

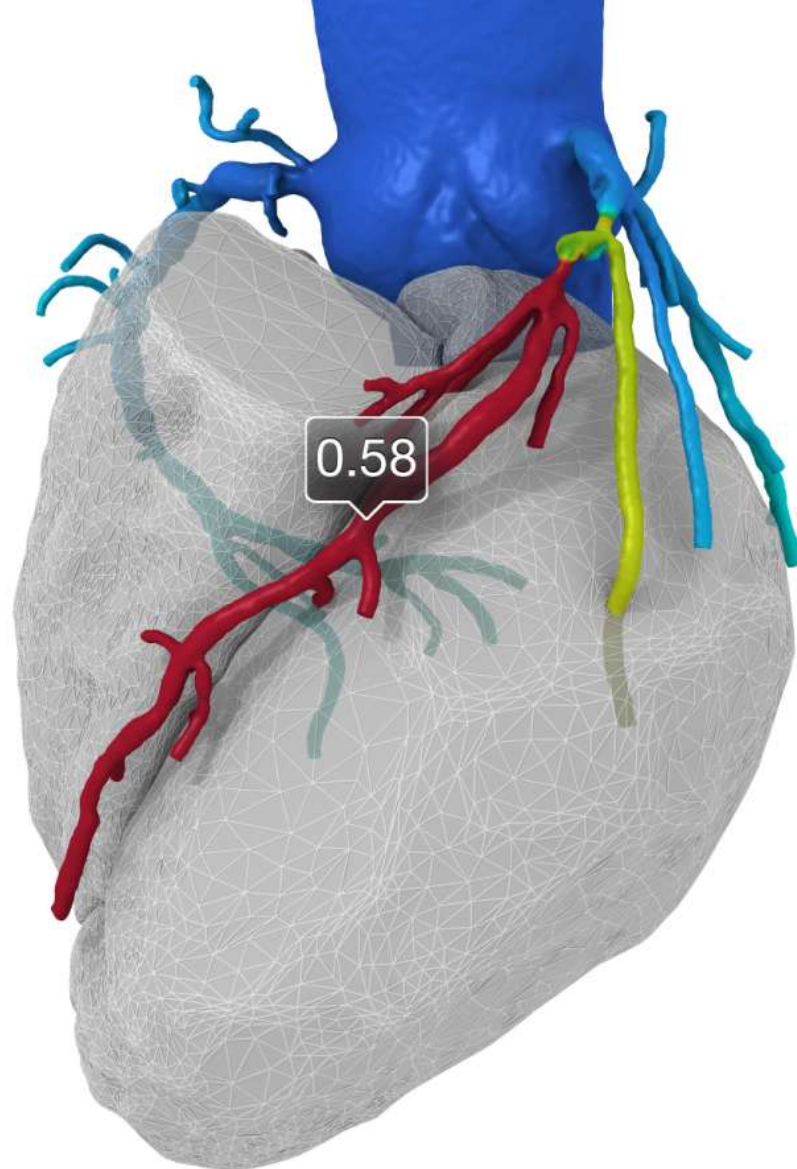


# FFR<sub>CT</sub> in Progress: Future Perspectives

**Charles A. Taylor, Ph.D.**

Founder and Chief Technology Officer  
HeartFlow, Inc.

