American College of Emergency Physicians®
ADVANCING EMERGENCY CARE

E·QUAL | EMERGENCY QUALITY NETWORK

Clinical Policy: Appropriate Utilization of Cardiovascular Imaging in ED Patients with Chest Pain

TCPi | Transforming Clinical Practices Initiative

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Presenters

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Michael Kontos, MD, FACC

APPROPRIATE CV IMAGING OF ED CP

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Baylor College of Medicine, Houston, TX
Accreditation Management Board of Directors

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DISCLOSURES

- **Frank Peacock**
  - **Research Grants:** Abbott, Boehringer Ingelheim, Brainbox, CSL Behring, Daiichi-Sankyo, Janssen, Ortho Clinical Diagnostics, Portola, Relypsa, Roche, Siemens
  - **Consultant:**Abbott, Astra-Zeneca, Bayer, Beckman, Ischemia Care, Dx, Instrument Labs, Janssen, Nabriva, Ortho Clinical Diagnostics, Relypsa, Roche, Quidel, Salix, Siemens
  - **Expert Testimony:** Johnson and Johnson
  - **Stock/Ownership Interests:** AseptiScope Inc, Brainbox Inc, Comprehensive Research Associates LLC, Emergencies in Medicine LLC, Ischemia DX LLC.
- **Michael Kontos**
  - None

APPROPRIATE UTILIZATION OF CARDIOVASCULAR IMAGING

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

Emergency Department Patients With Chest Pain Writing Panel

Frank J. Rybicki, MD, PhD, *Co-Chair*[a,1,2]
James E. Udelson, MD, *Co-Chair*[b]
W. Frank Peacock, MD, *Co-Chair*[c]
Samuel Z. Goldhaber, MD[b]
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Ella Kazerooni, MD[a]
Michael C. Kontos, MD[b]
Harold Litt, MD, PhD[a]
Pamela K. Woodard, MD[a]

[a]Official American College of Radiology Representative. [b]Official American College of Cardiology Representative. [c]Official American College of Emergency Physicians Representative.
[1]Ottawa Hospital Research Institute and Medical Imaging, The Ottawa Hospital. [2]Department of Radiology, The University of Ottawa.

JACC; 67 (7), 2016, 853–79

CLINICAL PRACTICE GUIDELINES, PERFORMANCE MEASURES AND APPROPRIATE USE CRITERIA

- Clinical Practice Guideline recommendations are “should” or “should not” directives
- Performance measures represent “must do”
- Appropriate use criteria “reasonable to do” clinical steps
- Together, define best practices based on evidence

APPROPRIATENESS CRITERIA

- Balances risk and benefit of a tx, test, or procedure in the context of available resources for an individual pt with specific characteristics

- Provides guidance to supplement the clinician's judgment as to whether a pt is a reasonable candidate for the given tx, test or procedure


TARRAGONA
TOTS SOM COLLA VELLA
Castellers
de Vilanova i la Geltrú

APPROPRIATENESS RATING

- 7, 8, or 9:
  - Appropriate as benefits generally outweighing risks
  - Effective but not always necessary
    - Depends on physician judgment and patient preferences

- 4, 5, or 6:
  - Maybe appropriate
    - Variable evidence or agreement regarding the benefit/risk ratio
  - Potential benefit on the basis of practice experience in the absence of evidence or due to variability in the population

- 1, 2, or 3
  - Rarely appropriate; lack of a clear benefit/risk advantage
  - Rarely effective option
  - Exceptions should have documentation of the reasons for proceeding

FINAL RATING

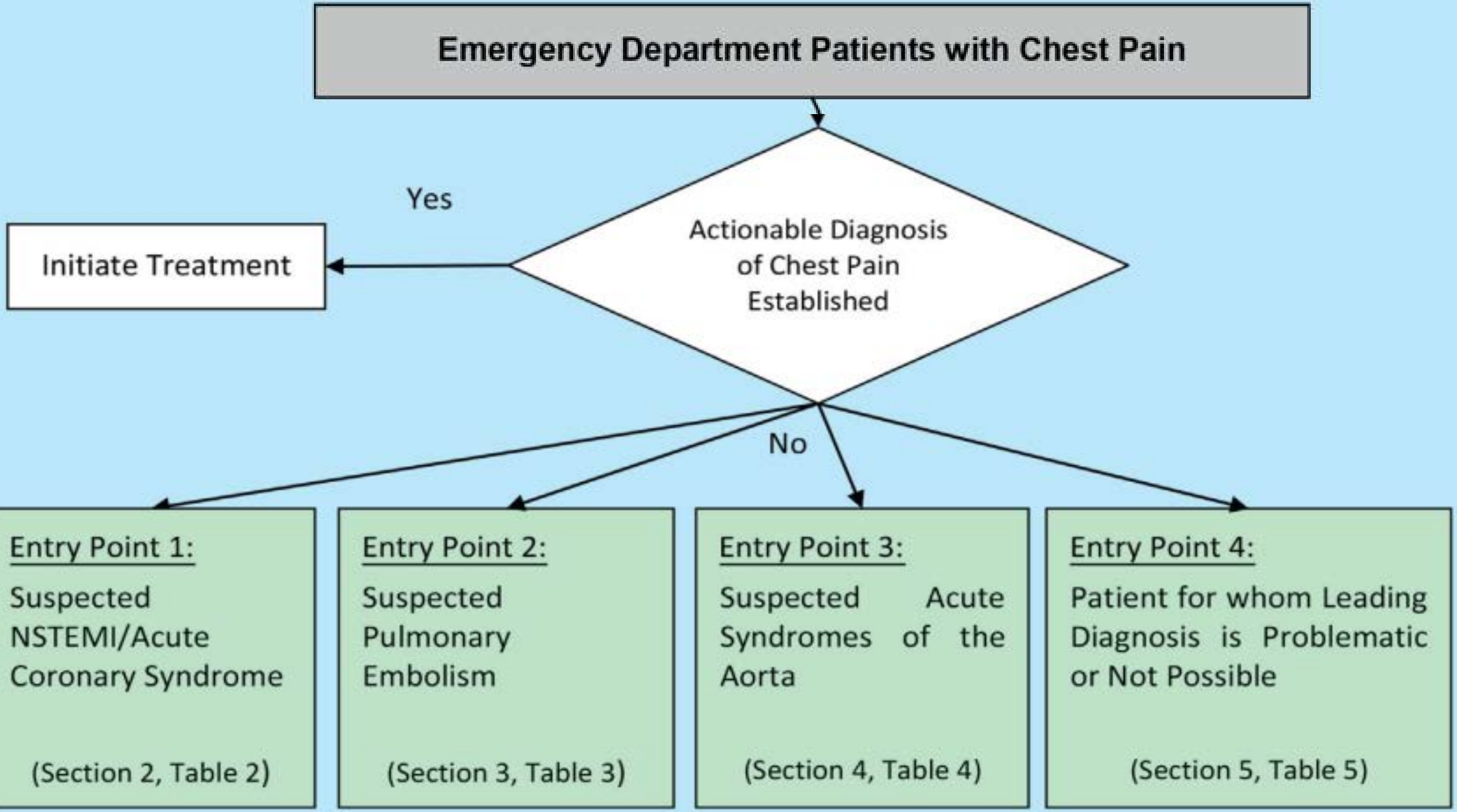
- Consensus was defined as ≥60% of the panel giving a rating of:
  - Appropriate (A)
  - May be appropriate (M)
  - Rarely appropriate (R)
- If consensus was not reached (>60% agreement) within a clinical scenario, the rating was assigned M*

