# Improving Global Public Health Through Cardiovascular CT

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# Disclosures

**Past-President**


**Blavatnik Family Foundation**

**Helen Gurley Brown Foundation**

**Gilinksi Family**

**NIH-NHLBI**

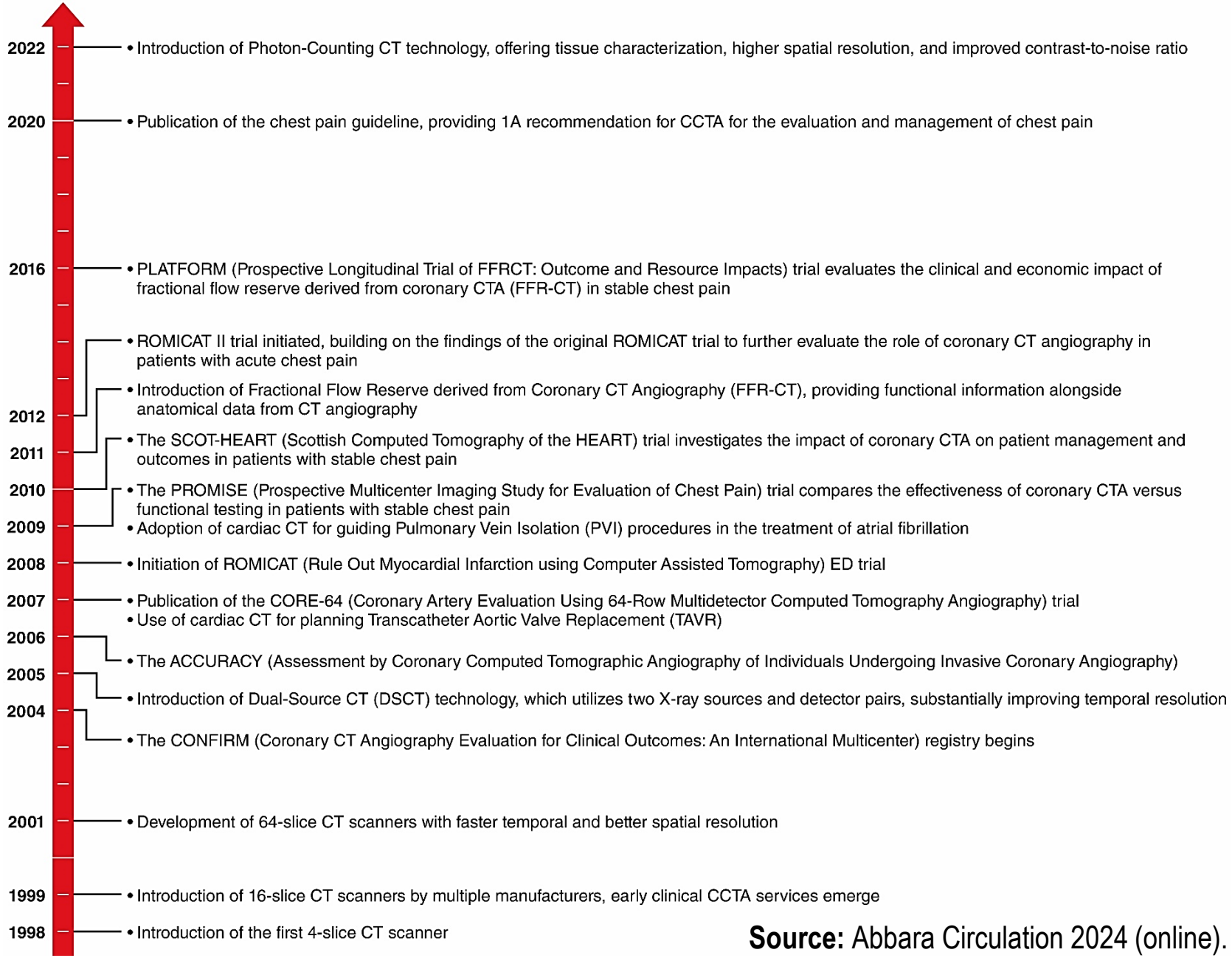
- U01HL10556 - ISCHEMIA Trial Imaging Coordinating Center
- R01HL159433 - Atherosclerotic Plaque Progression with COVID-19
- U01HL088942 - Multiparametric Imaging to Understand Mechanisms of Post-Intervention Benefit in the Percutaneous or Surgical Repair In Mitral Prolapse & Regurgitation Trial for ≥60 Year Olds

**DOD** Women's IschemiA TRial to Reduce Events In NonObstRuctive CAD (WARRIOR) Trial

**Invited Speaker / Unrestricted Grant Support** Heartflow

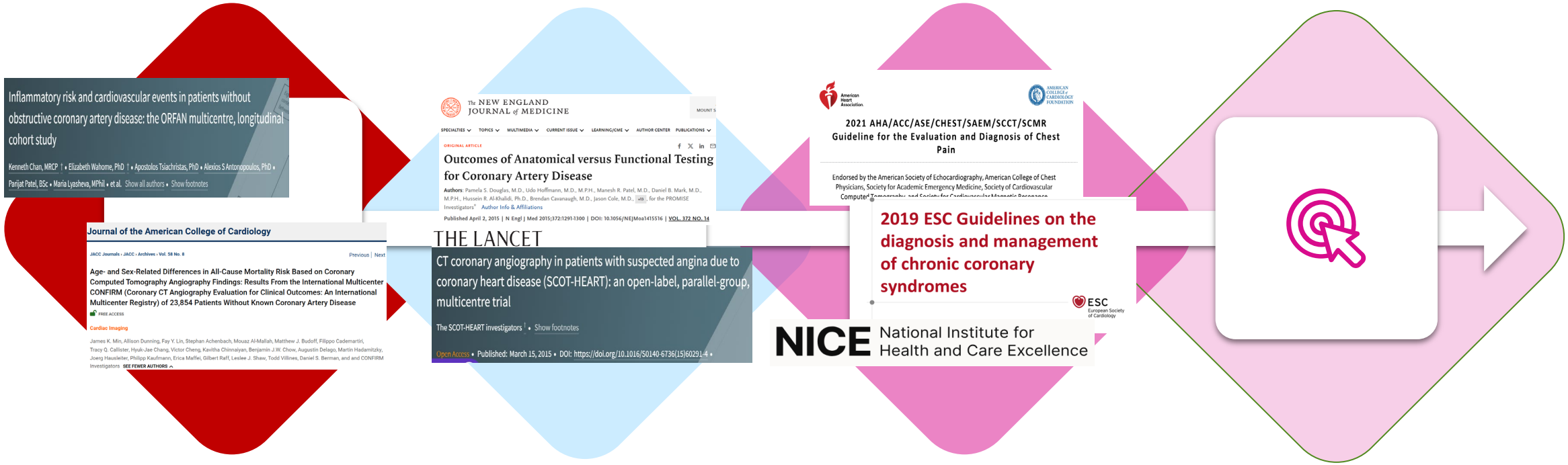
# Past, Present, & Future

**"After remarkable developments in recent decades, we seem to unlocked but a small portion of the enormous potential of cardiac CT."**




**Source:** Abbara Circulation 2024 (online).

# The CCTA Revolution!




## MULTICENTER REGISTRIES

CONFIRM, ORFAN…

## RANDOMIZED TRIALS

CT-STAT, PROMISE, SCOT-HEART…

## GUIDELINES

NICE, ESC, ACC-AHA…

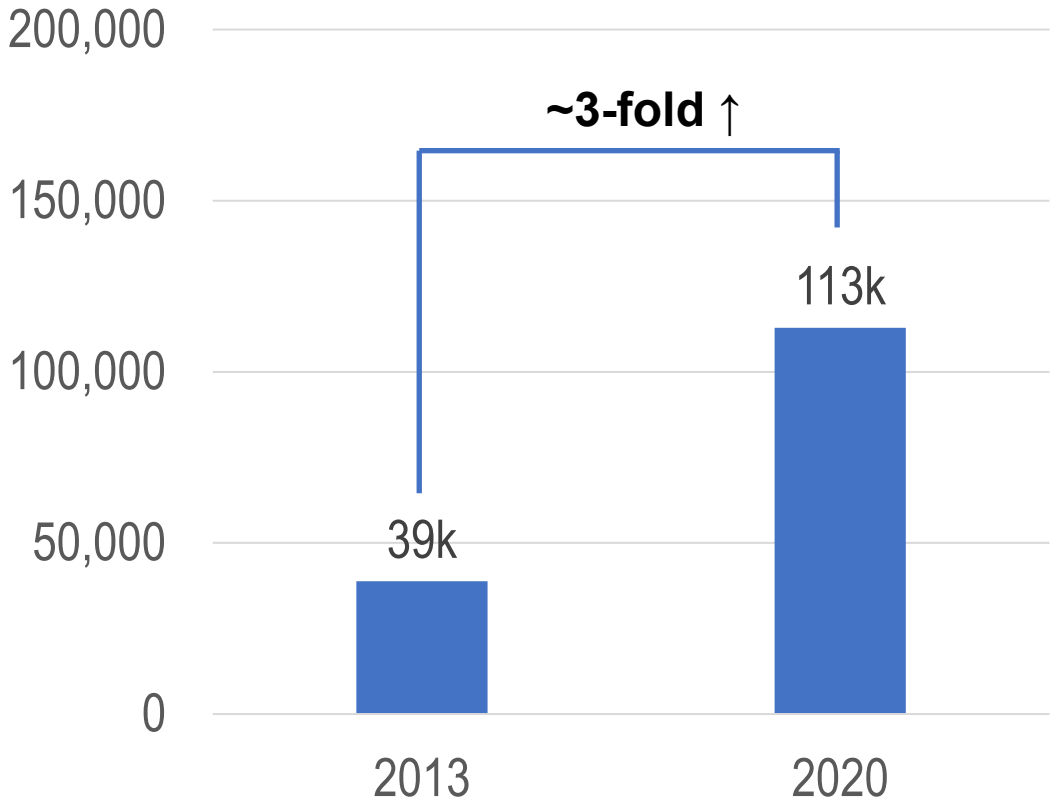
## WHAT'S NEXT?