Consulting Professor of Bioengineering  
Stanford University



# Potential conflicts of interest

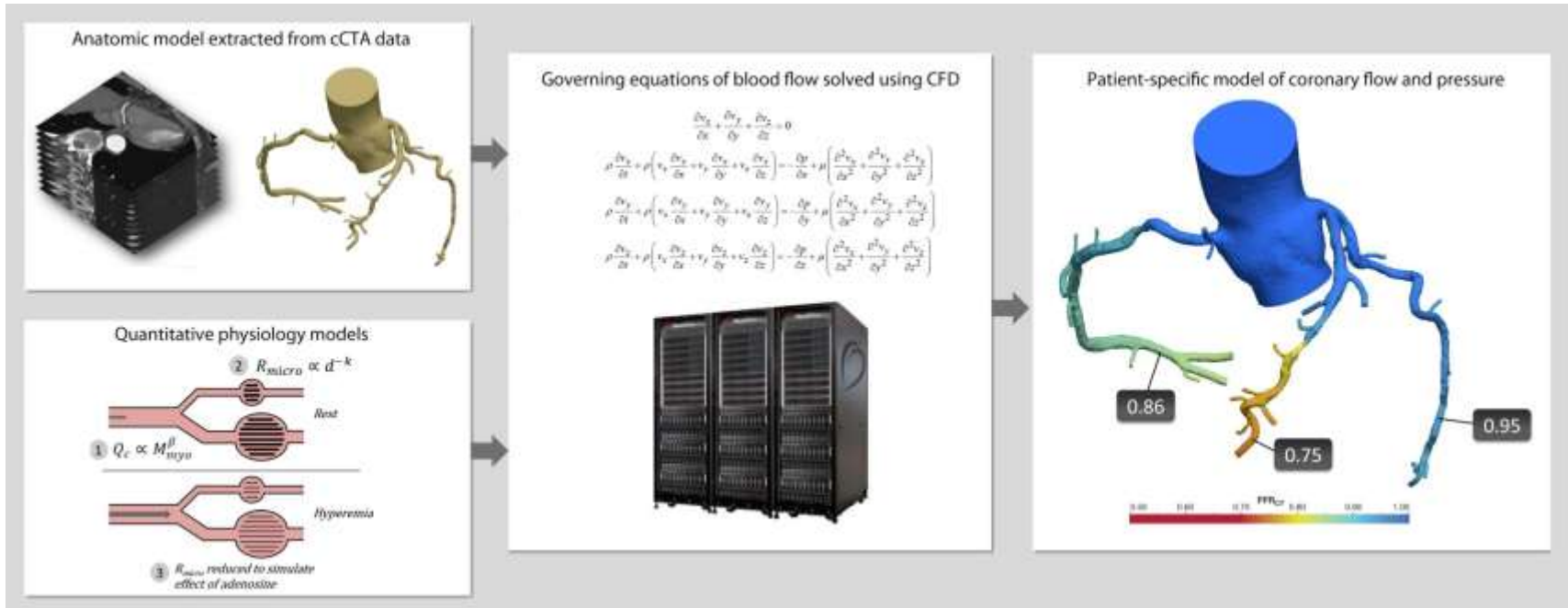
**Charles A. Taylor, Ph.D.**

**I have the following** potential conflicts of interest to report:

- Employment in industry
- Stockholder of a healthcare company

# FFR<sub>CT</sub> - Noninvasive Functional Assessment of CAD

*Unique patient-specific modeling technology based on over 20 years of research*



*Clinically validated in over 600 patients*

DISCOVER-FLOW - 2011

DeFACTO - 2012

NXT – 2013/2014



# HeartFlow Clinical Trial Data

- **DISCOVER-FLOW**

- P.I. Bon Kwon Koo, M.D., Ph.D.
- Completed 2011
- N=104 patients

- **DeFACTO**

- P.I. James Min, M.D.
- Completed 2012
- N=252 patients

- **NXT**

- P.I. Bjarne Norgaard, M.D., Ph.D.
- Completed 2013
- N=254 patients
- 10 Worldwide Sites
  - EU
  - Japan
  - Korea
  - Australia