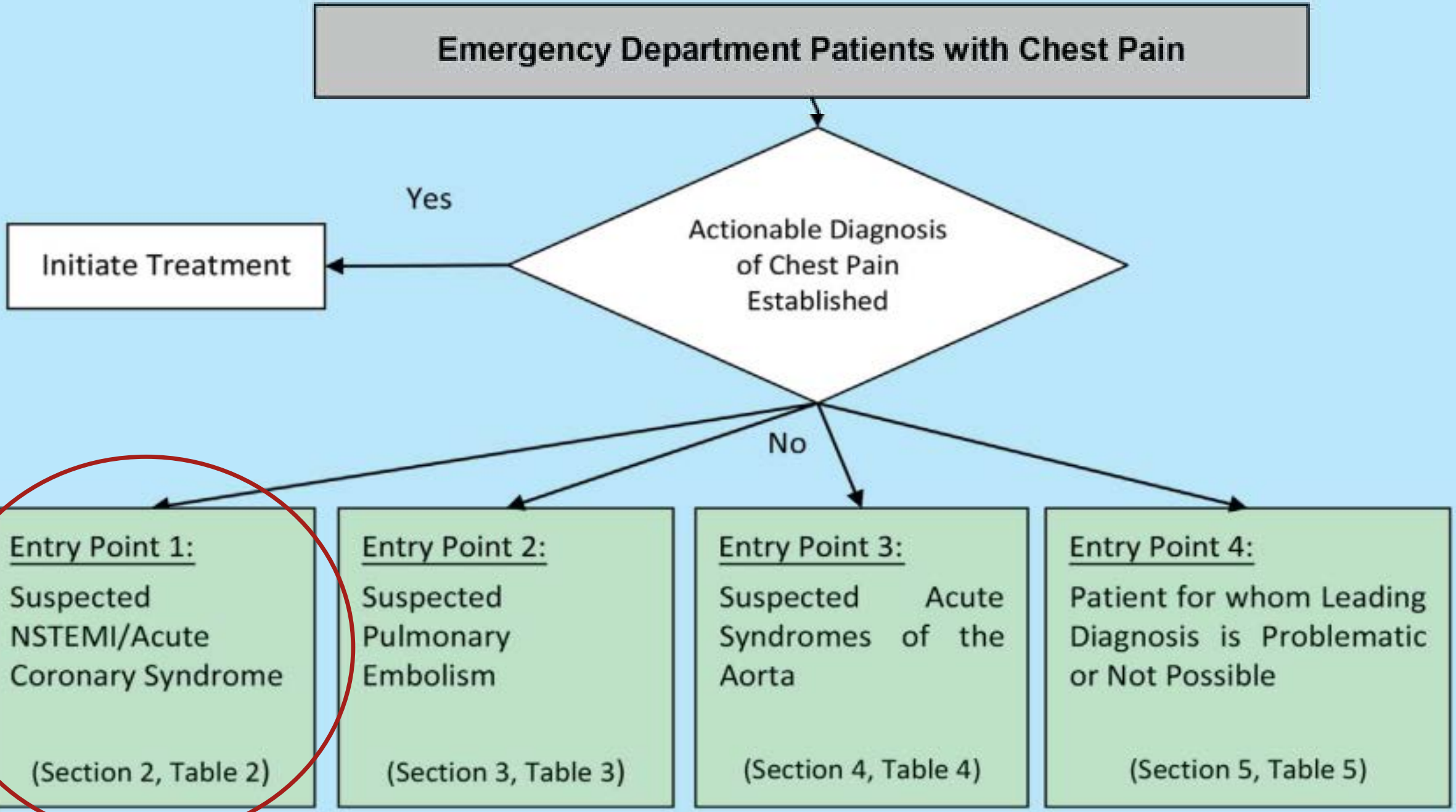
AUC

- Case based determinate of entering the criteria…..

ASSUMPTIONS

- All ED patients with potential CP syndromes undergo evaluations that include:
  - H and P
  - ECG to identify/exclude STEMI
  - Cardiac and/or pulmonary biomarker analysis
- Some patients will be diagnosed with non-CV illnesses→no imaging required
- Patients with STEMI on initial the ECG, or initial biomarkers and/or ECG clearly consistent with ACS/NSTEMI are admitted and treated according to guidelines
- After the initial evaluation, most patients will be risk stratified into 1of the 3 diagnoses:
  - ACS
  - PE
  - AAS
- A minority of patients for whom a leading diagnosis is not possible


Emergency Department Patients with Chest Pain
Actionable Diagnosis of Chest Pain Established
Yes
Initiate Treatment
No
Entry Point 1:
Suspected NSTEMI/Acute Coronary Syndrome
(Section 2, Table 2)
Entry Point 2:
Suspected Pulmonary Embolism
(Section 3, Table 3)
Entry Point 3:
Suspected Acute Syndromes of the Aorta
(Section 4, Table 4)
Entry Point 4:
Patient for whom Leading Diagnosis is Problematic or Not Possible
(Section 5, Table 5)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Patient for whom Leading Diagnosis is Problematic or Not Possible
(Section 5, Table 5)

AUC Indication

Indications 1 and 2

1. Diagnostic ECG for STEMI
2. Initial history/physical examination and/or chest radiography identifies a likely noncardiac diagnosis (e.g., pneumothorax, costochondritis, lesion in the esophagus)

Indications 3-7

Positive initial diagnosis of NSTEMI/ACS
3. Initial ECG and/or biomarker analysis unequivocally positive for ischemia
Equivocal initial diagnosis of NSTEMI/ACS
4. Equivocal initial troponin or single troponin elevation without additional evidence of ACS
5. Ischemic symptoms resolved hours before testing
Low/intermediate likelihood initial diagnosis of NSTEMI/ACS
6. TIMI risk score = 0, early hsTrop negative
7. Normal or nonischemic on initial ECG, normal initial troponin

Indications 8, 9, 10

8. Diagnosis unequivocally positive for NSTEMI/ACS
Serial troponins or ECG not positive for NSTEMI/ACS
9. Serial ECG and troponins negative for NSTEMI/ACS
10. Serial ECG or troponins borderline for NSTEMI/ACS

ED Evaluation Process

Step 1

Initial evaluation

ECG, H and P → STEMI → cath

↓

Not a STEMI

↓

Step 2

Further ED evaluation/risk stratification

ECG findings, initial troponin results

↓

Troponin → positive → cath

↓

Negative

↓

Step 3

Initial evaluation negative → obs status

Troponin results

AUC Indication

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↓

Troponin → positive → cath

↓

Negative

↓

Step 3

Initial evaluation negative → obs status

Troponin results

INITIAL WORKUP IS DX FOR STEMI OR A NONCARDIAC DX IS LIKELY

Indication	Chest Radiography	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
1. Diagnostic ECG for STEMI	M	R	R	R	R	A

Appropriate use key: A = appropriate; M = may be appropriate with rating panel consensus; R = rarely appropriate.