?

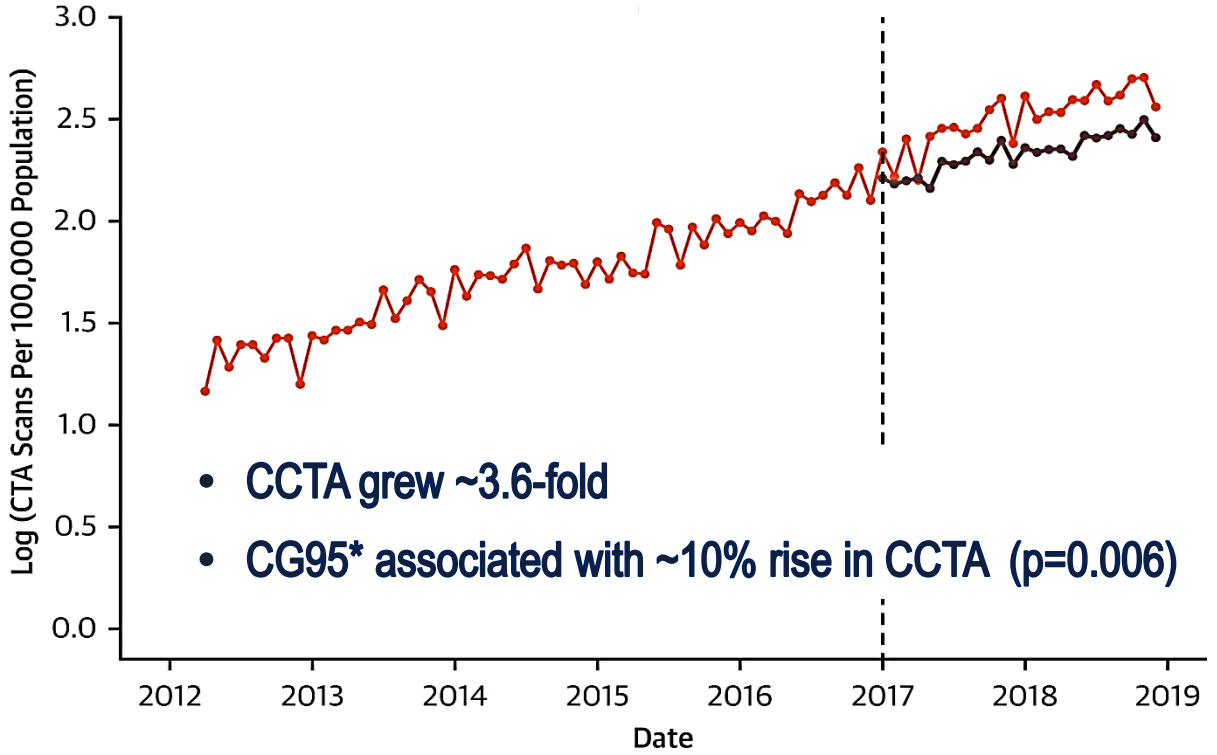
# Rising Demand for CCTA

- *Rising CCTA demand - $2^0$ to ↑ CAD risk worldwide combined with substantive research + supportive guidelines*

## CCTA Use Among Medicare Beneficiaries

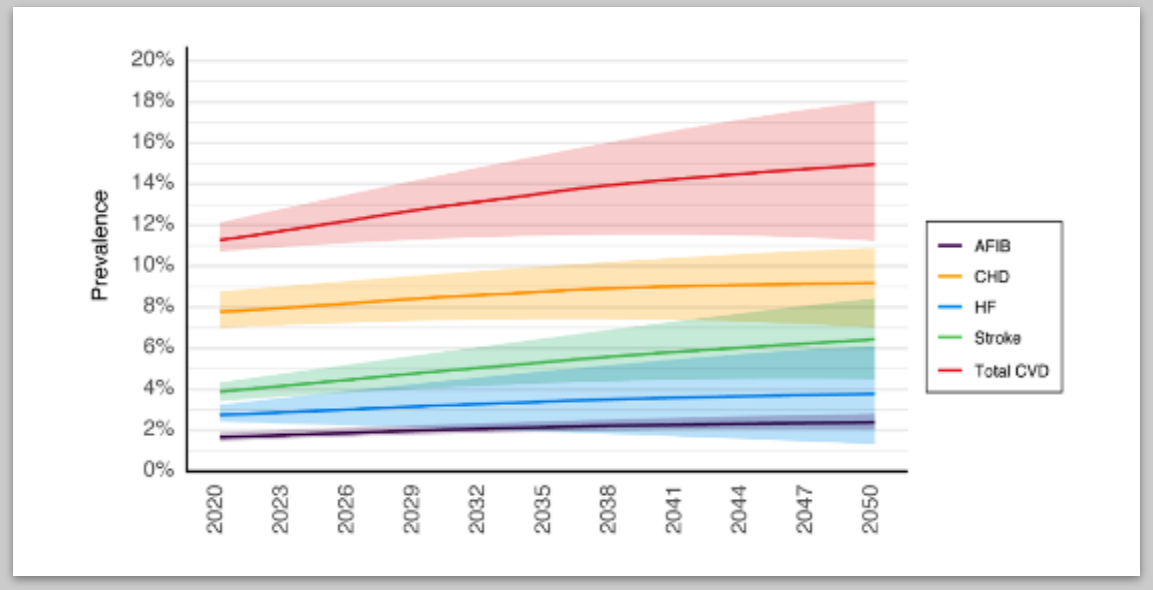


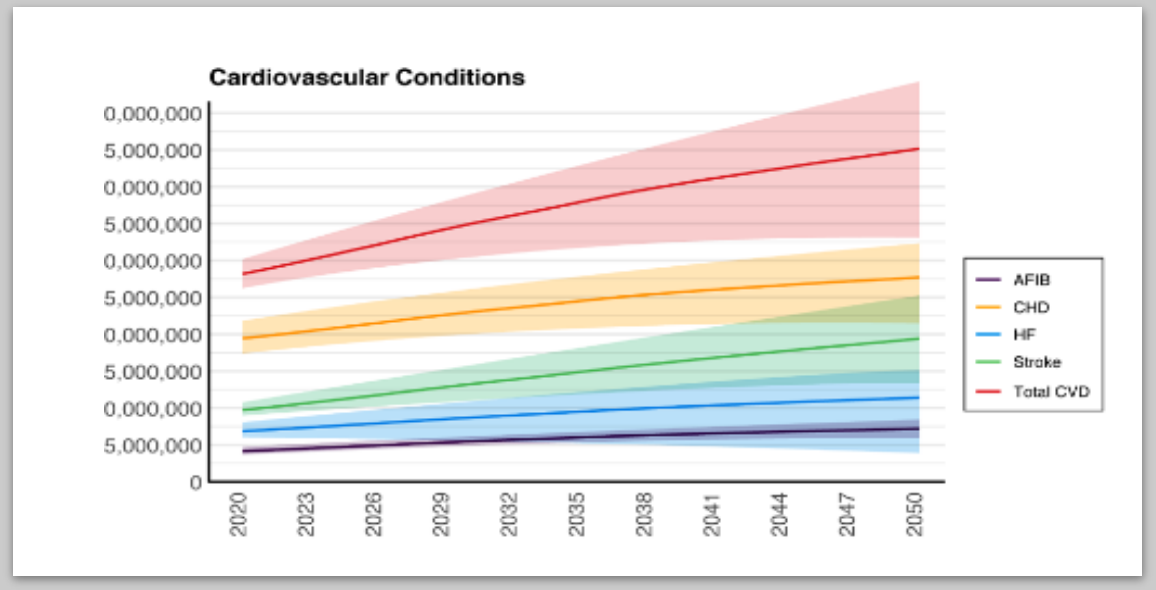

## UK Trends in CCTA Use (N=1,909,314)

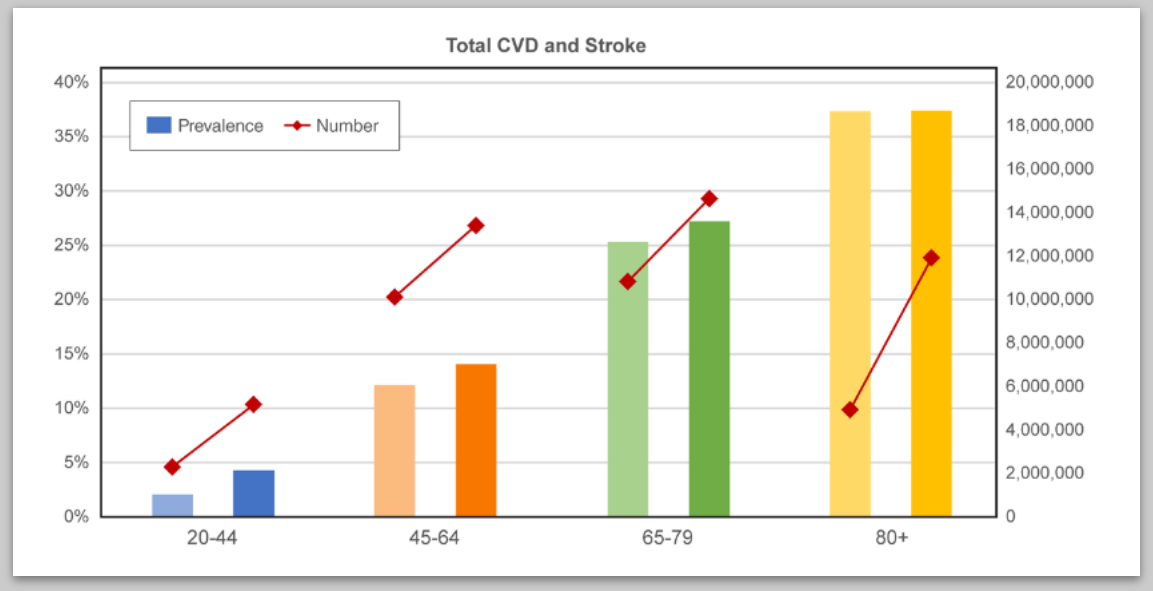



…CCTA market is growing with compounded annual growth rate ~6%

**Source:** Reeves Radiol: Cardiothoracic Imaging 2023;3:5., https://www.databridgemarketresearch.com, Al-Ogaili RSNA 2023., Weir-McCall JACC Imag 2023;16:659-671.




