



# Emergency Department Evaluation of Patients With Possible ACS



Heart House  
Roundtables



# What Should be Done with Imaging Test Results?

**TODD C. VILLINES, MD, FACC, FAHA, MSCCT**

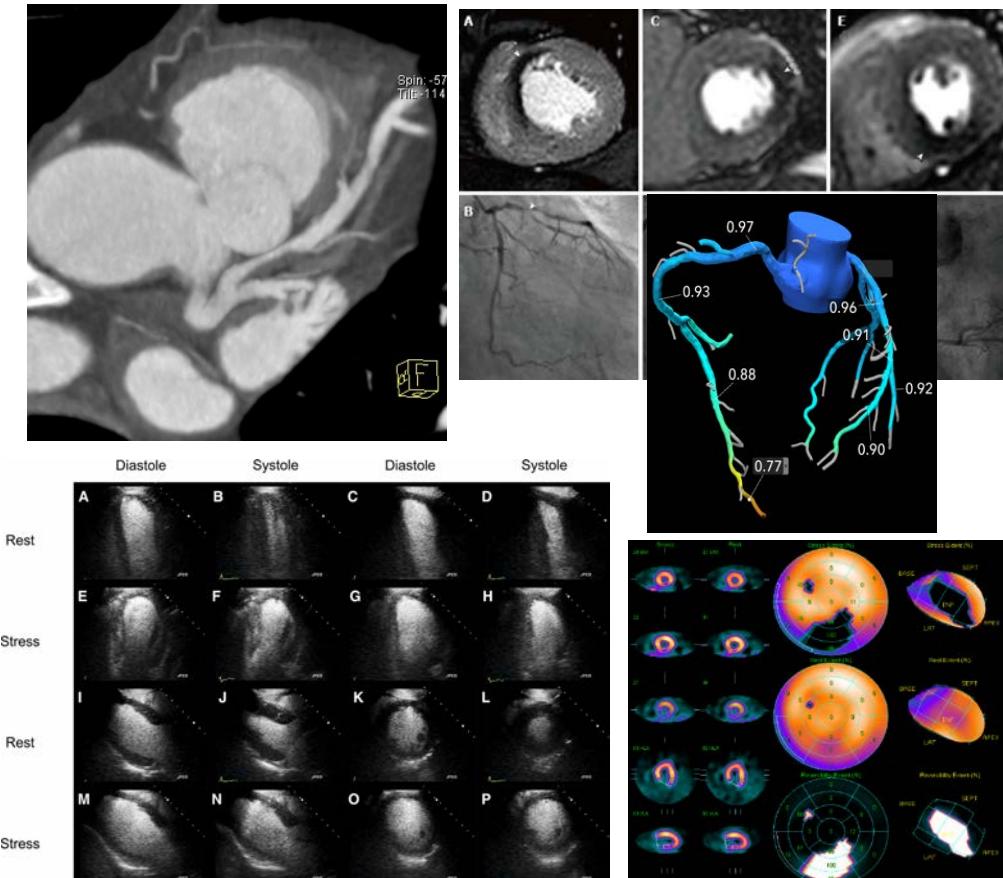
Professor of Medicine

Cardiovascular Division, University of Virginia

Chair, ACC Imaging Council

Editor-in-Chief, *Journal of Cardiovascular CT*

Past-President, Society of Cardiovascular CT



2015 ACR/ACC/AHA/AATS/ACEP/ASNC/NASCI/SAEM/SCCT/SCMR/SCPC/SNMMI/STR/STS Appropriate Utilization of Cardiovascular Imaging in Emergency Department Patients With Chest Pain

# Early Assessment in the ED

## 2015 AUC

TABLE 2.1

### Suspected Non-ST-Segment Elevation ACS: Early Assessment Pathway Based on Initial ECG, Biomarker Analysis, and Symptoms

Indication	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
<b>Positive initial diagnosis of NSTEMI/ACS</b>					
3. Initial ECG and/or biomarker analysis unequivocally positive for ischemia	R	R	R	R	A
<b>Equivocal initial diagnosis of NSTEMI/ACS</b>					
4. Equivocal initial troponin or single troponin elevation without additional evidence of ACS	M*	M*	A	A	R
5. Ischemic symptoms resolved hours before testing	R	M	M*	A	R
<b>Low/intermediate likelihood initial diagnosis of NSTEMI/ACS</b>					
6. TIMI risk score = 0, early hsTrop negative	R	R	R	A	R
7. Normal or nonischemic on initial ECG, normal initial troponin	R	R	M*	A	R

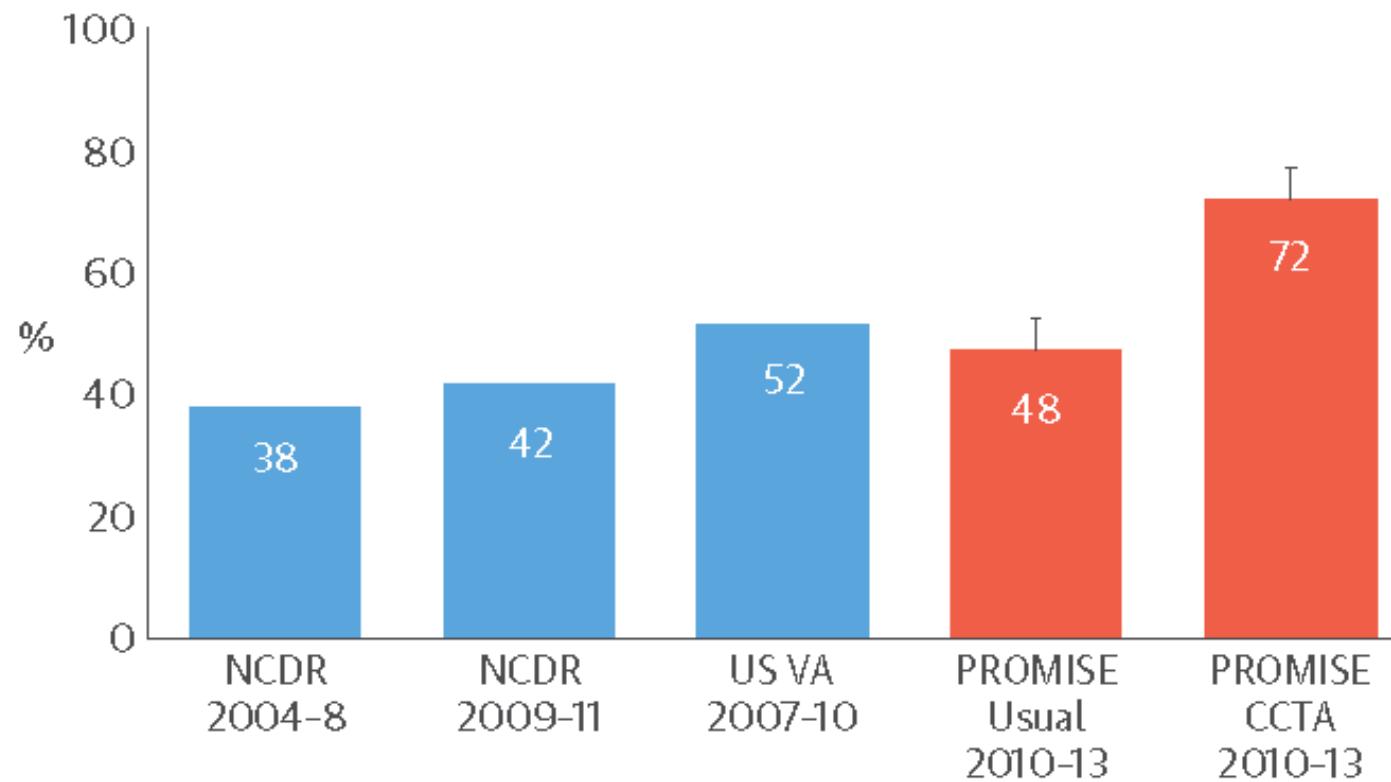
**A = Appropriate; M = May be appropriate; R = Rarely appropriate**