CCath, catheter-based coronary angiography; CCTA, coronary CT angiography; CMR, cardiovascular MR; ECG, electrocardiogram; SPECT, single-photon emission computed tomography; STEMI, ST-segment elevation myocardial infarction.

Will almost always do a CXR

2) H&P OR CXR IDENTIFIES LIKELY NONCARDIAC DX

INITIAL WORKUP IS DX FOR STEMI OR A NONCARDIAC DX IS LIKELY

Indication	Chest Radiography	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
1. Diagnostic ECG for STEMI	M	R	R	R	R	A
2. Initial history/physical examination and/or chest radiography identifies a likely noncardiac diagnosis (e.g., pneumothorax, costochondritis, lesion in the esophagus)		R	R	R	R	R

Appropriate use key: A = appropriate; M = may be appropriate with rating panel consensus; R = rarely appropriate.

CCath, catheter-based coronary angiography; CCTA, coronary CT angiography; CMR, cardiovascular MR; ECG, electrocardiogram; SPECT, single-photon emission computed tomography; STEMI, ST-segment elevation myocardial infarction.

SECTION 2:
IMAGING OF PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS

AUC Indication

Indications 1 and 2

1. Diagnostic ECG for STEMI
2. Initial history/physical examination and/or chest radiography identifies a likely noncardiac diagnosis (e.g., pneumothorax, costochondritis, lesion in the esophagus)

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ED Evaluation Process

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Initial evaluation

ECG, H and P → STEMI → cath

↓

Not a STEMI

↓

Step 2

Further ED evaluation/risk stratification

ECG findings, initial troponin results

↓

Troponin → positive → cath

↓

Negative

↓

Step 3

Initial evaluation negative → obs status

Troponin results

PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS

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

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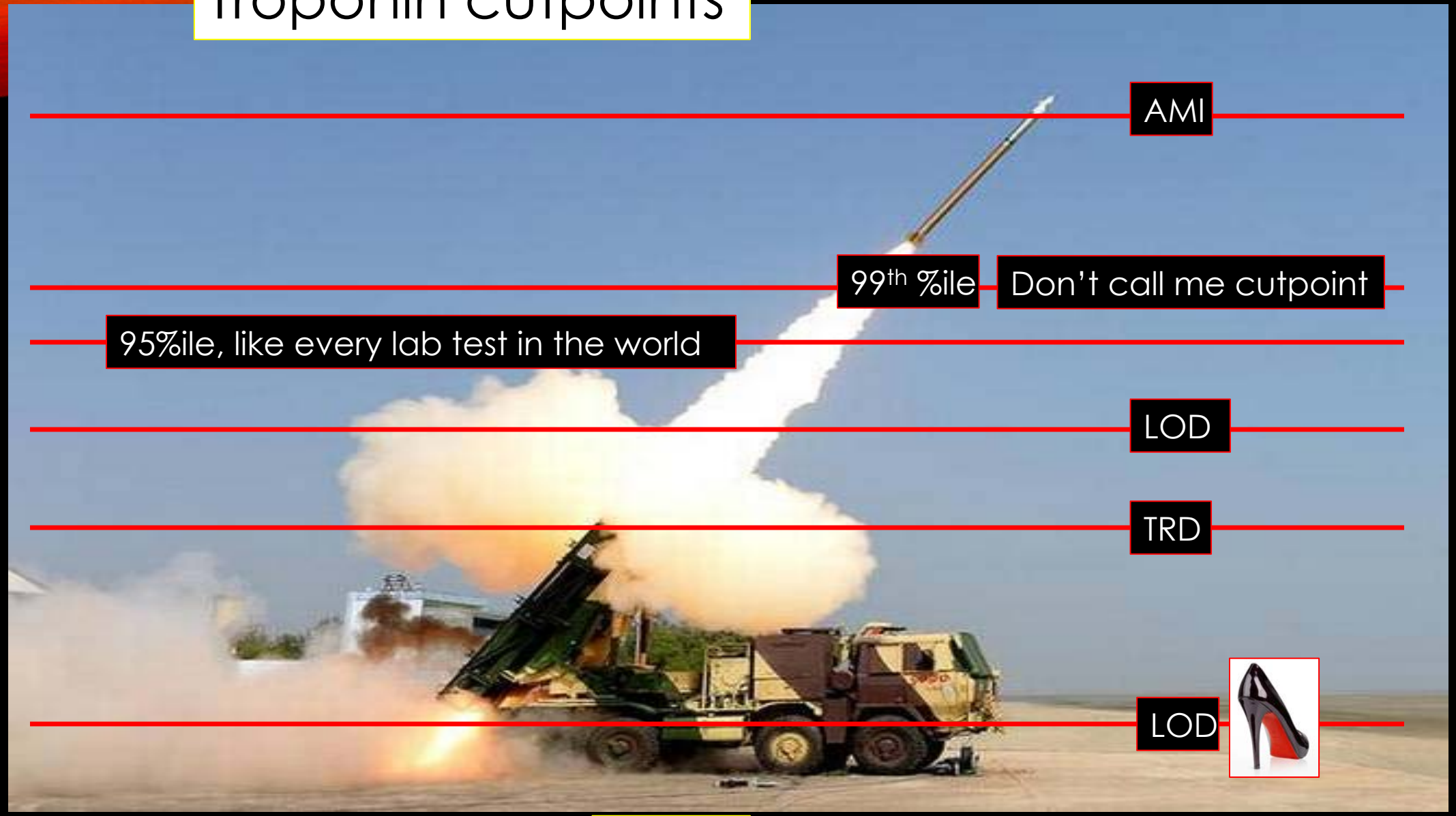
Troponin cutpoints



PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS

Indication	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
Positive initial diagnosis of NSTEMI/ACS					
3. Initial ECG and/or biomarker analysis unequivocally positive for ischemia	R	R	R	R	A

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PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS

Indication	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
Equivocal initial diagnosis of NSTEMI/ACS					
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