- Prevalence of *Hypertension* (51% in 2020 → 61.0% in 2050), *Diabetes* (16%→27%), *Obesity* (43%→61%)
- Prevalence of *CAD* (8%→9%), *HF* (3%→ 4%), & *Total CVD* (11%→15%)
- CVD-related costs expected to triple to $1.8 trillion by 2050

**Source:** Joynt Maddox Circulation 2024;149:e00–e00.

# Risk Factor Burden at Younger Ages is Shocking

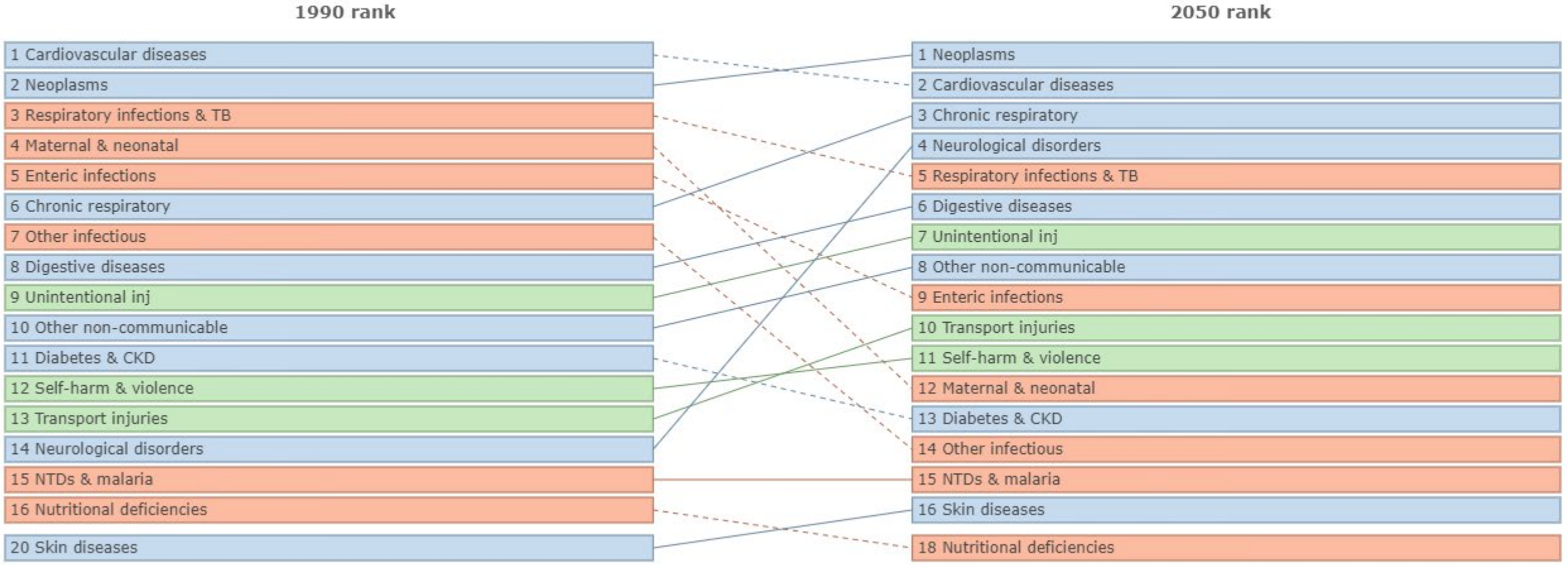
- High incidence of traditional risk factors early in life (age <50 years)
  - e.g., Age 20-40 years – 1 in 8 are hypertensive
  - Even higher rates among African American Individuals
  - African American women are at High Risk for Preeclampsia!
  - 40% of Ages 20-40 years are obese and 4% are diabetic (↑ type 2 DM)
- Cumulative exposure of risk factors leads to greater rates of progression & increased CVD event risk
- High rates of progression elevate ASCVD event risk

**Source:** PESA Circulation 2015;131:2104., Domanski J Am Coll Cardiol 2023;12:1151-.

# Global Burden of Cardiovascular Disease

- 9,440,000 Deaths Related to CAD
- Worldwide patterns emerge - massive population shifts to more urban environments
  Changing (and poor) dietary patterns, more physical inactivity, ….

What Would Change with Improved Risk Factor Control?




**Source:** Vaduganathan J Am Coll Cardiol 2022;80:2361-2371., Institute for Health Metrics and Evaluation.

# Challenge Longstanding Public Policy

- Screening Beyond ASCVD Risk Scores Not Accepted*
  - Suboptimal Accuracy of Risk Scores Across Diverse Populations of Women and Men Throughout the Continuum of Risk
    - Limited validation, Lack of Novel Risk Measures
  - Epidemic of obesity, HTN, diabetes, poor diet, physical inactivity…

- ***Clinical & public health interventions are needed to effectively manage, stem, and even reverse these adverse trends***

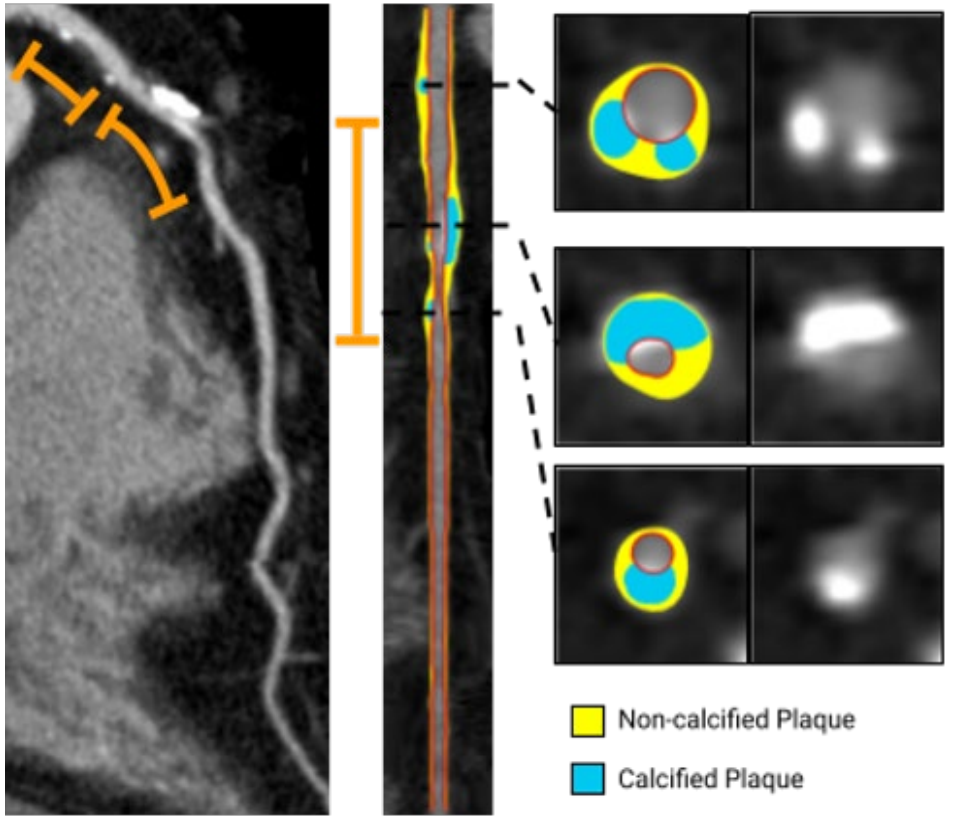
- ***Evidence is Substantial that CT-Based Imaging (CAC) Can Improve Risk Detection among Large Sectors of At-Risk Asymptomatic Individuals***

*UK National Screening Committee, US Preventive Services Taskforce

**Source:** Talha Cardiovasc Ther 2024;4133365., Rana J Am Coll Cardiol 2016; 67:2118–2130., Joynt Maddox Circulation 2024;149:e00–e00.