Source: Rybicki F, et al. JACC 2016

# We Need to Improve Patient Selection for Invasive Coronary Angiography

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Proportion with Angiographically Significant CAD on Catheterization



Sources: Patel *NEJM* 2010;362:886-95. Patel *Am Heart J* 2014;167:846-852.

# The performance of non-invasive tests to rule-in and rule-out significant coronary artery stenosis in patients with stable angina: a meta-analysis focused on post-test disease probability

Juhani Knuuti<sup>1\*</sup>, Haitham Ballo<sup>1†</sup>, Luis Eduardo Juarez-Orozco<sup>1†</sup>, Antti Saraste<sup>1</sup>, Philippe Kolh<sup>2</sup>, Anne Wilhelmina Saskia Rutjes<sup>3</sup>, Peter Jüni<sup>4</sup>, Stephan Windecker<sup>5</sup>, Jeroen J. Bax<sup>6</sup>, and William Wijns<sup>7</sup>

## Anatomically significant CAD

Test	Sensitivity (%), (95% CI)	Specificity (%), (95% CI)
Stress ECG	58 (46–69)	62 (54–69)
Stress echo	85 (80–89)	82 (72–89)
CCTA	97 (93–99)	78 (67–86)
SPECT	87 (83–90)	70 (63–76)
PET	90 (78–96)	85 (78–90)
Stress CMR	90 (83–94)	80 (69–88)

## For detection of:

- Stenosis >50% on cath
- FFR ≤ 0.80

## Functionally significant CAD

Test	Sensitivity (%), (95% CI)	Specificity (%), (95% CI)
ICA	68 (60–75)	73 (55–86)
CCTA	93 (89–96)	53 (37–68)
SPECT	73 (62–82)	83 (71–90)
PET	89 (82–93)	85 (81–88)
Stress CMR	89 (85–92)	87 (83–91)

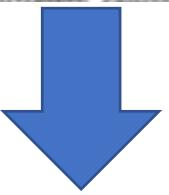
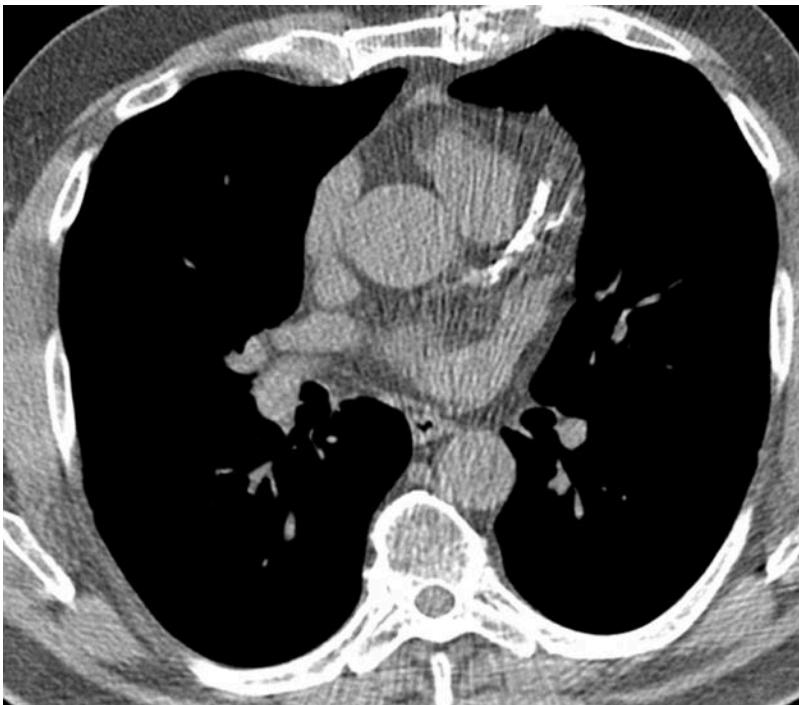
Source: Knuuti J, et al. Eur H J 2018



# Prior Imaging Test Results Matter

# Utilize Prior Imaging Results to Refine Management

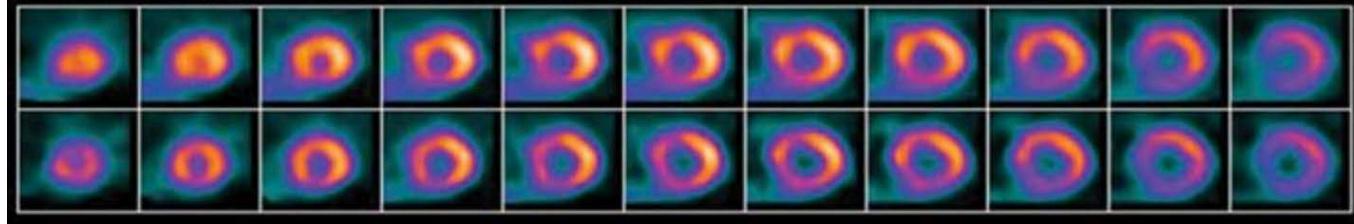
Prior Non-gated chest CT  
62 year-old smoker



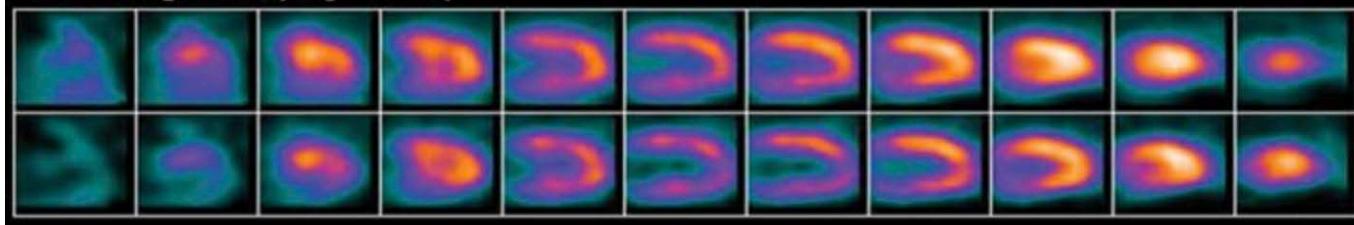
Functional Imaging Preferred

Prior Equivocal Stress MPI (SPECT)  
50 year-old with no risk factors

Short Axis (Apex->Base)



