Case Studies in Acute Chest Pain:
Diagnosis, Risk Stratification, & Test Selection

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Disclosures:

Kanny S. Grewal

None

Shirlien Metersky

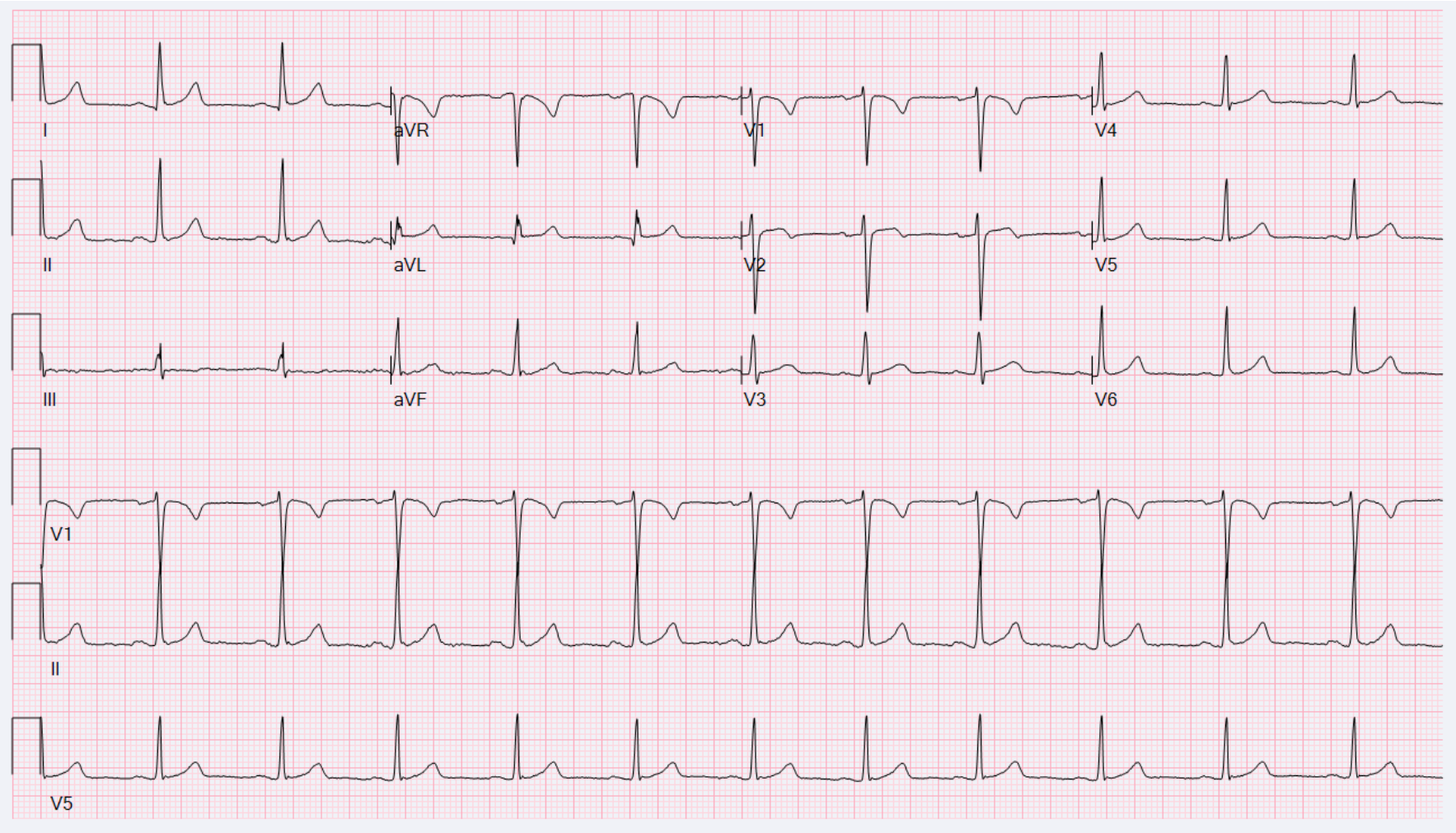
- None

Case Study #1

Emergency Room Presentation

- 46 y.o. female with PMH of hypothyroid who presents with isolated episode of nonexertional left sided CP described as sharp and stabbing lasting 2 minutes while sitting on couch watching TV
- Nonsmoker, denies HTN or hyperlipidemia
- She reports that her brother, age 55 just had a PCI last month
- Exam normal
- Troponin: undetectable

Case 1: EKG



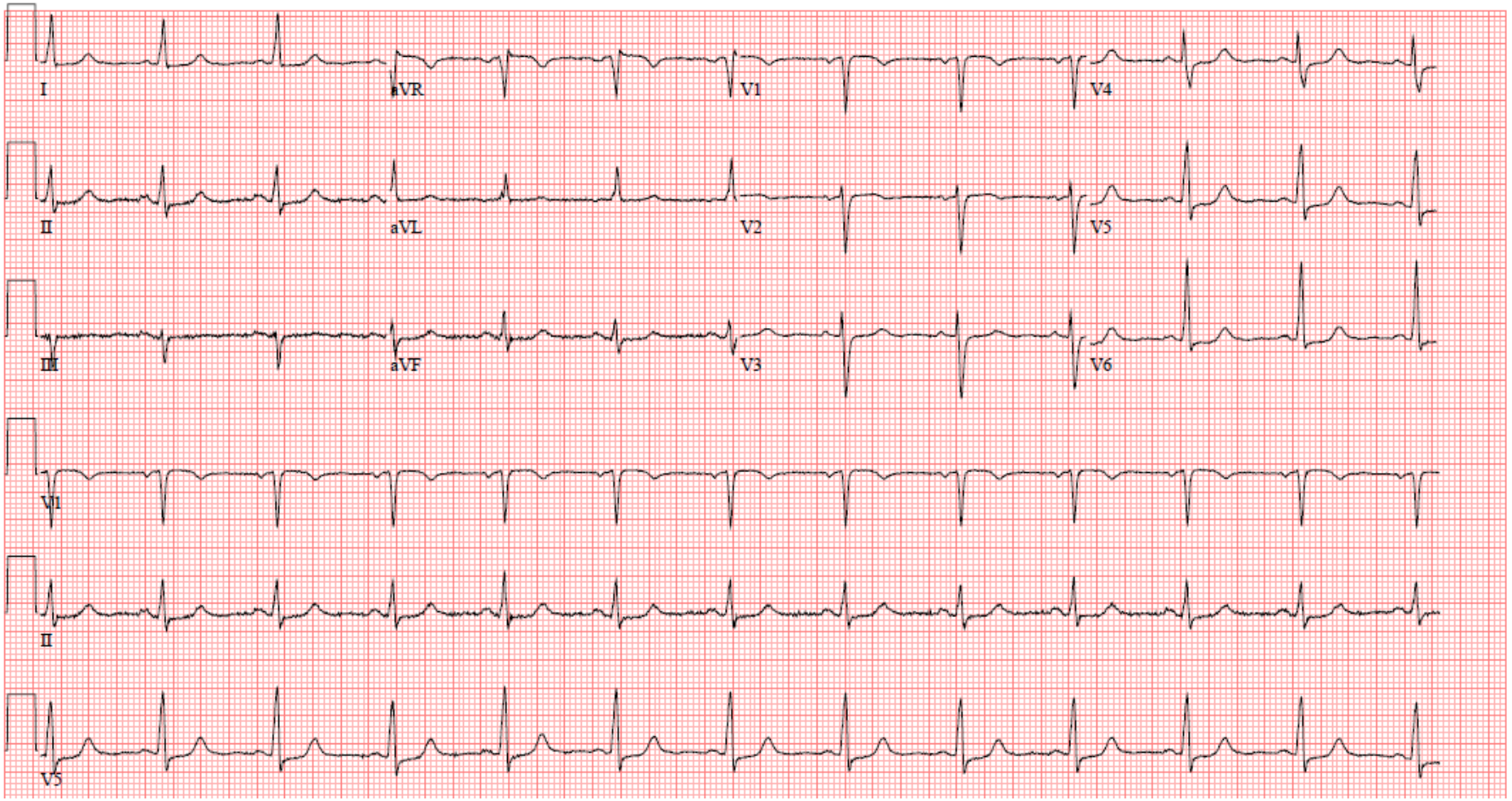
Case 1: How would you classify patient's acute risk and recommended testing?

- A: Low — Discharge, outpatient testing
- B: Low — Observation, inpatient testing
- C: Intermediate — Observation, inpatient testing
- D: High — Admit, inpatient testing

Case 1 “b”:

- 86 year old female presents to RMH, dull chest pain intermittent for several weeks, sometimes with exertion. No associated sx. Patient is independent, active for age.
- PMH: HTN, hyperlipidemia, prior smoker
- LHC 20 years ago – “unremarkable”, no h/o PCI
- Exam normal
- Troponin: < 6
- EKG:

Case Study: 86 y.o. female



Case 1b: How would you classify patient's acute risk and recommended testing?

- A: Low — Discharge, outpatient testing
- B: Low — Observation, inpatient testing
- C: Intermediate — Observation, inpatient testing
- D: High — Admit, inpatient testing

Case Study #2

Observation Status Patient with CP

- 78 yo widowed male living in an independent AL facility with history of PMH of CKD stage 3, HTN, HLD, anemia, diverticular GIB requiring prior blood transfusions, PAF on OAC, and CAD s/p CABG admitted for exertional CP similar to prior angina.
- Admit Labs: Hbg 9.6, WBC 11.3, Creatinine 1.6, CrCL 41, K+ 3.8, troponin trend consistent with NSTE-ACS
- Current cardiac medications: ASA 81mg, Eliquis, atorvastatin, and amlodipine

Case 2: What is patient's risk assessment and your recommended evaluation?

Risk		Evaluation
• A:	Low	Medical Management only
• B:	Intermediate	Pharmacologic Stress Test
• C:	High	Medical Management only
• D:	High	Coronary Angio +/- PCI

Case Study #3

Patient Admitted with Chest Pain

- 82 yo female presented to ED with progressive exertional MSCP with associated progressive LE edema and DOE
- Diagnostic testing
  - CXR: small bilateral pleural effusions, mild interstitial edema
  - ECG: nonspecific STTWA
  - Labs: **Troponin T**: time 0 (32 ng/L), time 3 hrs (36 ng/L)
  - **NT-proBNP** 2084, **creatinine** 1.5, **Hbg** 9.7
  - Physical Exam: Bilateral LE edema 2+ pretibial, bibasilar rales with fine diffuse wheezing, harsh 2/6 SEM

Case 3: What is likely etiology of elevated troponin T?

- A: Type 1 NSTEMI
- B: Type 2 NSTEMI
- C: Aortic Stenosis and CHF with preserved EF (HFpEF)
- D: False positive due to renal disease

Case Study #4

Patient Transferred from OLH with Equivocal Nuclear Stress Test

- 48 y.o. Caucasian male with PMH of poorly controlled HTN, DJD, and cardiac FMH who presented to OLH with left sided CP that woke him up from sleep lasting 1 hour not relieved with SL NTG administered by EMS. Nonsmoker.
- Admit ECG nonischemic, troponin trend negative x 3. BMI = 31.
- Underwent Pharmacologic SPECT (unable to exercise due to DJD) that showed preserved LVEF (58%), suboptimal quality, small primarily fixed defect in basal inferior region with “possible” peri-infarct ischemia

Case 4: What test do you recommend for further assessment?