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ED VISITS - US

130,000,000 annually

10.4 million chest pain pts (8.0%)

4.1 million pt sent home non-cardiac

50,000 MIs

6.24 million pt suspected or actual cardiac

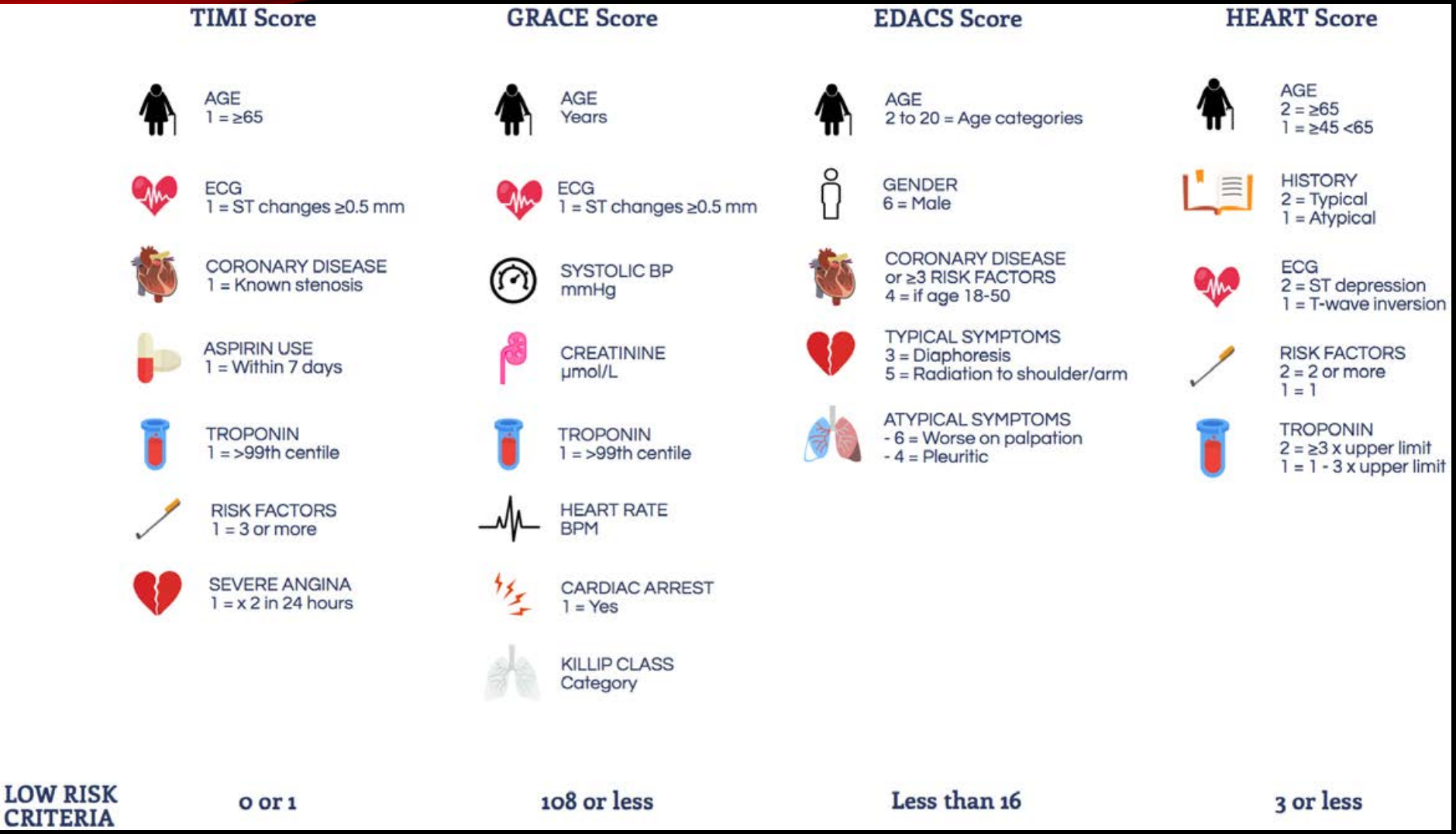
3.1 M non-cardiac (50%)

1.2 M AMI (20%)

1.5 M UA (24%)

374,400 sudden death (6%)

