# Chest Pain Evaluation:
# New Chest Pain Guideline and Implications

**Deepak L. Bhatt, MD, MPH**

***Executive Director of Interventional Cardiovascular Programs,***
***Brigham and Women's Hospital***
***Professor of Medicine, Harvard Medical School***

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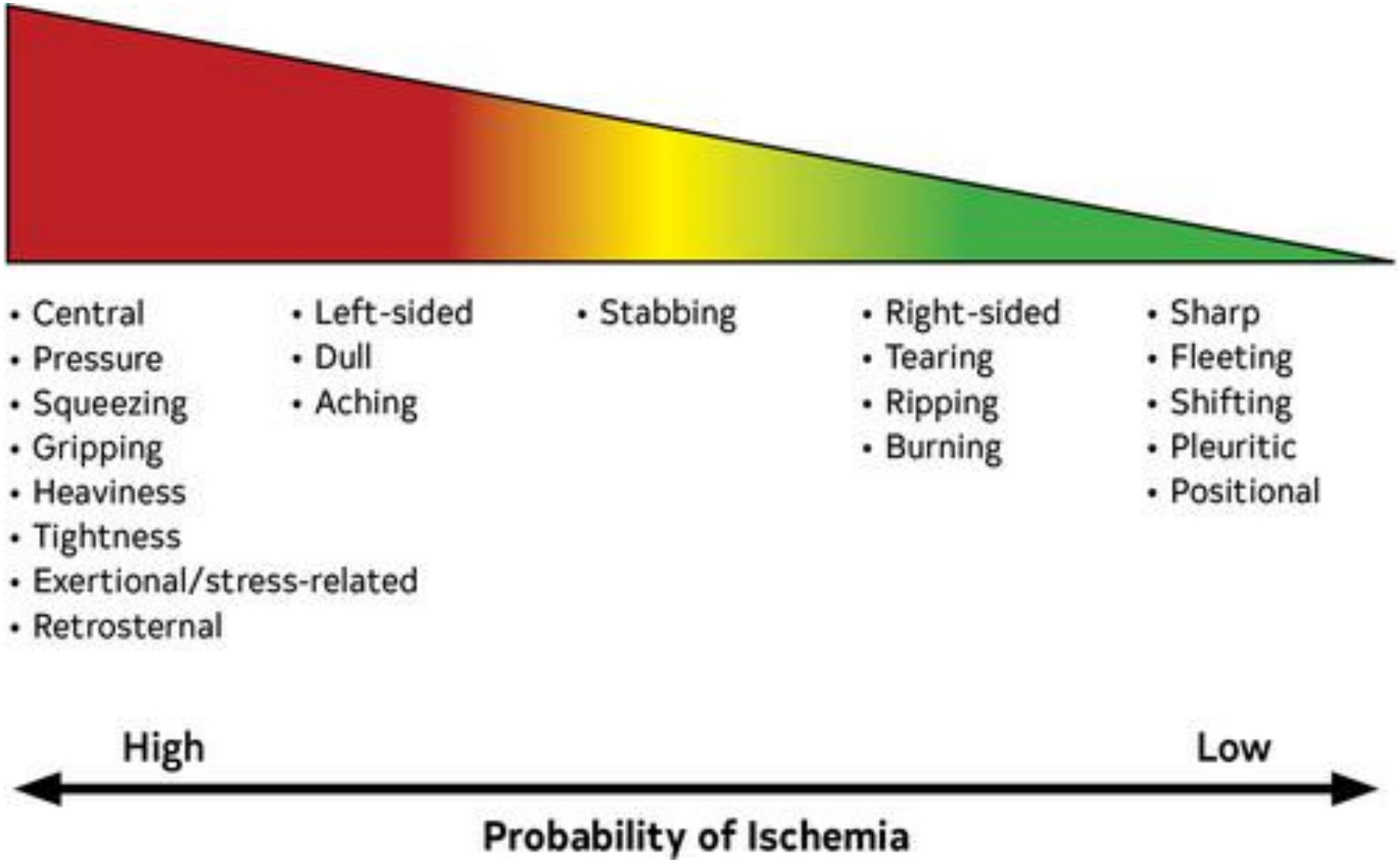
# Disclosures

**Dr. Bhatt discloses the following relationships** - Advisory Board: Bayer, Boehringer Ingelheim, Cardax, CellProthera, Cereno Scientific, Elsevier Practice Update Cardiology, Janssen, Level Ex, Medscape Cardiology, Merck, MyoKardia, NirvaMed, Novo Nordisk, PhaseBio, PLx Pharma, Regado Biosciences, Stasys; Board of Directors: Boston VA Research Institute, DRS.LINQ (stock options), Society of Cardiovascular Patient Care, TobeSoft; Chair: Inaugural Chair, American Heart Association Quality Oversight Committee; Data Monitoring Committees: Acesion Pharma, Assistance Publique-Hôpitaux de Paris, Baim Institute for Clinical Research (formerly Harvard Clinical Research Institute, for the PORTICO trial, funded by St. Jude Medical, now Abbott), Boston Scientific (Chair, PEITHO trial), Cleveland Clinic (including for the ExCEED trial, funded by Edwards), Contego Medical (Chair, PERFORMANCE 2), Duke Clinical Research Institute, Mayo Clinic, Mount Sinai School of Medicine (for the ENVISAGE trial, funded by Daiichi Sankyo; for the ABILITY-DM trial, funded by Concept Medical), Novartis, Population Health Research Institute; Rutgers University (for the NIH-funded MINT Trial); Honoraria: American College of Cardiology (Senior Associate Editor, Clinical Trials and News, ACC.org; Chair, ACC Accreditation Oversight Committee), Arnold and Porter law firm (work related to Sanofi/Bristol-Myers Squibb clopidogrel litigation), Baim Institute for Clinical Research (formerly Harvard Clinical Research Institute; RE-DUAL PCI clinical trial steering committee funded by Boehringer Ingelheim; AEGIS-II executive committee funded by CSL Behring), Belvoir Publications (Editor in Chief, Harvard Heart Letter), Canadian Medical and Surgical Knowledge Translation Research Group (clinical trial steering committees), Cowen and Company, Duke Clinical Research Institute (clinical trial steering committees, including for the PRONOUNCE trial, funded by Ferring Pharmaceuticals), HMP Global (Editor in Chief, Journal of Invasive Cardiology), Journal of the American College of Cardiology (Guest Editor; Associate Editor), K2P (Co-Chair, interdisciplinary curriculum), Level Ex, Medtelligence/ReachMD (CME steering committees), MJH Life Sciences, Piper Sandler, Population Health Research Institute (for the COMPASS operations committee, publications committee, steering committee, and USA national co-leader, funded by Bayer), Slack Publications (Chief Medical Editor, Cardiology Today's Intervention), Society of Cardiovascular Patient Care (Secretary/Treasurer), WebMD (CME steering committees); Other: Clinical Cardiology (Deputy Editor), NCDR-ACTION Registry Steering Committee (Chair), VA CART Research and Publications Committee (Chair); Research Funding: Abbott, Afimmune, Aker Biomarine, Amarin, Amgen, AstraZeneca, Bayer, Beren, Boehringer Ingelheim, Bristol-Myers Squibb, Cardax, CellProthera, Cereno Scientific, Chiesi, CSL Behring, Eisai, Ethicon, Faraday Pharmaceuticals, Ferring Pharmaceuticals, Forest Laboratories, Fractyl, Garmin, HLS Therapeutics, Idorsia, Ironwood, Ischemix, Janssen, Javelin, Lexicon, Lilly, Medtronic, Merck, Moderna, MyoKardia, NirvaMed, Novartis, Novo Nordisk, Owkin, Pfizer, PhaseBio, PLx Pharma, Recardio, Regeneron, Reid Hoffman Foundation, Roche, Sanofi, Stasys, Synaptic, The Medicines Company, 89Bio; Royalties: Elsevier (Editor, Cardiovascular Intervention: A Companion to Braunwald's Heart Disease); Site Co-Investigator: Abbott, Biotronik, Boston Scientific, CSI, St. Jude Medical (now Abbott), Philips, Svelte; Trustee: American College of Cardiology; Unfunded Research: FlowCo, Takeda.

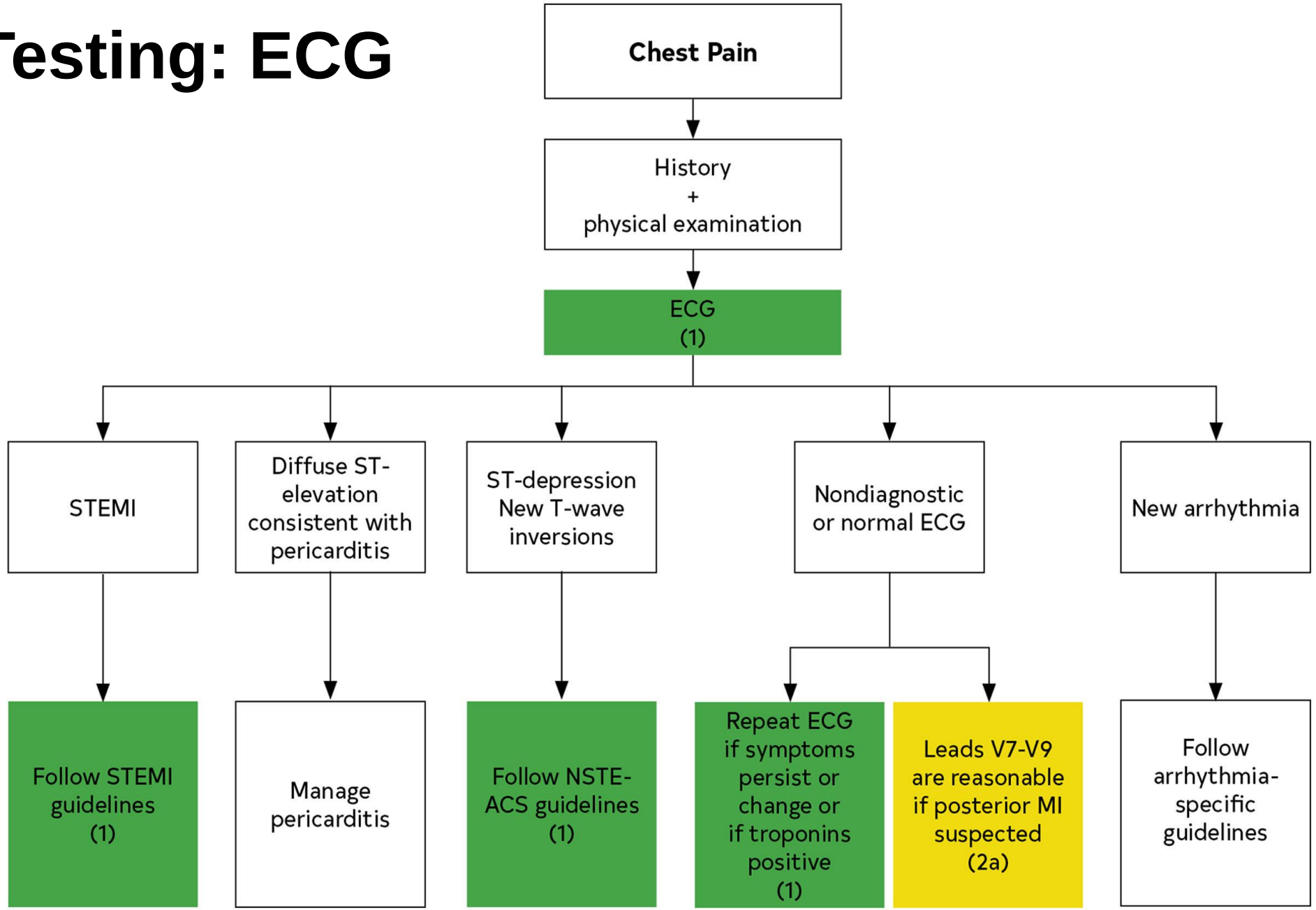
**This presentation includes off-label and investigational uses of drugs and devices.**