- A: Coronary angiography
- B: Dobutamine Stress Echo with contrast
- C: Coronary CT angiogram (CCTA)
- D: Stress PET perfusion scan

Case Study #5

Observation Status Patient with Chest Pain

- 66 yo female with PMH of CAD, HTN, GERD, HLD, and NIDDM who presents to ED with intermittent sharp CP,nonexertional. Chronic dyspnea with exertion, slightly worse recently. On day of presentation her CP woke her from sleep and relieved by SL NTG administered by EMS.
- Exam normal, BMI = 37.
- PCI to RCA 12 years ago. Left heart cath 3 years ago: patent stent, mild CAD.
- Vasodilator SPECT 18 months ago: probable normal with breast attenuation artifact
- Admit ECG nonischemic, troponin trend negative
- Admitted to Observation Unit for further evaluation

Case 5: What test do you recommend for further assessment?

- A: Coronary angiography
- B: Dobutamine Stress Echo with contrast
- C: Coronary CTA (CCTA)
- D: Stress PET perfusion scan

Reference Slides
Cases 1-5

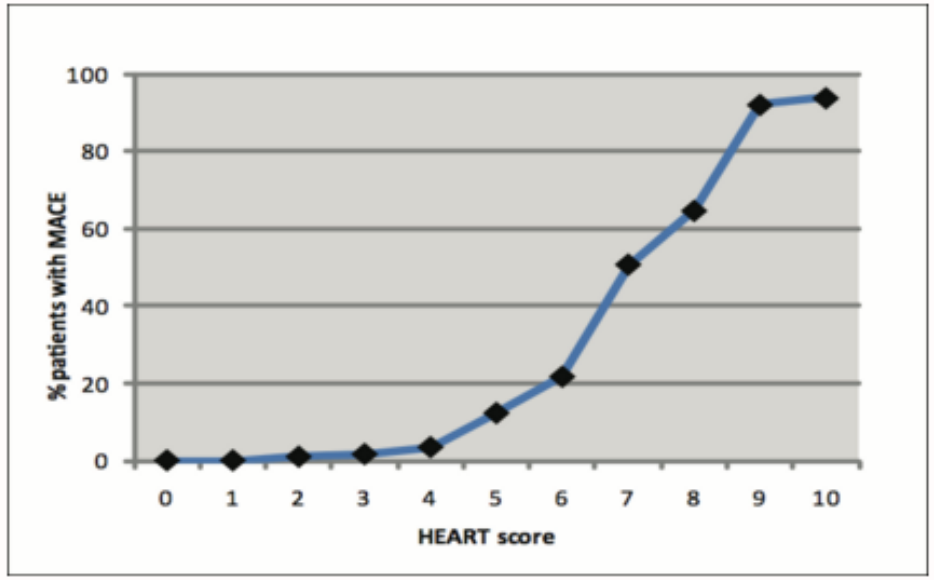
HEART Score Tool

- Risk stratification tool used in ED for patients presenting with CP that the physician deems appropriate for ACS workup to predict risk of major adverse cardiac events (MACE)

HEART

HEART score for chest pain patients			
History	Highly suspicious	2	
	Moderately suspicious	1	
	Slightly suspicious	0	
ECG	Significant ST-deviation	2	
	Non specific repolarisation disturbance / LBTB / PM	1	
	Normal	0	
Age	≥ 65 years	2	
	> 45 and < 65 years	1	
	≤ 45 years	0	
Risk factors	≥ 3 risk factors or history of atherosclerotic disease*	2	
	1 or 2 risk factors	1	
	No risk factors known	0	
Troponin	≥ 3x normal limit	2	
	> 1 and < 3x normal limit	1	
	≤ 1x normal limit	0	
		Total	

HEART Score	Risk of MACE
0 - 3	1,6%
4 - 6	13%
7 - 10	50%



www.heartscore.nl

OhioHealth HEART Score Criteria

K. Grewal MD

History

Chest Pain Risk Features:

- Retrosternal pressure
- Radiation (jaw, arm)
- Exertion
- Relief (nitrates or rest)
- Duration (5-15 min)
- Diaphoresis/Nausea

0 : No features **(noncardiac)**

1: 1-2 features **(atypical)**

2: 3 or more features **(typical)**

EKG

Definite Ischemia:
- ST elevation
- >1 mm ST depression
- New T wave inversion
- No LBBB, LVH, etc

Nonspecific:
- LBBB
- LVH
- Nonspecific ST/T wave changes

0 : Normal EKG

1: Nonspecific

2: Definite Ischemic

Age

0 : <45

1 : 45-64

2 : ≥ 65

Risk Factors

- Hypertension (Treated, or > 160/100)
- Hyperlipidemia (Treated)
- Diabetes
- Smoker (Current or quit <90 d)
- BMI ≥ 30
- Family History of premature CAD (men < 55, women < 65)

0 : No RF and no known CVD

1 : 1-2 RF and no known CVD

2 : ≥ 3 RF, or known CVD (CAD, PVD or CVA/TIA)

Troponin (use local lab cutoffs)

0 : **< 15/23** ng/L

1 : **15/23** to **50** ng/L

2 : **> 50** ng/dl

OhioHealth HEART Score Criteria (DRAFT)

K. Grewal MD

History

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Troponin

(use local lab cutoffs)

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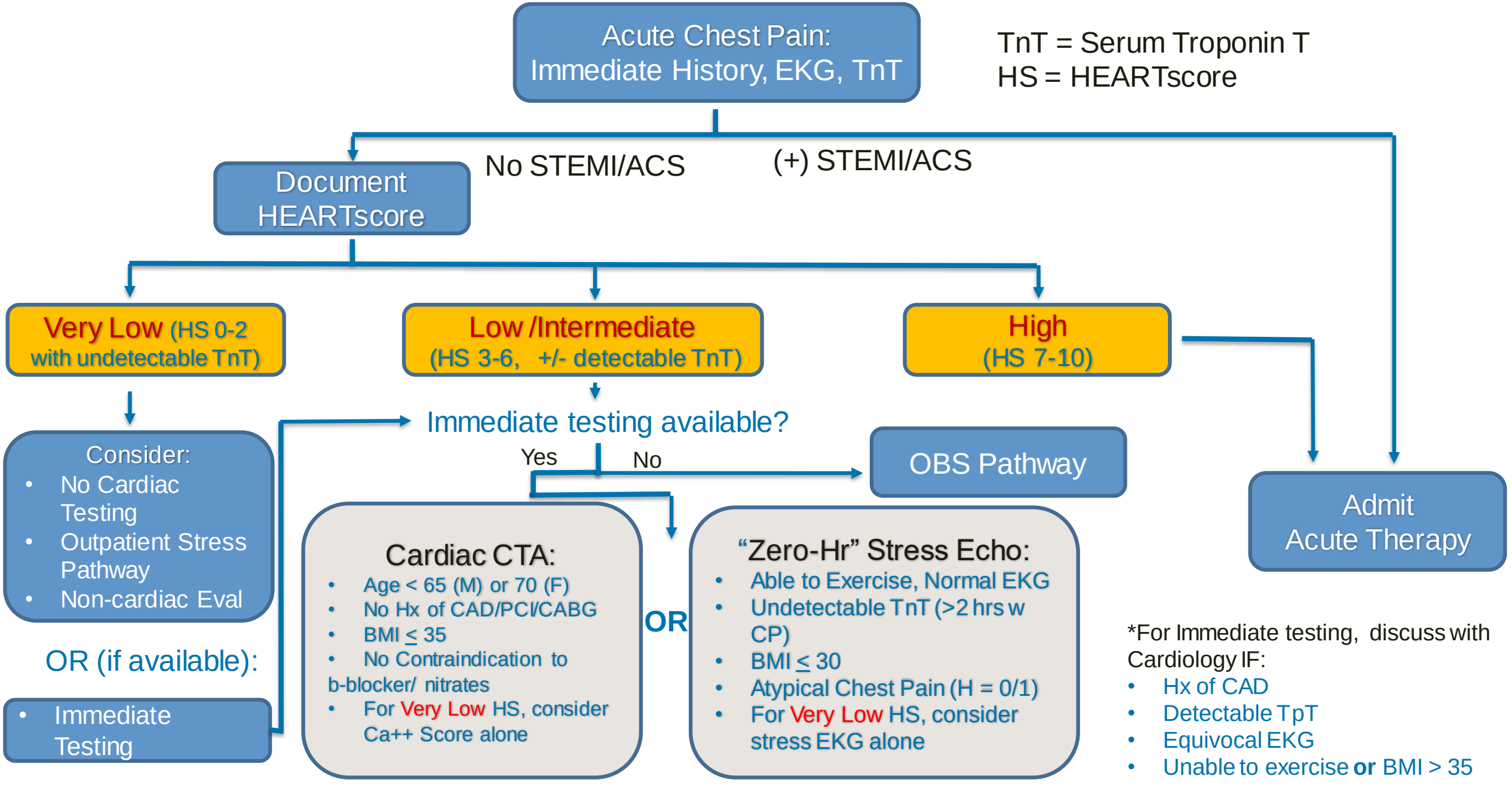
Heart Score	Risk level	30 day event rate:
0-2 (with undetectable Tpn)	Very Low	< 0.5%
0-3	Low	0.5 – 1.5%
4-6	Intermediate	>5%
7-10	High	>20%