ASC RISK SCORES



Common Variables

Age
ECG
Markers
History

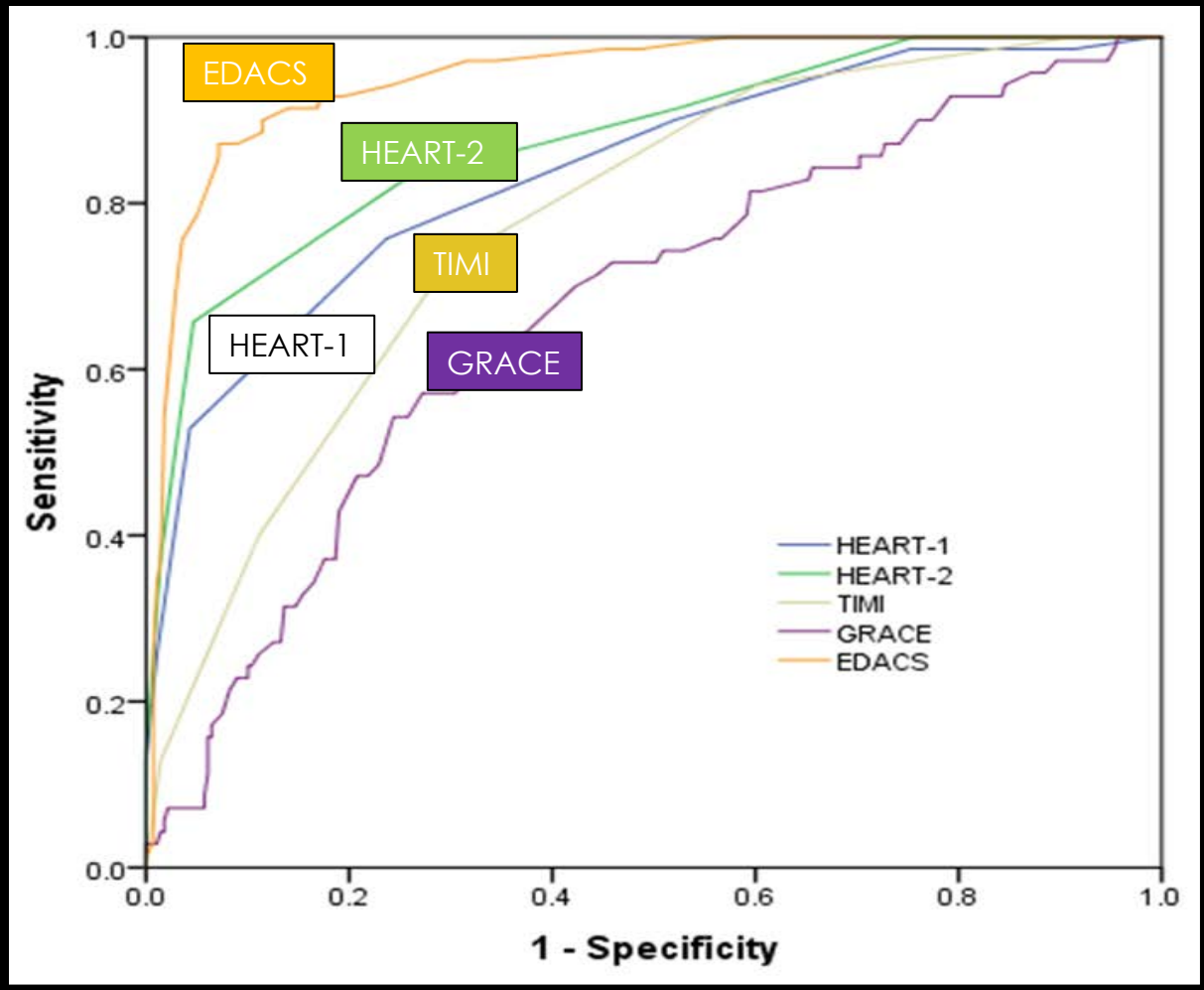
Other Variables

Risk factors
Known CAD
Vital Signs

Chapman AR et al *Circulation.* 2018;138:1654–1665

LOW RISK……COMPARING RISK SCORES

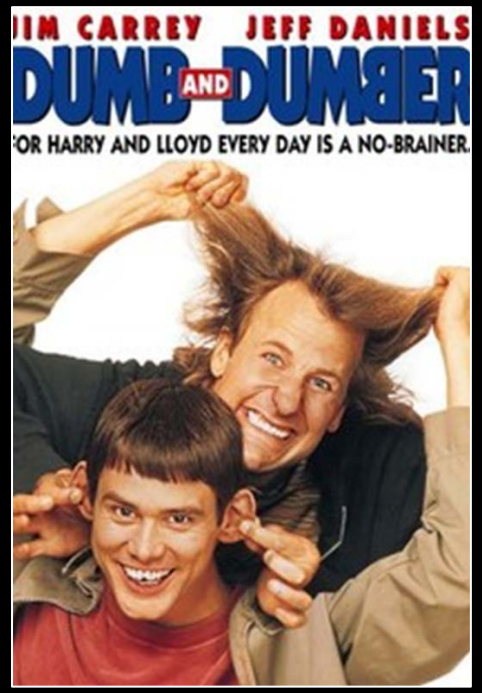
- PEARL data set:
  - 7 ERs
  - N=458
- Suspected ACS patients
- Dr documented risk of MI before Tn results known as: Low, Moderate, or High



Singer A. Am JEM, 2017, Jan 5. pii: S0735-6757(17)30003-7. doi: 10.1016/j.ajem.2017.01.003. [Epub ahead of print]

EFFECT OF USING THE HEART SCORE IN PATIENTS WITH CHEST PAIN IN THE ED
A STEPPED-WEDGE, CLUSTER RANDOMIZED TRIAL

- N=3648 (1827 SOC vs 1821 HEART score)
  - Low-risk cohort; MACE = 2.0% (95% CI, 1.2% to 3.3%)
- **No difference in ……..**
  - **Early discharge**
  - **ED revisits**
  - **Readmissions**
  - **Outpatient visits**
- Dr's were hesitant to refrain from admission and diagnostic tests in low risk HEART score pts.
- Using the HEART score in CP patients is safe, but the effect on health care resources is limited.



Poldervaart JM. *Ann Intern Med.* 2017;166:689-697

EDACS-ADP

ED ASSESSMENT CHEST PAIN SCORE - ACCELERATED DIAGNOSTIC PROCEDURE

Characteristic	Parameter	Points
History	18-50 yo with CAD, or >2 risk factors	+4
Age	18-45	+2
	46-50	+4
	51-55	+6
	56-60	+8
	61-65	+10
	66-70	+12
	71-75	+14
	76-80	+16
	81-85	+18
	>85	+20

Characteristic	Parameter	Points
Sex	Male	+6
Signs and Symptoms	Diaphoresis	+3
	Arm or shoulder radiation	+5
	Pain occurred or worsened with inspiration	-4
	Pain is reproduced with palpation	-6

Low Risk Criteria

- **EDACS Score <16**
- **No new ECG ischemia**
- **Negative 0 and 2h Tn**

ICare-ACS Improving Care Processes for Patients With Suspected ACS

METHODS

- 7 Hospitals
- Agnostic: Tn platform/timing
  - 4 Roche Gen 5 hsTnT
  - 1 Abbott Architect hsTnI
  - 2 Siemens Ultra TnI
- Agnostic: Risk Stratification Tool
  - 5 EDACS (low risk <16)
  - 2 TIMI (Low risk = 0)

Than MP. *Circulation. 2017 Nov 14. pii: CIRCULATIONAHA.117.031984*

METHODS

= AMB

- Implementation of a clinical pathway for the assessment of suspected ACS that included:
  - ✓ A clinical pathway document
  - ✓ Structured risk stratification
  - ✓ Specific times for ECG & serial Tn w/in 3 hrs of arrival
  - ✓ Directions for combining risk stratification, ECG, and Tn in an ADP

Than MP. *Circulation. 2017 Nov 14. pii: CIRCULATIONAHA.117.031984*

RESULTS

- Pre-implementation: N=11,529
- Post-implementation: N=19,803
- Mean 6-hour D/C rate increased
  - from 8.3% (range, 2.7%–37.7%) to 18.4% (6.8%–43.8%).
  - Odds of being D/C within 6 hours = 2.4 higher

- Pts without ACS; median LOS decreased by 2.9 hrs
  - (95% confidence interval, 2.4–3.4)
- If D/C by 6 hrs;
  - No change in 30-day MACE rates
    - SOC=0.52% vs ADP=0.44% (*P*=0.96)

Than MP. *Circulation. 2017 Nov 14. pii: CIRCULATIONAHA.117.031984*

PATIENTS WITH CP AND A LEADING DIAGNOSIS OF NSTE ACS

Indication	Echocardiography Rest	CMR Rest	SPECT Rest	CCTA	CCath
Low/intermediate likelihood initial diagnosis of NSTEMI/ACS					
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

Appropriate use key: A = appropriate; M = may be appropriate with rating panel consensus; M* = may be appropriate as determined by lack of consensus by rating panel; R = rarely appropriate.