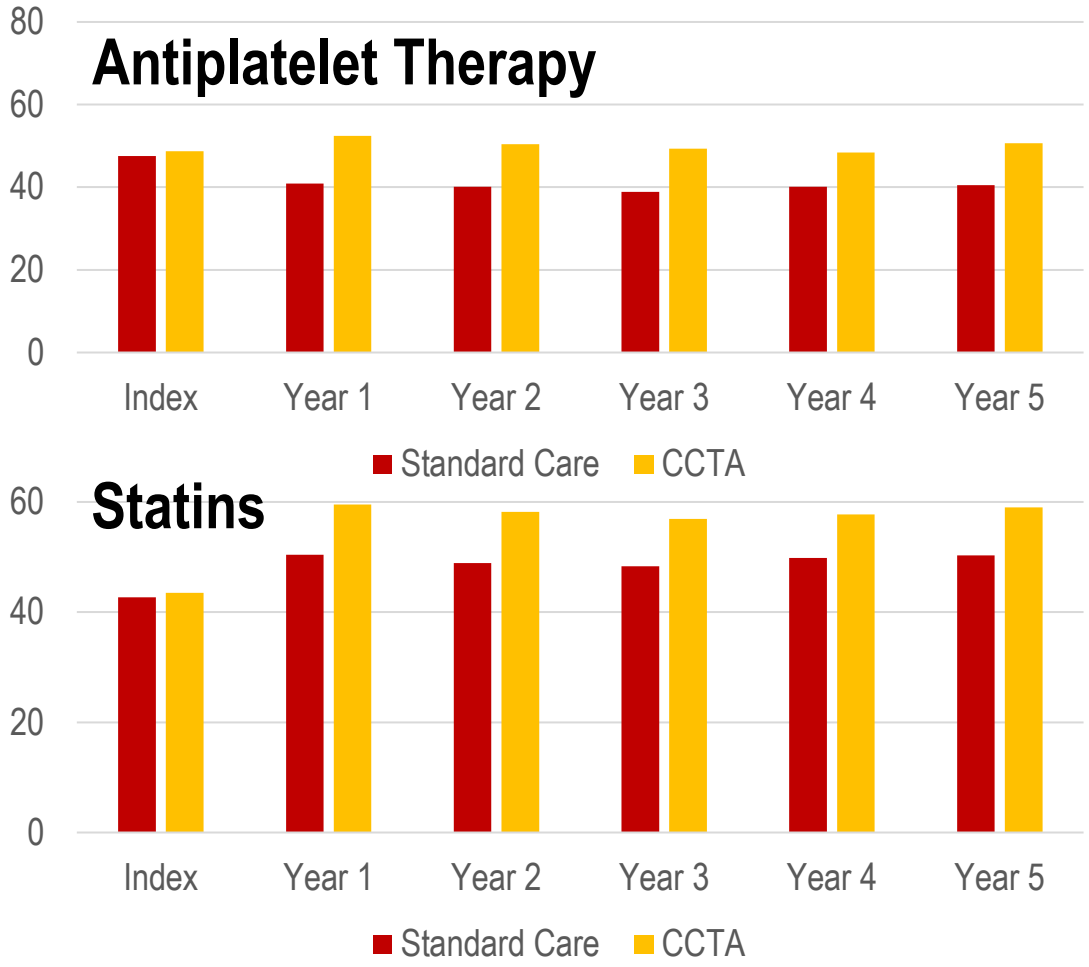
# Detecting Early Atherosclerosis

- With the introduction of plaque imaging into clinical practice, it is abundantly clear that basing CAD diagnosis on inducible myocardial ischemia is fundamentally flawed
- It is recognizing a problem too late along the disease continuum by detecting advanced atherosclerosis
- Our next challenge is to target early atherosclerotic plaque that is amenable to regression / averting ACS



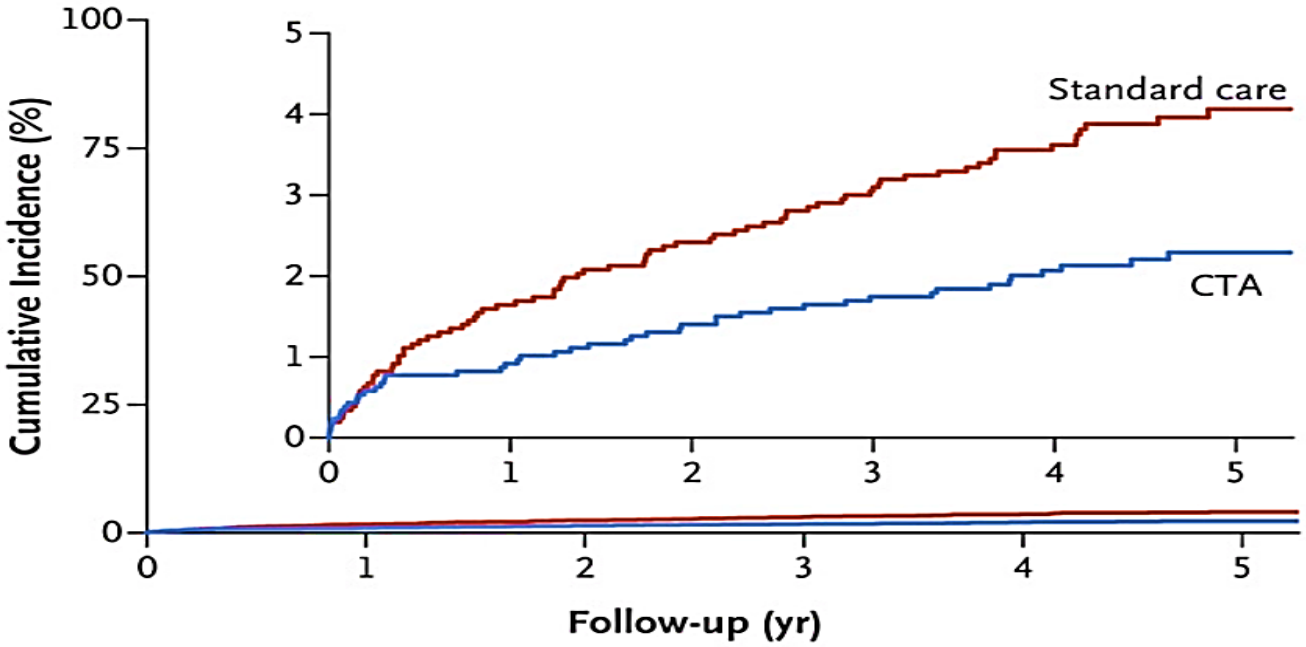

**Source:** Koo JACC Img 2024:S1936-878X(24)00130-X.

# SCOT-HEART: CT-Prompted Preventive Care




Protocol Prompted Preventive Care for Patients with Nonobstructive / Obstructive CAD