References: Mark et al, *JACC* 2018; 71(606)
McCord *Circ CV Outcomes* 2017

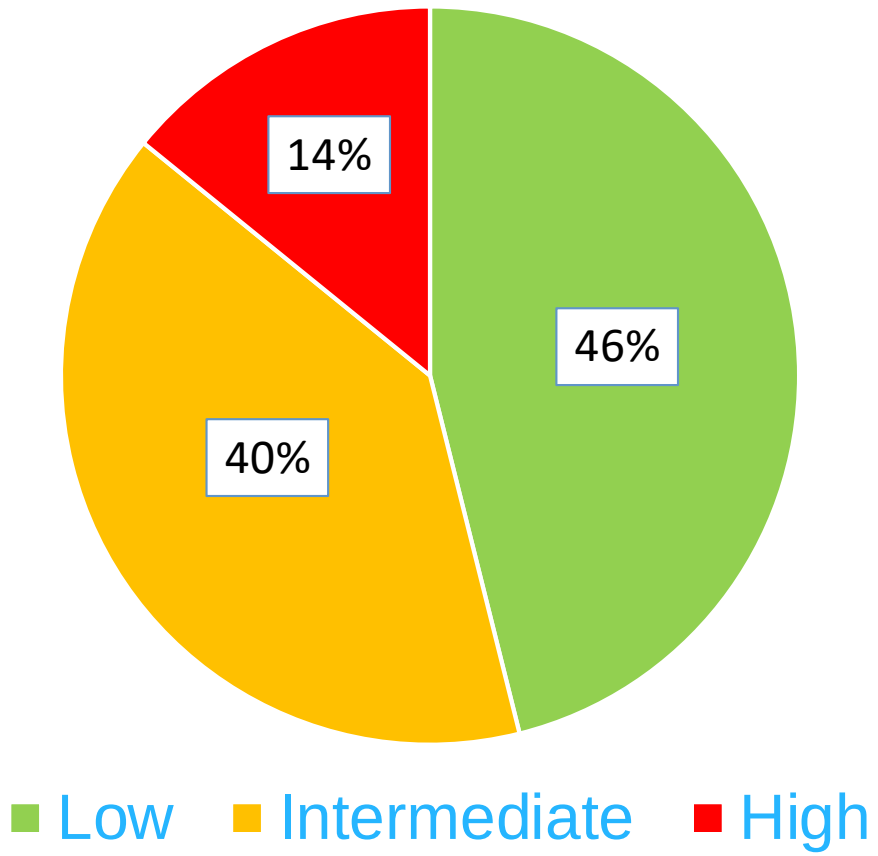
RMH: Acute Care Chest Pain Pathway

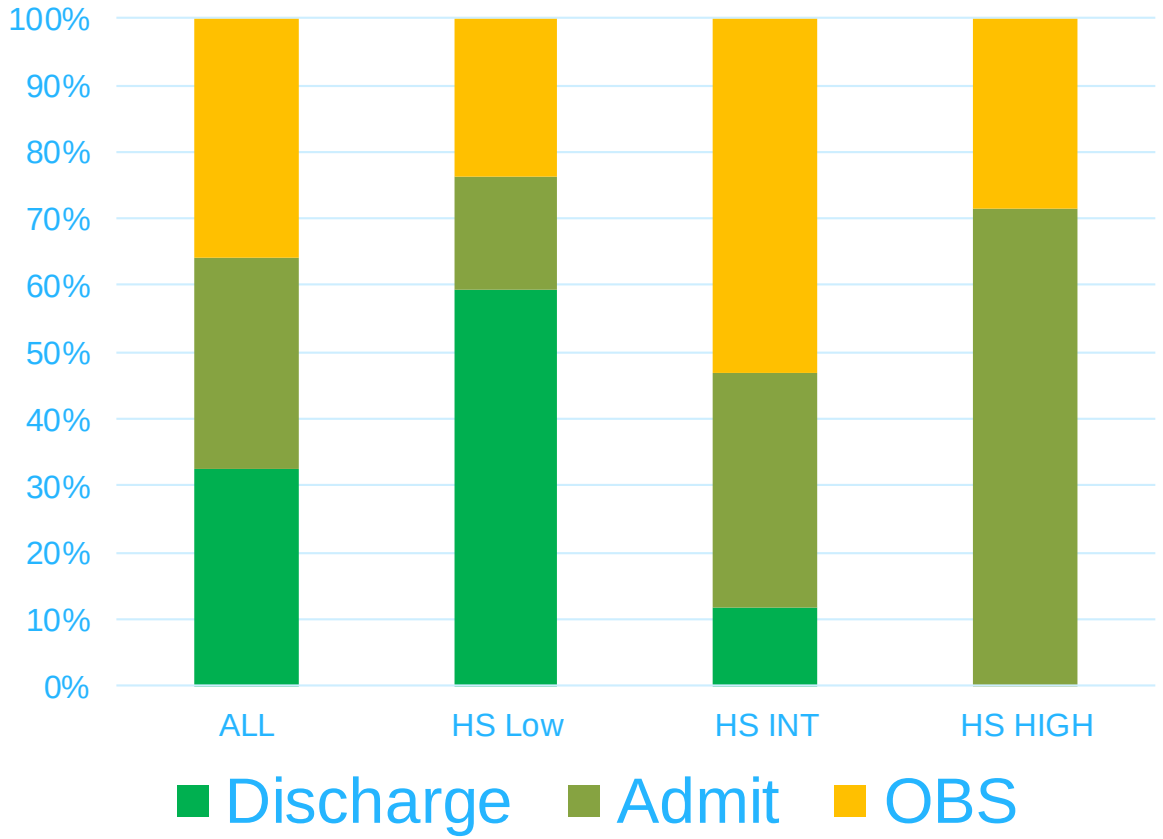


1131-405 The Predictive Value of the HEARTscore Tool using High-sensitivity Troponin T: Comparison to Current Generation Troponin T in a United States Acute Chest Pain Population

Karanvir Grewal (1), Deep Shah(1), Galen Hayek(1), Shray Jain(1), Nathan Nahhas (1), Caroline Lerner(1), Susan Fuhrman(1), Anand Gupta(2), and Tamara McMath(2),
OhioHealth Riverside Methodist Hospital, Columbus, OH, USA (1); OhioHealth Research & Innovation Institute, Columbus, OH, USA (2)

OhioHealth
Riverside Methodist Hospital





HeartScore Results and Disposition
(410 consecutive patients with Chest Pain in RMH ED)

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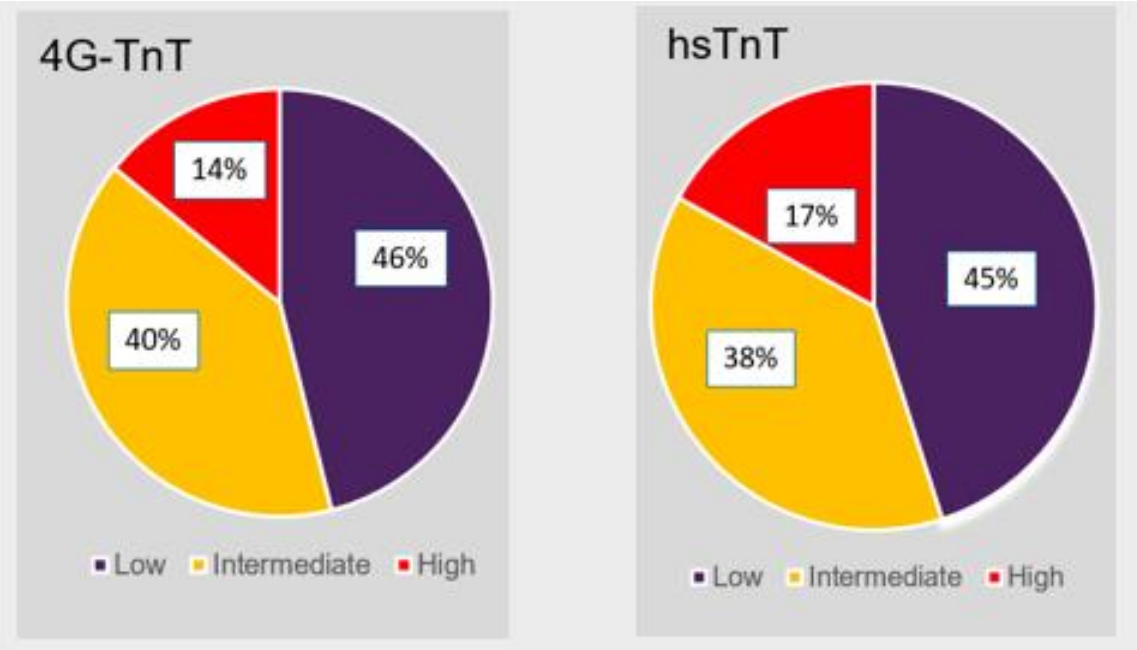
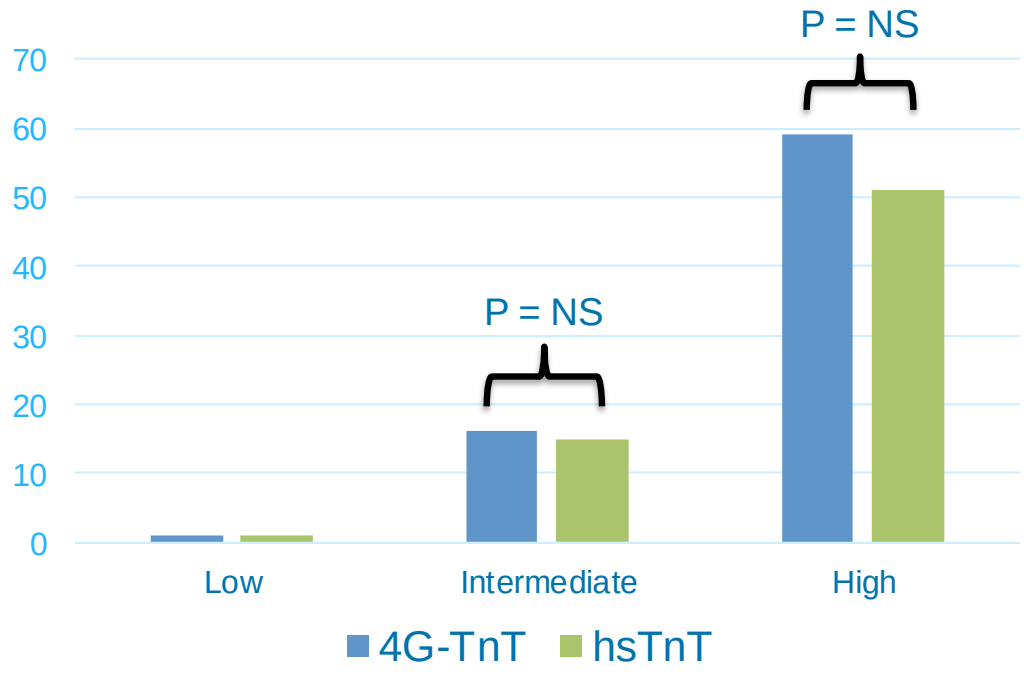
OhioHealth Riverside Methodist Hospital

Heart Score Results(4G vs hsTNT)

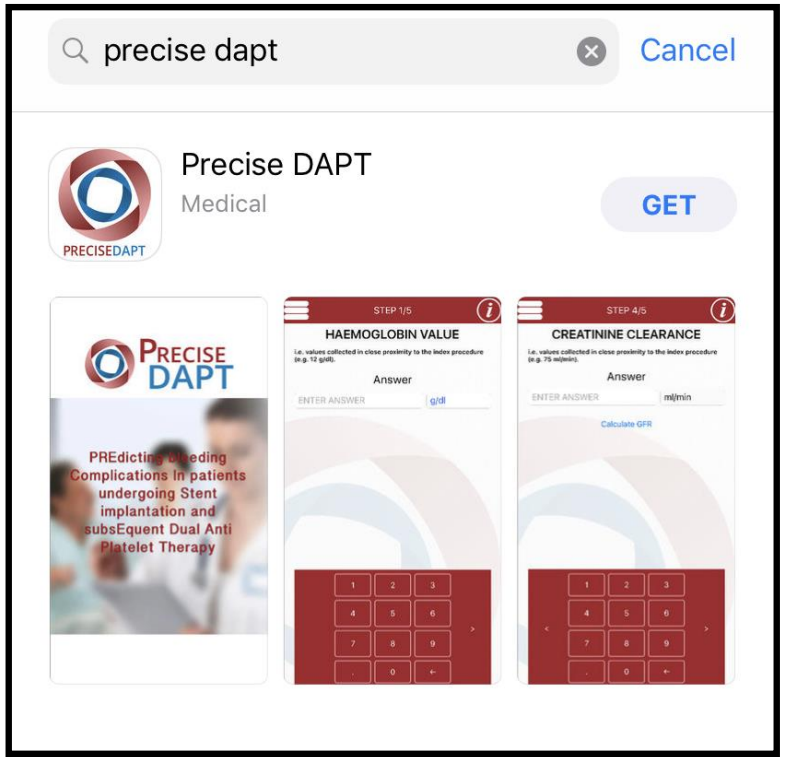
N = 410 ED patients with Chest Pain



Positive Predictive Value (4G vs hsTNT)



