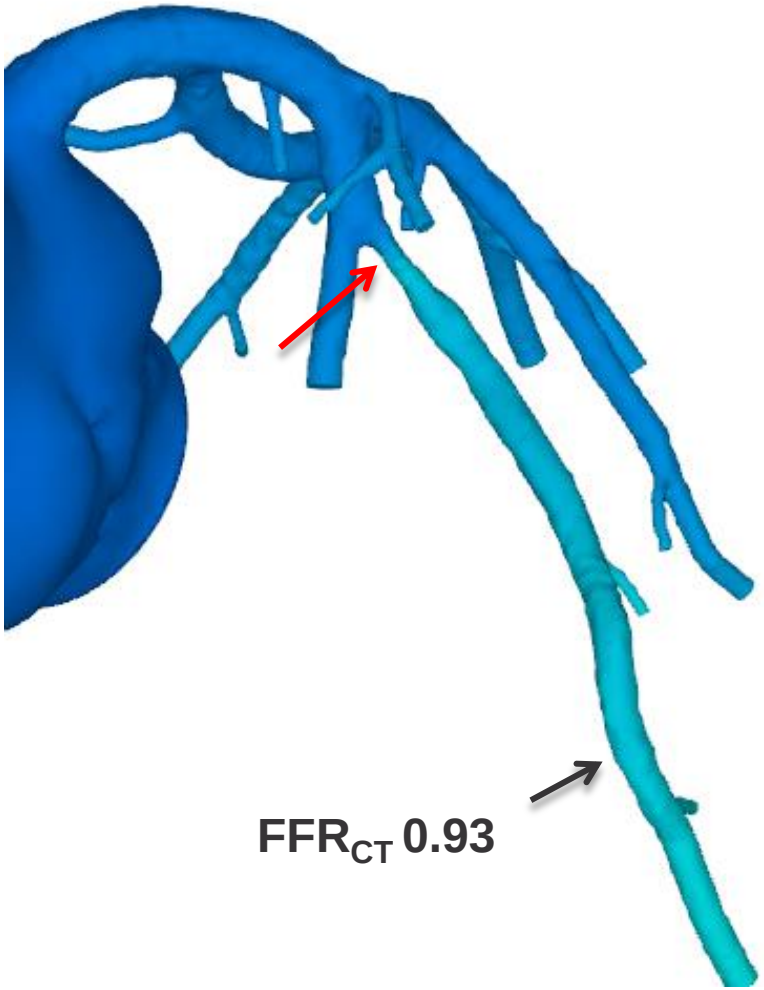


Case Example

LAD stenosis 70-90%





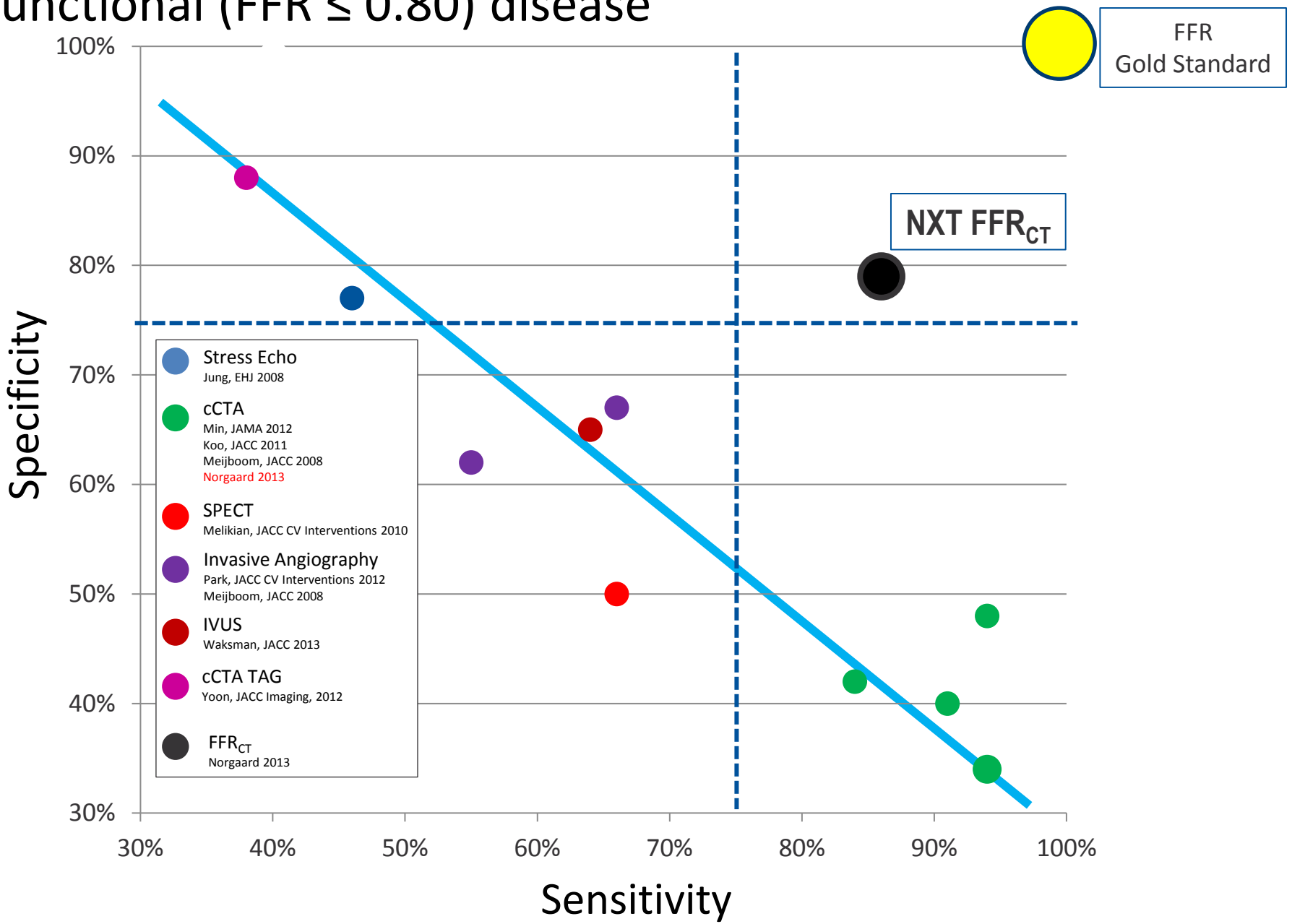


FFR$_{CT}$ Model

Conclusions

- FFR_{CT} met its primary endpoint in this trial and demonstrated high diagnostic accuracy for detection of ischemia
- When compared to anatomic interpretation by coronary CTA or invasive angiography, FFR_{CT} led to a marked increase in diagnostic accuracy, specificity, and PPV
- FFR_{CT} is performed from standard acquired CT datasets without the need for additional imaging, radiation or medication

Diagnostic performance of Coronary diagnostic tests for Functional (FFR ≤ 0.80) disease



Thank you.