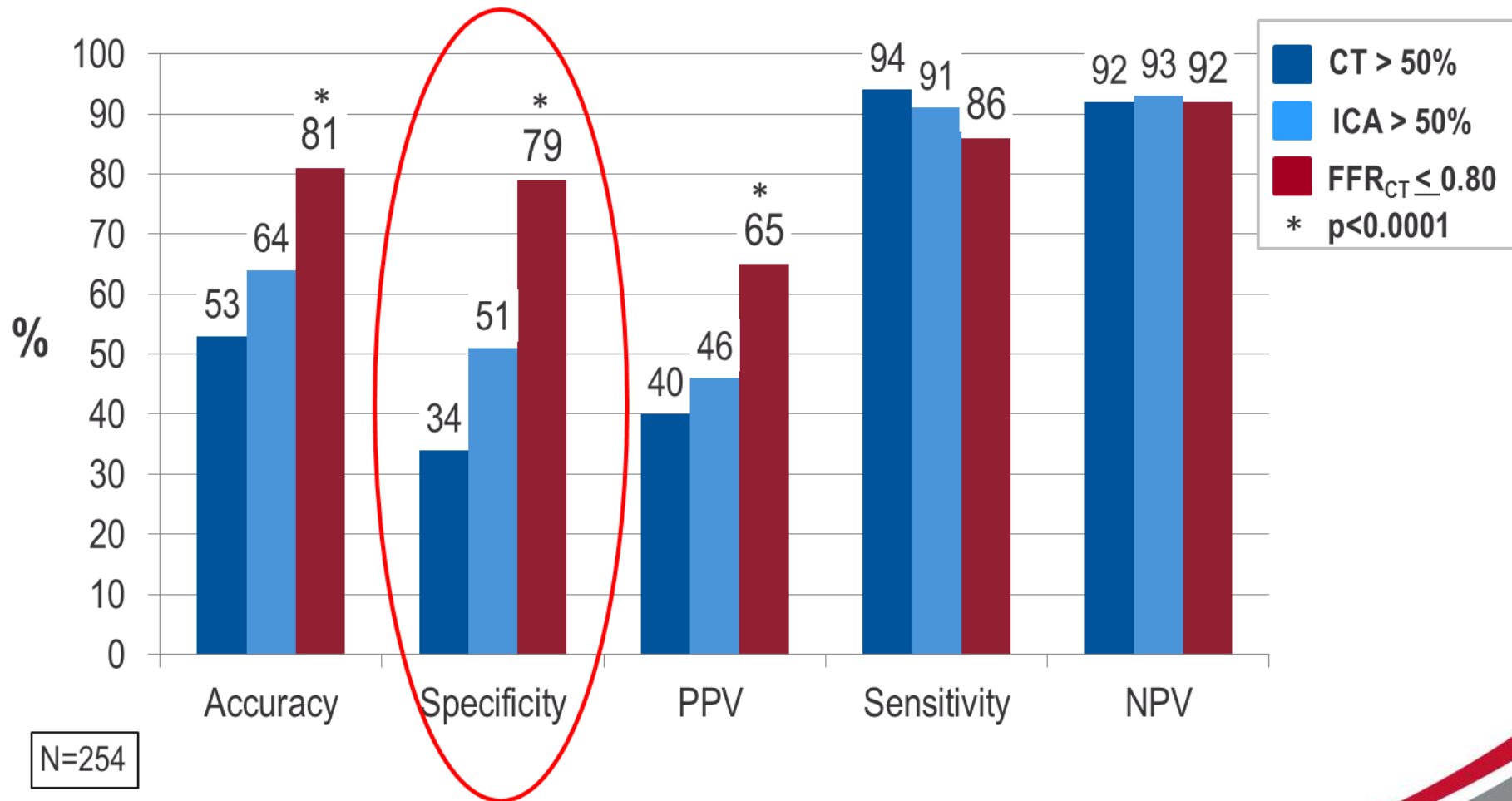
ONLINE FIRST

## Diagnostic Accuracy of Fractional Flow Reserve From Anatomic CT Angiography

JAMA. 2012;308(12):doi:10.1001/2012.jama.11274



# Per-Patient Diagnostic Performance





# FFR<sub>CT</sub> reclassification

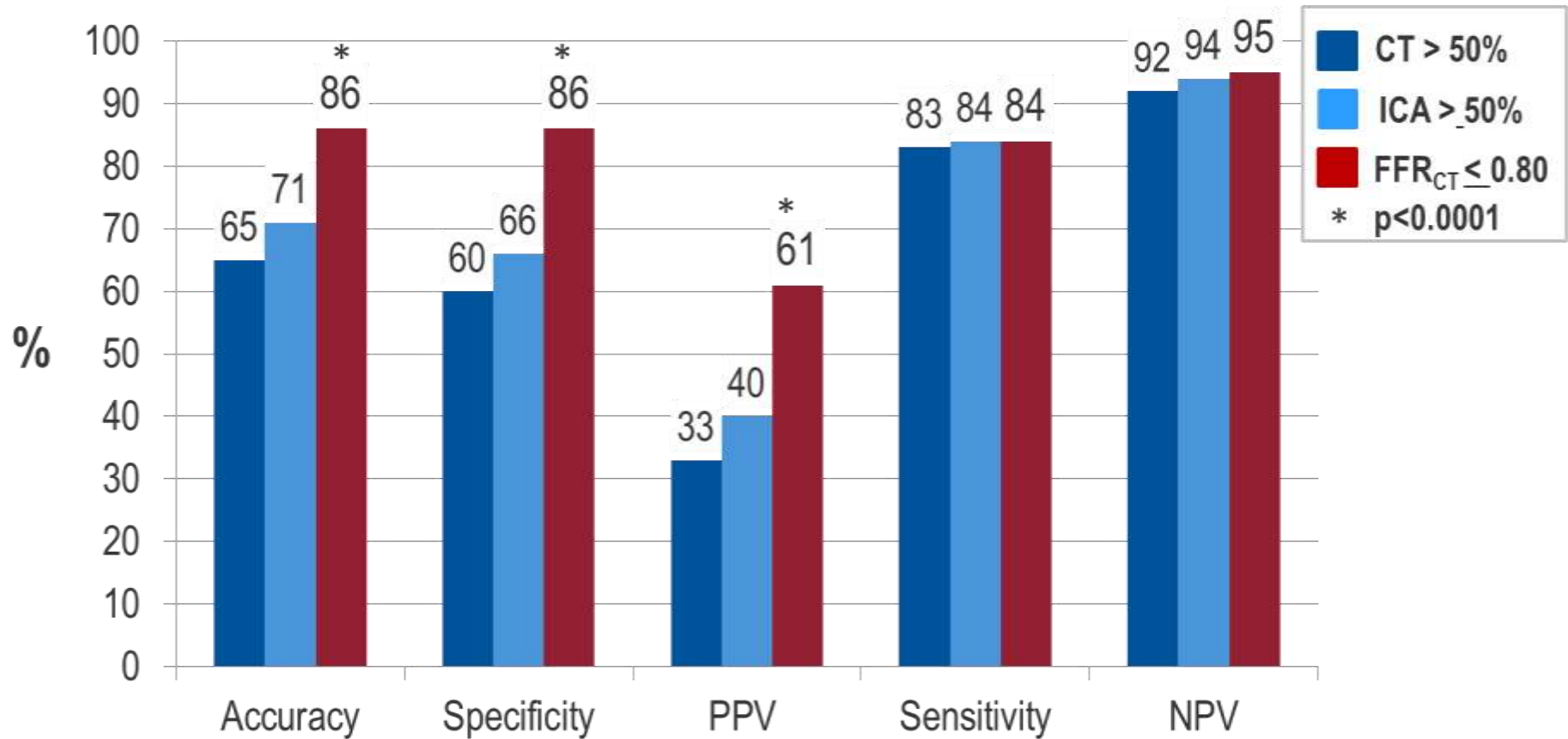
Per-patient

		Coronary CTA stenosis	
		≥50%	<50%
FFR	≤0.80	75 (30%)	5 (2%)
	>0.80	115 (45%)	59 (23%)

		FFR <sub>CT</sub>	
		≤0.80	>0.80
FFR	≤0.80	69 (27%)	11 (4%)
	>0.80	37 (15%)	137 (54%)

- FFR<sub>CT</sub> reclassified **68%** of CT **false positives** as **true negatives**
- If FFR<sub>CT</sub> were used prospectively, 148 of 254 patients could have been deferred from diagnostic cath

# Per-Vessel Diagnostic Performance



N=484

# FFR<sub>CT</sub>: Building the Body of Evidence

PLATFORM

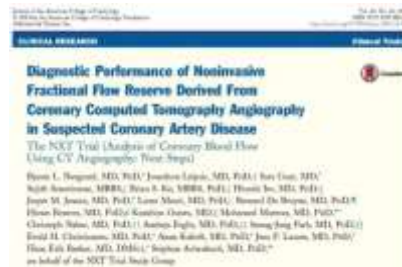
PROMISE, ACRIN PA, ...