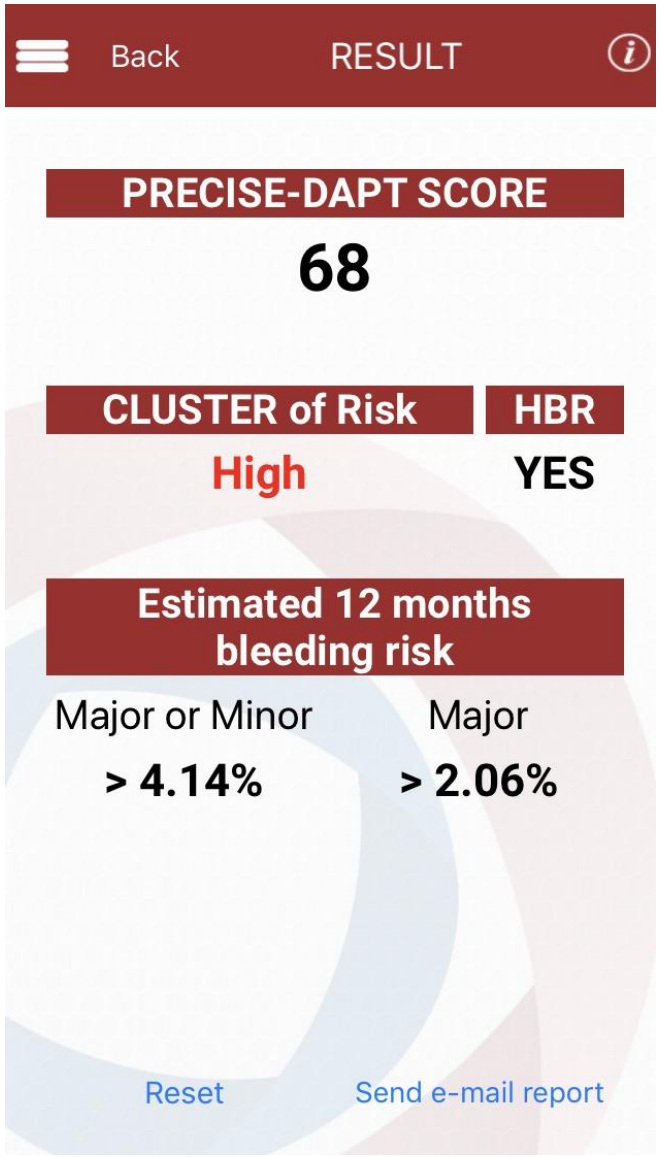
- Risk calculator to predict the risk of bleeding in individual patients with CAD, treated with coronary stenting and subsequent DAPT
- Developed from a collaborative data set including date from 8 RCT
- Risk calculator made up of 5 items with total score range 0-100
  - Hbg level
  - Age
  - WBC level
  - Creatinine Clearance
  - Prior bleeding (defined as history of spontaneous bleeding requiring medical attention)
- Score of ≥ 25 – patient may benefit from shorter course of DAPT (< 12 months)



PRECISE DAPT

www.precisedaptscore.com

PRECISE DAPT



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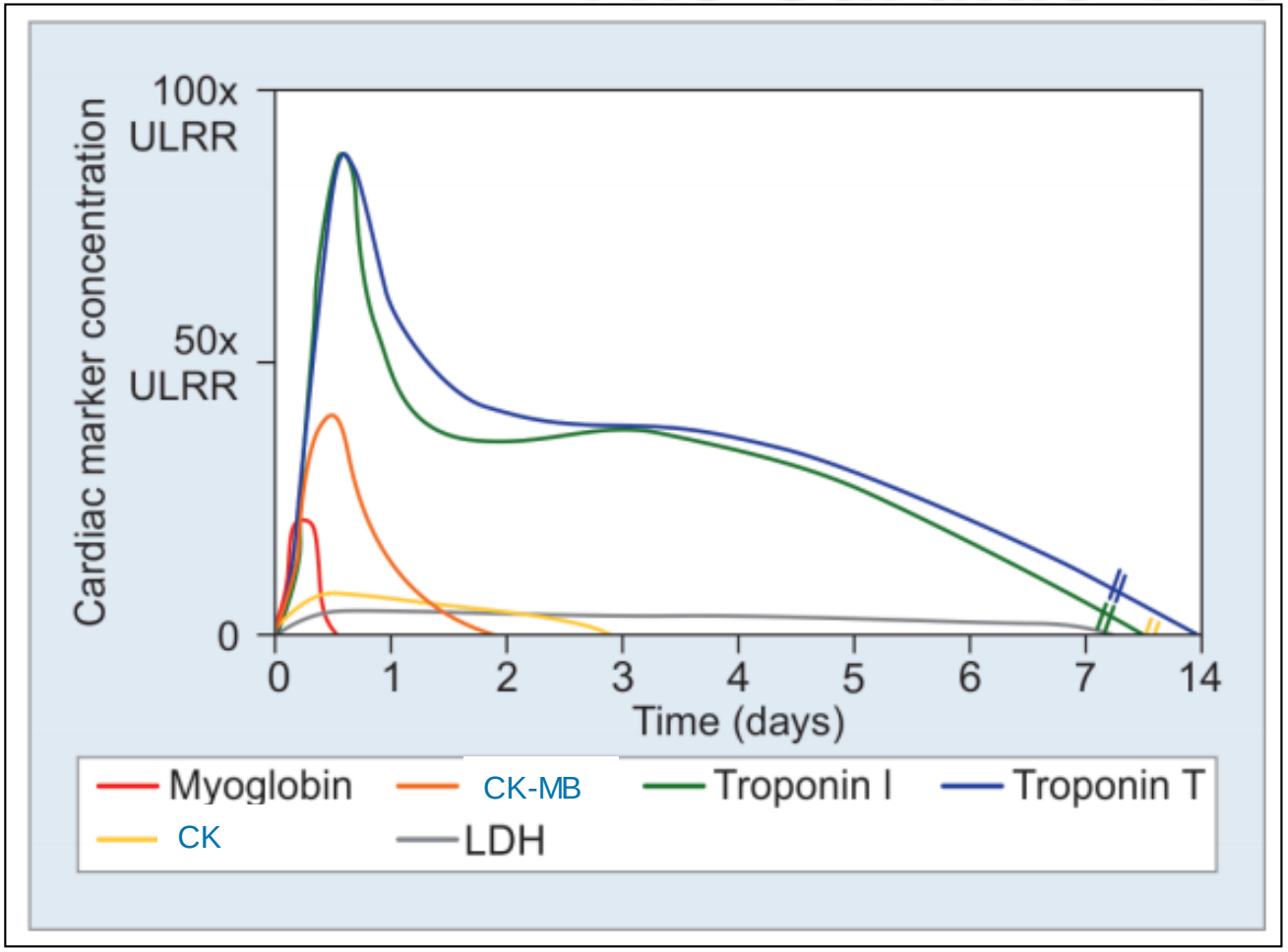
Decision making on type of ischemic workup

- Age and frailty
  - Functional capacity
  - Is there underlying dementia and to what degree
  - Can their symptoms be managed conservatively
- Anemia
  - Stress test and heart catheterization routinely not performed with Hbg < 8.0
  - Is the patient receiving routine blood transfusions
  - is the source of their anemia known
- Renal Insufficiency
  - Risk for contrast induced nephropathy with LHC that may lead to risk of needing dialysis
- Can the patient tolerate DAPT?
  - Is there upcoming surgery planned with need for DAPT to be held and patient now with new DES
  - Anemia considerations; oral AC considerations

The Cardiac Troponin Complex



- Troponin I
  - Multiple assays
  - Values are not transferable
- Troponin T
  - Single assay (Roche)
  - 5th generation approved in USA 2017

5th Generation ("high-sensitive") Troponin-T – ng/L

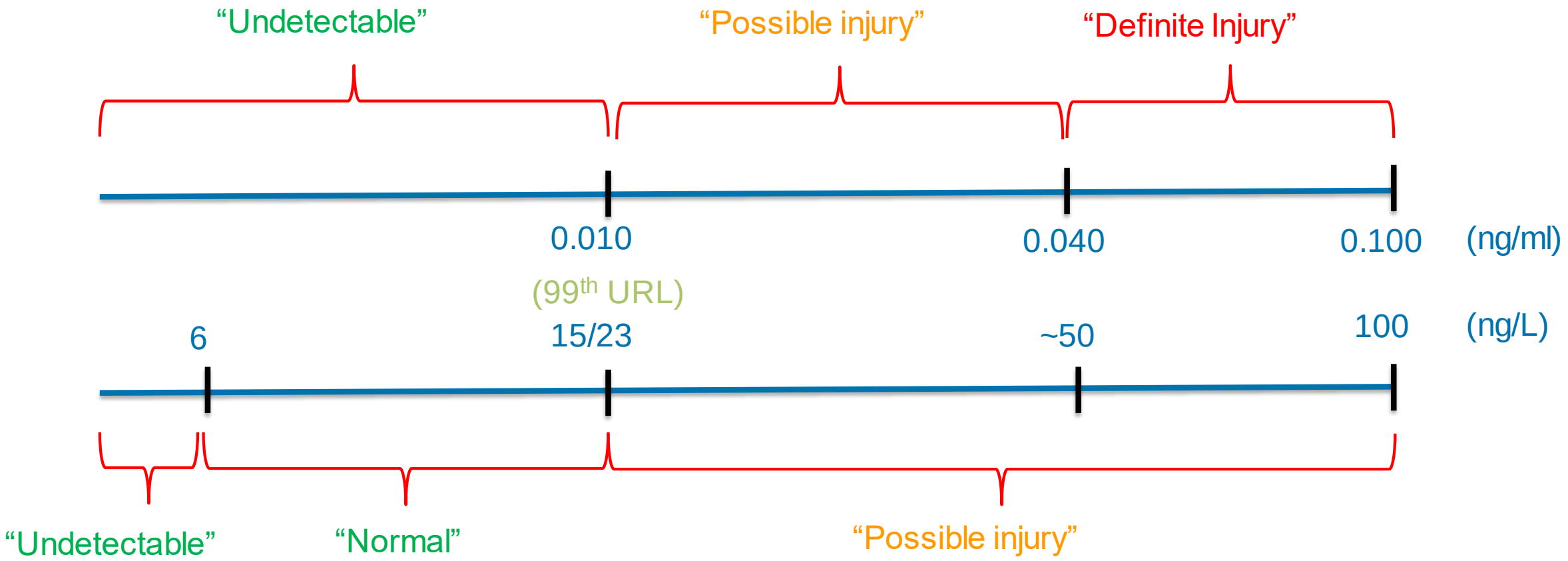
- Detects very low circulating cTn-T (ng/L) – below "normal" threshold
  (Emphasis on serial change - "delta troponin")
- Detects acute myocardial injury EARLIER (faster "rule-in") and excludes acute injury SOONER (faster "rule-out")
- "Flat" elevation in renal disease, non-ischemic cardiac disease, etc.
- Sex-specific cutoffs (to maximize specificity and sensitivity)

Myocardial Infarction: 4th Universal Definition
(WHF/ACC/AHA/ESC expert consensus, 2018)

- MYOCARDIAL INJURY: Cardiac Troponin (cTn) > 99th percentile of URL
- ACUTE INJURY: >99th URL plus rise or fall >20% ("delta" cTn)
- INFARCTION = Acute Injury Plus Clinical ischemia
  - Type 1 (primary thrombosis) or Type 2 (secondary ischemia)
  - ST elevation or non-ST elevation

  - Ischemic EKG changes
    or
  - Ischemic Symptoms

4th Generation Troponin-T (4G) – ng/ml



5th Generation Troponin-T (5G) – ng/L

5G Troponin T: Non-MI elevation

- Renal disease (reduced clearance)
- Skeletal Myopathies (cross reaction with assay)
- Non-MI myocardial injury
  - Cardiac
    - Heart Failure
    - Arrhythmia
    - Hypertensive Urgency
    - Valvular Disease
    - Drug toxicity
    - Myocarditis, infiltrative diseases
    - Takotsubo Cardiomyopathy
    - Cardiac contusion / trauma
  - Non-Cardiac
    - Aortic Dissection
    - Sepsis
    - Shock
    - Pulmonary Embolism
    - Acute Neurologic event
    - Thyroid disease
    - Rhabdomyolysis
    - Extreme endurance efforts