Vert Long Axis (Sep->Lat)



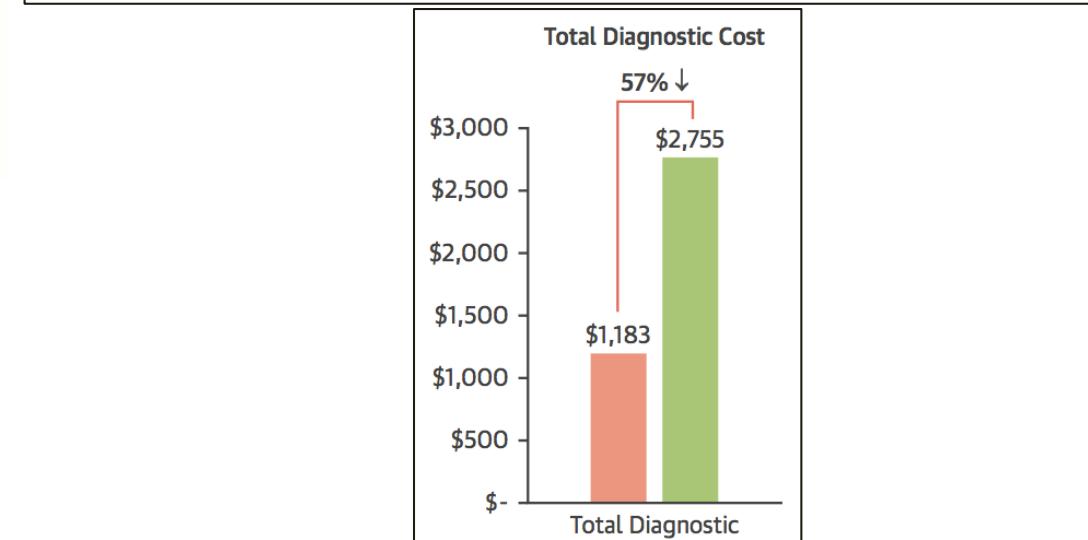
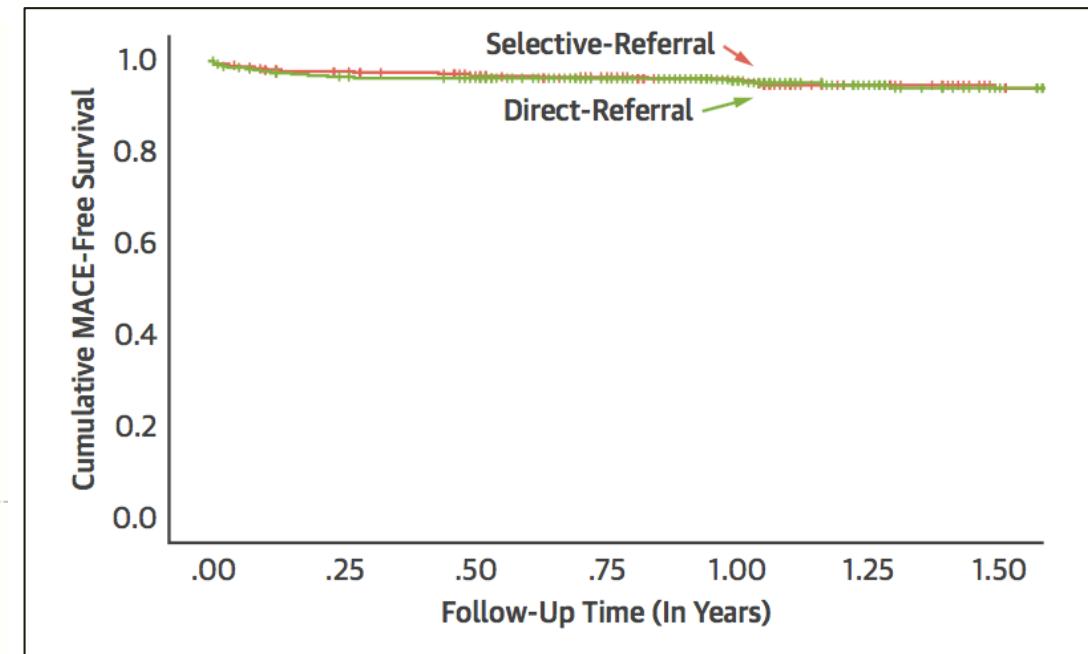
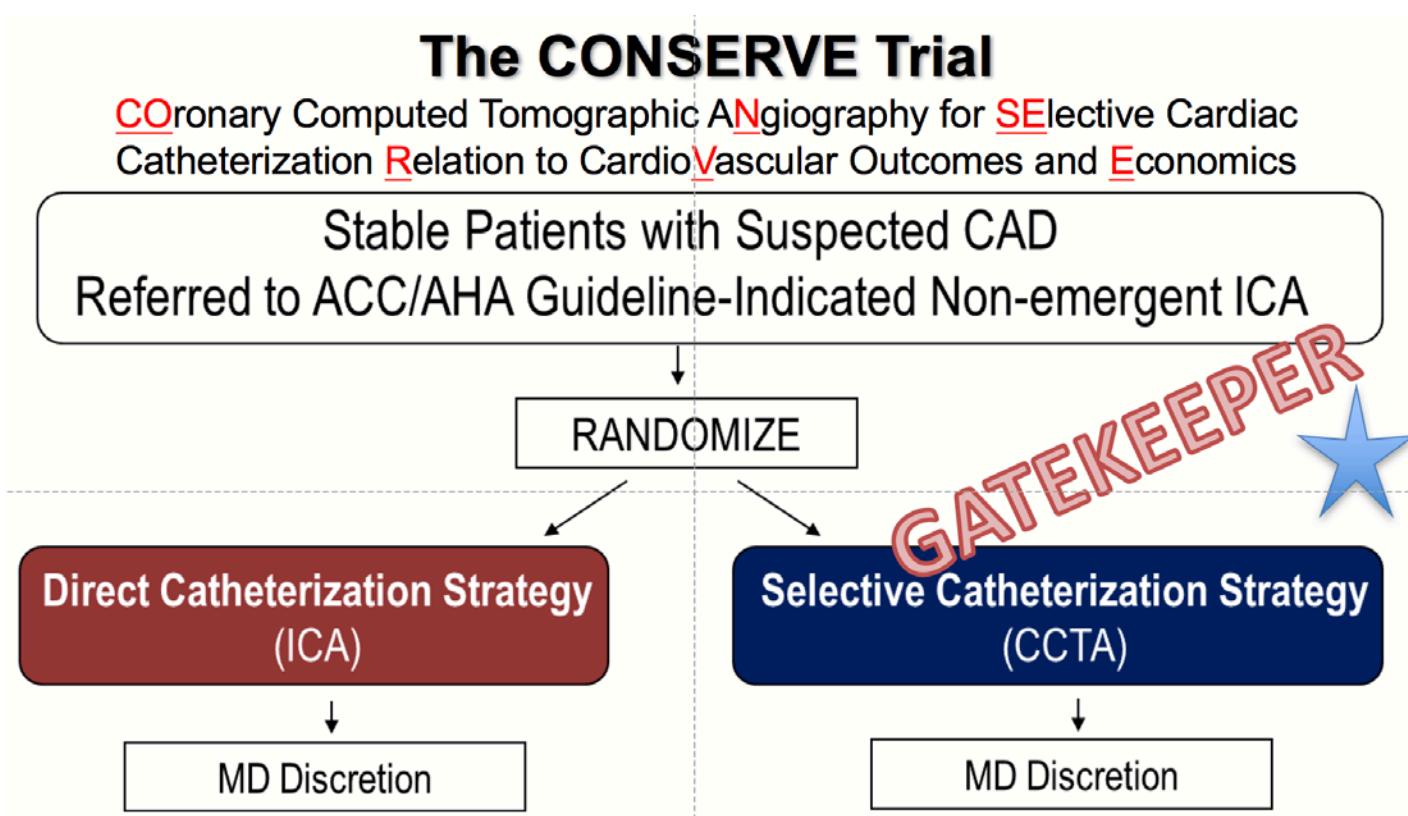
Coronary CTA: *Gatekeeper Role*