Randomized Control Trial  
(planning underway)

DISCOVER-FLOW

HFNXT

DeFACTO



30-90%  
Stenosis  
Dx Accuracy

Stable  
Angina  
Outcomes and  
resources

ACS  
(- enzyme)  
Outcomes and  
resources

Cath lab  
Population  
Dx Accuracy

2012

2013

2014

2015

...



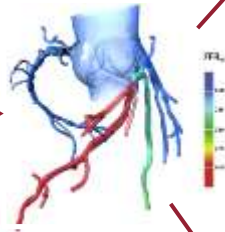
# FFR<sub>CT</sub> – Future Perspectives

← *Does my patient have CHD?* → ← *How do I treat it?* →

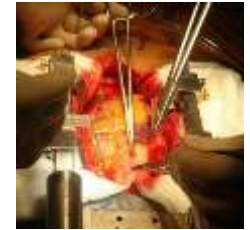
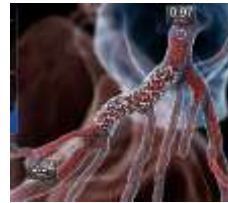
Cardiac CT  
Angiography



HeartFlow<sup>®</sup>  
FFR<sub>CT</sub>



HeartFlow<sup>®</sup>  
PCI Planner



HeartFlow<sup>®</sup>  
CABG Planner

HeartFlow<sup>®</sup>  
Medical Therapy  
Planner





# Virtual Stenting

JACC: CARDIOVASCULAR INTERVENTIONS  
 © 2013 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION  
 PUBLISHED BY ELSEVIER INC.

901 ■ 90 ■ 2013  
 ISSN 1556-0144/128.00  
<http://dx.doi.org/10.1016/j.jcin.2013.05.028>

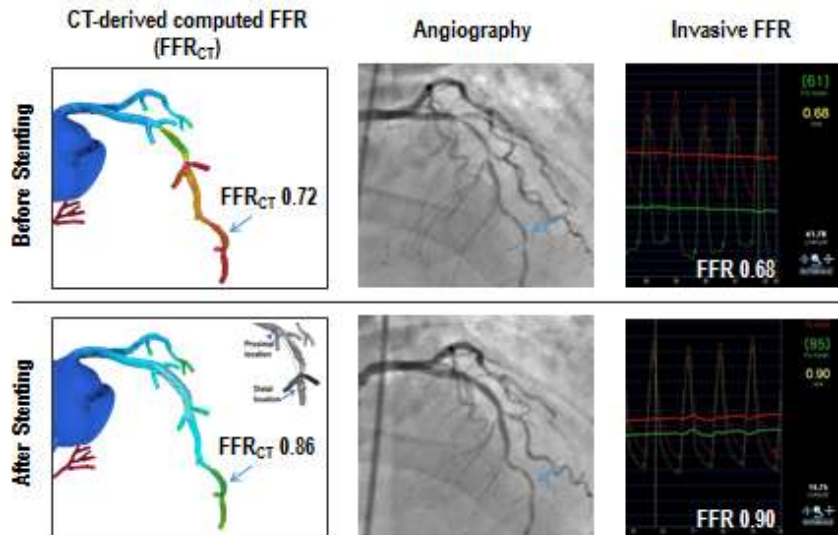
**CLINICAL RESEARCH**

**A Novel Noninvasive Technology for Treatment Planning Using Virtual Coronary Stenting and Computed Tomography-Derived Computed Fractional Flow Reserve**

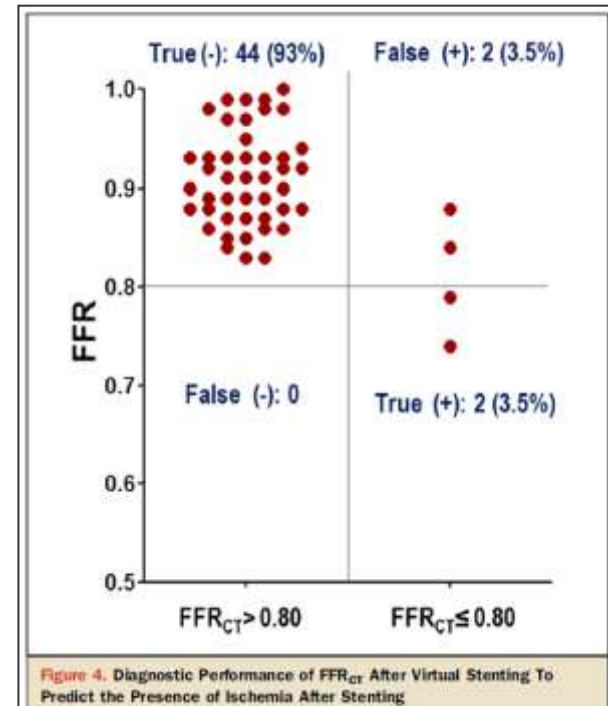
Kyung-Hee Kim, MD,<sup>1</sup> Joon-Hyung Doh, MD,<sup>1</sup> Bon-Kwon Koo, MD,<sup>1</sup> James K. Min, MD,<sup>1</sup> Andrejs Erglis, MD,<sup>1</sup> Han-Mo Yang, MD,<sup>1</sup> Kyung-Woo Park, MD,<sup>1</sup> Hae-Young Lee, MD,<sup>1</sup> Hyun-Jae Kang, MD,<sup>1</sup> Yong-Jin Kim, MD,<sup>1</sup> Sung Yun Lee, MD,<sup>1</sup> Hyo-Soo Kim, MD<sup>2</sup>

<sup>1</sup>Seoul, and <sup>2</sup>Gyeong, Republic of Korea; <sup>3</sup>Los Angeles, California; and <sup>4</sup>Riga, Latvia