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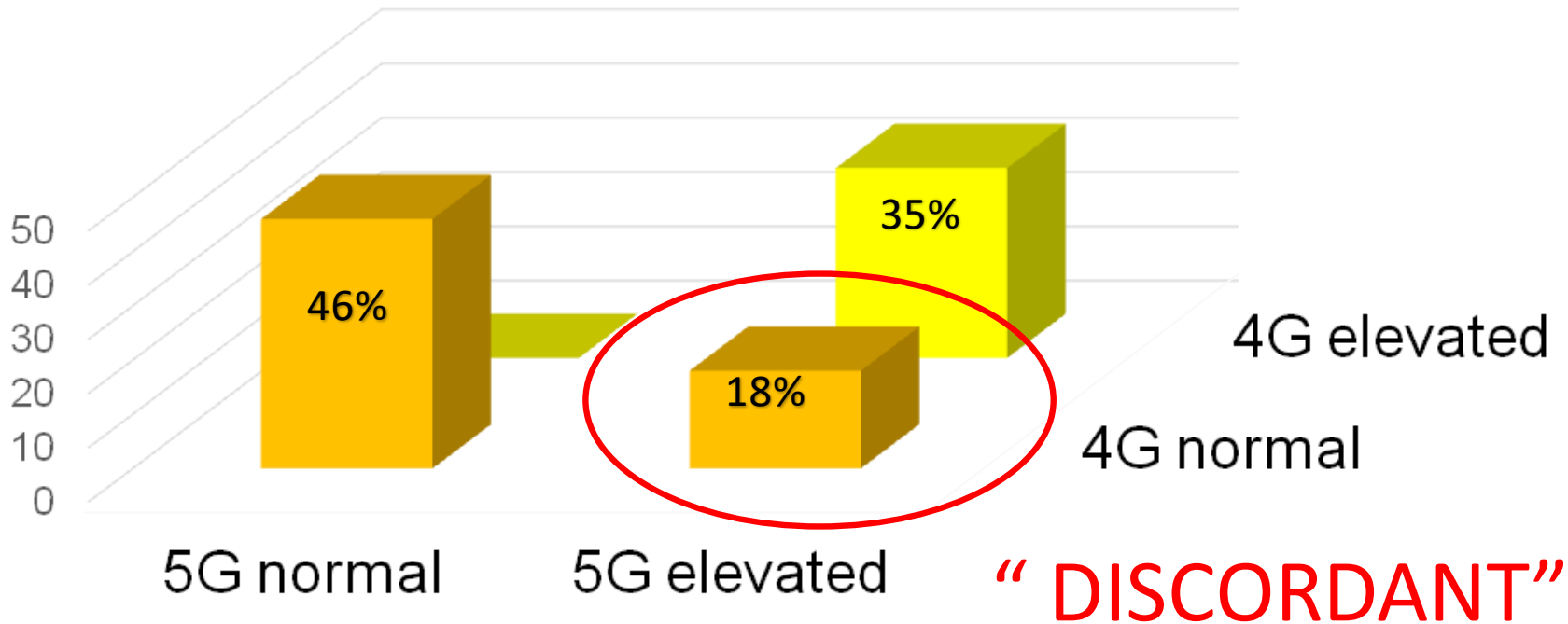
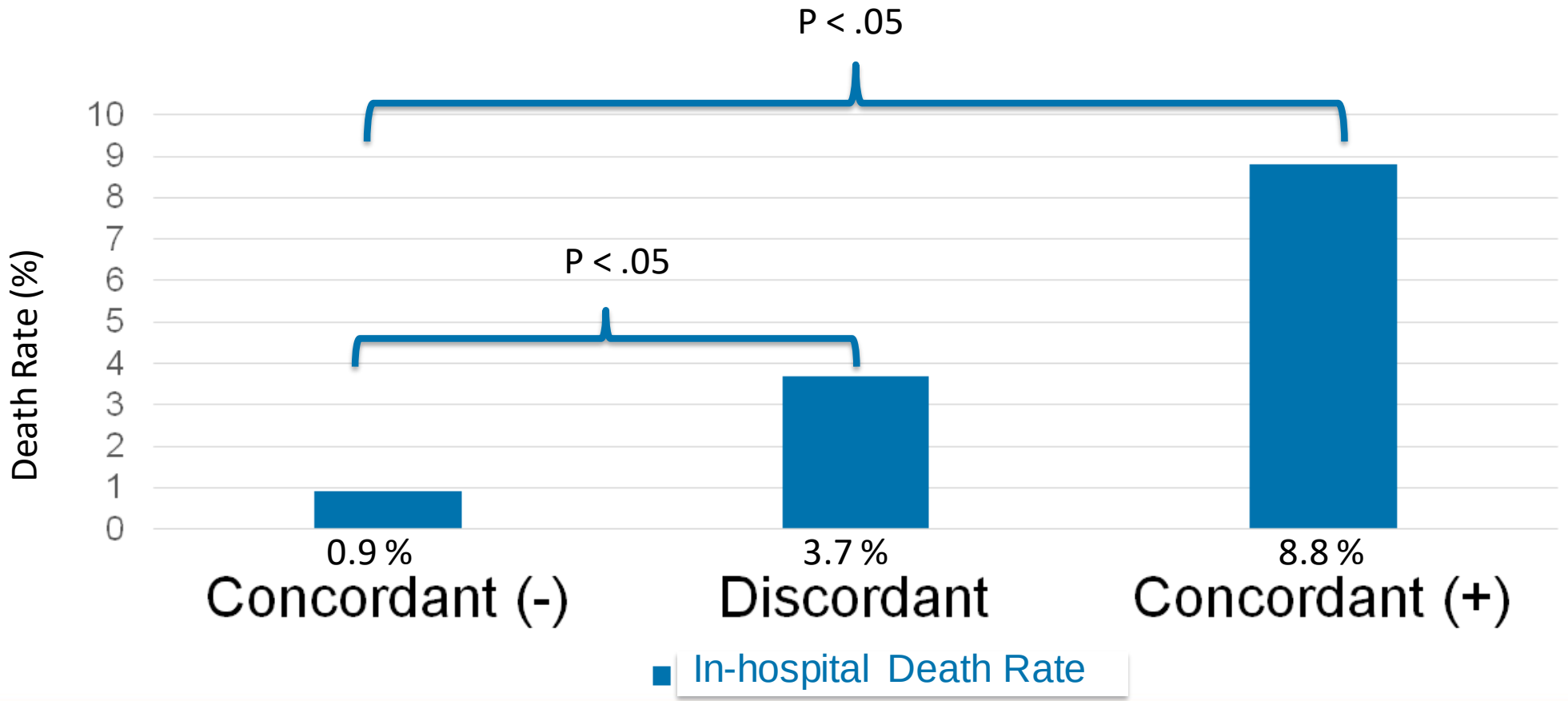
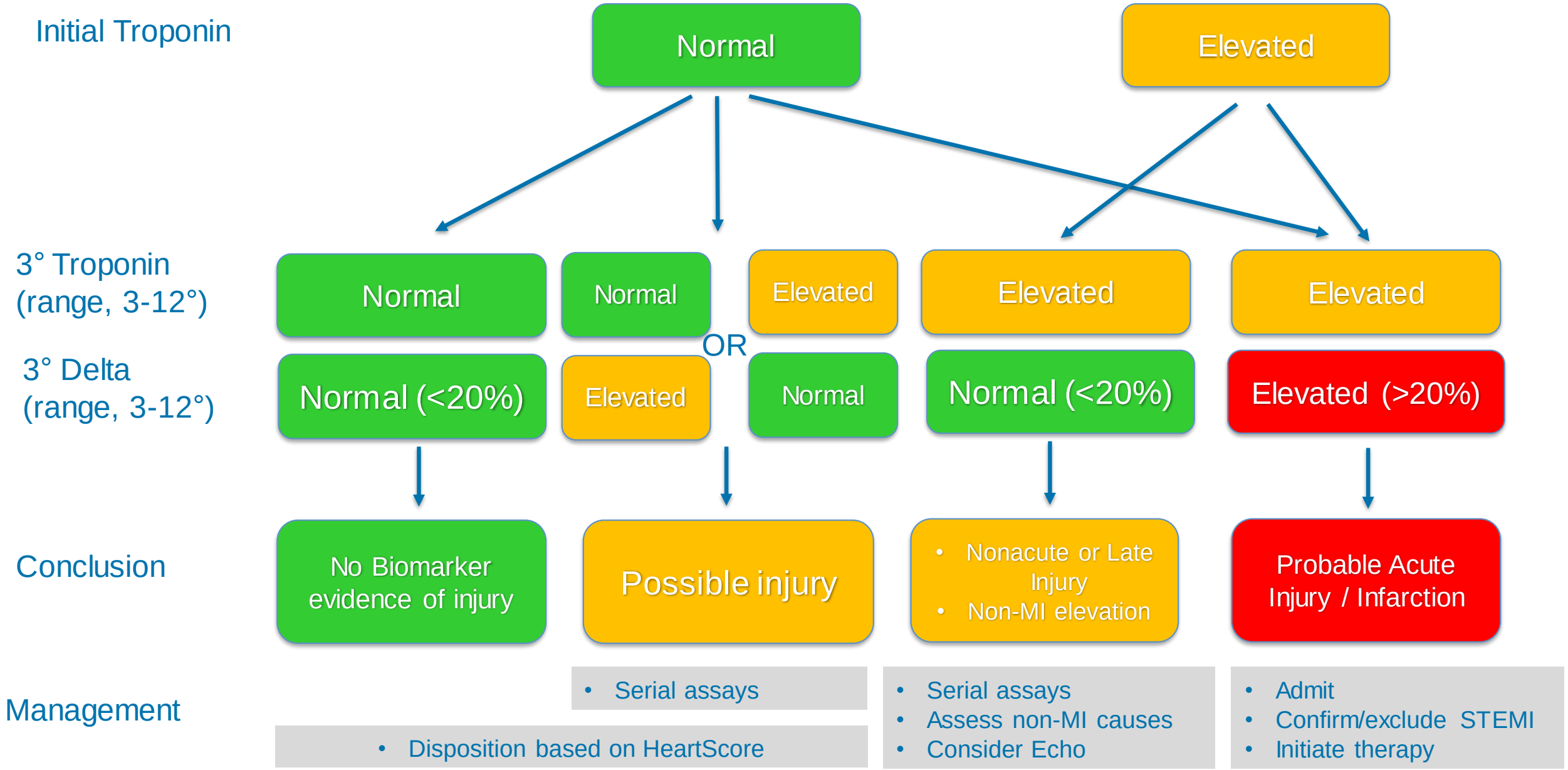
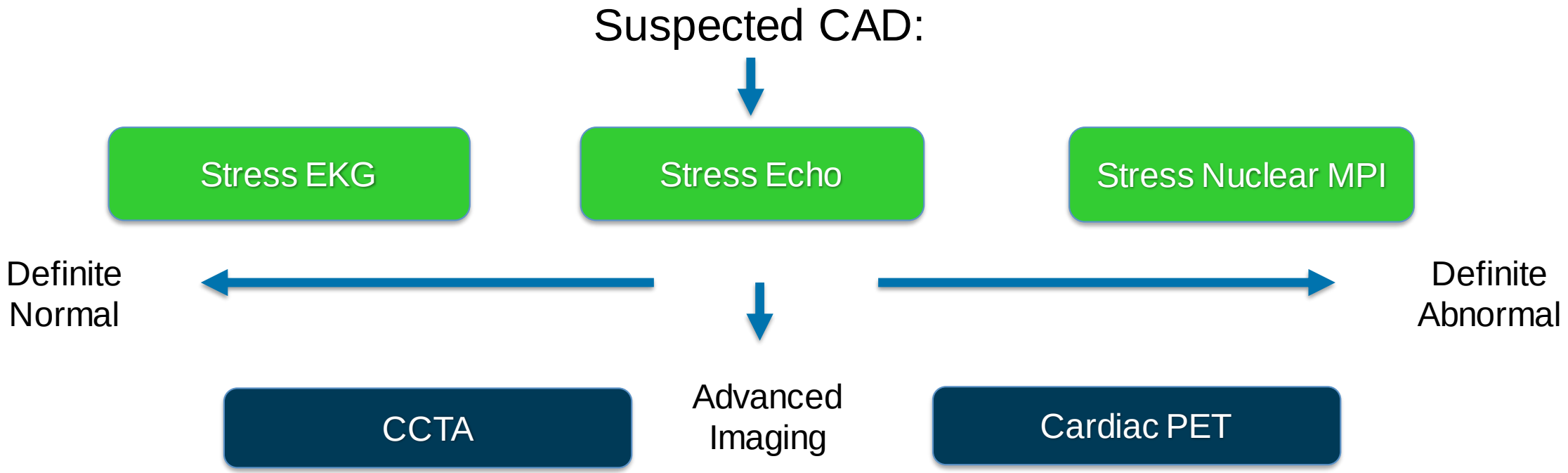
4G vs. 5G Troponin T: Results (2060 patients, 3891 total samples)