# Symptoms and Signs: Chest Pain



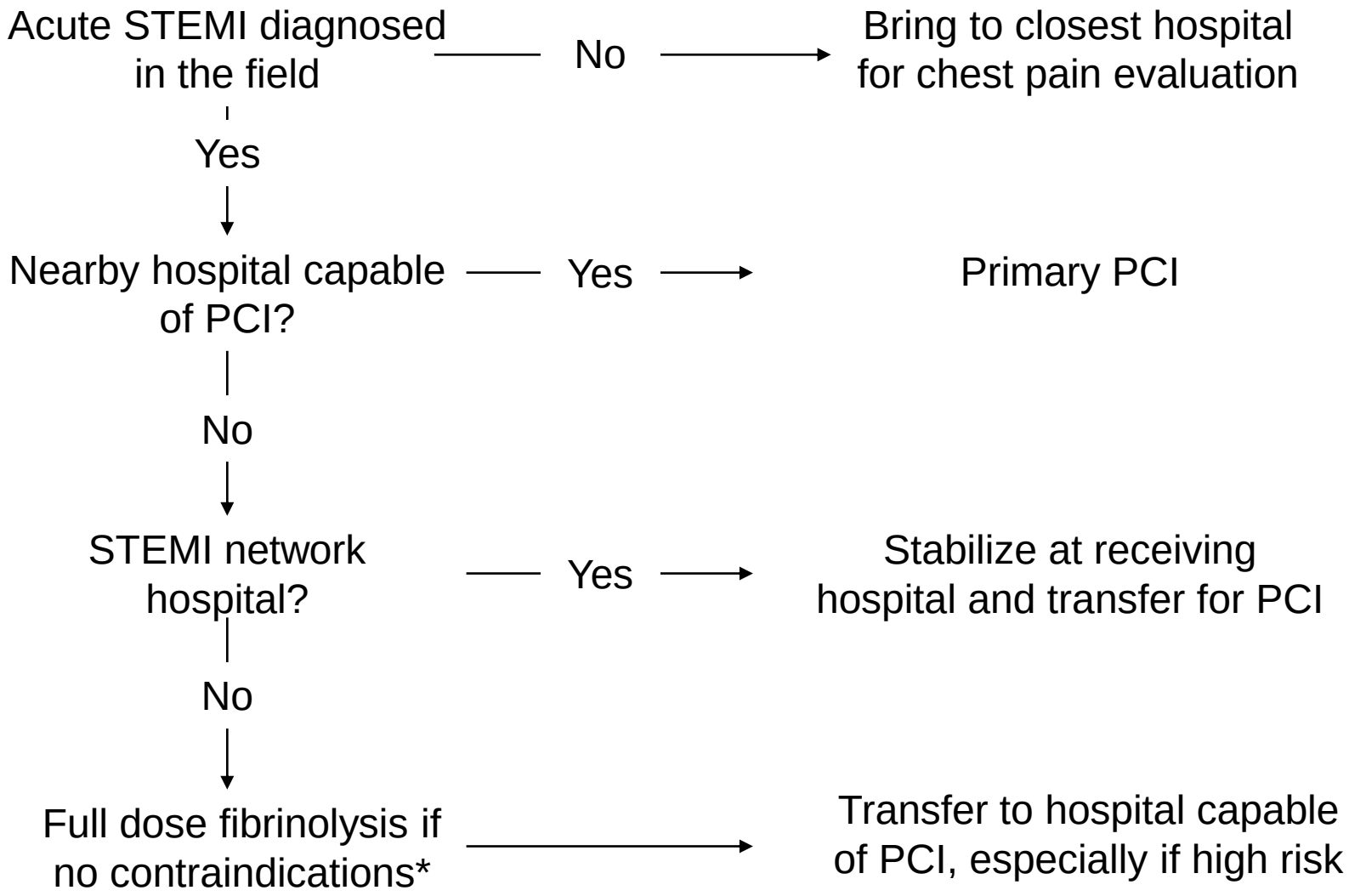

Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.

# Testing: ECG




**Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.**

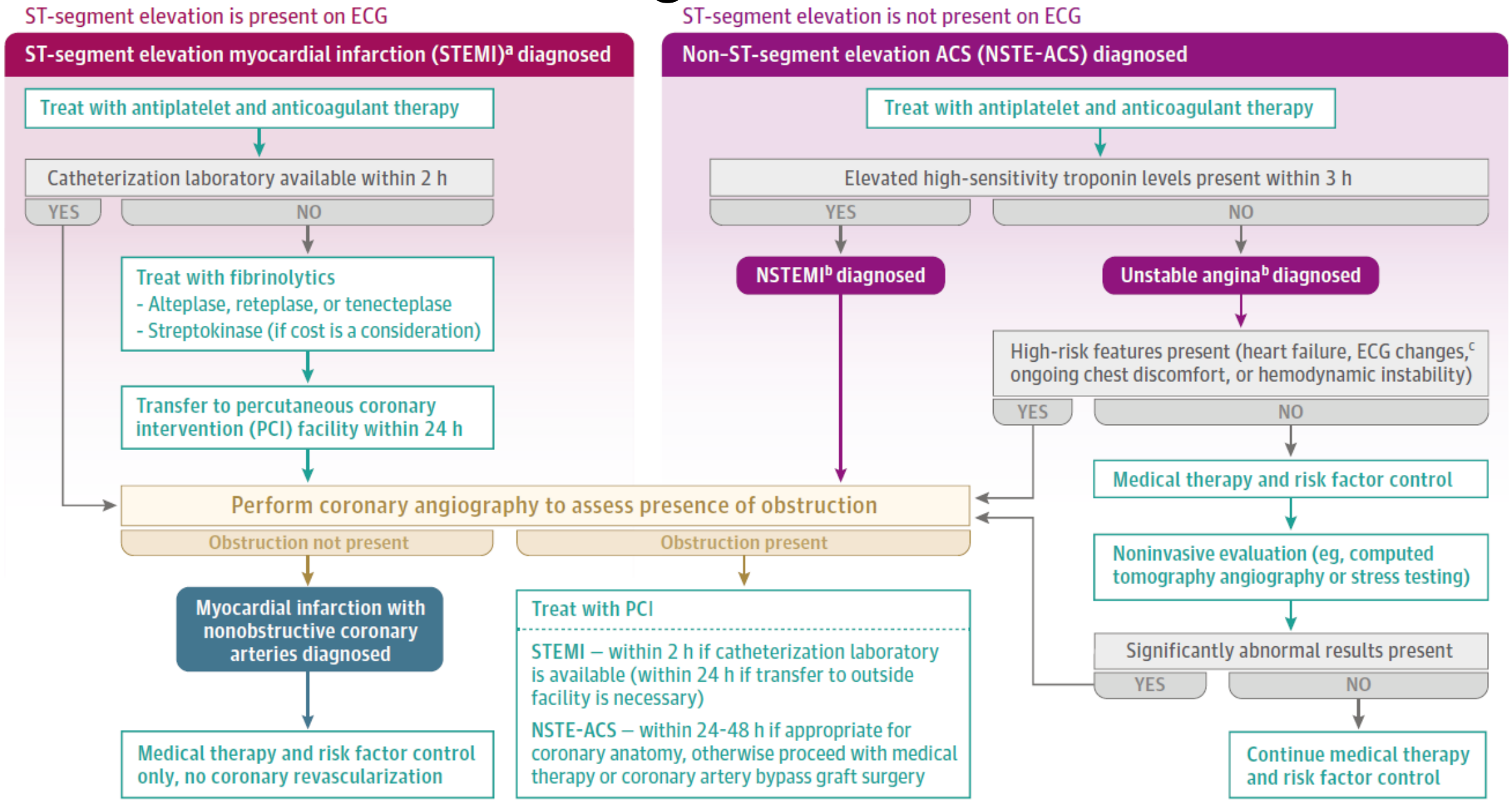
# Treatment of STEMI Algorithm




*Consider half-dose agent if 75 years of age or older

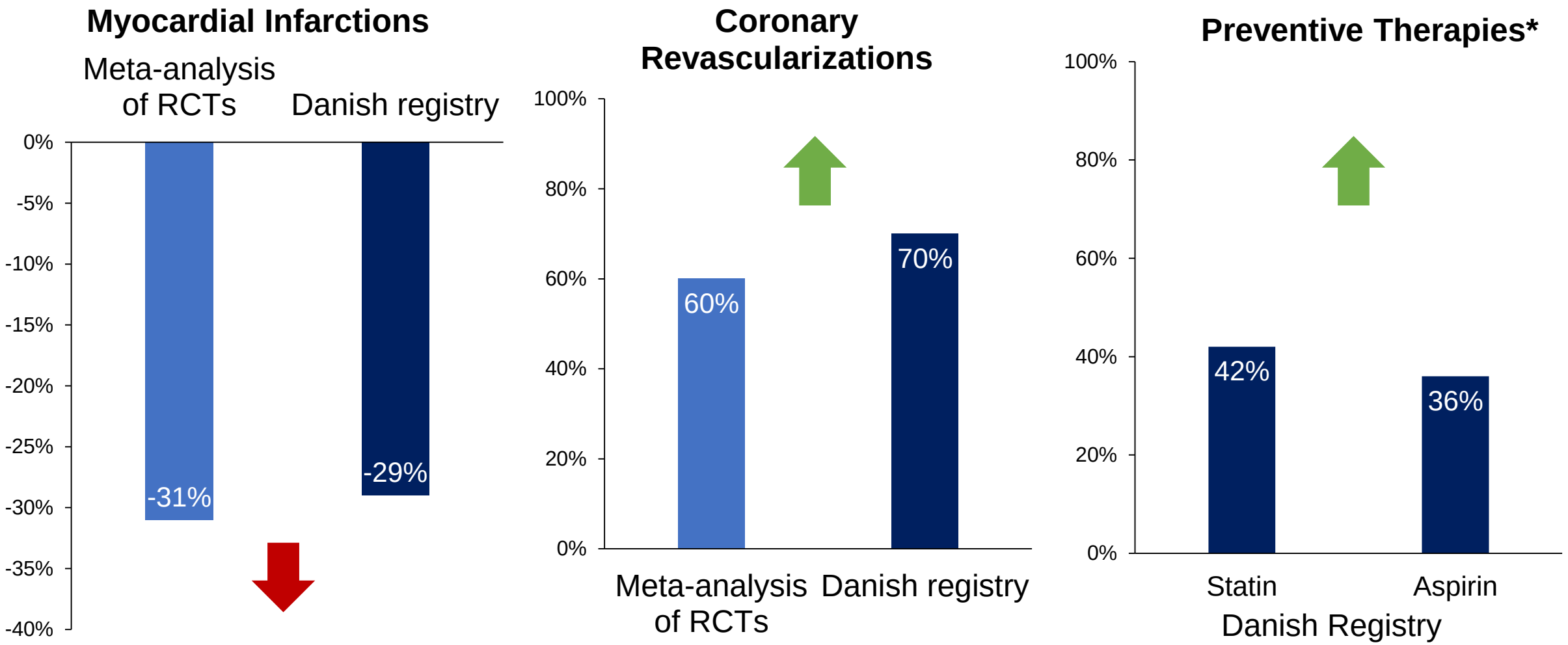
**Bhatt DL. *N Engl J Med*. 2013;368:1446-7.**

# Initial Diagnosis of ACS




Bhatt DL, Lopes RD, Harrington RA. *JAMA*. 2022;327:662-675.