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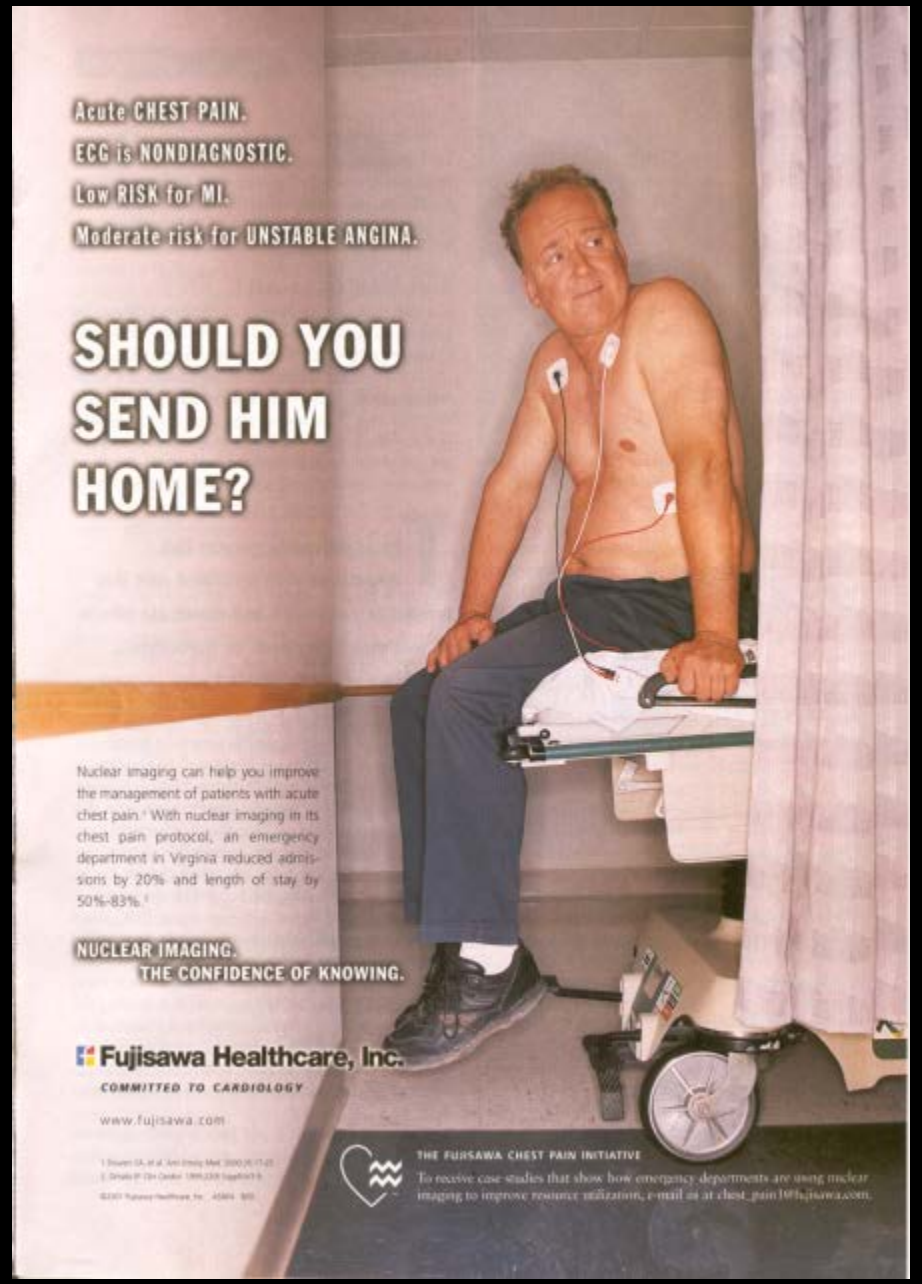
ER

Lost to follow up

MY ULCER

Admit them all and let the insurance company sort them out…

Discharge them all and let God sort them out…



Normal troponin/ECG
High Risk Score?

AUC Indication

Indications 1 and 2

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Positive initial diagnosis of NSTEMI/ACS

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Indications 8, 9, 10

8. Diagnosis unequivocally positive for NSTEMI/ACS

Serial troponins or ECG not positive for NSTEMI/ACS

9. Serial ECG and troponins negative for NSTEMI/ACS
10. Serial ECG or troponins borderline for NSTEMI/ACS

ED Evaluation Process

Step 1

Initial evaluation

ECG, H and P → STEMI → cath

↓

Not a STEMI

↓

Step 2

Further ED evaluation/risk stratification

ECG findings, initial troponin results

↓

Troponin → positive → cath

↓

Negative

↓

Step 3

Initial evaluation negative → obs status

Troponin results

OBSERVATIONAL PATHWAY

8) ANY ECG OR TN UNEQUIVOCALLY (+) FOR NSTEMI/ACS

		Echocardiography		CMR		SPECT/PET			
Indication	**Exercise ECG**	**Rest**	**Stress/Rest**	**Rest**	**Stress/Rest**	**Rest**	**Stress/Rest**	**CCTA**	**CCath**
8. Diagnosis unequivocally positive for NSTEMI/ACS	M*	M*	M*	M*	M*	M*	M*	M*	A