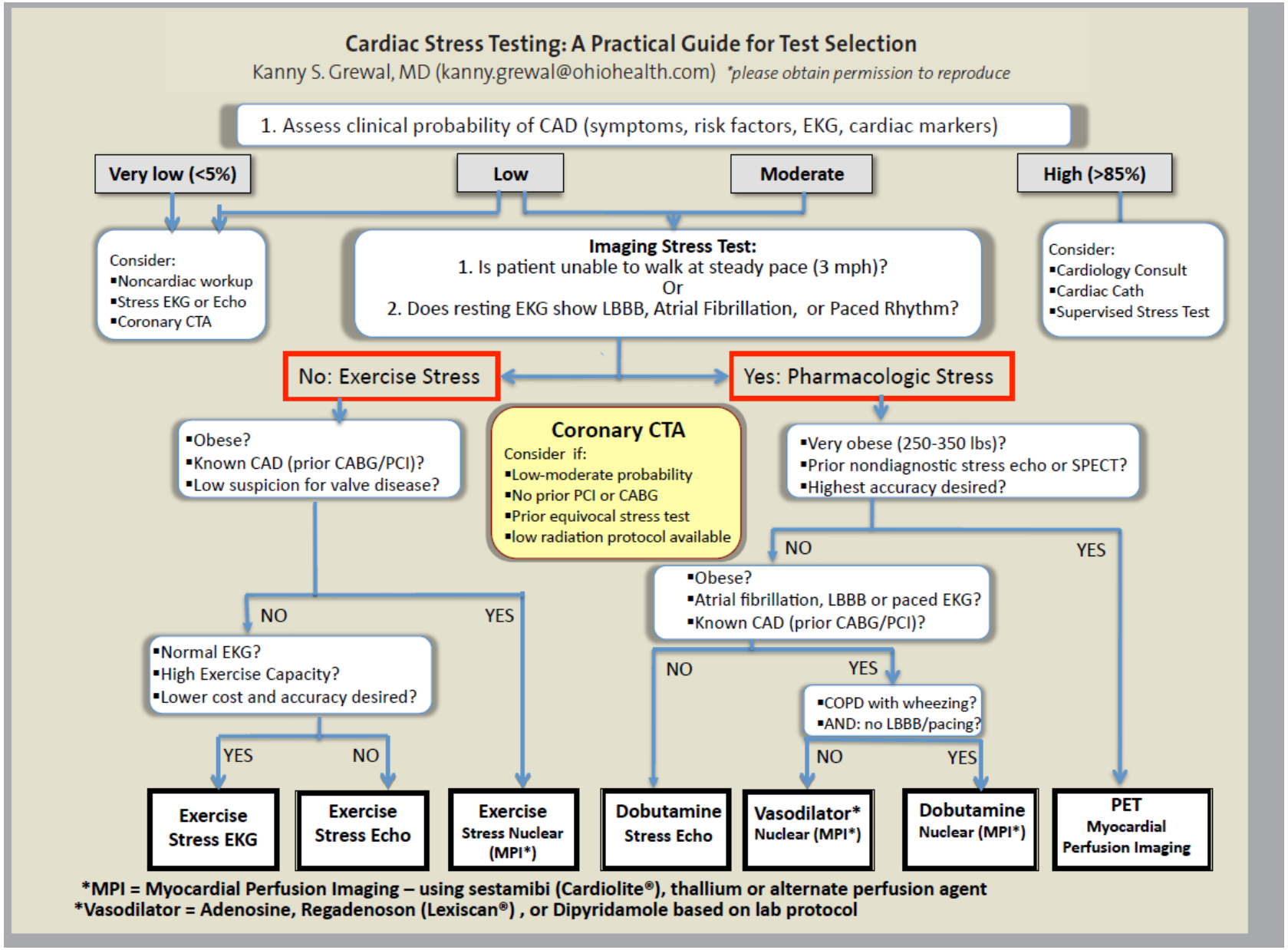
OhioHealth 5G Troponin T study:
In-hospital Death Rate (Any Cause)







Clinical Suspicion:	Low	Mod/High
Age:	<70	Any
BMI:	Lower	Any
Known CAD:	No	Yes
Arrhythmia:	No	Yes



Test	Preferred Settings:	Avoid if:
Exercise Stress EKG	• Lowest cost desired • Assess exercise capacity	• Resting EKG abnormalities • Unable to exercise • Higher accuracy desired • Localization of ischemia desired
Exercise Stress Echo	• Good functional capacity • BMI < 30 • Valve disease suspected •Avoid Radiation	• LBBB or Paced EKG • Unable to exercise • Obese patients, lung disease • Known Cardiomyopathy/ prior MI
Exercise Stress Nuclear (Myocardial Perfusion Imaging: MPI)	• Able to exercise • Higher Accuracy Desired • Known CAD (prior PCI/CABG)	• Valve disease suspected
Dobutamine Echo	• Unable to exercise • Valve disease suspected • Avoid Radiation	• LBBB or Paced EKG • Atrial or ventricular arrhythmia • Obese patients, lung disease
Vasodilator Stress MPI	• Preferred test if unable to exercise • Known CAD (prior PCI/ CABG) • Obese patients (but < 400 lbs.) • LBBB or Paced EKG	• Active Bronchospasm • Caffeine use <12 hrs.
Dobutamine Stress Nuclear MPI	• Unable to exercise • Active bronchospasm/ COPD	• LBBB or Paced EKG • Atrial or ventricular arrhythmia
Vasodilator PET MPI	• Unable to exercise or LBBB/ paced rhythm • Prior nondiagnostic Echo/ SPECT • Obese patients (but < 350 lbs.) • Highest accuracy desired	• Valve disease suspected • Caffeine use <12 hrs. • Currently only for Outpatients
Cardiac CTA	• Age <70, • Low/int probability • No known CAD • Anatomy assessment desired	• Known CAD (prior PCI or CABG) • Arrhythmia or tachycardia • Renal disease or iodine allergy

OhioHealth Heart & Vascular Physicians

Cardiac Stress Testing: Practical Guide for Test Selection

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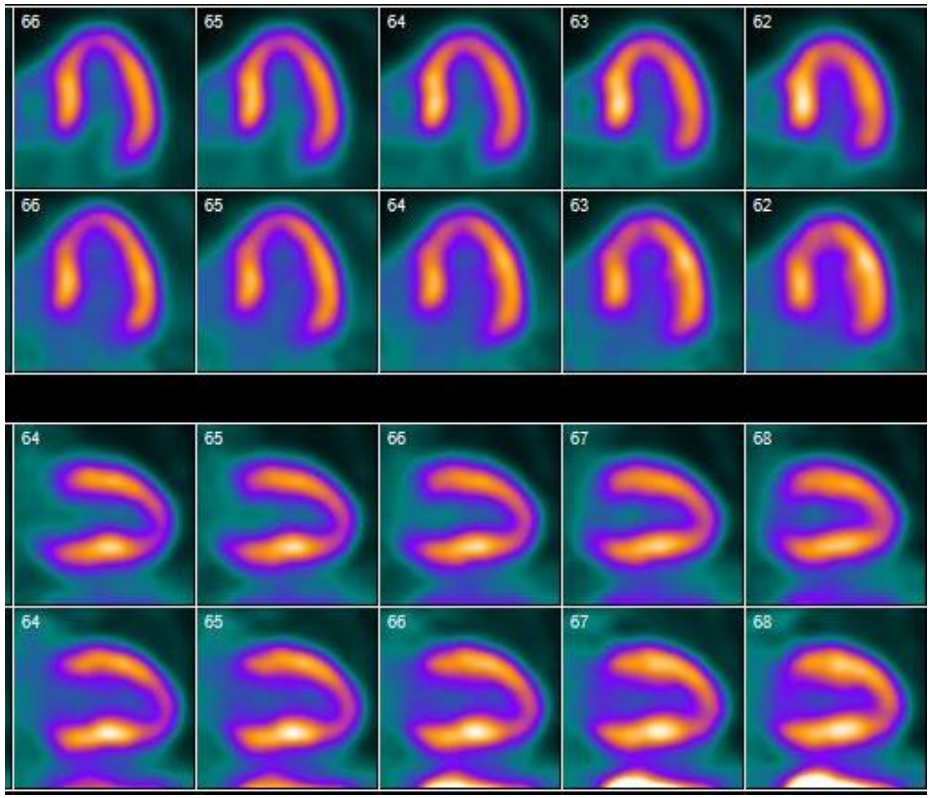
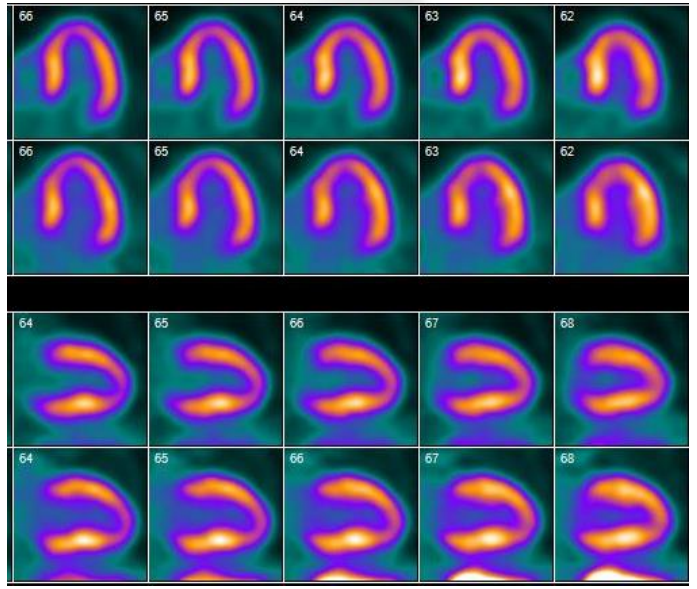
Cardiac PET imaging