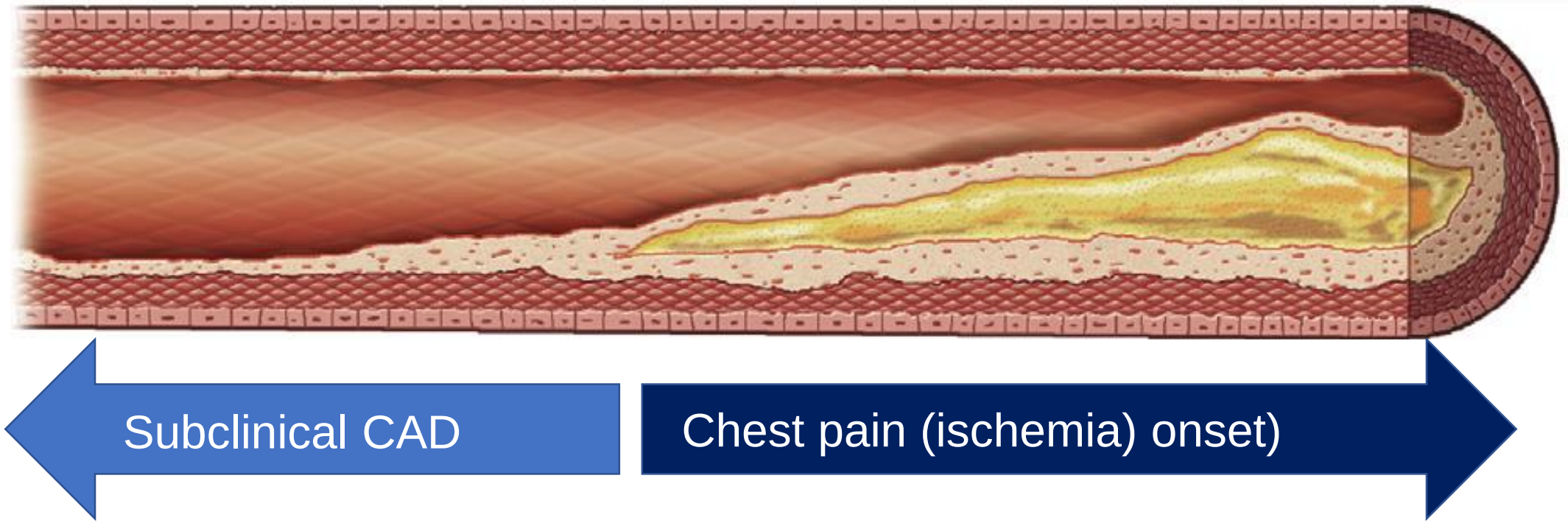
# Evaluating Stable Chest Pain: Coronary CTA vs Functional Testing




*Similar data on medical therapy were not available for the meta-analysis.

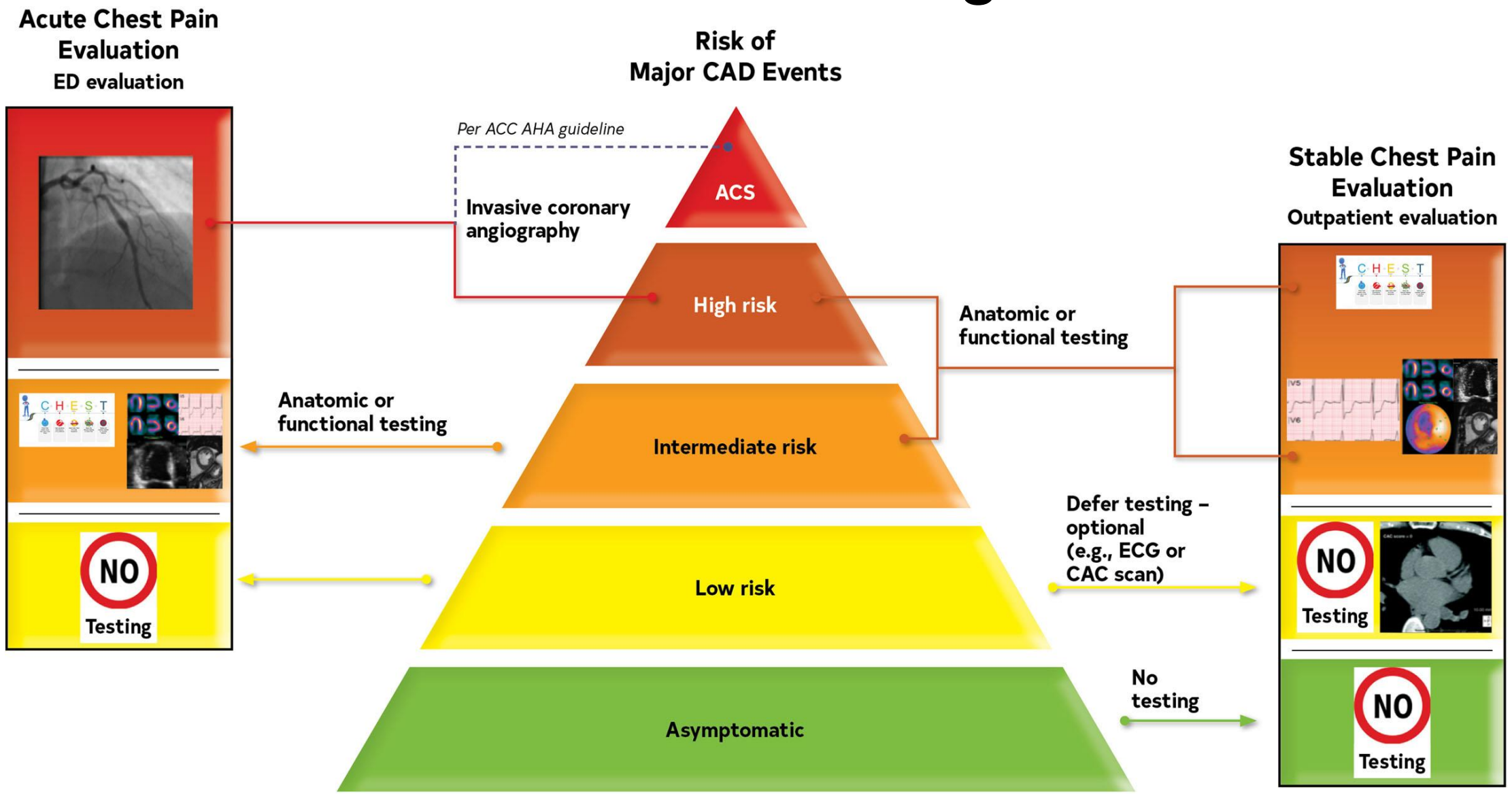
**Blankstein R, Bittencourt MS, Bhatt DL. *J Am Coll Cardiol*. 2017;69:1771-1773.**

# Key Questions for Cardiac Imaging (Select Appropriate Strategy)



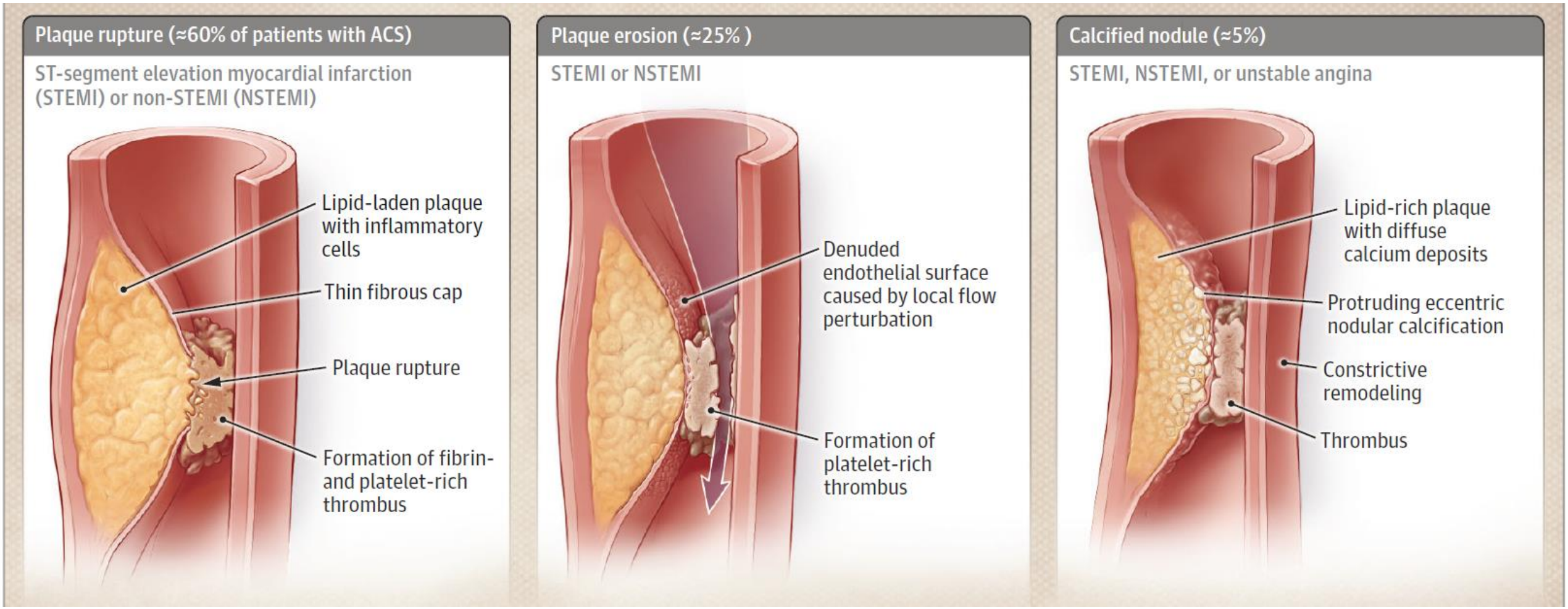

Bhatt DL, Taqueti VR. *JACC Cardiovasc Imaging*. 2017;10:350-353.