- ↑ Use of Antiplatelet / Statin Therapy

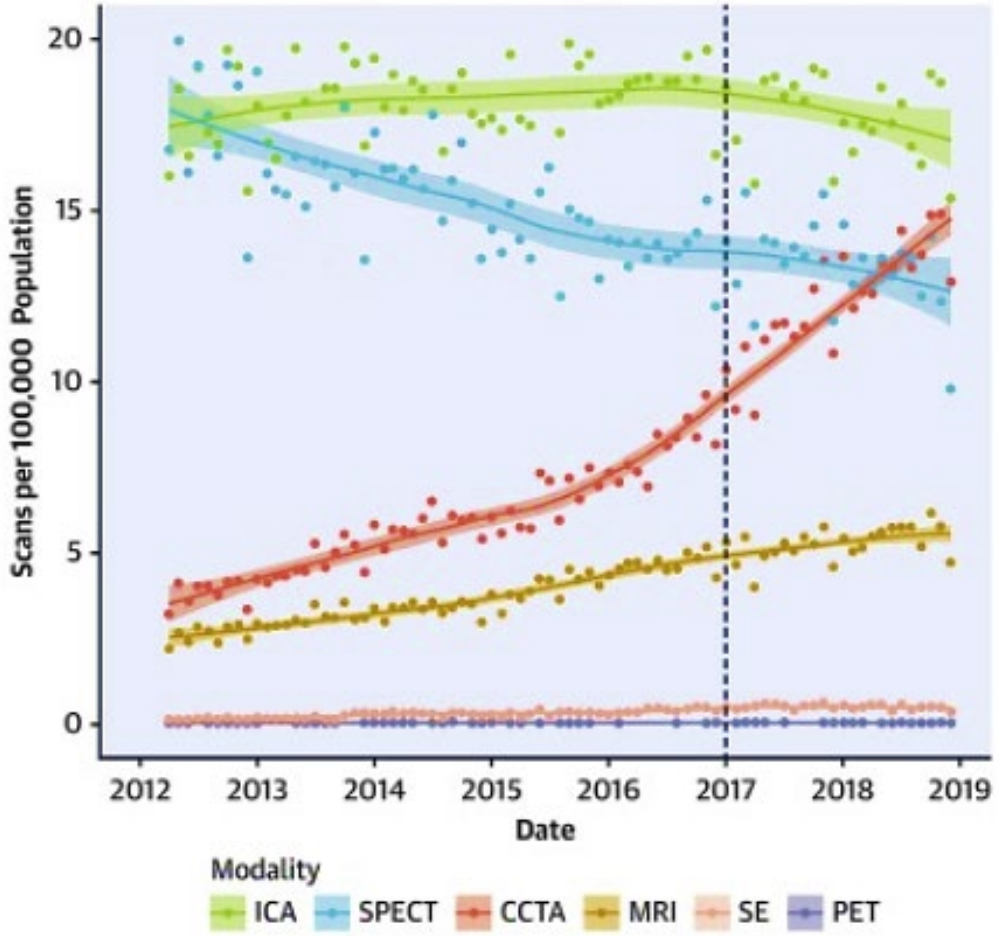


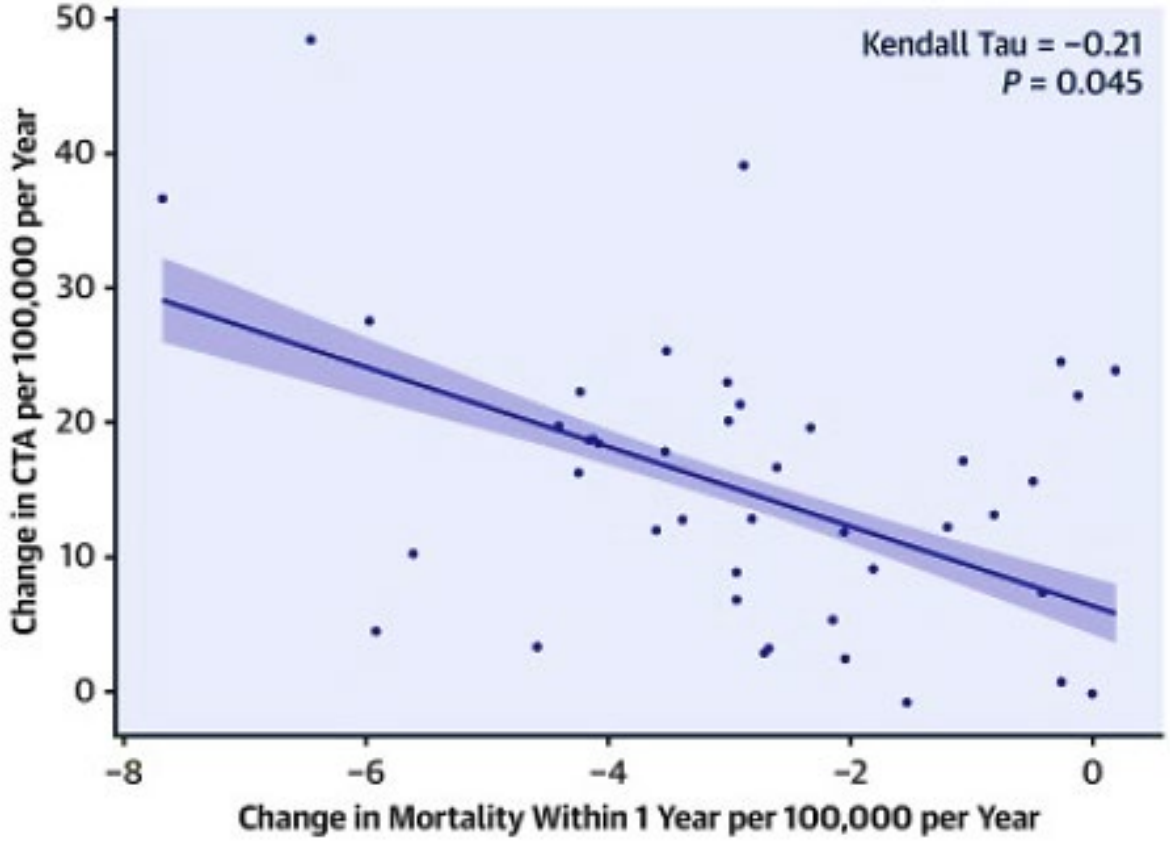

Scottish COmputed Tomography of the HEART (SCOT-HEART) Trial

**Source:** SCOT-HEART NEJM 2018;379:924-933.

# Does CCTA Improve Outcomes?

UK National Health Service - 1,909,314 investigations for CAD



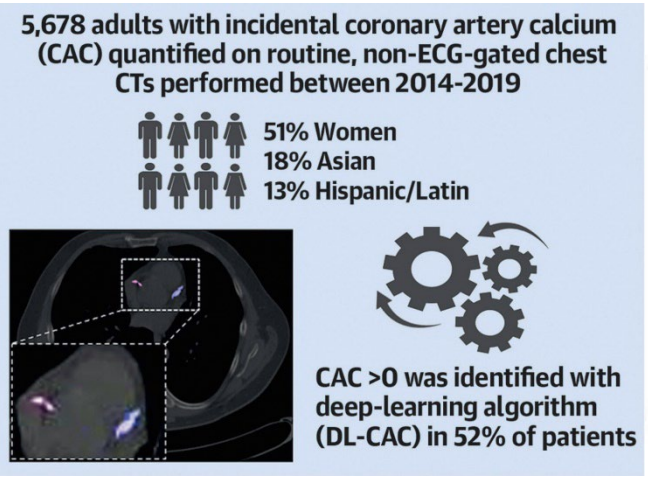



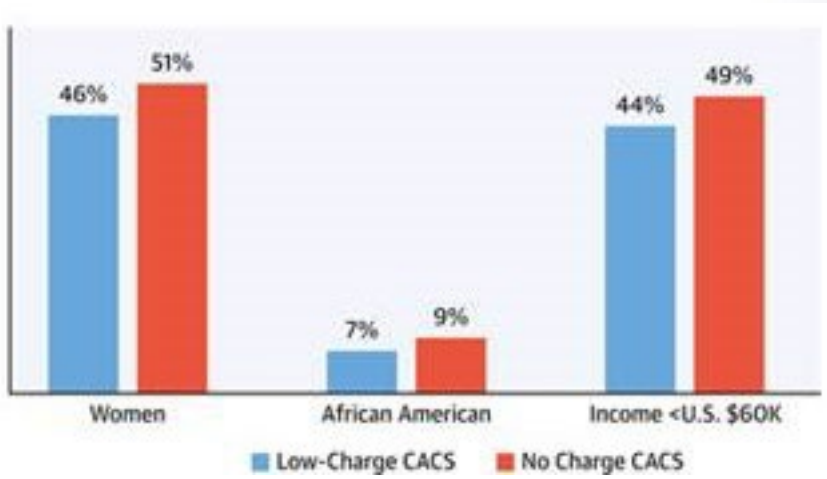

**Source:** Weir-McCall JACC Imag 2023;16:659-671.

# Scalability Across the Globe - Finding Solutions for Limited Resource Settings

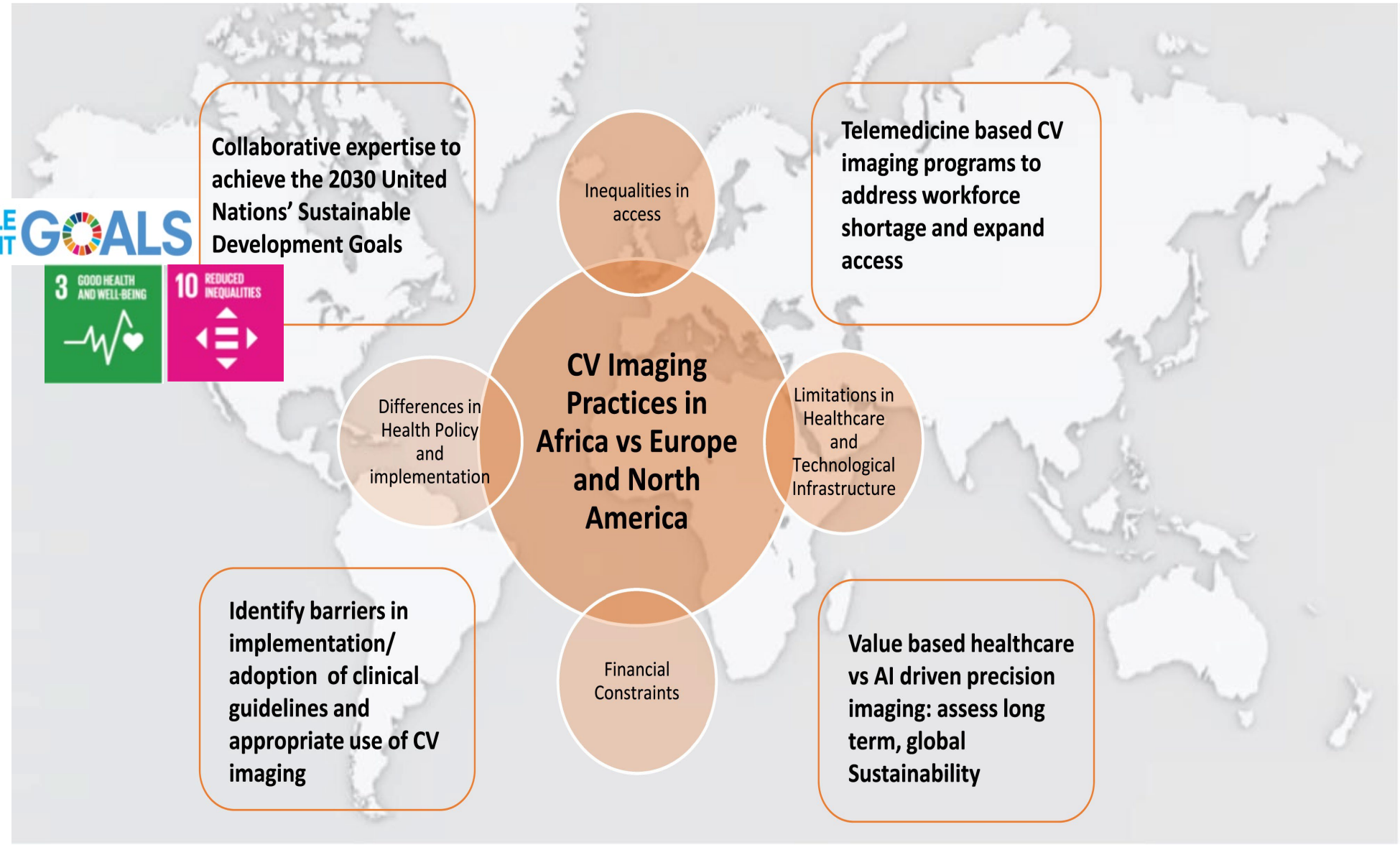
Low-Middle Income Countries + Equally Challenging  Rural + Urban Areas in the US

- Public policies must provide adequate funding to address the burden of atherosclerosis
  - Promote CCTA use to promote timely & equitable access
  - Cost effectiveness will be key
    - Varied CT approaches may be needed to characterize plaque - CAC, SIS…
    - No cost scanning
  - Low-cost AI approaches integrating Imaging with EHR



**Source**: Al-Kindi JACC 2020;76:1259-1262., CAD-RADS 2.0™ app.




**Source:** Lakshmanan Eur Heart J - Imaging Methods Practice, 2023;1(1):qyad005.

# A Call to Action!

- Novel CCTA strategies should expand focus toward early forms of atherosclerosis prior to functional ischemia with obstructive stenosis
- Atherosclerosis detection should target disease states + treatments capable of halting progressive atherosclerosis / reducing later stage complications of atherosclerosis
- Improve implementation and scalability of high quality CCTA-guided care around the world

11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
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13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
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8 DECENT WORK AND ECONOMIC GROWTH

FULL TEXT ARTICLE

# Standards for quantitative assessments by coronary computed tomography angiography (CCTA)

Article in Press: Corrected Proof

Koen Nieman, Hector M. García-García, Alexandre Hideo-Kajita, Carlos Collet, Damini Dey, Francesca Pugliese, Gaby Weissman, Jan G.P. Tijssen, Jonathon Leipsic, Maksymilian P. Opolski, Maros Ferencik, Michael T. Lu, Michelle C. Williams, Nico Bruining, Pablo Javier Blanco, Pal Maurovich-Horvat and Stephan Achenbach