PET perfusion imaging

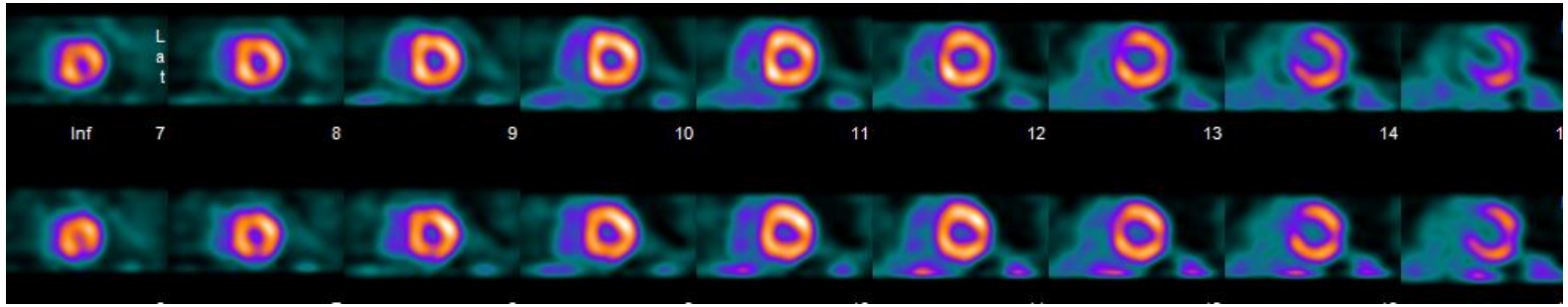
- Highest quality perfusion imaging
- Higher accuracy, less artifact than SPECT
- Short half life, therefore quicker exam and less radiation exposure than SPECT
- Allows
  - rest and stress EF (EF reserve)
  - CT attenuation correction, allows CACS assessment
  - Rest/stress coronary flow assessment
- Assess Viability, Sarcoidosis, Endocarditis
- BUT. . . Expensive, requires pharmacologic stress