# Cardiac Testing



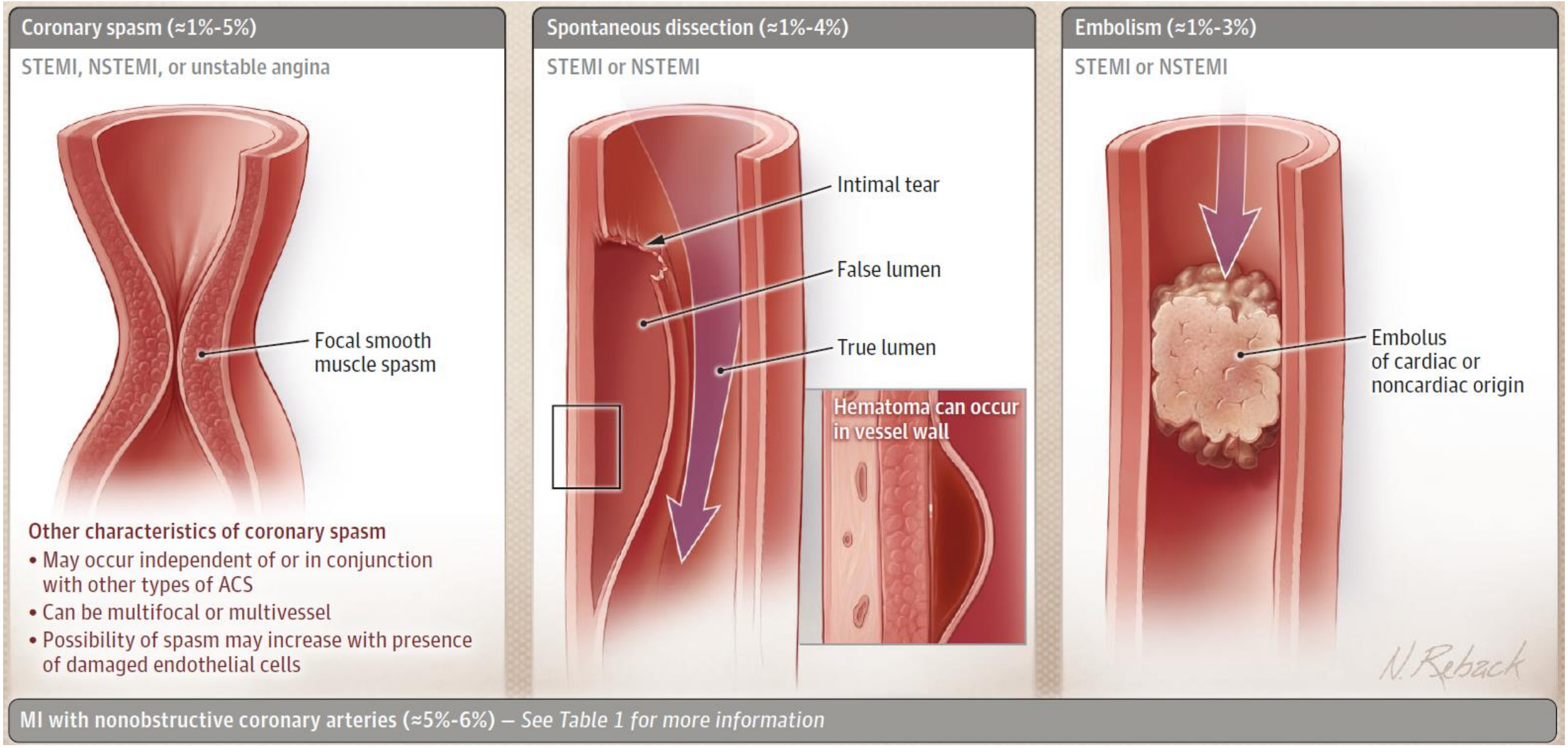

Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.

# Causes of ACS




Bhatt DL, Lopes RD, Harrington RA. *JAMA*. 2022;327:662-675.

# Causes of ACS




Bhatt DL, Lopes RD, Harrington RA. *JAMA*. 2022;327:662-675.

ESC European Society of Cardiology

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https://doi.org/10.1093/eurjpc/zwab210

**INVITED EDITORIAL**

# In NSTEMI, are patients without SMuRFs real?

**Purvi Parwani[1]* and Deepak L. Bhatt[2]**

[1]Division of Cardiology, Department of Medicine, Loma Linda University Health, 11234 Anderson St, Loma Linda, CA 92354, USA; and [2]Brigham and Women's Hospital, Harvard Medical School, 75 Francis Street, Boston, MA 02115, USA

**This editorial refers to 'Addressing disparities of care in non-ST-segment elevation myocardial infarction (NSTEMI) patients without standard modifiable risk factors: insights from a nationwide cohort study.', by S.M. Moledina *et al.* doi:10.1093/eurjpc/zwab200.**

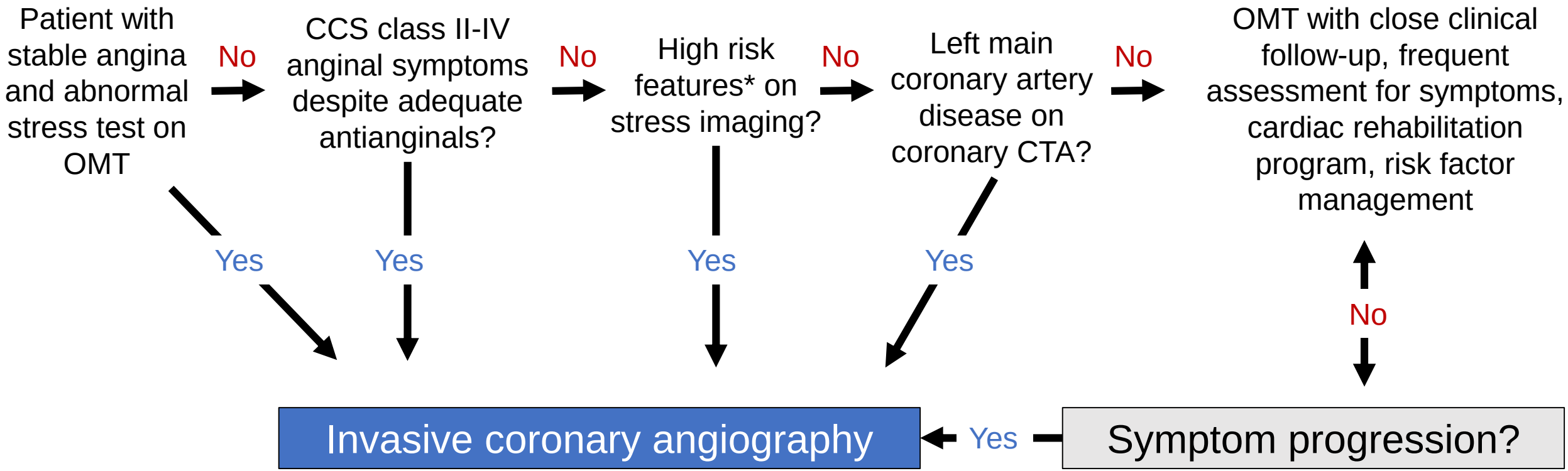
Improvement in diagnosis and treatment of conventional cardiovascular (CV) risk factors (diabetes, hypertension, hypercholesterol-

ascertainment and accuracy of classification of diagnoses,[7] it remains a challenge with most of the observational data. Identification of SMuRF status is based on interrogation of medical records and is not independently validated with biochemical testing; thus, it may be susceptible to underdiagnosis. In the present analysis, former smoking, and family history of coronary artery disease (CAD) was not counted as risk factors, and information on established risk factors such as triglycerides (TG), HDL-c, and lip-

SMuRF=standard modifiable cardiovascular risk factors

**Parwani P, Bhatt DL. *Eur J Prev Cardiol*. 2022;00:1-3.**

# Management of Chronic Stable Angina in Patients with Abnormal Stress Imaging Treated with Optimal Medical Therapy



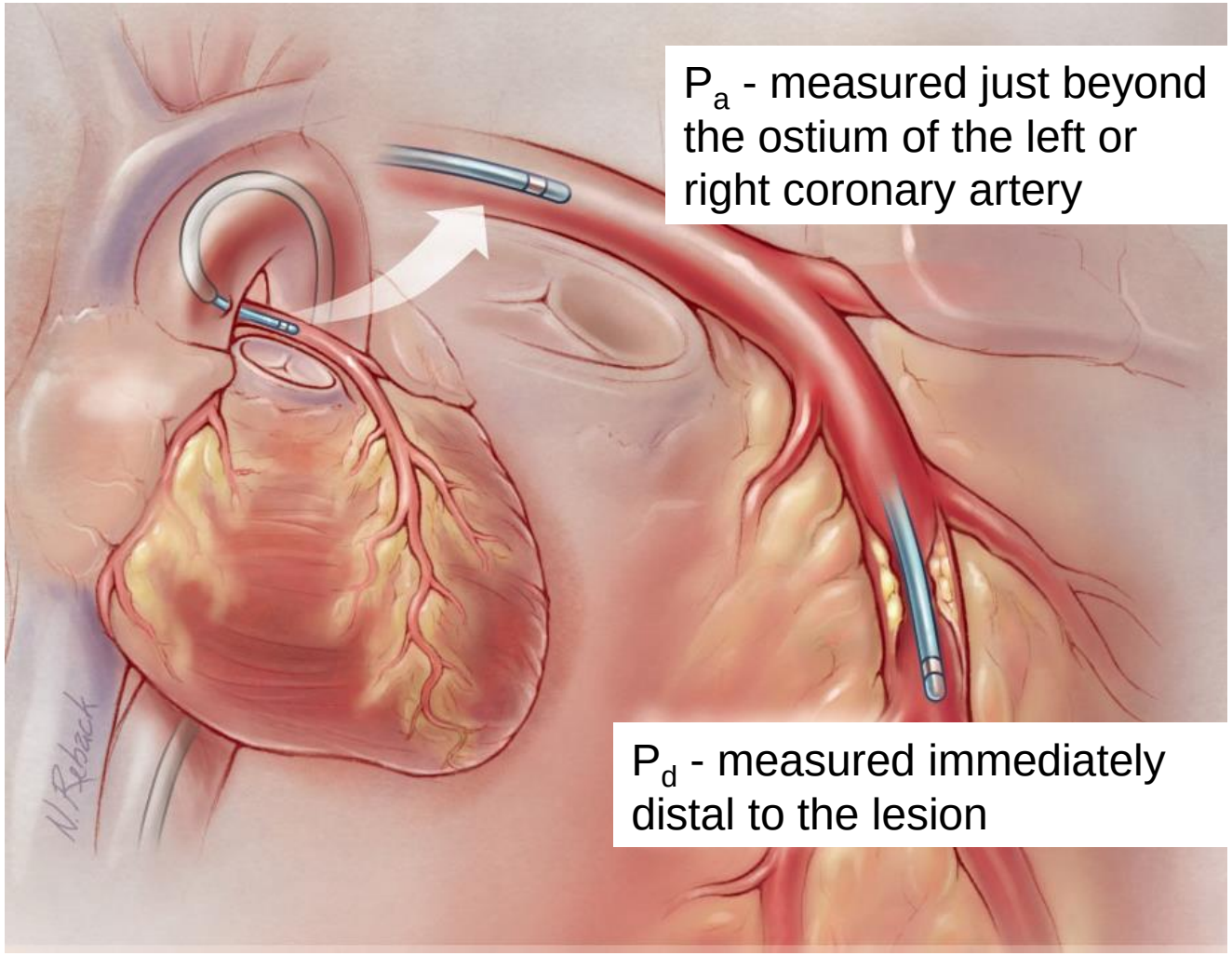

*e.g., large or multivessel ischemia region, reduced LVEF, ischemic dilation

**Bhatt DL, Peterson BE. *JACC Cardiovasc Imaging*. 2021;14:1394-1397.**

# Fractional Flow Reserve Measurement for the Physiological Assessment of Coronary Artery Stenosis Severity

- Adding FFR to angiography aids understanding of angiographically ambiguous lesions
- A wire equipped with a pressure sensor measures intracoronary pressure proximal and distal to the lesion
- FFR = ratio of $P_d$ to $P_a$
- A value of 1.0 is considered normal flow
- The instantaneous wave-free ratio value for ischemia is ≤ 0.89
- An FFR ≤ 0.80 can diagnose myocardial ischemia either at rest or after vasodilator