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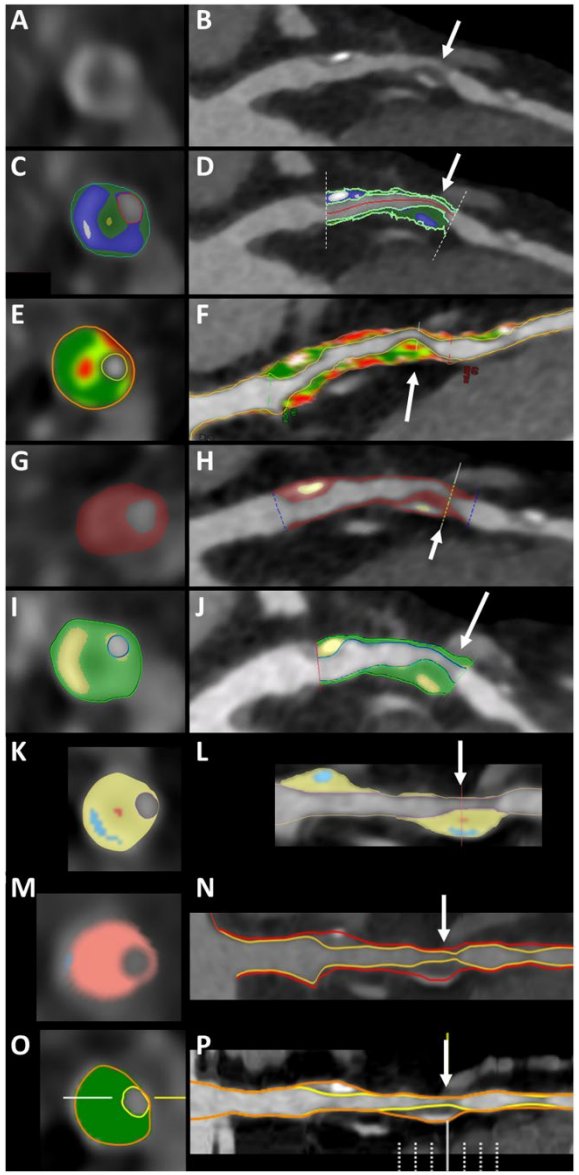
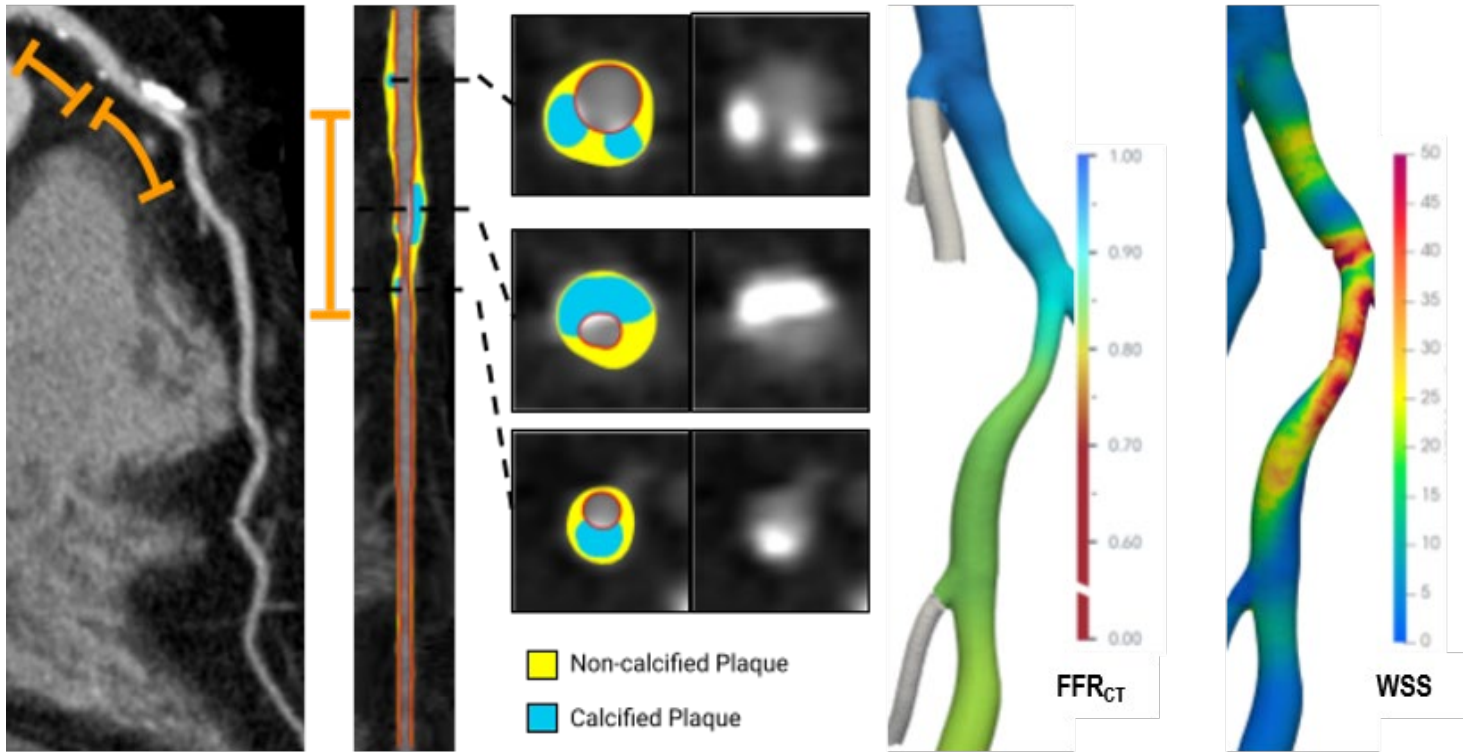



**Source:** Nieman JCCT 2024 (online).

# Exploring the Mechanism of Plaque Rupture in ACS using CCTA & Computational Fluid Dynamics II) Study (*EMERALD II Study*)



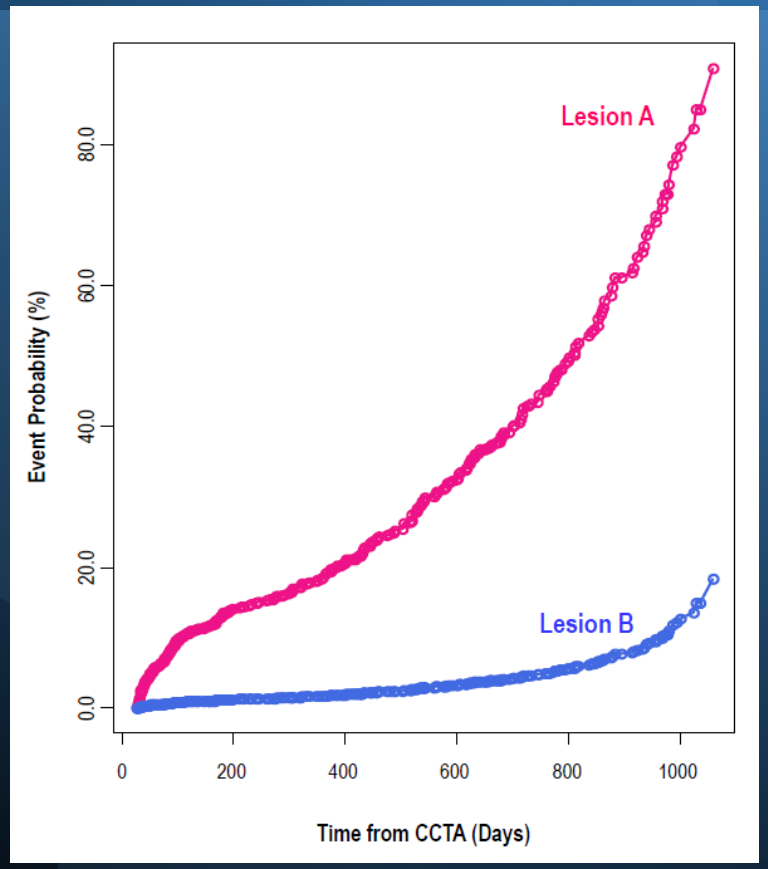

TPV: Total plaque volume, NCPV: Noncalcified plaque volume, LAPV: Low attenuation plaque volume, WSS: Wall shear stress; APS: Axial plaque stress, MBF: Myocardial blood flow, Plaque burden (cross-sectional plaque area/vessel area @ minimum lumen area site

351 Patients with Definite ACS Culprit Lesions



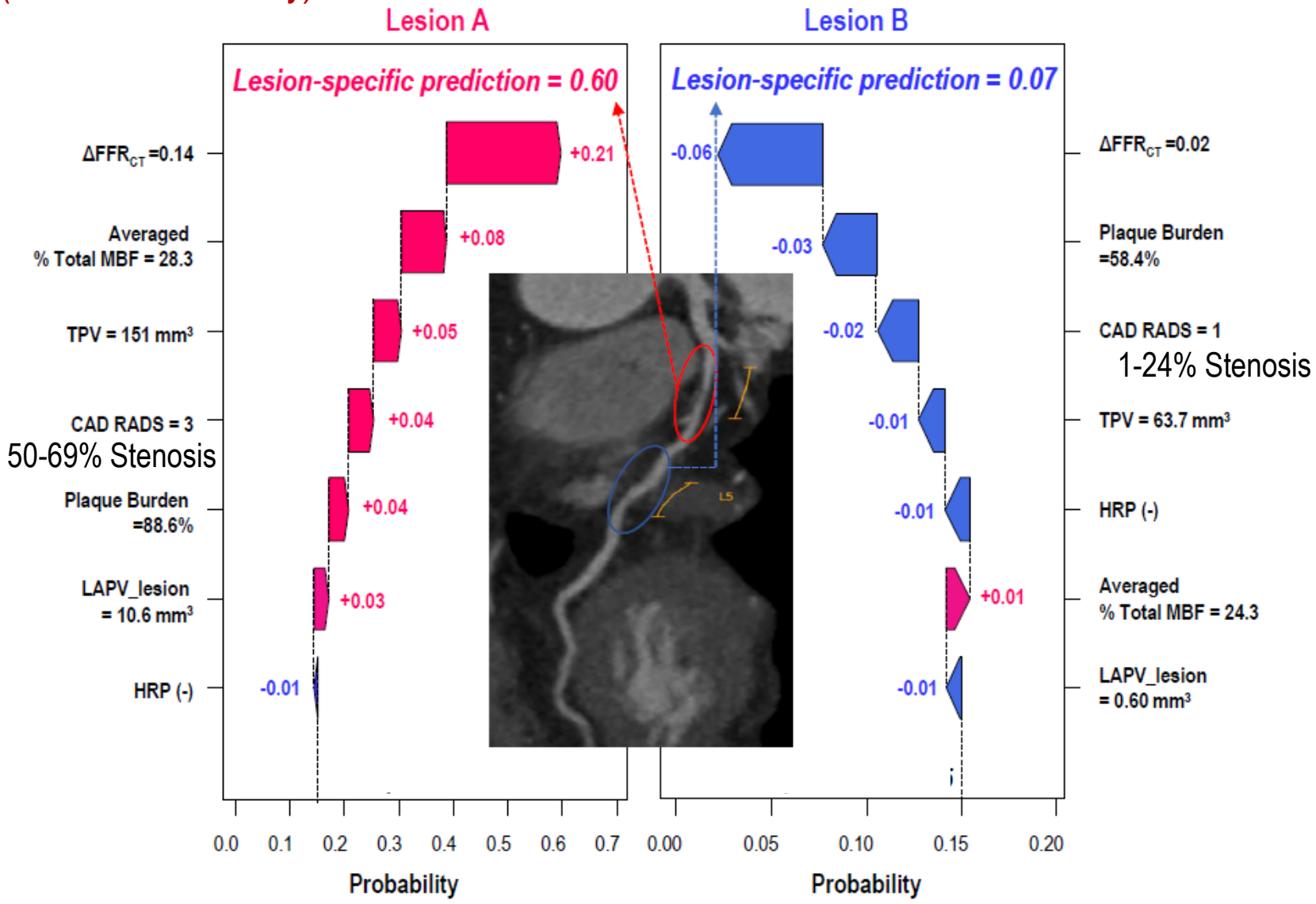
**Source:** Koo JACC Img 2024:S1936-878X(24)00130-X.