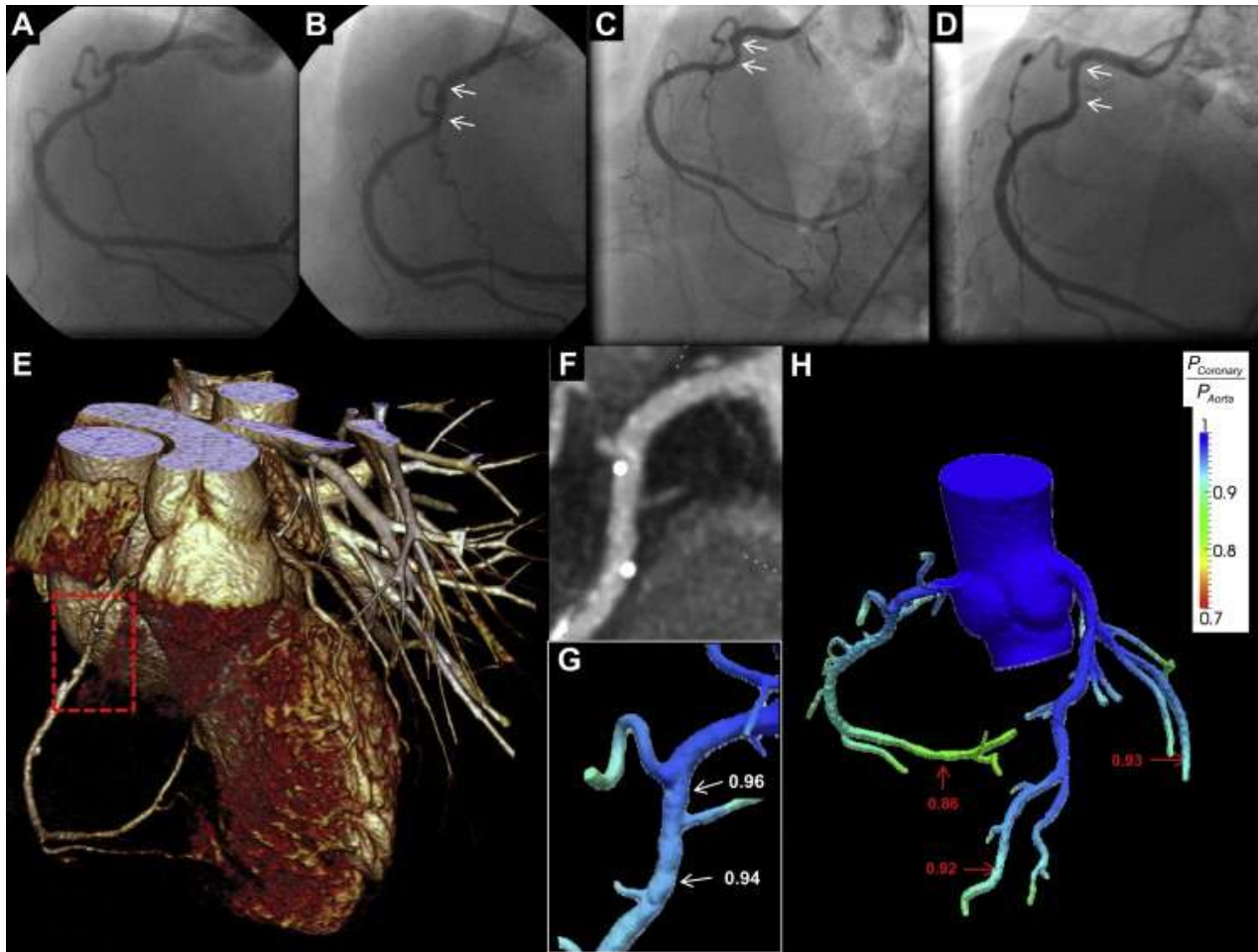
## Case example – Change in FFR<sub>CT</sub> with PCI



Source: Kim et al. JACC Interventions, 2013



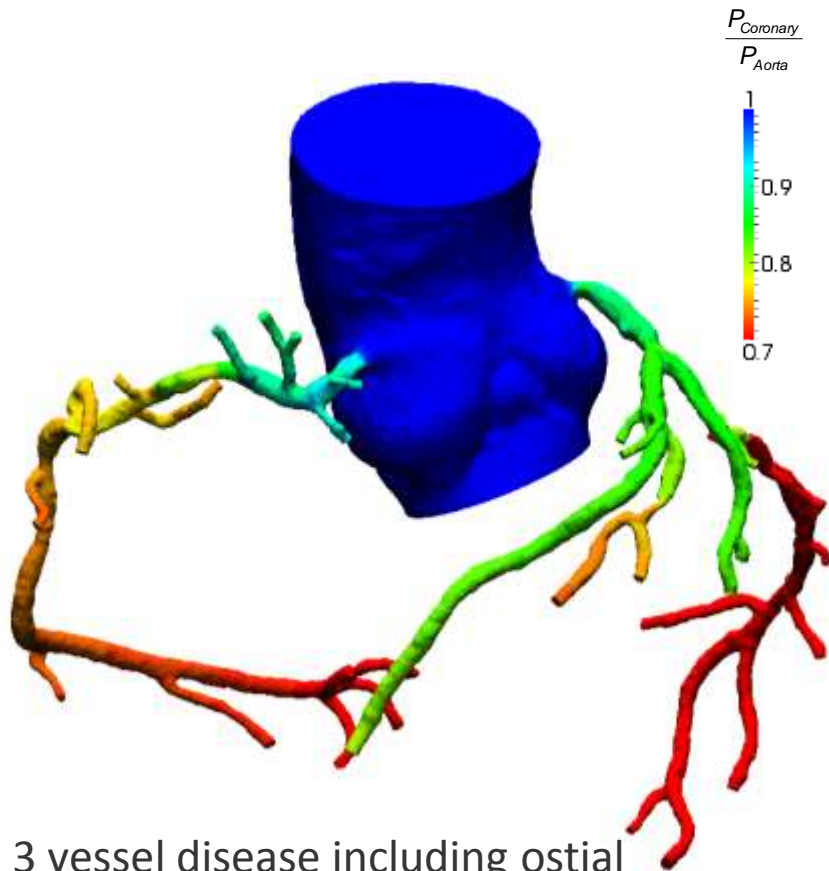
# Noninvasive Assessment of Bioabsorbable Scaffolds