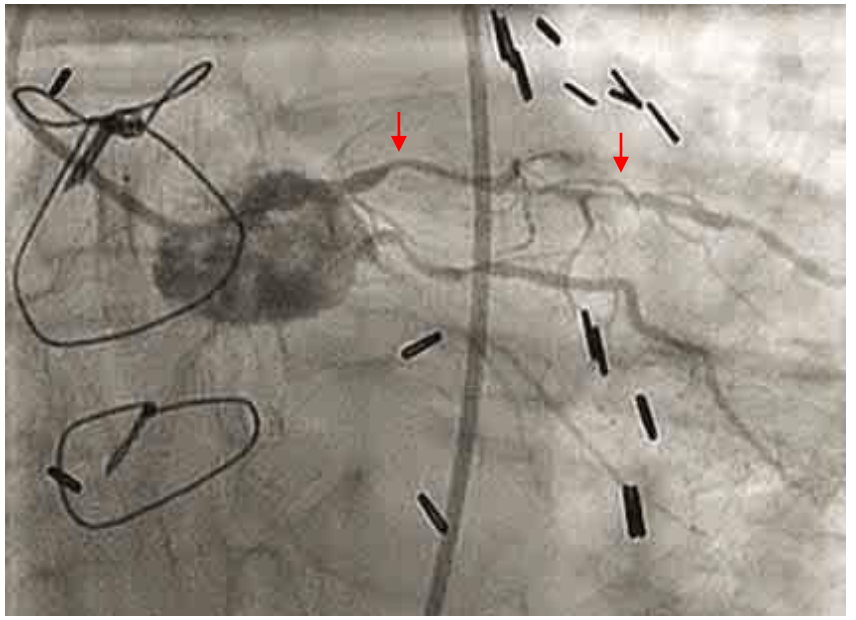
$$\frac{Pd}{Pa} = \frac{75}{100} = 0.75$$



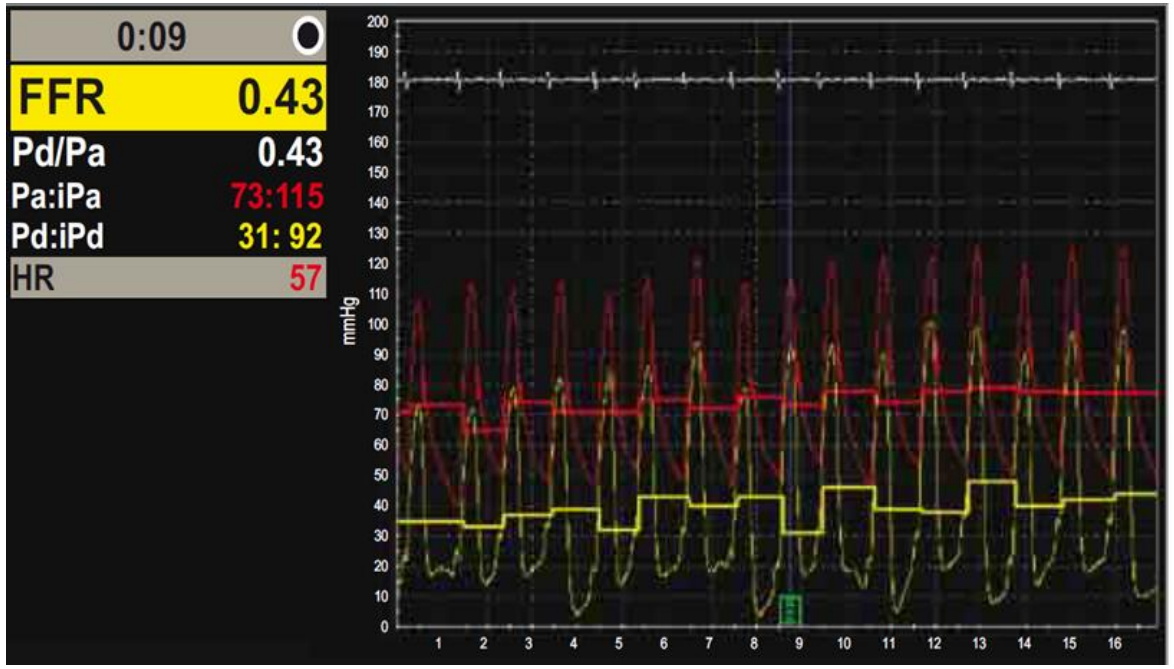

**Bhatt DL. *JAMA*. 2018;320:1275-1276.**

# FFR Example

- This patient received a 2.5 × 23-mm everolimus-eluting stent initially placed in the distal lesion, as it was more hemodynamically significant
- AFFR with adenosine was repeated after this
- procedure for the proximal lesion, revealing a nadir value of 0.78
- The patient received an overlapping 2.75 × 18-mm everolimus-eluting stent in the proximal lesion
- With stents in both lesions, the repeated FFR value with adenosine was 0.93
- >0.95 is ideal post stent placement, but the residual proximal disease in this patient can be treated medically



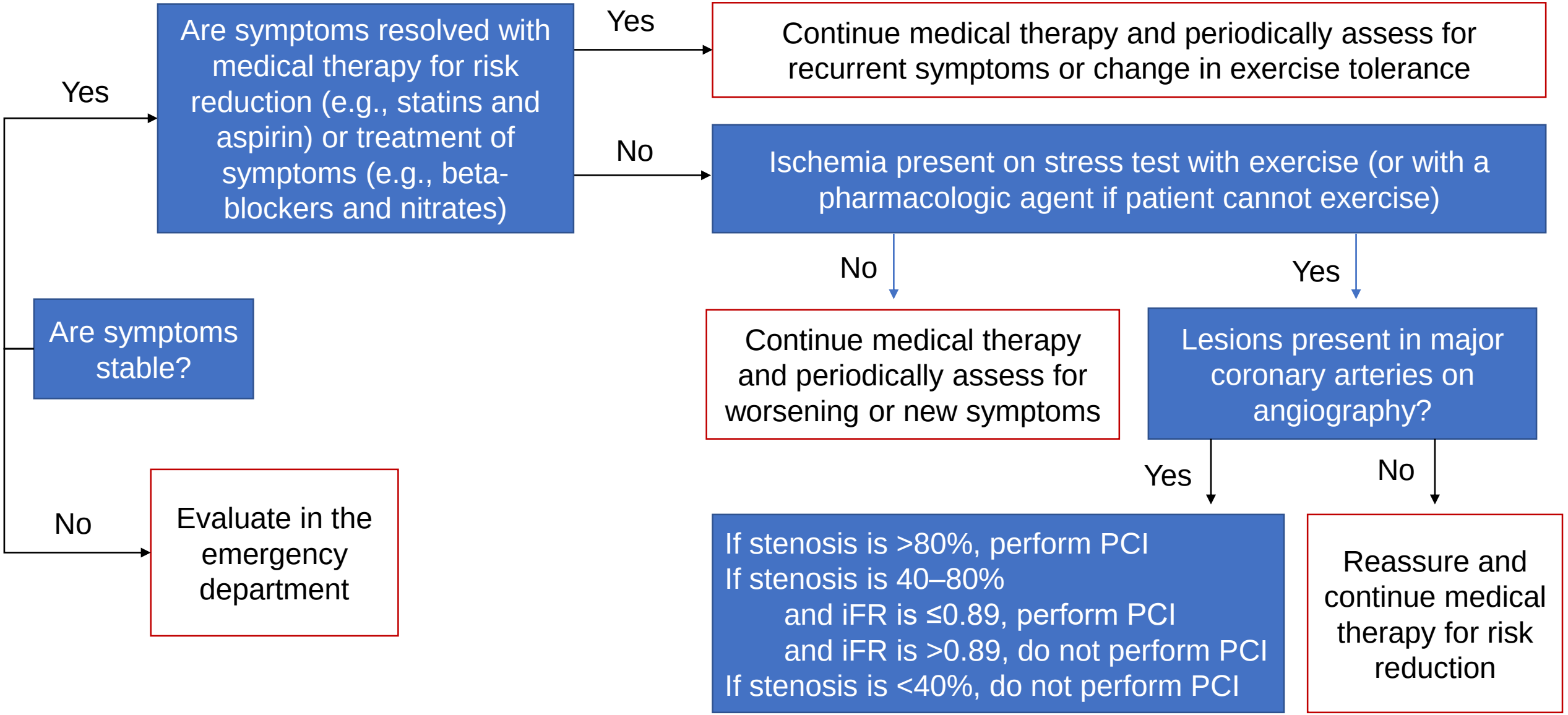
2 serial lesions of intermediate severity