# ACS Precision Risk Assessment




## Exploring the Mechanism of Plaque Rupture in ACS using CCTA & Computational Fluid Dynamics II) Study

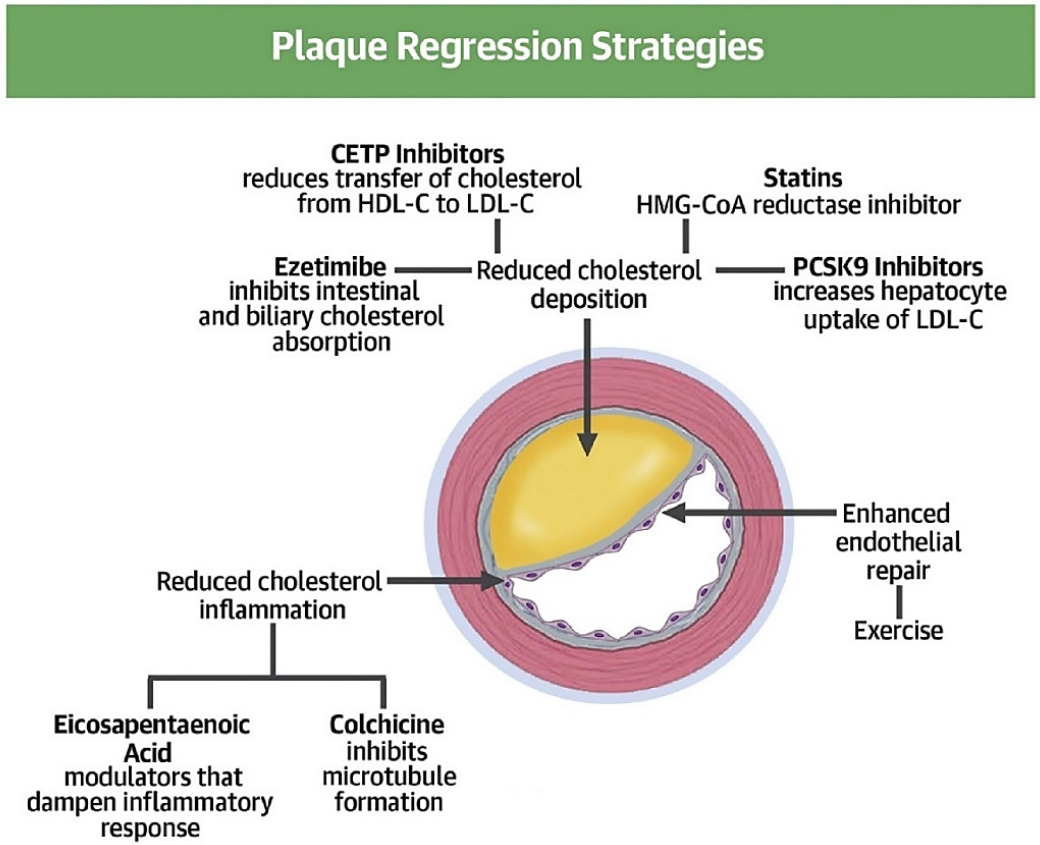
*(EMERALD II Study)*



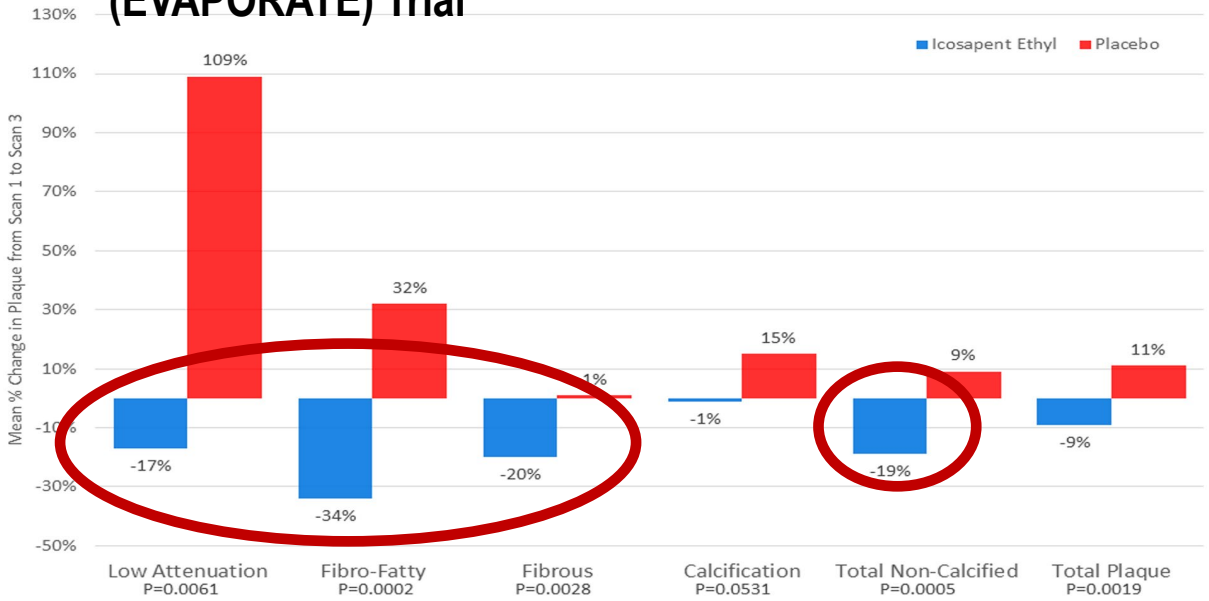

351 Patients with Definite ACS Culprit Lesions

**Source:** Koo JACC Img 2024:S1936-878X(24)00130-X.

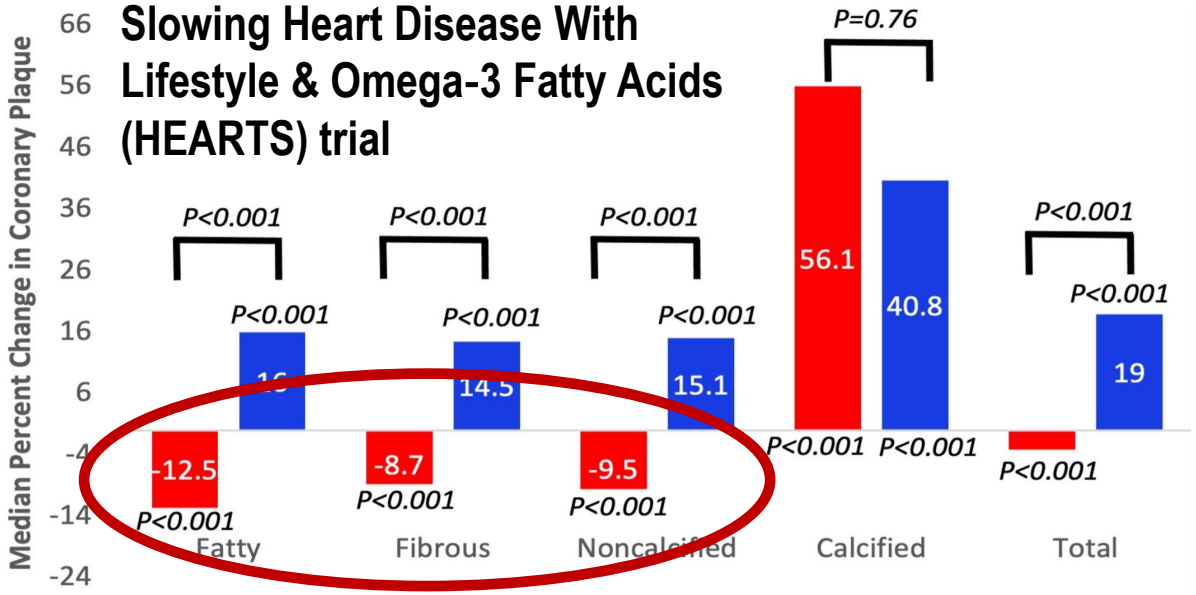
# Treatment-Induced Regression of Atherosclerotic Plaque




## Effect of Vascepa on Improving Atherosclerosis in People with Elevated Triglycerides on Statin Therapy (EVAPORATE) Trial




## Slowing Heart Disease With Lifestyle & Omega-3 Fatty Acids (HEARTS) trial




**Source:** Dawson JACC 2022;79:66-82., Budoff Eur Heart J 2020;41:3925-3932., Welty JAHA 2023;12:e030071.

# Methods for Assessing CCTA Atherosclerotic Plaque

- Standards for Regression / Progression
  - Beyond Repeatability
  - Clinically Meaningful Change in Prognosis
- Optimal Timing for Risk and/or Treatment Effect
- Issues Specific to CCTA*