# Potential Gatekeeper Role for Imaging

# Gatekeeper Role of Coronary CTA ?

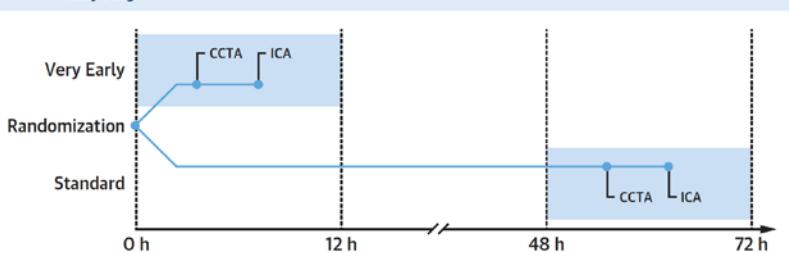
CONSERVE: Randomized Controlled Trial (n=1631) of Direct Cath vs. Selective Cath



Source: Chang HJ et al. JACC Cardiovasc Imaging 2018

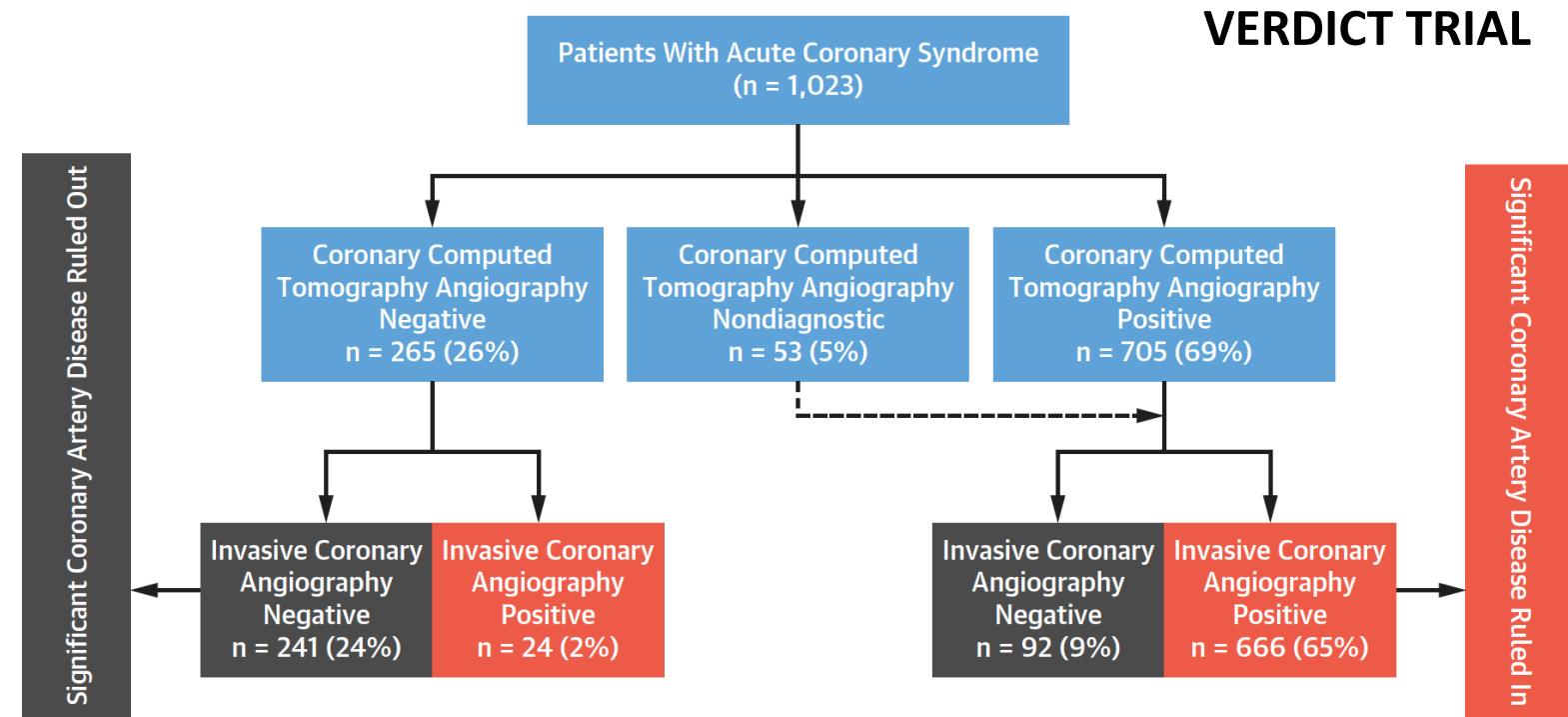
# CTA Gatekeeper Role in Higher Risk NSTEACS ?