FFR measurement post induction of maximal hyperemia

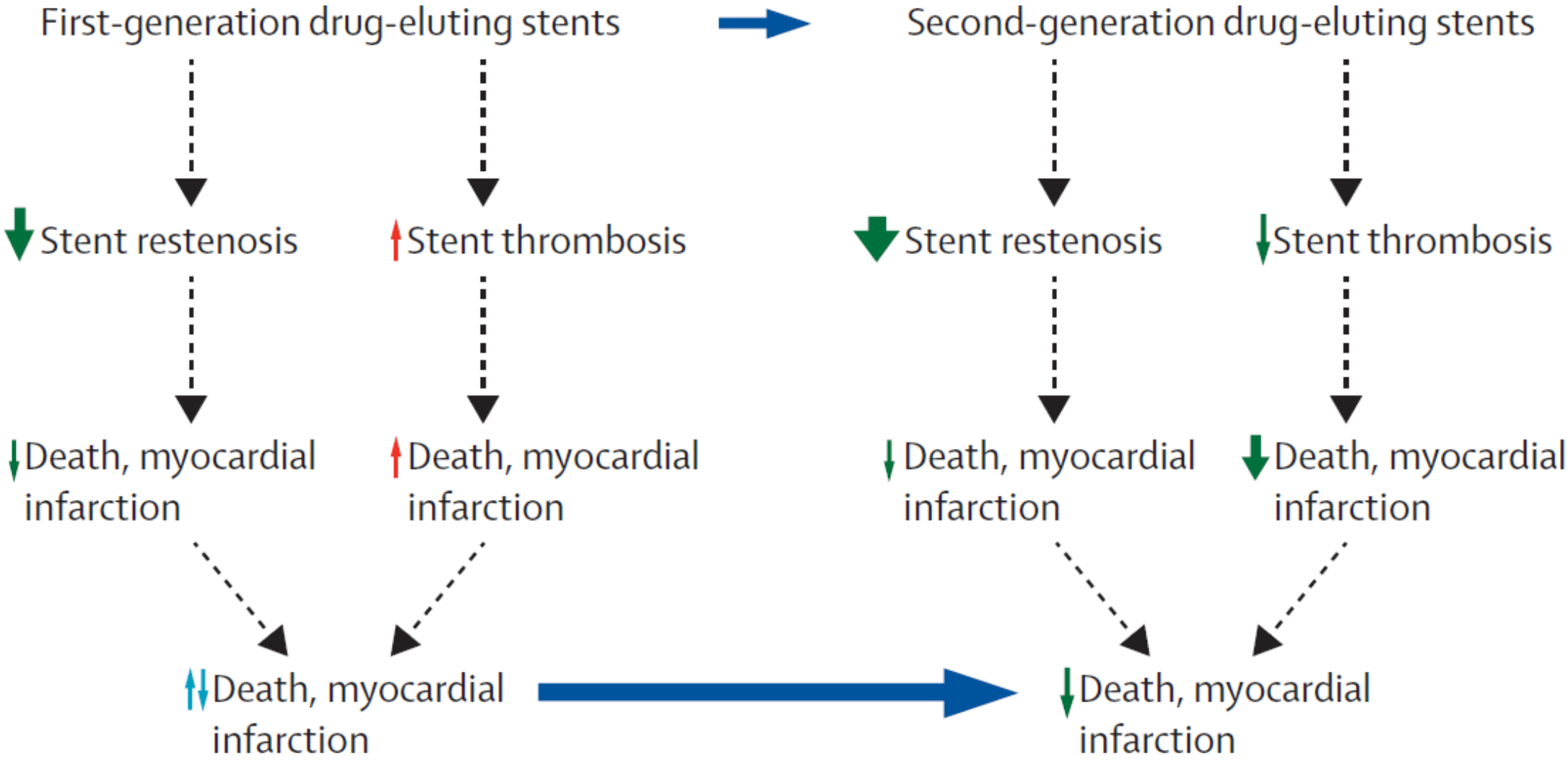
**Kumbhani DJ, Bhatt DL. *JAMA Cardiol.* 2016;1:359-360.**

# Stable Coronary Disease: Evaluation




**Bhatt DL. *N Engl J Med*. 2017;376:1879-1881.**

# Second Generation Drug-Eluting Stents and Decreased Risk of MI and CV Death: Theoretical Framework



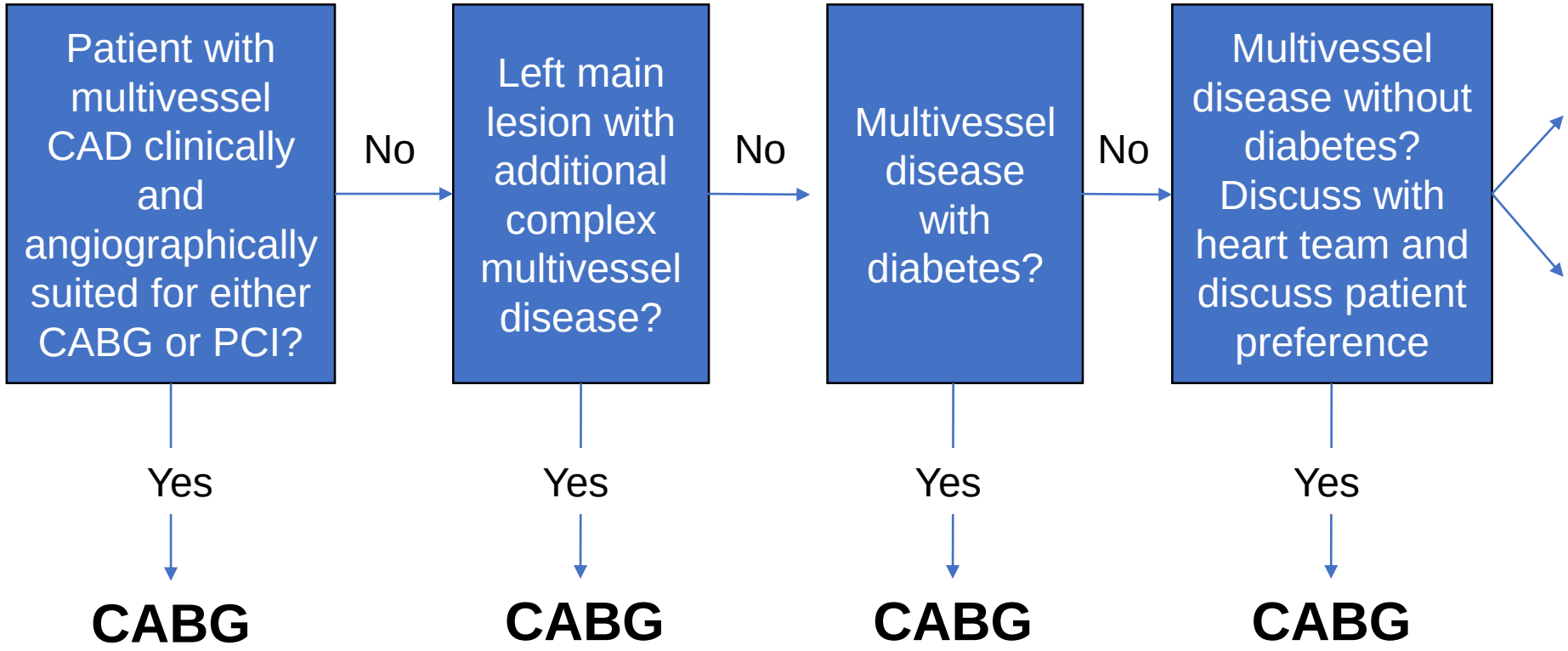

Bhatt DL. *Lancet*. 2012;380:1453-5.

# Timing of PCI Based on Clinical Syndrome

| Stable Angina | NSTEMI or Unstable Angina | STEMI |
|---|---|---|
| • ~20% treated with PCI<br>• Severe stenosis on angiogram<br>• PCI elective: after patient begins maximally tolerated medical therapy, if substantial symptoms and ischemia persist<br>• PCI improves angina and reduces future need for urgent revascularization in severe single-vessel disease; advantages and disadvantages vs CABG in multivessel disease and in left-main disease<br>• If no PCI: antianginal medications, which may require dose escalation with time; when medications are no longer effective there may be a need for elective or urgent revascularization | • ~50% treated with PCI<br>• Ulcerated lesion on angiogram<br>• PCI urgent: 24-48 hours (within 24 ideal)<br>• PCI emergent: if ongoing symptoms or dynamic ECG changes<br>• PCI reduces the composite of death or myocardial infarction<br>• If no PCI, stress test prior to discharge, and if significant ischemia, coronary angiography and revascularization based on coronary anatomy | • ~90% treated with PCI<br>• Occlusive lesion on angiogram<br>• Emergent: within 90-120 minutes (within 60 ideal)<br>• PCI reduces death<br>• If no PCI, treatment with fibrinolytics, with prompt transfer for probable PCI |

**Bhatt DL. *JAMA*. 2018;319:2127-8.**

# CABG for Patients with Diabetes and Multivessel Disease




**Favors CABG:**

Patient with high lesion complexity due to lower incidence of repeat revascularization and lower burden of residual angina

**Favors PCI:**

Patient with high stroke risk or advanced age due to less arrythmia, bleeding, and wound complications as well as faster recovery time

**Bhatt DL. *Lancet*. 2018;391:913-914.**

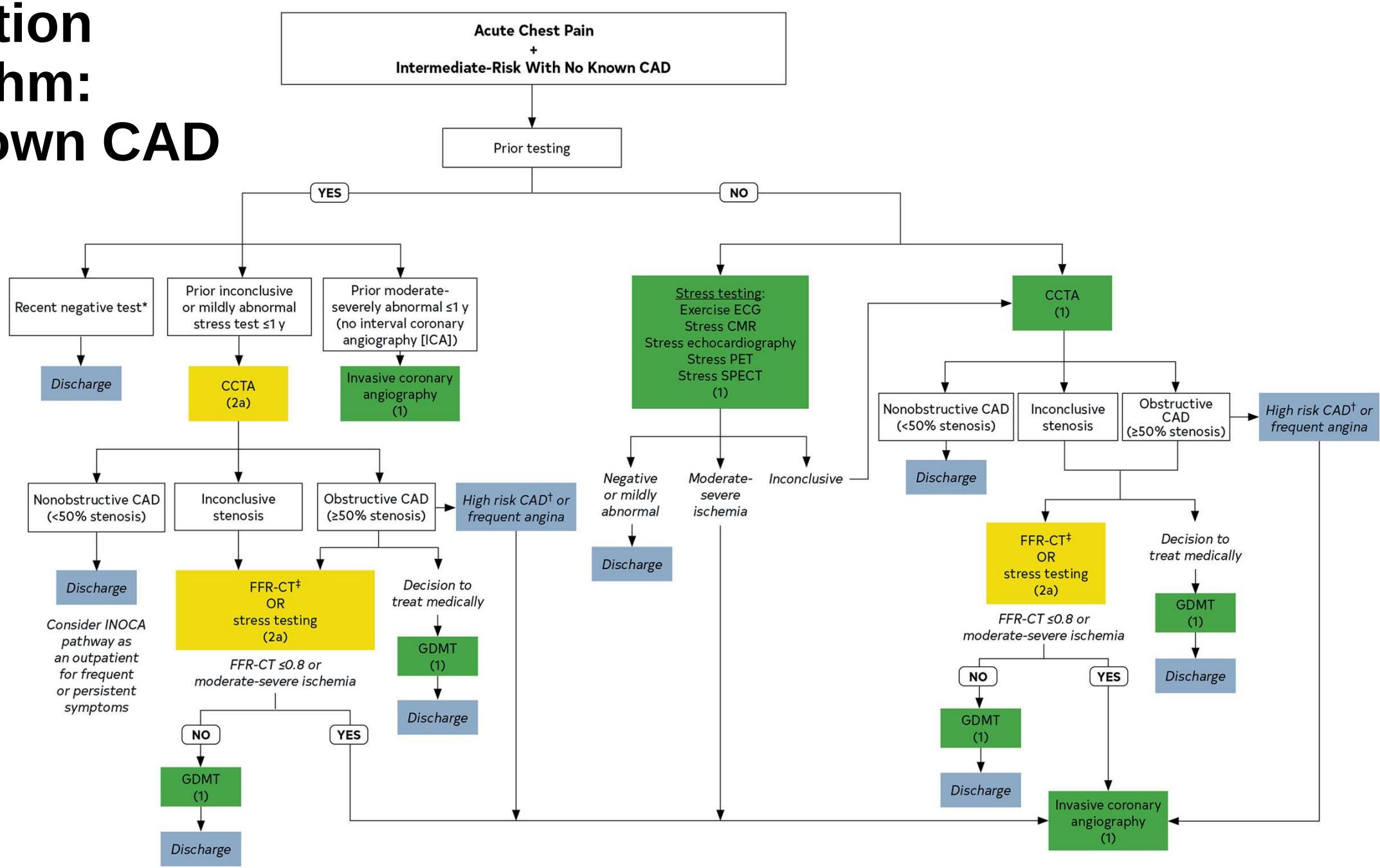
# Management of Stable Angina in Patients with CAD: Revascularization