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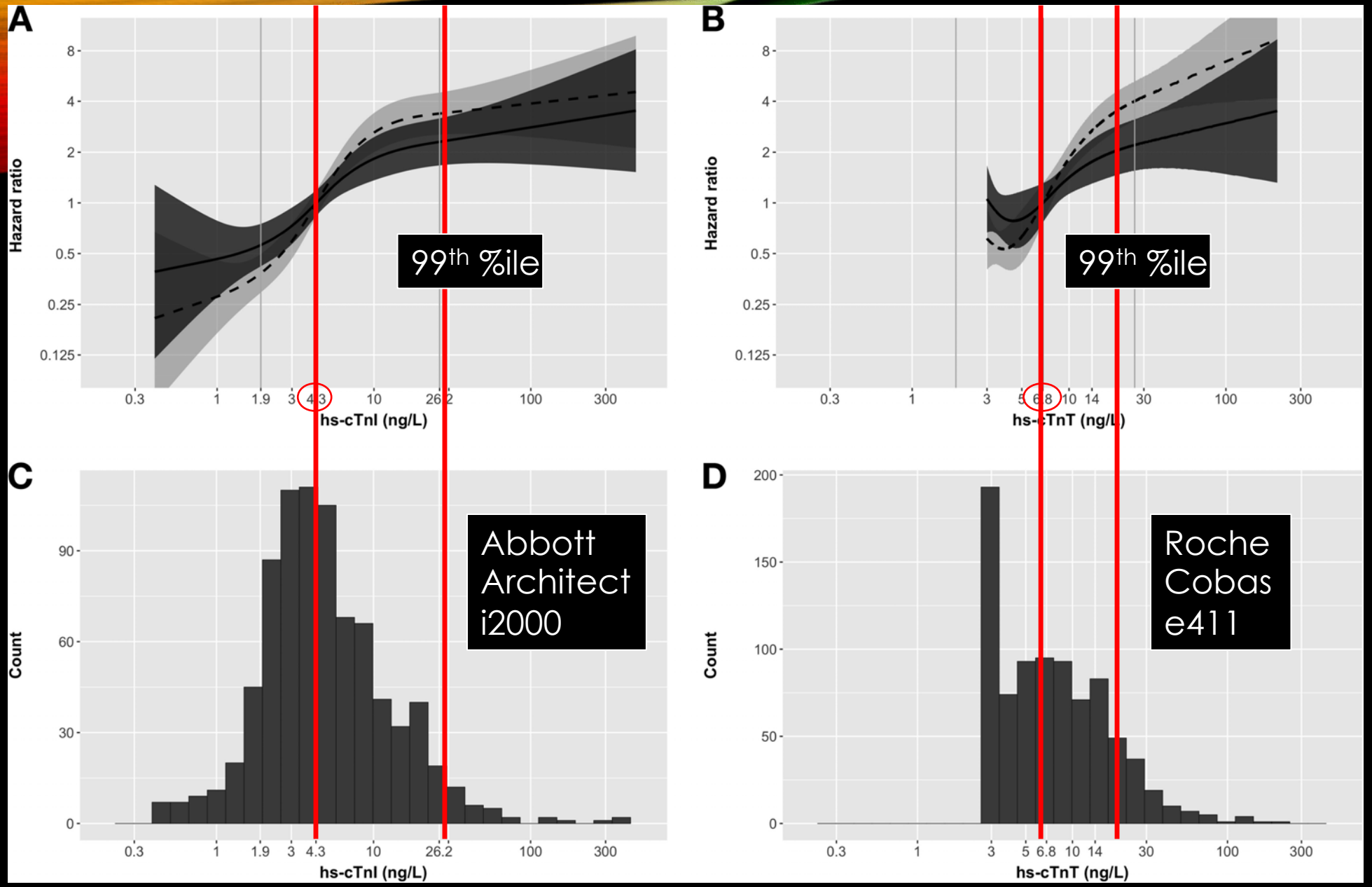
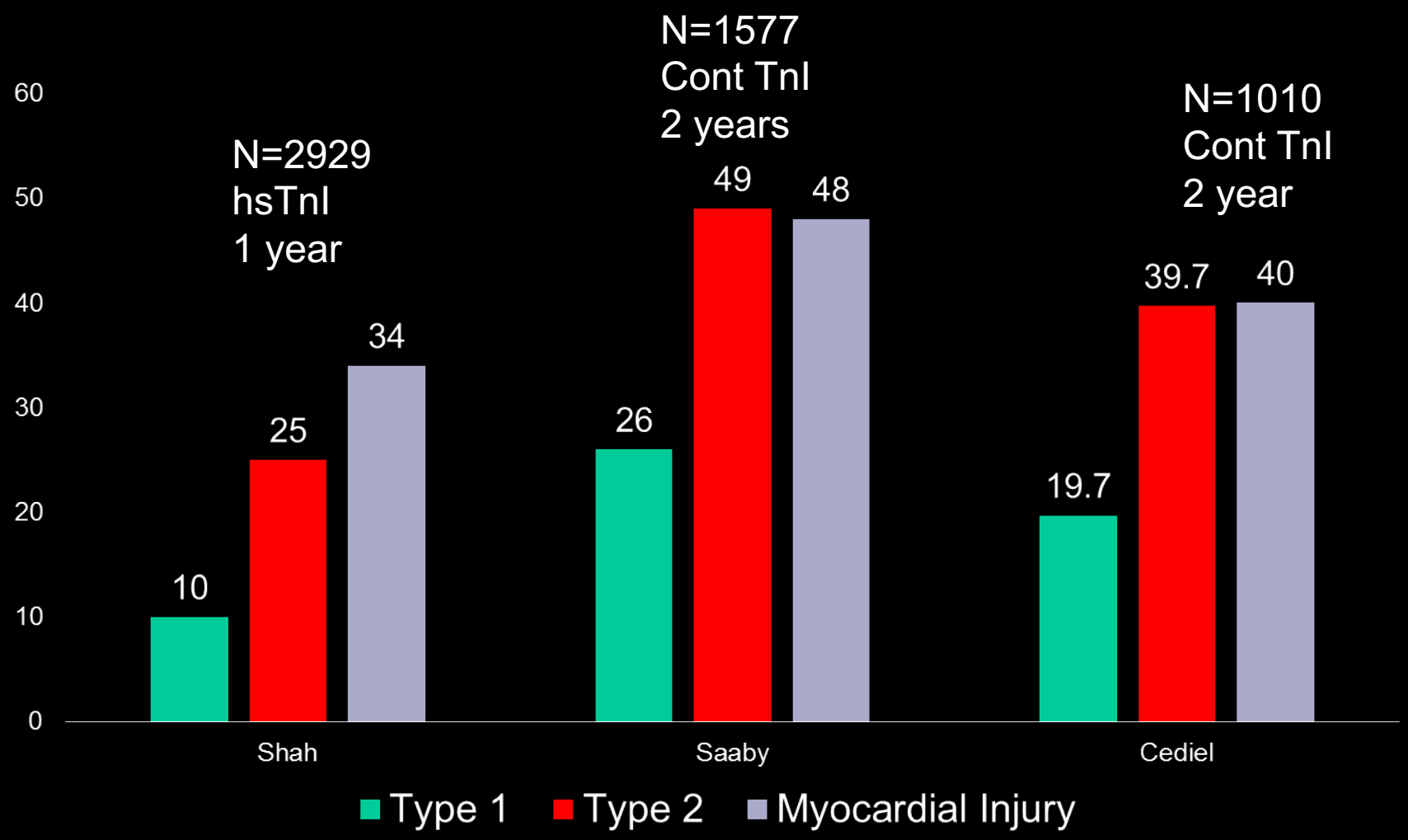


- N= 1113
- ED CP
- 5 yr F/U
- MACE
  - MI
  - HF
  - CV die

Than MP. Clin Chem 64:7, 1044–1053 (2018)