FIGURE 1 Study Design



- Mean age 62 years
- 24% known ASCVD
- 15% prior MI
- 80% + troponin
- 40% dynamic ECG changes
- 40% GRACE score >140

## CENTRAL ILLUSTRATION Diagnostic Accuracy of Coronary Computed Tomography Angiography Using Invasive Coronary Angiography as Reference Standard

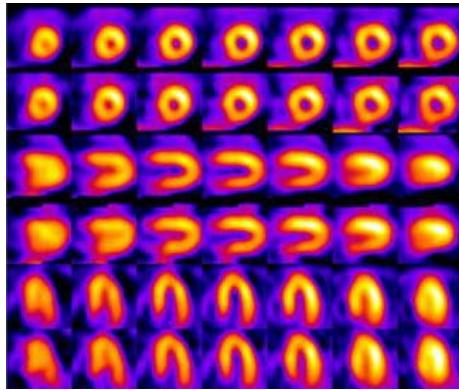


- 1/3 of patients no significant CAD on cath
- CTA: SENS 96.5%, NPV 91%, PPV 88%

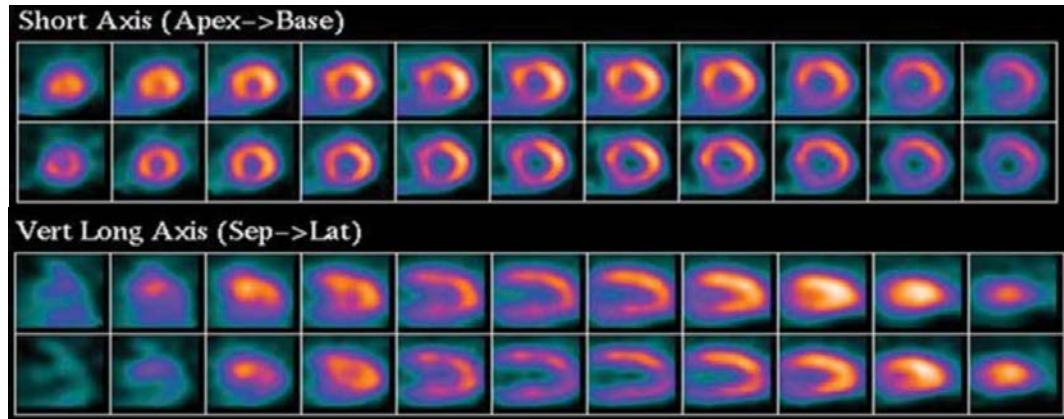


# Management Following Functional Imaging Tests

# Management Based on Functional Imaging Tests



Normal study = conservative management



Equivocal or artifact: Dealing with uncertainty

- Integrate with clinical risk and patient shared decision-making
- Medical management, early follow-up or coronary CTA

## Abnormal Studies: Key Determinants of Risk

- LV size and EF
- % myocardium ischemia (>10%)
- Wall motion
- ECG changes

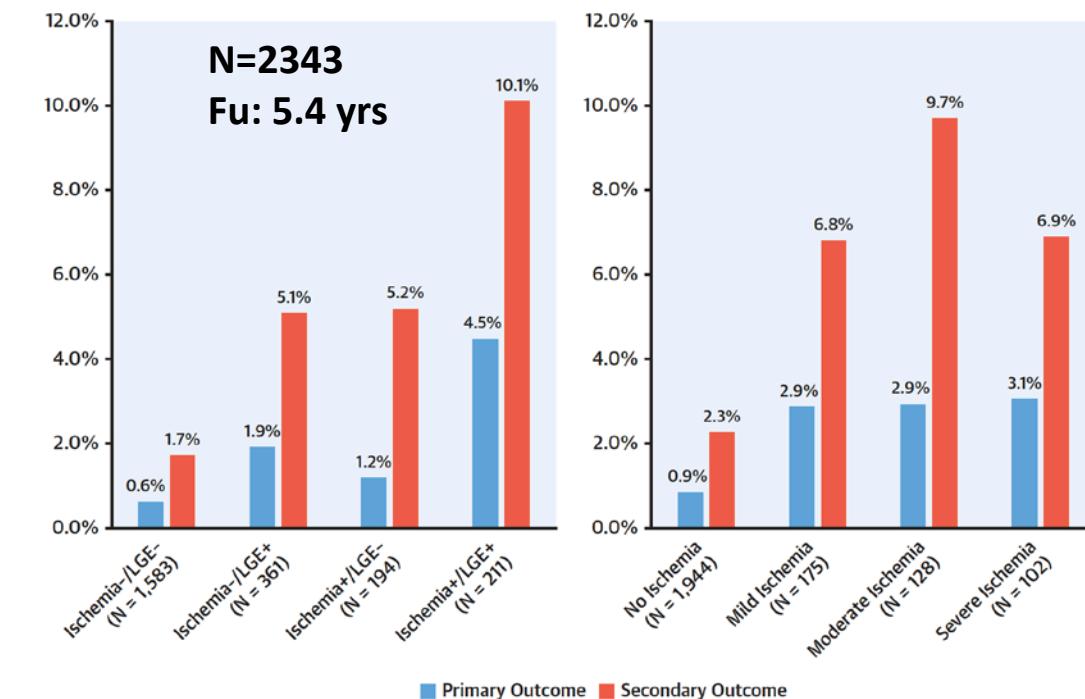


Cardiac Magnetic Resonance Stress  
Perfusion Imaging for Evaluation of  
Patients With Chest Pain



Source: Kwong RY, et al. JACC 2019.