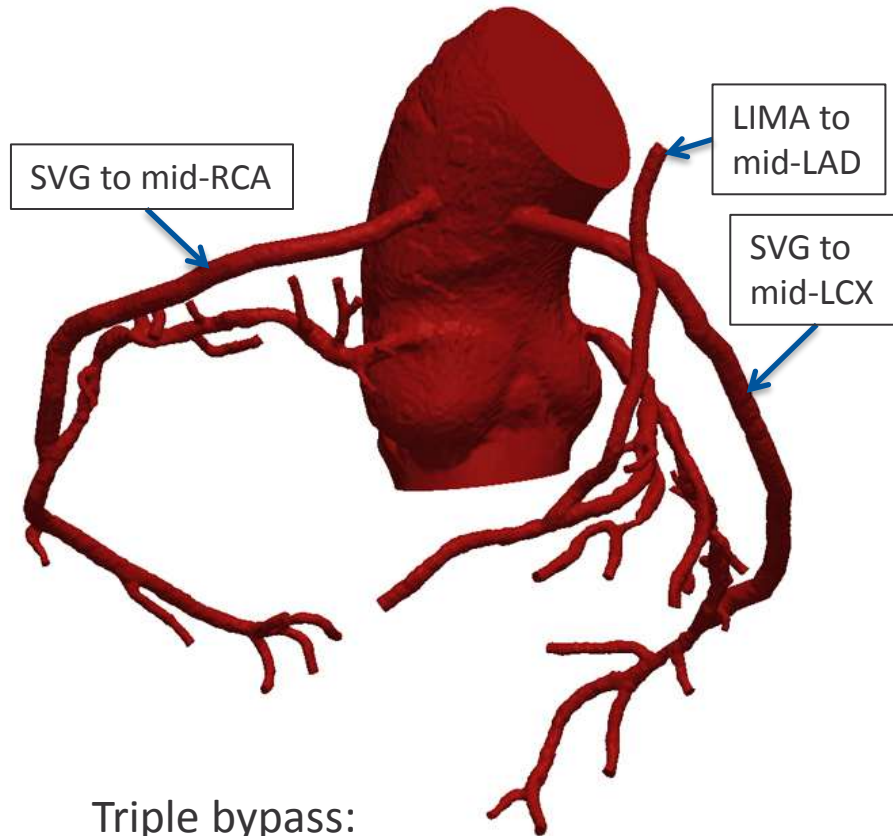
Onuma Y, Dudek D, Thuesen L, Webster M, Nieman K, Garcia-Garcia HM, Ormiston JA, Serruys PW. Five-year clinical and functional multislice computed tomography angiographic results after coronary implantation of the fully resorbable polymeric everolimus-eluting scaffold in patients with de novo coronary artery disease: the ABSORB cohort A trial. *JACC Cardiovasc Interv.* 2013 Oct;6(10):999-1009.



# Virtual CABG



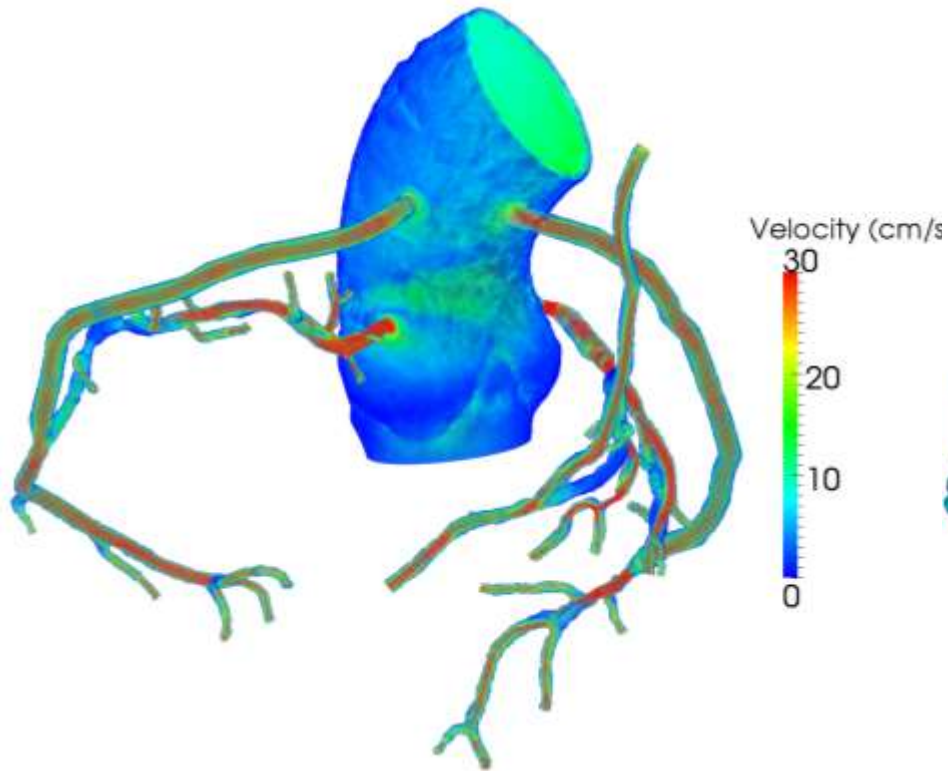
3 vessel disease including ostial lesions at origin of RCA and LM