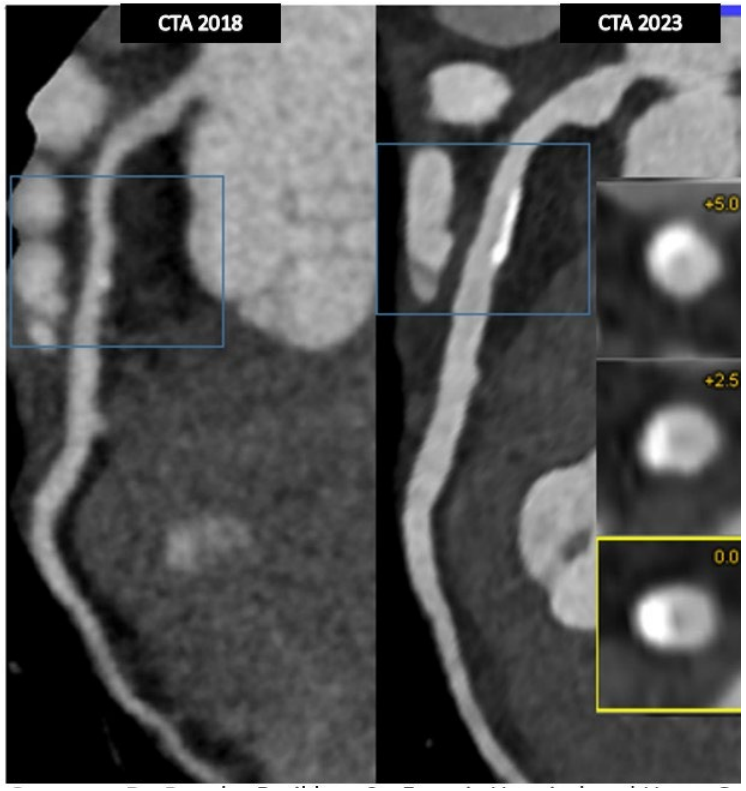
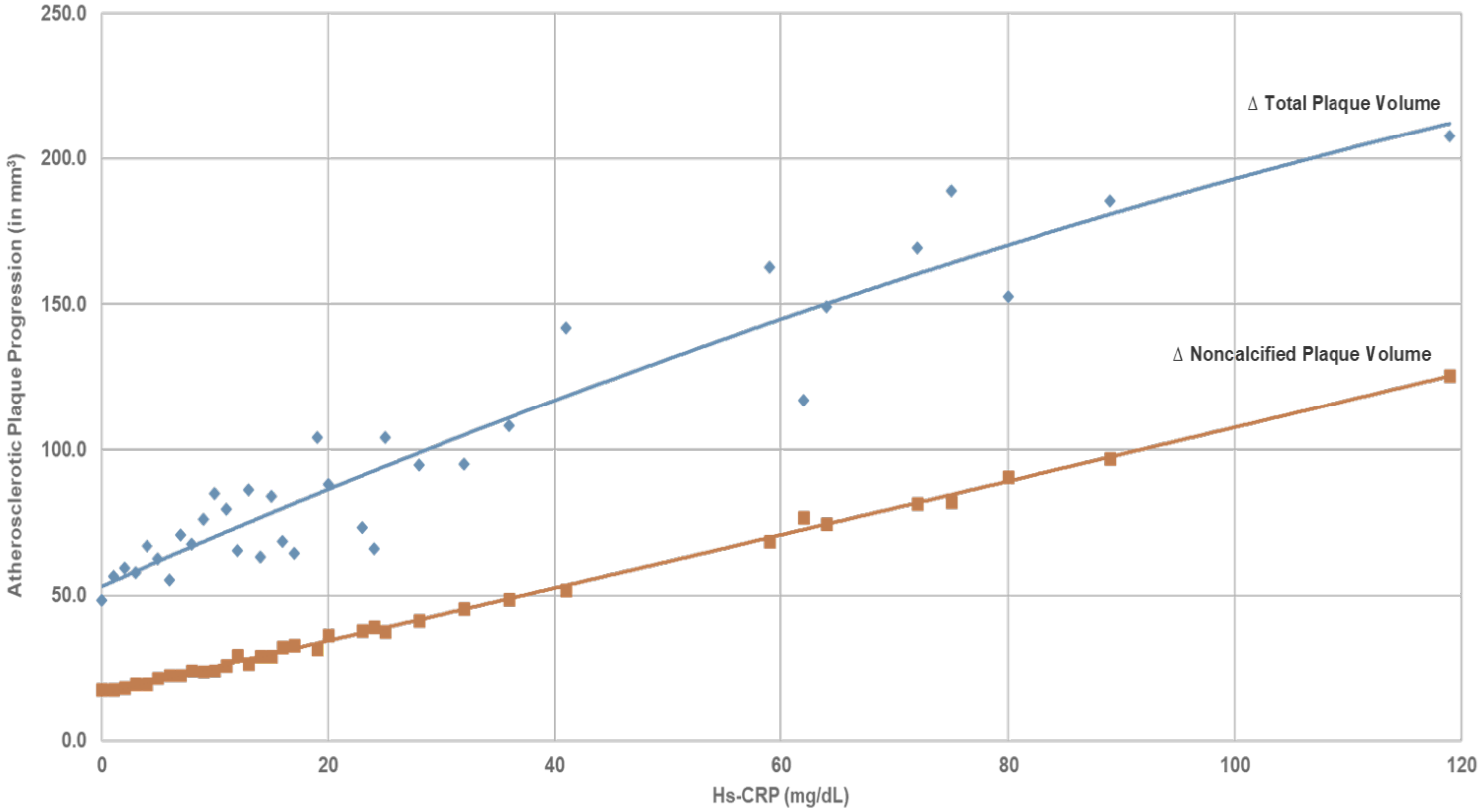



*Image quality, adaptive thresholding for HU intensities in the lumen (for different kv), media border exclusion…

# Atherosclerotic Plaque Progression and Inflammation




- Plaque progression >2-fold ↑ with Hs-CRP ≥2 mg/dL for Total and Noncalcified (necrotic core and fibrofatty) plaque ($p<0.01$); even when controlling for risk factors & statin use
- Calcified plaque progression was unrelated to Hs-CRP ($p=0.3$)
- Associations between HIV infection and a greater burden of noncalcified plaque are also reported

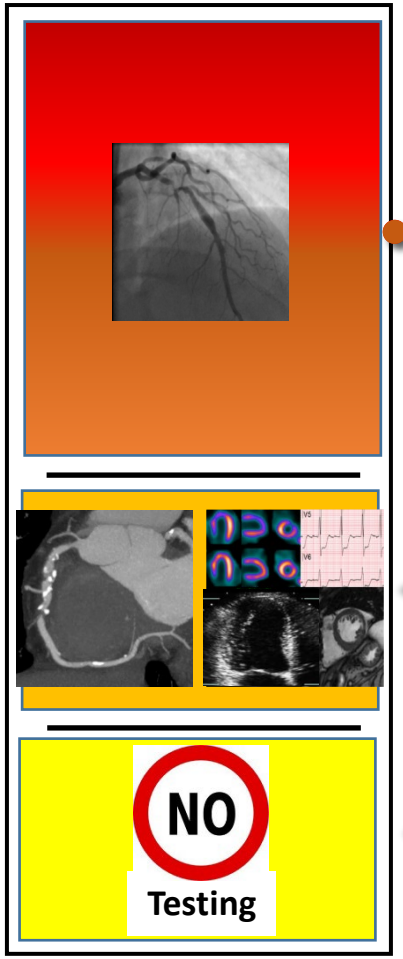
**Source:** Bienstock JACC Imaging 2024;17:212-213.

# Concluding Remarks

- Growing Evidence for Plaque Assessment with CCTA
- More Prognostic Data is Needed
- A lot we do not know, factors that will be essential for regression & links to improved patient outcomes

# Acute Chest Pain Evaluation

ED Evaluation




Risk of Major CAD Events

*Per ACC / AHA Guideline*

ACS

INVASIVE CORONARY ANGIOGRAPHY

High Risk

ANATOMIC OR FUNCTIONAL TESTING

Intermediate Risk

ANATOMIC OR FUNCTIONAL TESTING

Low Risk

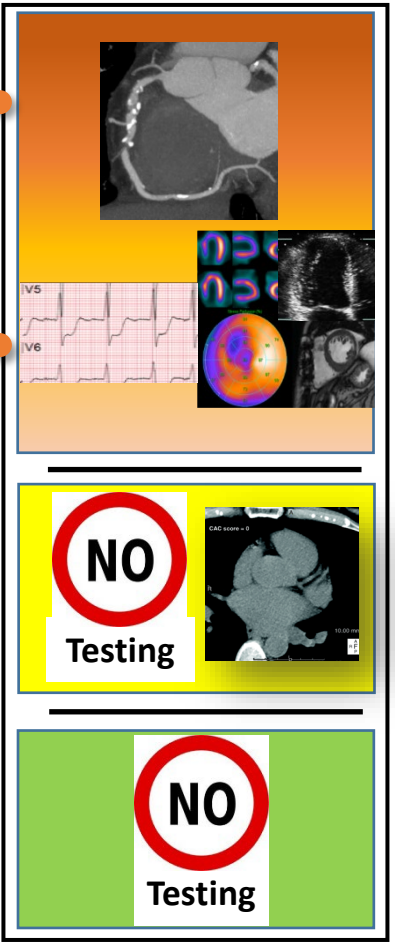
DEFER TESTING - OPTIONAL Ex ECG or CAC SCAN

Asymptomatic

NO TESTING

# Stable Chest Pain Evaluation

Outpatient Evaluation




AMERICAN COLLEGE of CARDIOLOGY FOUNDATION

American Heart Association.

**Source:** Gulati JACC 2021;78:e187-e285., JACC 2021;78:2218-2261., Circulation 2021;144:e368-e454.