FIGURE 1 Primary and Secondary Outcome Event Rates



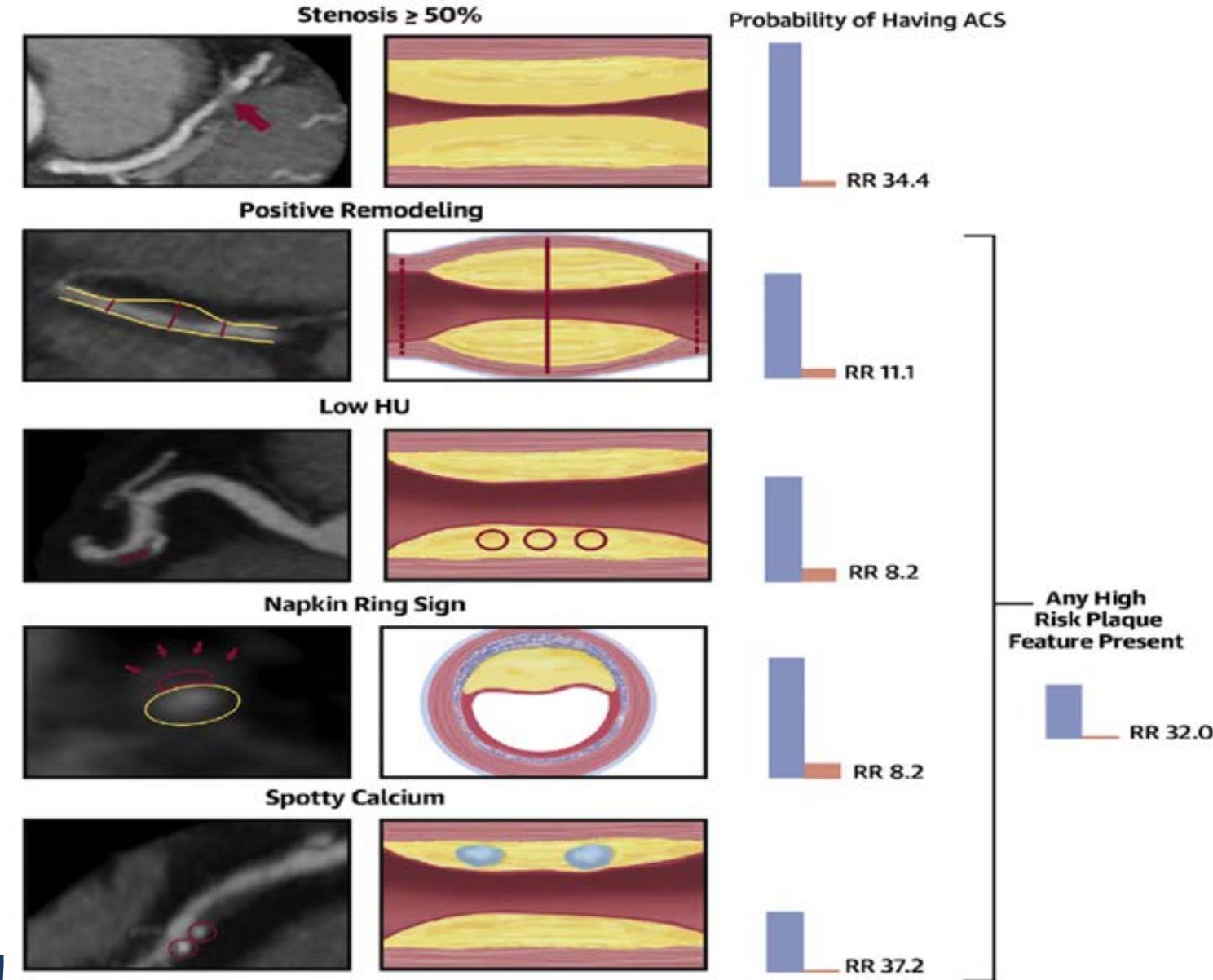


# Coronary CTA: Dealing with Angiography in the ED

# ROMICAT II

- CTA: safe, effective, efficient
- Stenosis matters most
- High risk plaque features matter, too
- CAC = 0 insufficient to rule-out ACS

★ Non-obstructive plaque: opportunity for prevention!



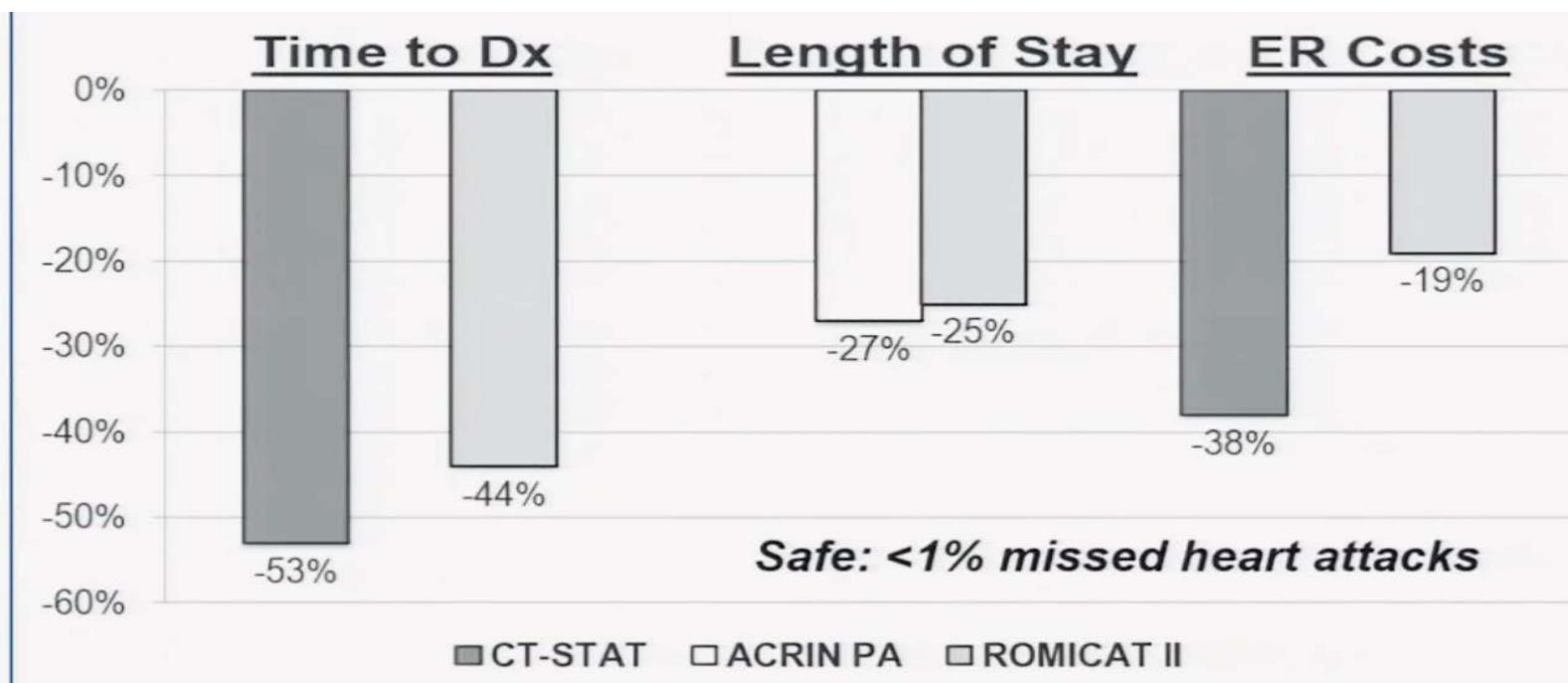
# Outcomes After Coronary Computed Tomography Angiography in the Emergency Department