Case 5: Rest and Stress PET perfusion

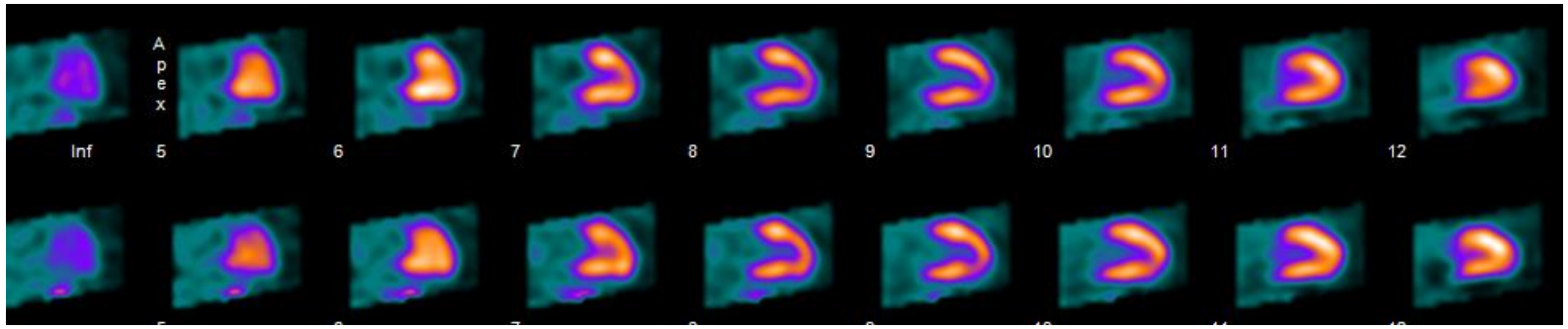
Peak-Stress

Rest



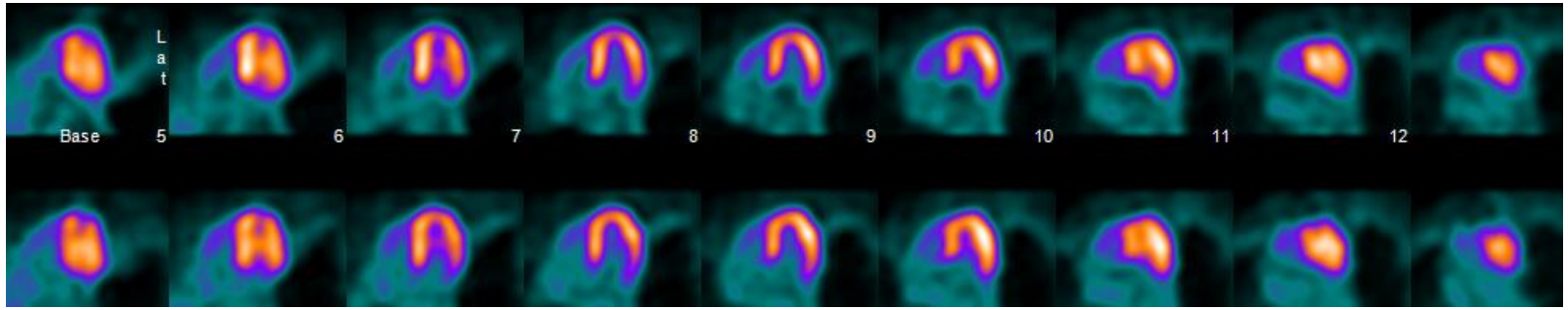
Peak-Stress

Rest



Peak-Stress

Rest



Peak Stress

EF = 67%

EDV = 52 ml

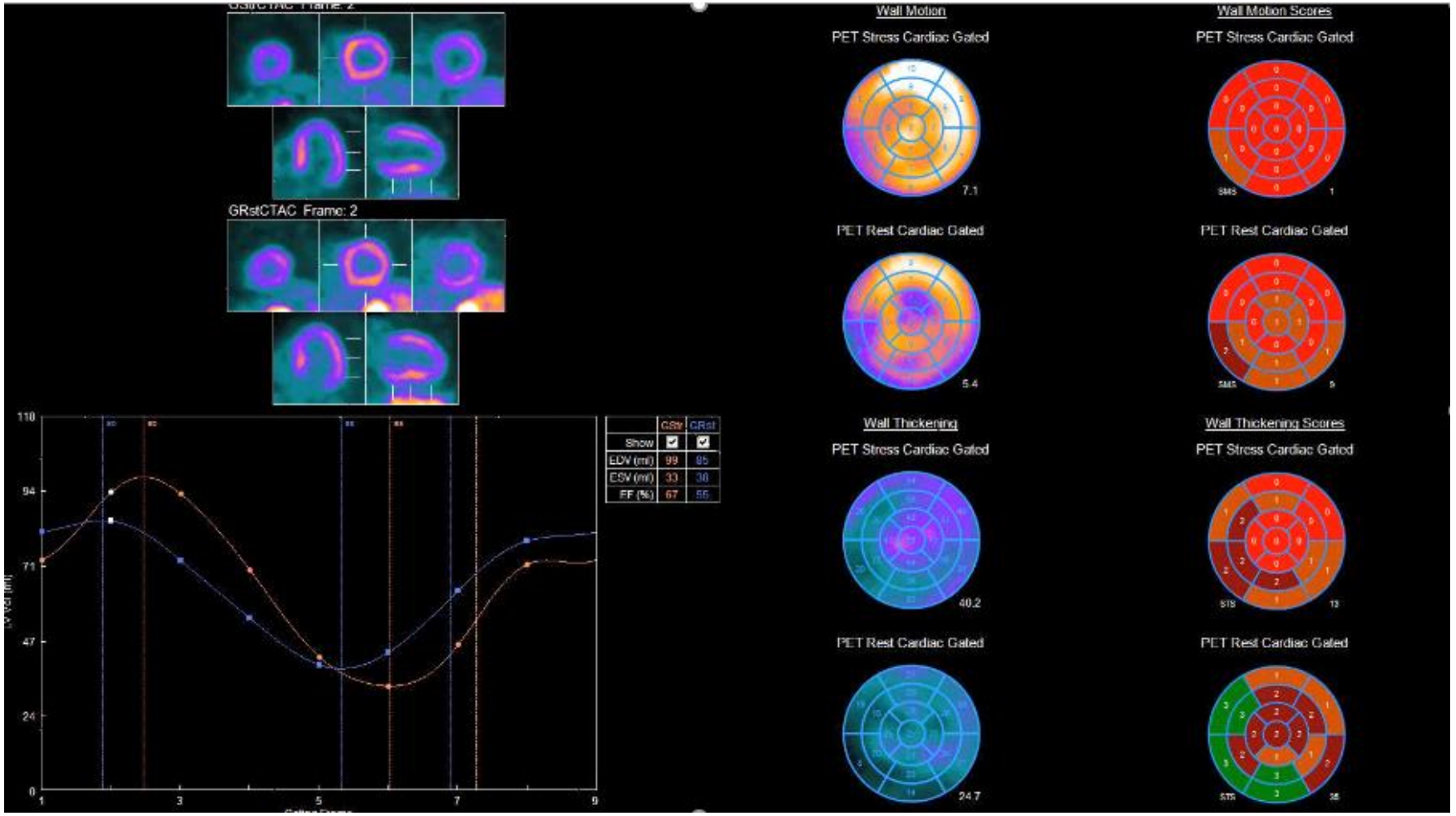
ESV = 17 ml

Resting

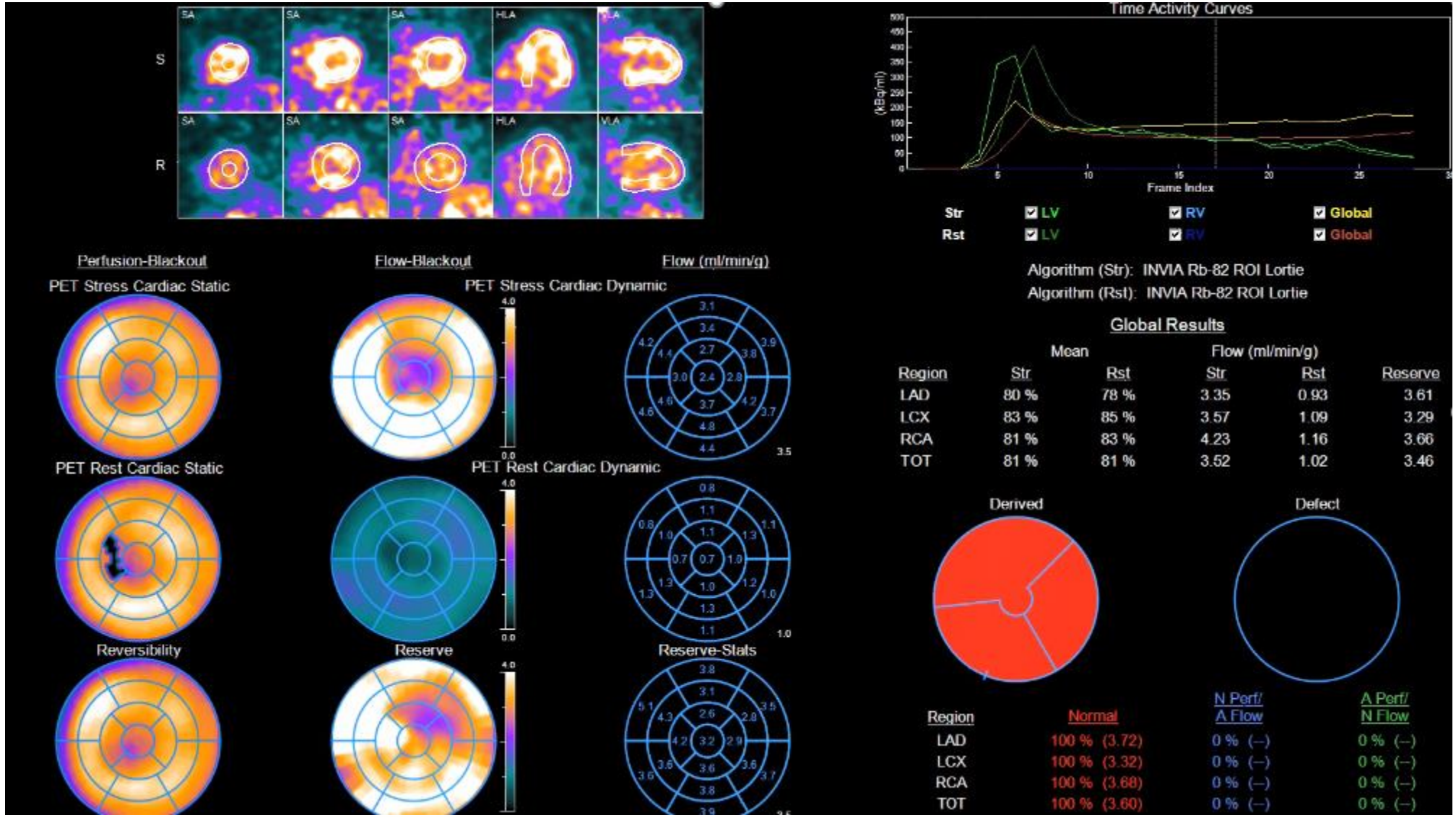
EF = 55%

EDV = 62 ml

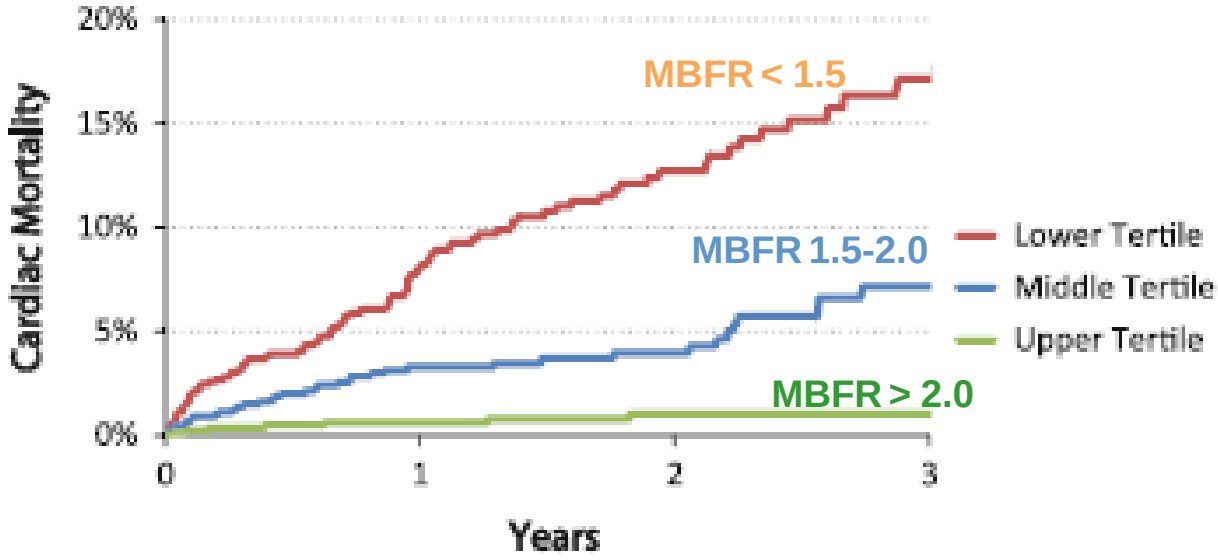
ESV = 21 ml



Case 5: Quantitative MBF and MBFR



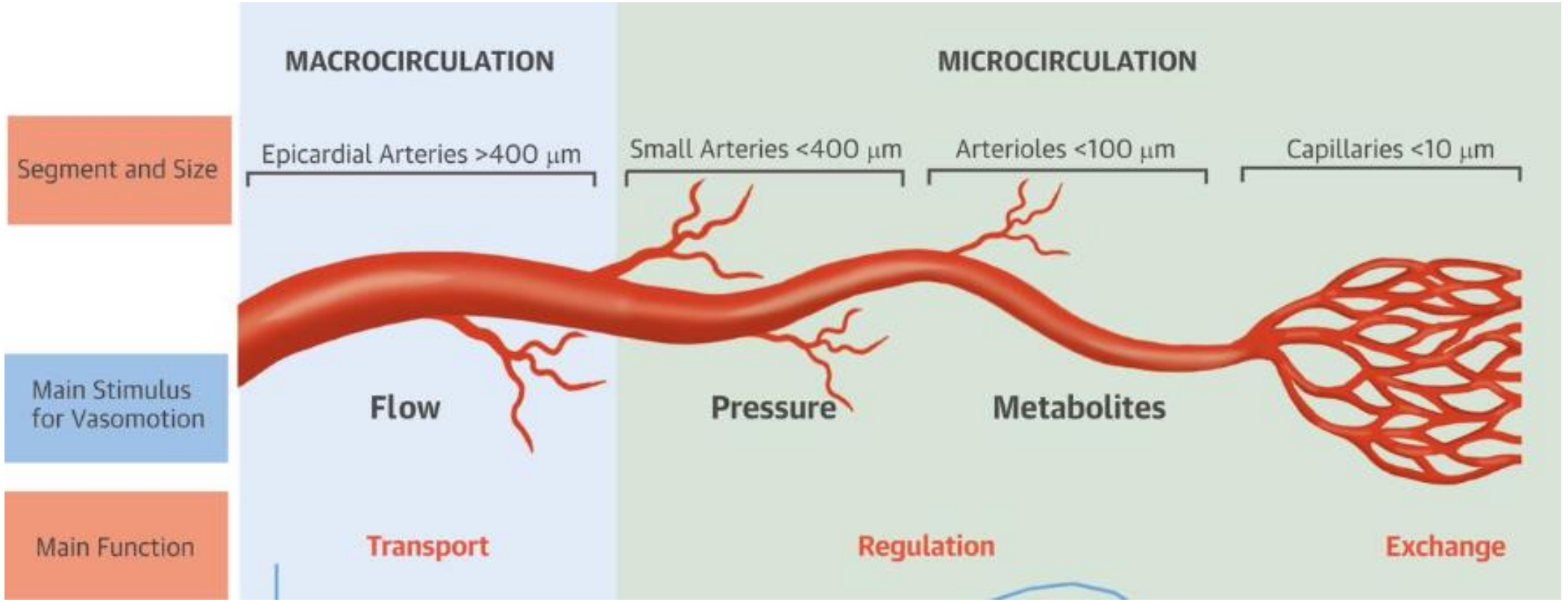
Myocardial Blood Flow Reserve and Cardiac Mortality



N=2783

MBFR < 1.5 vs MBFR > 2.0	*p < 0.001	*HR 5.6 (2.5-12.4)
MBFR 1.5-2.0 vs MBFR > 2.0	*p = 0.003	*HR 3.46 (1.5-7.7)

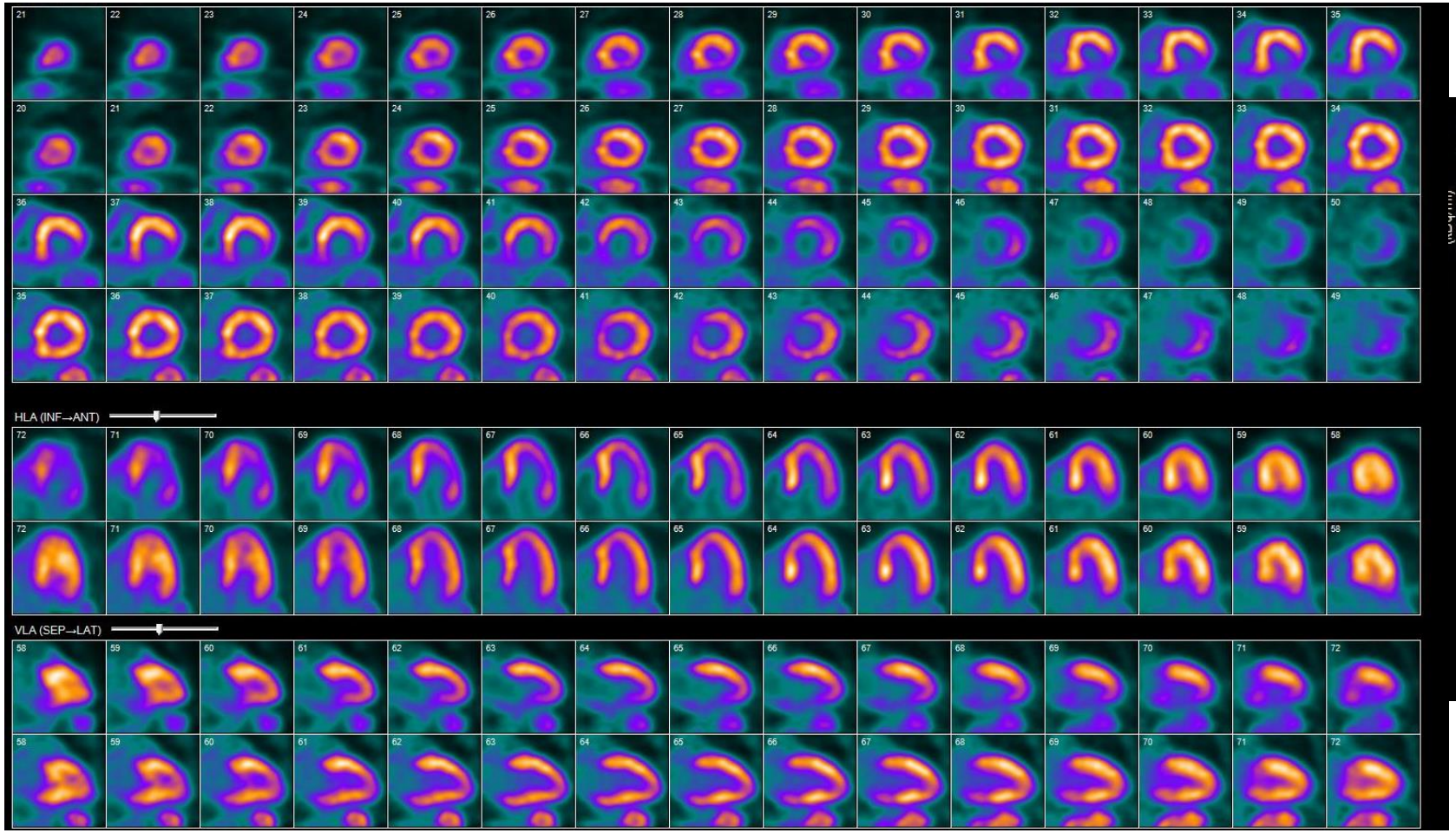
Murthy et al. Circulation 2011;124:2215-24

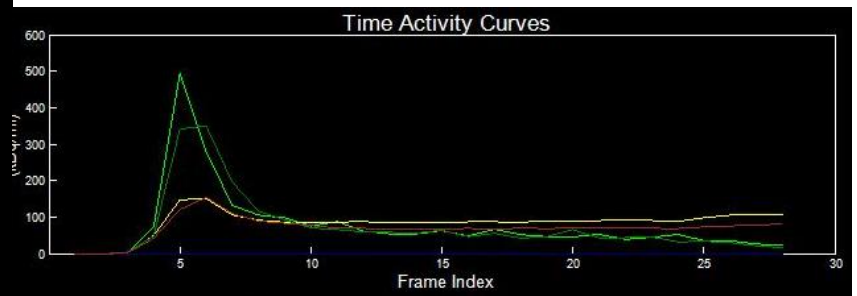


FFR (Fractional Flow Reserve)

CFR (Coronary Flow Reserve)

Example: Inferior Ischemia





Algorithm (Str): INVIA Rb-82 ROI Lortie
Algorithm (Rst): INVIA Rb-82 ROI Lortie
* RPP normalization, RPP Reference = 9000

Global Results

Region	Mean Flow (ml/min/g) Str	Rst	Str	Rst *	Reserve
LAD	85 %	84 %	2.20	0.81	2.71
LCX	71 %	88 %	1.79	0.83	2.16
RCA	61 %	83 %	1.27	0.77	1.64
TOT	75 %	85 %	1.79	0.78	2.28

Thank You!

Case Studies in Acute Chest Pain:
Diagnosis, Risk Stratification, & Test Selection

April 17, 2019

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