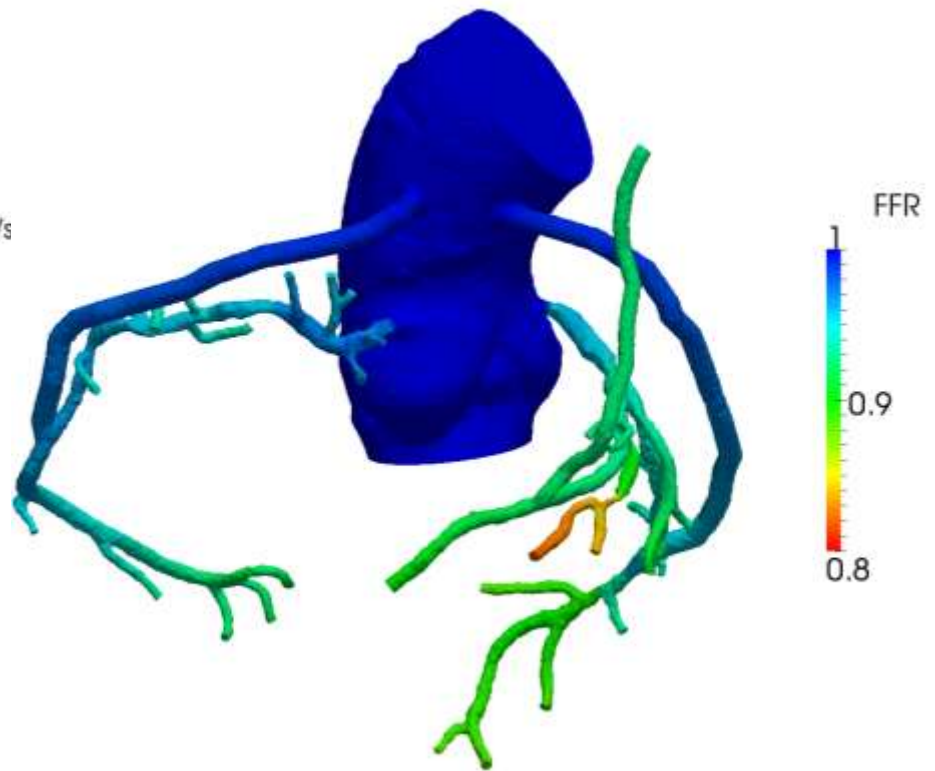
Triple bypass:

1. SVG to mid-RCA
2. SVG to mid-LCX
3. LIMA to mid LAD

# Virtual CABG



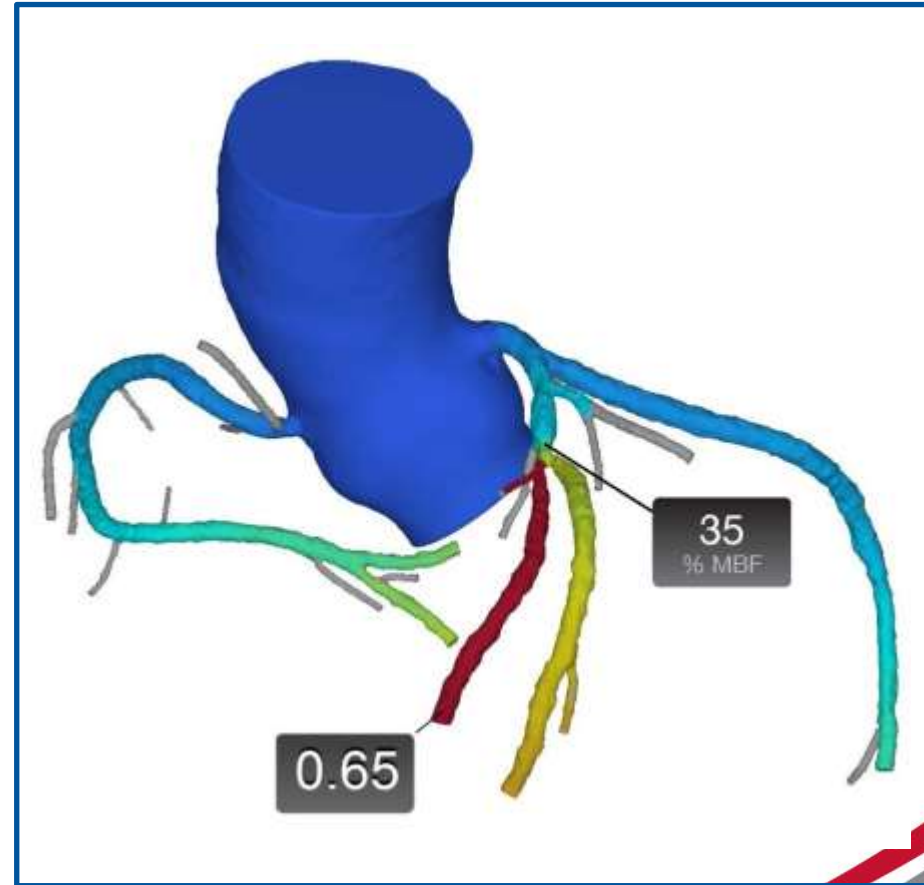
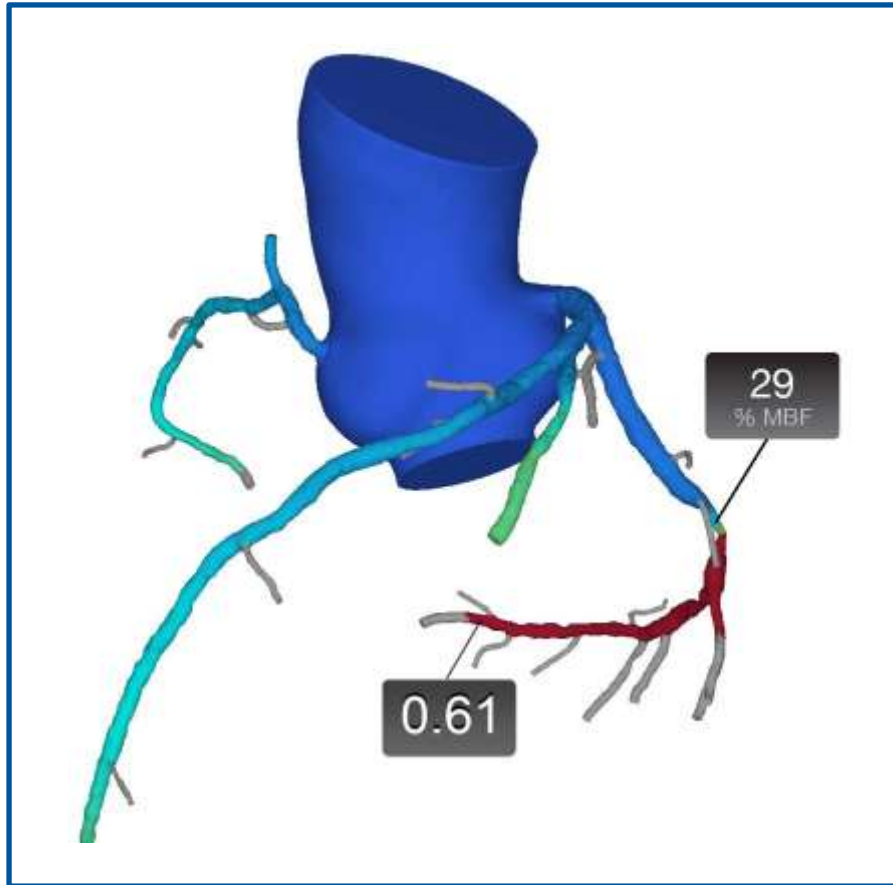
Velocity and Flow



Post-CABG FFR

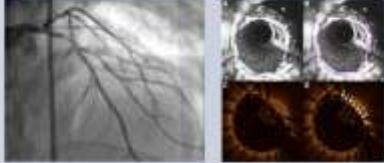
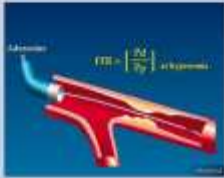

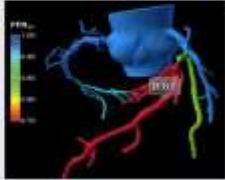


# Myocardial Territory at Risk due to Ischemia-causing stenoses



# FFR<sub>CT</sub> - Delivering Anatomical AND Functional Capabilities in One Noninvasive Test

- Clear need for a better noninvasive CAD diagnostic test combining anatomy and function
- FFR<sub>CT</sub> demonstrates high diagnostic accuracy validated in 3 prospective multicenter clinical trials
- FFR<sub>CT</sub> leverages high-fidelity image processing, well established physiology principles and robust computational fluid dynamics methods to solve the laws of physics governing blood flow

	<u>ANATOMY</u> Identify obstructive CAD	<u>FUNCTION</u> Identify lesion-specific ischemia that may benefit from PCI
<i>Invasive</i>		
<i>Non-invasive</i>		

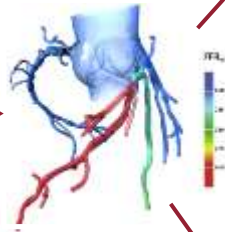
# Predicting outcomes of interventions is on the horizon.

← *Does my patient have CHD?* → ← *How do I treat it?* →

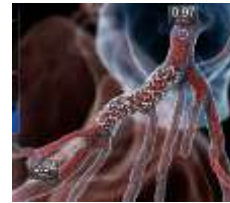
Cardiac CT  
Angiography



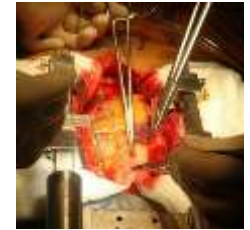
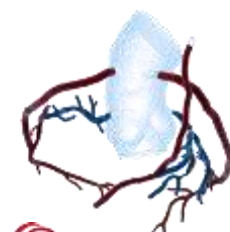
HeartFlow<sup>®</sup>  
FFR<sub>CT</sub>



HeartFlow<sup>®</sup>  
PCI Planner



HeartFlow<sup>®</sup>  
CABG Planner



HeartFlow<sup>®</sup>  
Medical Therapy  
Planner



Thank you