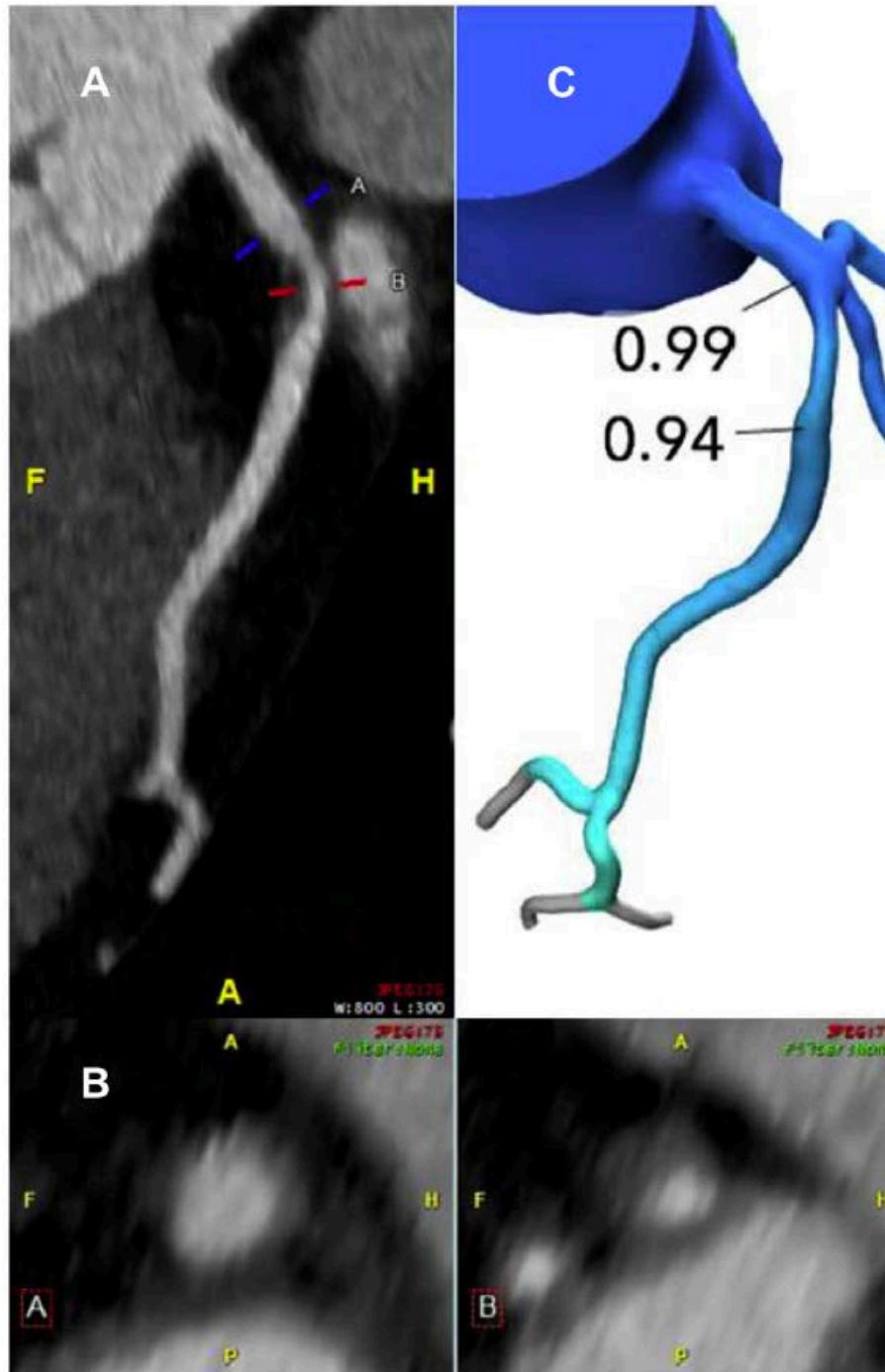
A Systematic Review and Meta-Analysis  
of Randomized, Controlled Trials

Edward Hulten, MD, MPH,\* Christopher Pickett, MD,† Marcio Sommer Bittencourt, MD,\*  
Todd C. Villines, MD,† Sara Petrillo, MD,‡ Marcelo F. Di Carli, MD,\* Ron Blankstein, MD\*

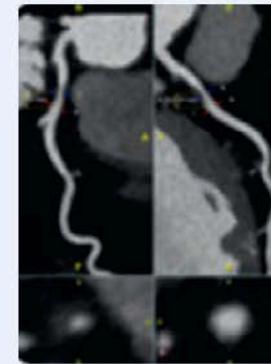
Source: Hulten E, et al. JACC 2013

- Significantly shorter length of ER stay and costs with CTA
- CTA: 2% higher rate of invasive cardiac catheterization (OR 1.36) and increased likelihood to get PCI/CABG (20 per 1000 scanned)



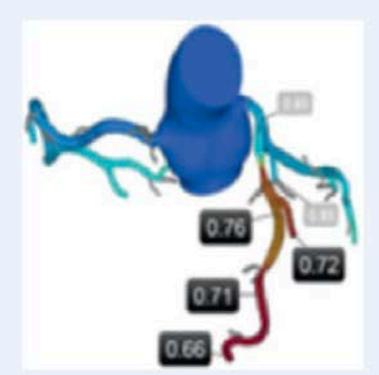


# Clinical Use of CT-Derived Fractional Flow Reserve in the Emergency Department



+

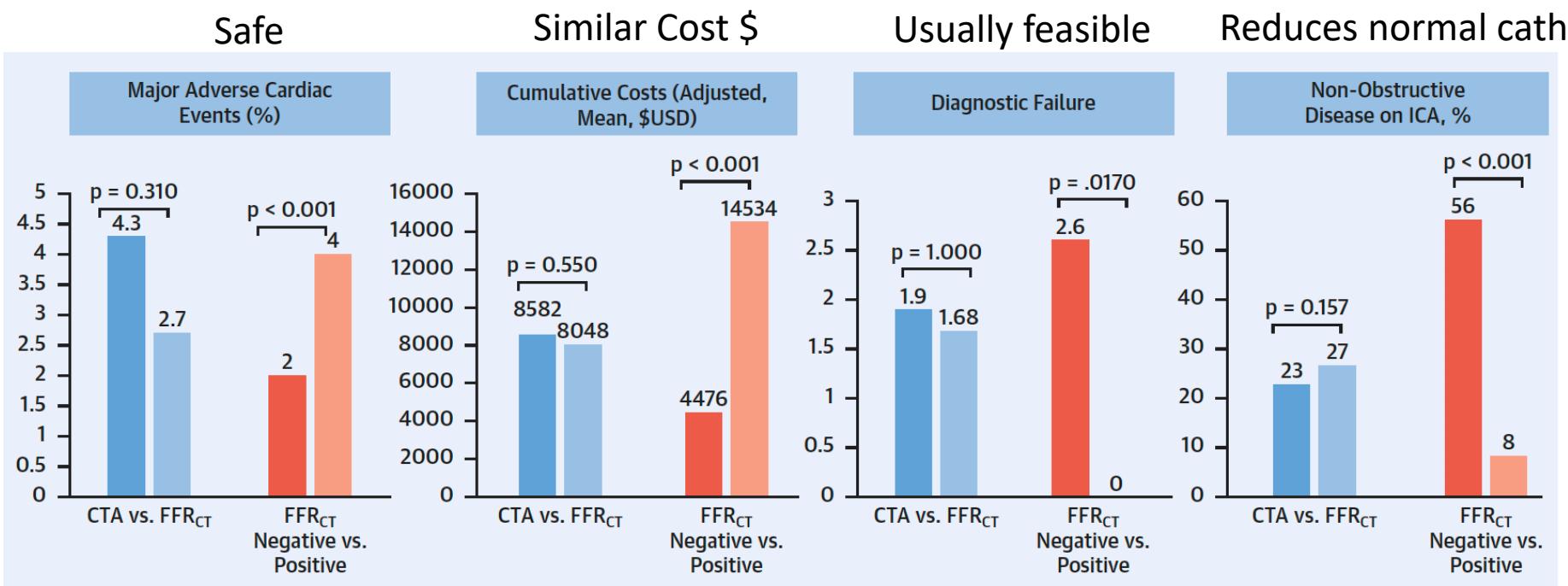
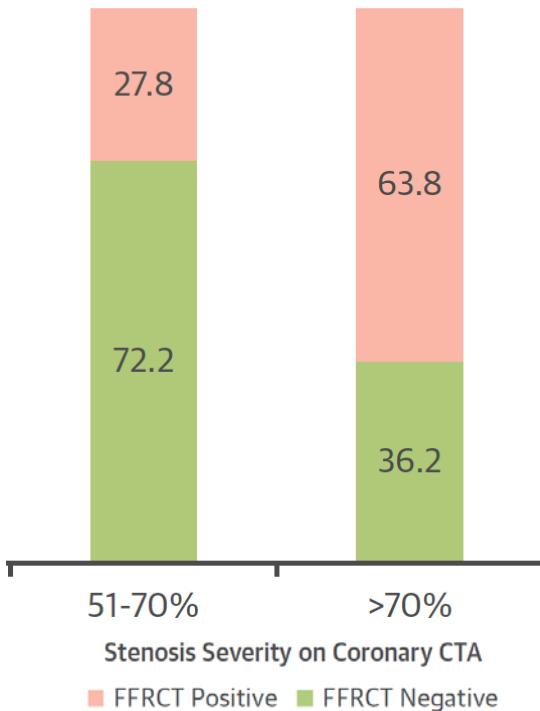
CTA stenosis >50% OR CTA  
stenosis >25% + high-risk plaque