**Both surgical and percutaneous revascularization outcomes are impaired in the setting of T2DM, with increased risk of both procedural complications and recurrent ischemic events**

| Multivessel CAD, left main disease, complex coronary artery | | | |
|---|---|---|---|
| CABG is associated with lower MACEs compared to PCI | Use of internal mammary artery to anterior wall is an important driver of benefit of CABG | Typically achieve more complete revascularization with CABG vs PCI | Newest-generation drug-eluting stents have narrowed the gap between CABG and PCI |

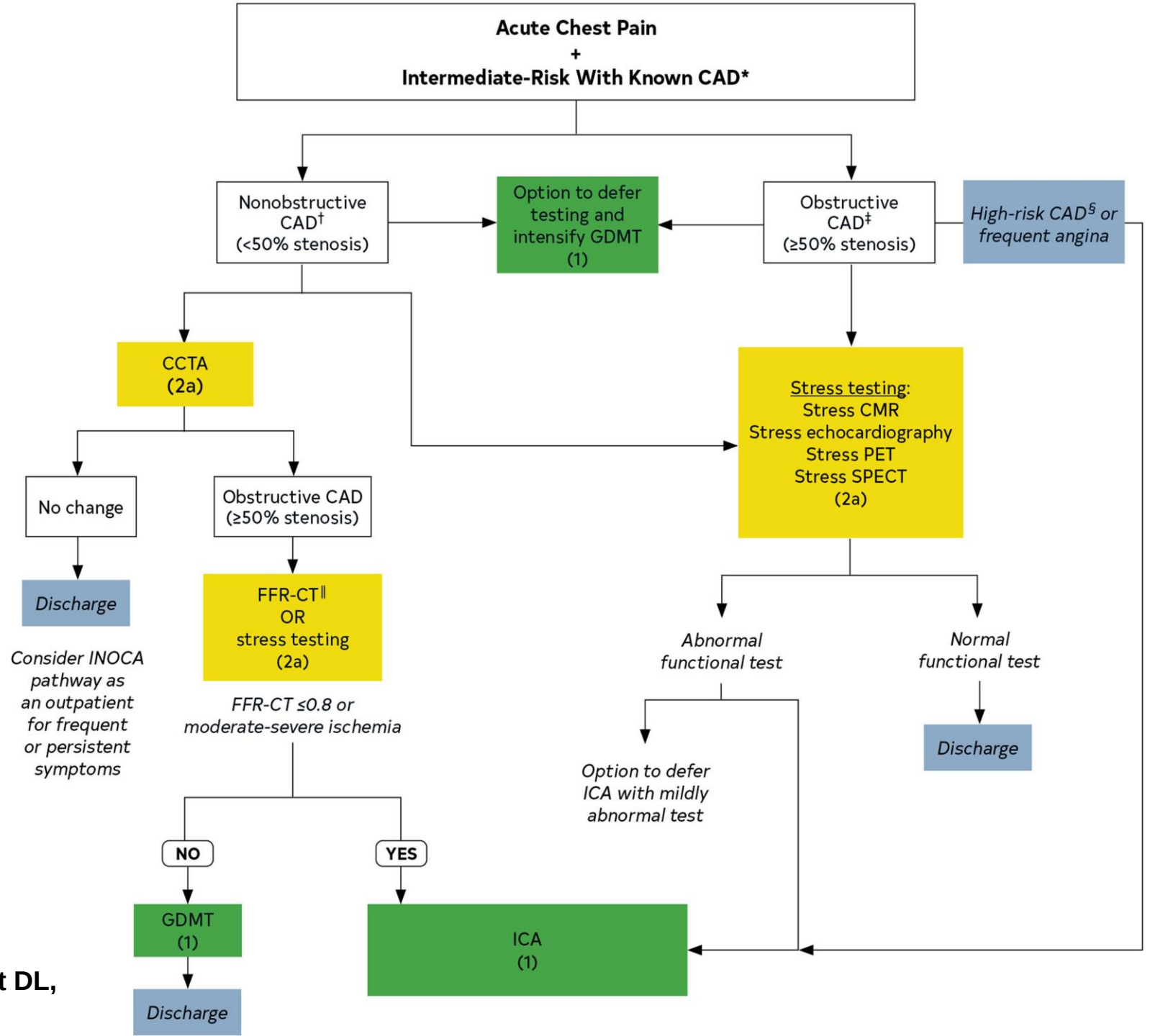
Arnold SV, Bhatt DL, Barsness GW, Beatty AL, Deedwania PC, Inzucchi SE, et al. *Circulation*. 2020;141:e779–e806

# Evaluation Algorithm: No Known CAD




Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.

# Evaluation Algorithm: Known CAD




Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.

# Testing: Choosing the Right Test

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pretest likelihood of CAD** | Low | → No testing necessary | → Option for CAC for ASCVD risk stratification | | | |
| | Intermediate-high | → Younger patient (<65 y of age) | **OR** | Less obstructive CAD suspected | → CCTA favored | |
| | Intermediate-high | → Older patient (≥65 y of age) | **OR** | More obstructive CAD suspected | → Stress testing favored | |

| **Stress testing information** | | | | | |
|---|---|---|---|---|---|
| | **ETT** | **Stress echocardiography** | **SPECT MPI** | **PET MPI** | **Stress CMR MPI** |
| **Patient capable of exercise** | ✓ | ✓ | ✓ | | |
| **Pharmacologic stress indicated** | | ✓ | ✓ | ✓ | ✓ |
| **Quantitative flow** | | | | ✓ | ✓ |
| **LV dysfunction/scar** | | ✓ | ✓ | ✓ | ✓ |

CCTA = coronary computed tomography angiography; ETT = exercise tolerance test; SPECT = single-photon emission computed tomography; CMR = cardiovascular magnetic resonance

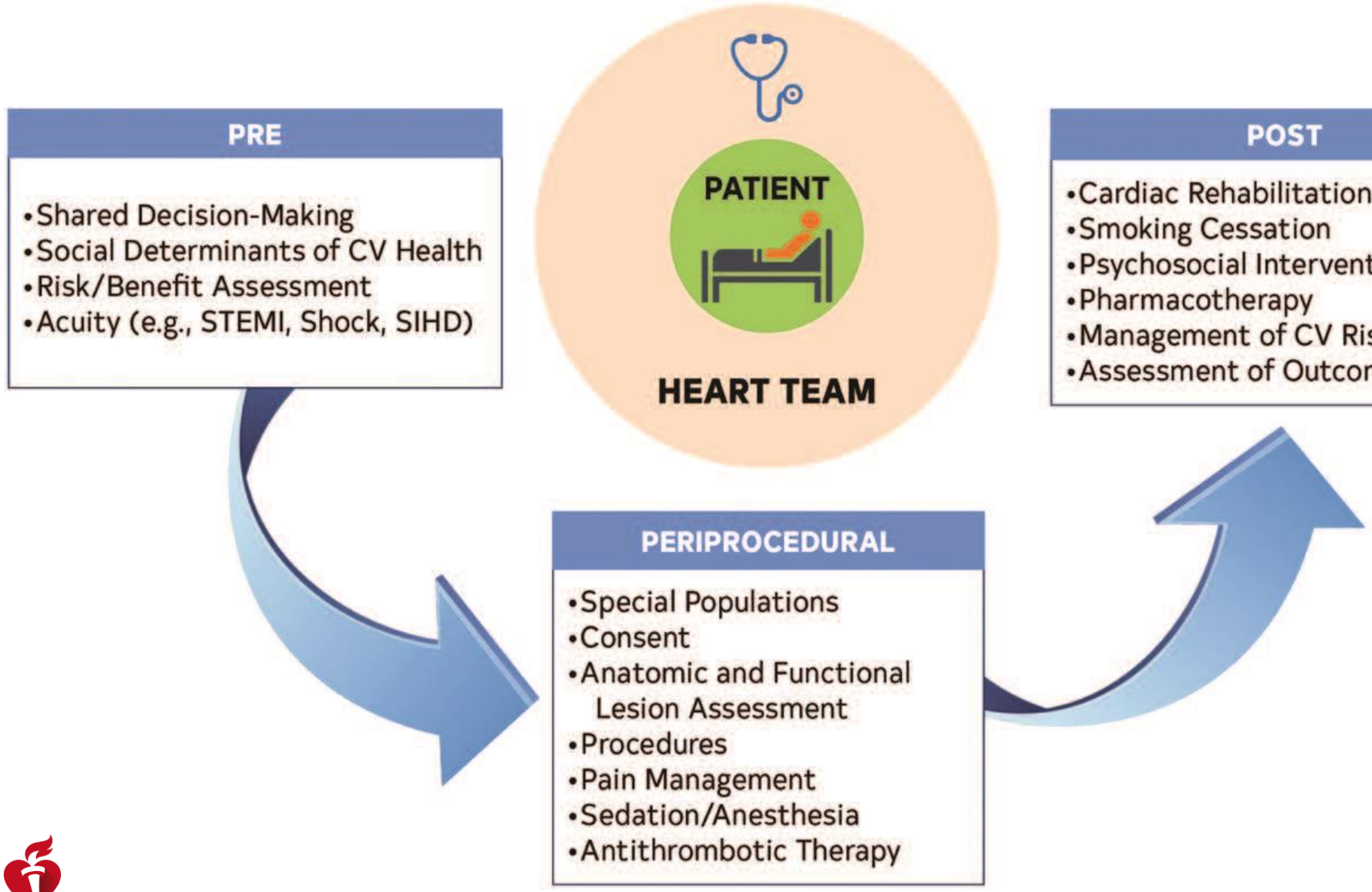
**Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.**

# Testing: Choosing the Right Test

| | Favors use of CCTA | Favors use of stress imaging |
|---|---|---|
| **Goal** | • Rule out obstructive CAD<br>• Detect nonobstructive CAD | • Ischemia-guided management |
| **Availability and expertise** | • High-quality imaging and expert interpretation routinely available | • High-quality imaging and expert interpretation routinely available |
| **Likelihood of obstructive CAD** | • Age <65 y | • Age ≥65 y |
| **Prior test results** | • Prior functional study inconclusive | • Prior CCTA inconclusive |
| **Other compelling indications** | • Anomalous coronary arteries<br>• Require evaluation of aorta or pulmonary arteries | • Suspect scar (especially if PET or stress CMR available)<br>• Suspect coronary microvascular dysfunction (when PET or CMR available) |

**Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, et al. *Circulation*. 2021;144:e368-e454.**

# Revasc Guidelines: Patient-Centered Care

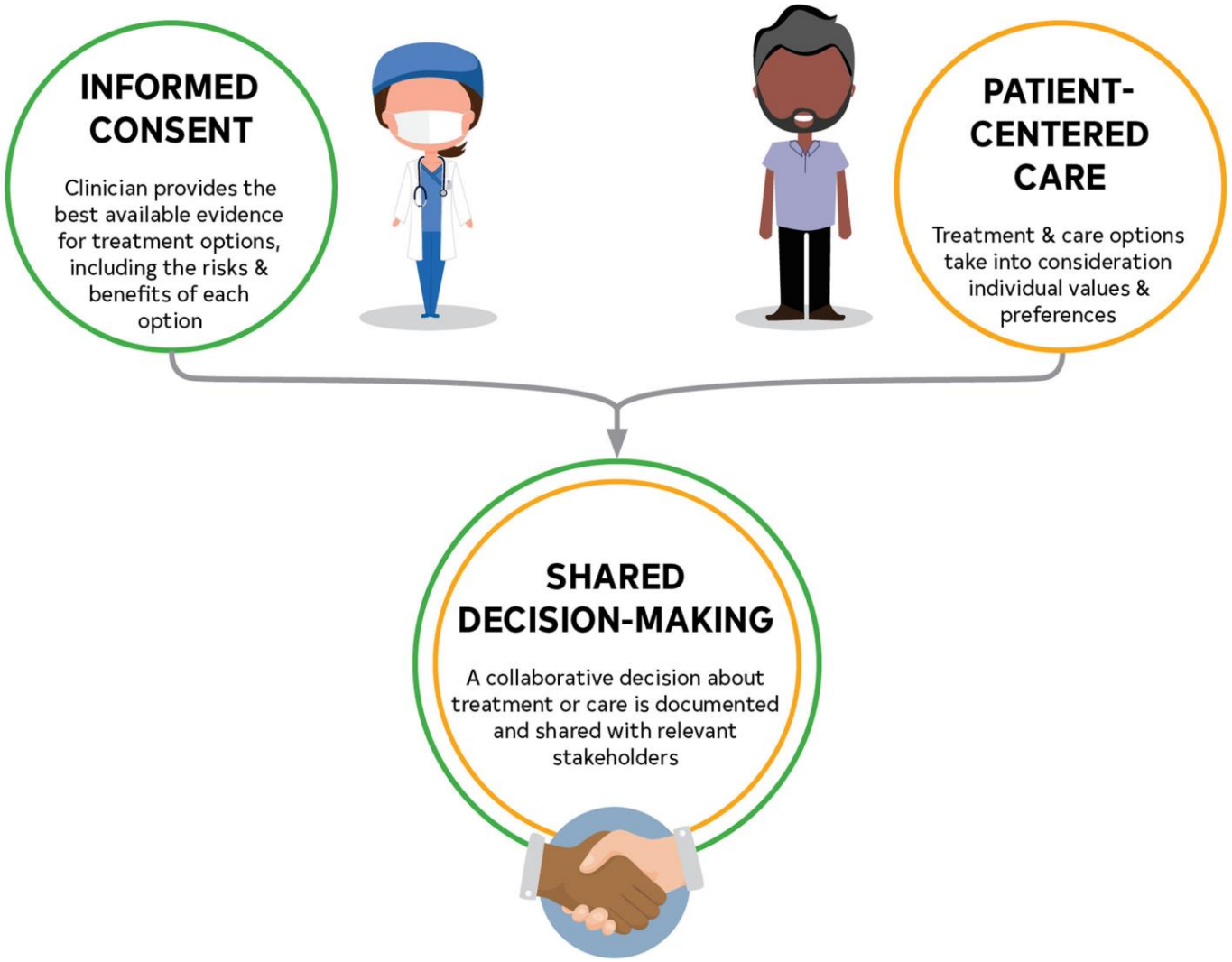



When the optimal treatment strategy is unclear, **a Heart Team approach** that includes representatives from interventional cardiology, cardiac surgery, and clinical cardiology is recommended to improve patient outcomes



**Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, Beckie TM, Bischoff JM, et al. *Circulation*. 2022;145:e18-e114.**

# Revasc Guidelines: Shared Decision-Making






**Lawton JS, Tamis-Holland JE, Bangalore S, Bates ER, Beckie TM, Bischoff JM, et al. *Circulation*. 2022;145:e18-e114.**

# 2021 Chest Pain Guidelines: Novel Aspects

- First U.S. or international guideline for evaluating chest pain
- Recommendations for both acute and stable chest pain
- Deferral of testing in low-risk individuals
- Contemporary models to estimate risk/pretest probability of CAD
- Emphasis on more selective use of imaging
- Evidence-based recommendations (with increased quantity and quality vs prior)
- Emphasis on intensification of preventive therapies
- Incorporates use of contemporary imaging techniques

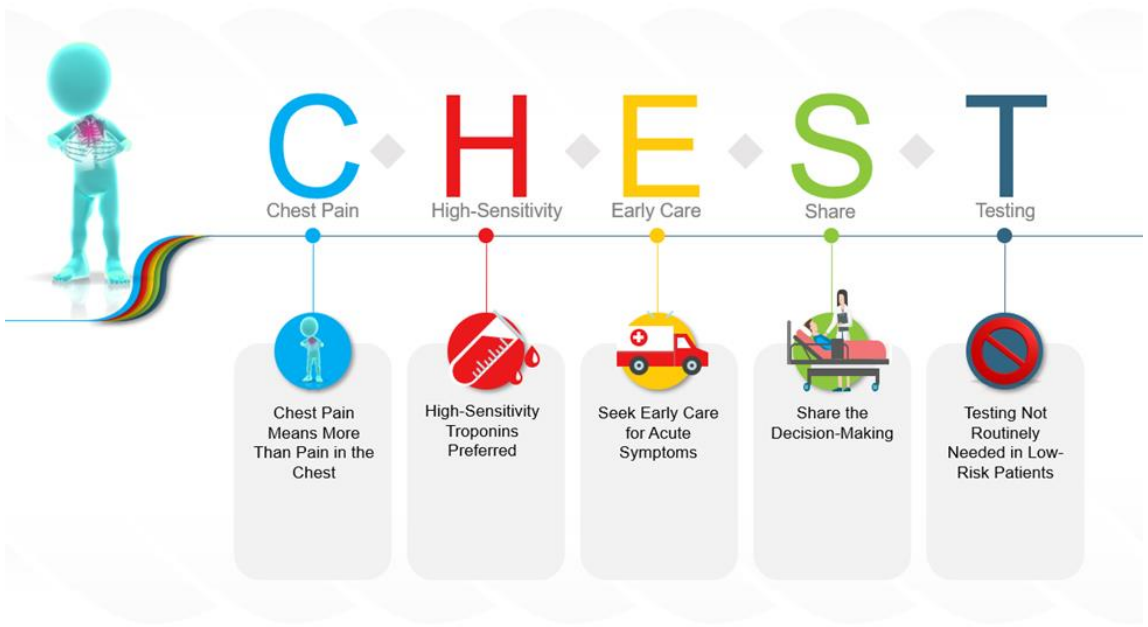
Blankstein R, Gulati M, Jaber WA, Bullock-Palmer RP, Bhatt DL, Shaw LJ. *JACC Cardiovasc Imaging*. 2022;15:140-144.

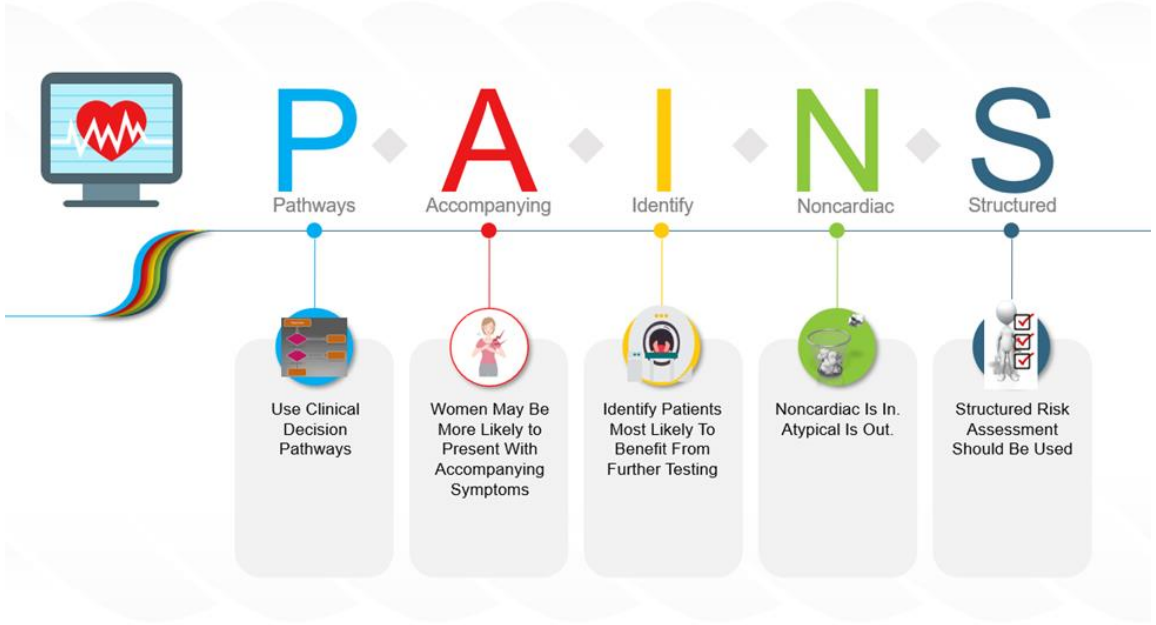
# 2021 Chest Pain Guidelines: Novel Aspects

- **Specific recommendations for the evaluation of nonobstructive CAD**
- **Emphasis on unique aspects of evaluating women with chest pain, including microvascular disease and ischemia with nonobstructive CAD**
- **Moving away from atypical chest pain as a descriptor**
- **Incorporation of prior test results when deciding on patient management and need/type of testing, including warranty period of prior normal coronary CTA and stress test results**
- **Factors to consider when selecting between coronary CTA and stress testing**
- **Detailed recommendations on evaluating noncardiac causes of chest pain**

**Blankstein R, Gulati M, Jaber WA, Bullock-Palmer RP, Bhatt DL, Shaw LJ. *JACC Cardiovasc Imaging*. 2022;15:140-144.**

# Take-Home Messages for the Evaluation and Diagnosis of Chest Pain

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Heart & Vascular Center

# *Thank You!*


Deepak L. Bhatt, MD, MPH
*Executive Director,*
*Interventional Cardiovascular Programs,*
*BWH Heart & Vascular Center;*
*Professor of Medicine,*
*Harvard Medical School*
Email: DLBhattMD@post.Harvard.edu
Twitter: @DLBhattMD


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