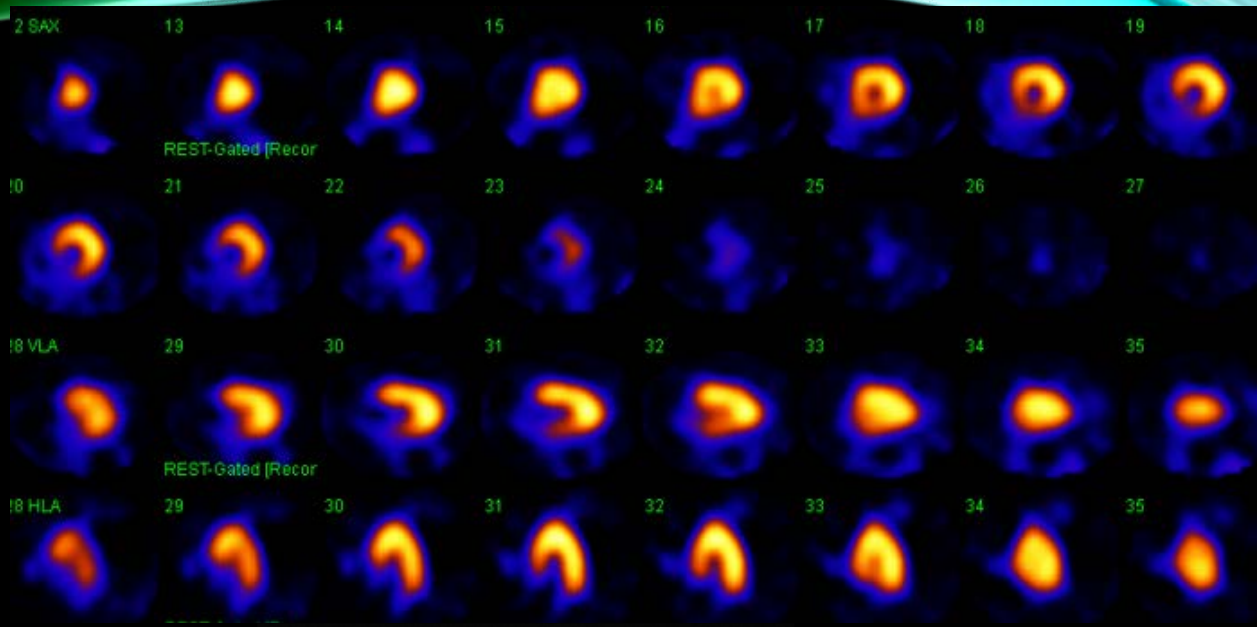
Mortality based on Type of Troponin Elevation



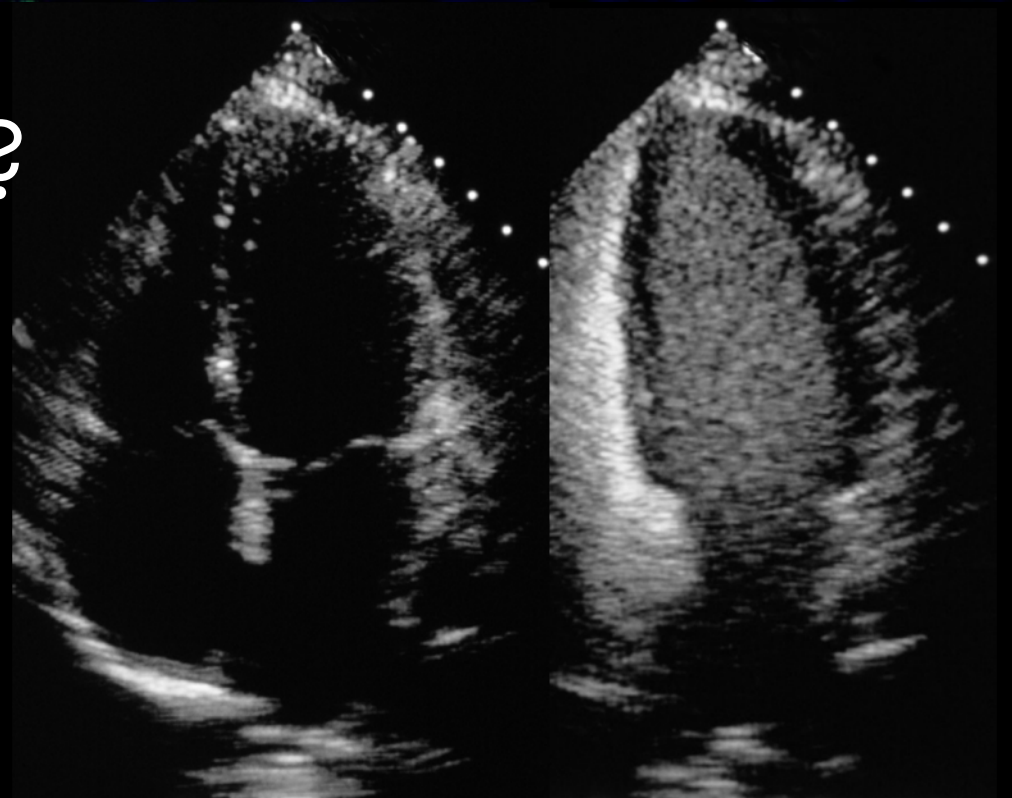
Shah ASV et al AJM 2015;128;493-501; Saaby L et al AJM 2014;127;295-302; Cediel Heart 2017;103:616-622

"NON-SPECIFIC" TN ELEVATIONS ARE ASSOCIATED WITH WORSE OUTCOMES

- Associated with underlying cardiac abnormalities
- Usually associated with "sicker" presentation
- Variably found as an independent predictor
- In most cases, should indicate further cardiac evaluation is (probably) necessary
- Unclear exactly what test and when should be performed



What Test Next?



OBSERVATIONAL PATHWAY

Indication	Exercise ECG	Echocardiography		CMR		SPECT/PET		CCTA	CCath
		Rest	Stress/Rest	Rest	Stress/Rest	Rest	Stress/Rest		
Serial troponins or ECG not positive for NSTEMI/ACS									
9. Serial ECG and troponins negative for NSTEMI/ACS	A	R	A	R	A	R	A	A	R
10. Serial ECG or troponins borderline for NSTEMI/ACS	M*	M*	A	R	A	R	A	A	M*

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SECTION 5: IMAGING OF PATIENTS FOR WHOM A LEADING DIAGNOSIS IS PROBLEMATIC OR NOT POSSIBLE

I DON'T HAVE A CLUE

19) OVERALL LIKELIHOOD OF ACS, PE, OR AAS IS LOW

20) OVERALL LIKELIHOOD OF ACS, PE, OR AAS IS NOT LOW

Indication	"Triple-Rule-Out" CTA
19. Overall likelihood of ACS, PE, or AAS is low	R
20. Overall likelihood of ACS, PE, or AAS is not low	A

Appropriate use key: A = appropriate; R = rarely Appropriate.

AAS, acute aortic syndrome; ACS, acute coronary syndrome; CTA, CT angiography; PE, pulmonary embolism.

SUMMARY

- Must consider clinical impression
  - Enter the AUC with the appropriate pre-test probability
  - A (-) test does not mean it was an inappropriate test
- Changing landscape
  - hsTn
  - Increased availability of echocardiography in real time
  - Improved CT scanners
- Consider local availability and expertise
  - MR, stress echo
- Changing diagnostic options
- There is still plenty of controversy

For More Information

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