Kavitha M. Chinnaiyan, MD, Robert D. Safian, MD, Michael L. Gallagher, MD, Julie George, MS,  
Simon R. Dixon, MBCB, Abhay N. Bilolikar, MD, Amr E. Abbas, MD, Mazen Shoukfeh, MD, Marc Brodsky, MD,  
James Stewart, MD, Elvis Cami, MD, David Forst, MD, Steven Timmis, MD, Jason Crile, MD, Gilbert L. Raff, MD

Chinnaiyan KM, et al. JACC CV Img 2020

- May reduce normal catheterizations for intermediate lesions
- FFRct: Normal does a good job of ruling out functionally significant CAD



CAD-RADS™ Coronary Artery Disease – Reporting and Data System.  
An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Radiology (ACR) and the North American Society for Cardiovascular Imaging (NASCI). Endorsed by the American College of Cardiology

# Coronary CTA Management Recommendations: CAD-RADS

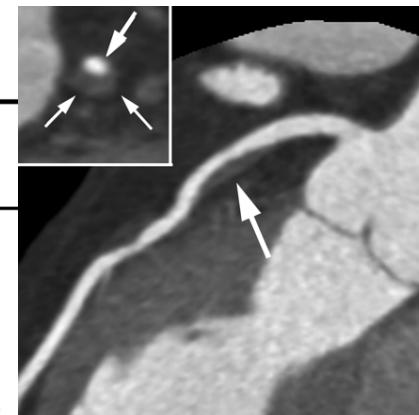
- ~50% of patients: no CAD
- 30-35%: <50% stenosis on CTA



ACS Unlikely



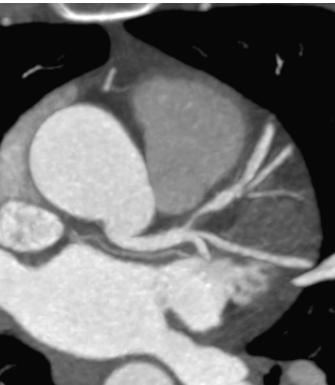
Non-obstructive CAD: prevention



	Degree of maximal coronary stenosis	Interpretation	Management
<b>CAD-RADS 0</b>	0%	ACS <sup>a</sup> highly unlikely	<ul style="list-style-type: none"> <li>- No further evaluation of ACS is required.</li> <li>- Consider other etiologies.</li> </ul>
<b>CAD-RADS 1</b>	1–24% <sup>b</sup>	ACS highly unlikely	<ul style="list-style-type: none"> <li>- Consider evaluation of non-ACS etiology, if normal troponin and no ECG changes.</li> <li>- Consider referral for outpatient follow-up for preventive therapy and risk factor modification.</li> </ul>
<b>CAD-RADS 2</b>	25–49% <sup>c</sup>	ACS unlikely	<ul style="list-style-type: none"> <li>- Consider evaluation of non-ACS etiology, if normal troponin and no ECG changes.</li> <li>- Consider referral for outpatient follow-up for preventive therapy and risk factor modification.</li> <li>- If clinical suspicion of ACS is high or if high-risk plaque features are noted, consider hospital admission with cardiology consultation.</li> </ul>

## Coronary CTA Management Recommendations: CAD-RADS

- 15-20% of patients: Stenosis >50%



### ACS Possible or Likely

- Admission
- Cardiology consultation



**CAD-RADS 3** 50–69% ACS possible

- Consider hospital admission with cardiology consultation, functional testing and/or ICA<sup>d</sup> for evaluation and management.

**CAD-RADS 4**  
A – 70–99% or  
B – Left main >50% or 3-vessel  
obstructive disease ACS likely

- Recommendation for anti-ischemic and preventive management should be considered as well as risk factor modification. Other treatments should be considered if presence of hemodynamically significant lesion.

**CAD-RADS 5** 100% (Total occlusion) ACS very likely

- Consider hospital admission with cardiology consultation. Further evaluation with ICA and revascularization as appropriate.



## What Should be Done with Imaging Test Results?

# Conclusions

- hs Troponin: changing who we test
- We currently over test & we can do better in who we refer to the cath lab
- Prior chest imaging and test results: *often overlooked*
- Population has changed – most patients do not have ACS or significant CAD
- **Recommendation – testing pathways: If testing is warranted**
  - No known CAD:  Coronary CTA
  - Known CAD or high CAC:  Functional testing (do the test that you do well)
  - Equivocal prior functional test results:  Coronary CTA
- **Non-obstructive CAD matters: *Opportunity for prevention and education***



# What Should be Done with Imaging Test Results?

**TODD C. VILLINES, MD, FACC, FAHA, MSCCT**

Professor of Medicine

Cardiovascular Division, University of Virginia

Chair, ACC Imaging Council

Editor-in-Chief, *Journal of Cardiovascular CT*

Past-President, Society of Cardiovascular CT

