



# Hs-cTn

**TO USE OR NOT TO USE**

JEROLD SAEF MD FACC

- 
- ▶ CARDIOLOGY
  - ▶ VA WESTERN COLORADO HEALTH CARE SYSTEM
  - ▶ CONFLICTS: NONE

# WHAT WE WILL DISCUSS

- ▶ 1. WHAT IS TROPONIN?
- ▶ 2. WHAT IS CONVENTIONAL VS HIGH SENSITIVITY?
- ▶ 3. NEW CONCEPTS OF MYOCARDIAL INFARCTION AND INJURY
- ▶ 4. USE OF THE HIGH SENSITIVITY RESULT
- ▶ 5. FACILITY IMPLEMENTATION

# WHAT IS TROPONIN?

- ▶ PART OF THE MYOCARDIAL SARCOMERE
- ▶ SPECIFIC PROTEIN SUBCOMPONENT
- ▶ TYPES "T" AND "I"

# TROPONIN IS....

- ▶ TROPONIN IS ORGAN SPECIFIC
- ▶ TROPONIN IN THE SERUM IS ABNORMAL

# WHAT IS THE MEANING OF CONVENTIONAL VS HIGH SENSITIVITY

- ▶ CONVENTIONAL TROPONIN
  - ▶ NOW HAS ESSENTIALLY REPLACED THE OLD MARKERS OF
    - ▶ FRACTIONATED CPK
    - ▶ LDH
    - ▶ SGOT

# CONVENTIONAL TROPONIN

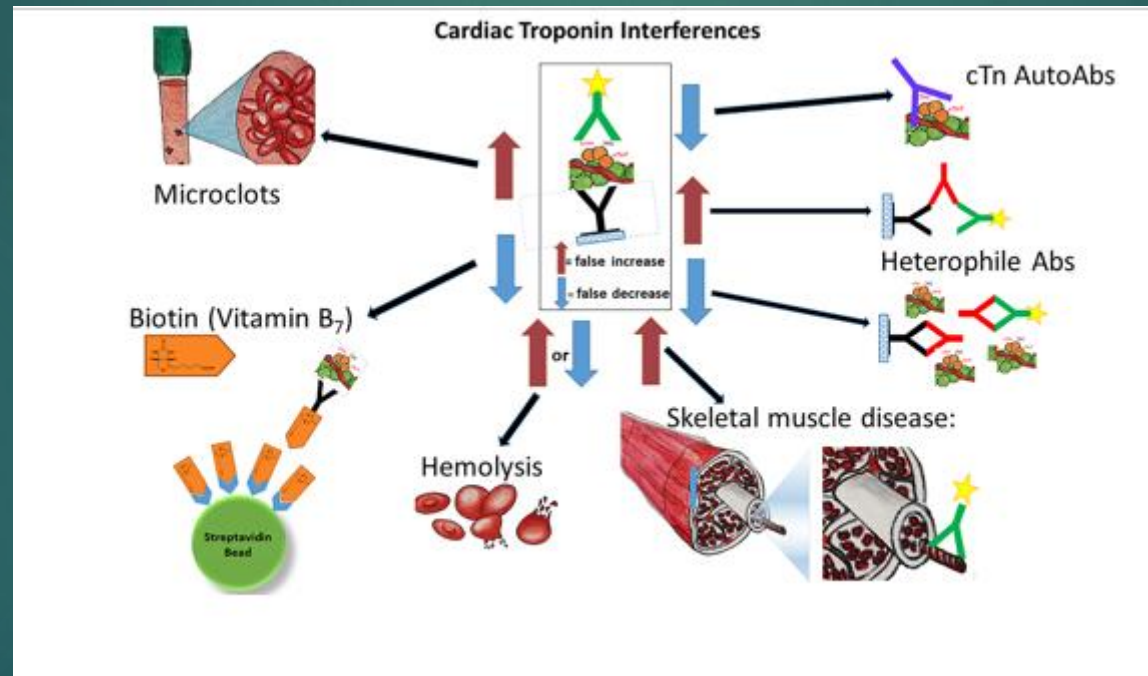
- ▶ SENSITIVITY AND SPECIFICITY BOTH ABOUT 85%
- ▶ MEASURED IN UNITS OF NG/ML
- ▶ WE ARE ACCUSTOMED TO A NORMAL RANGE OF “<0.015.”

# HIGH SENSITIVITY TROPONIN

- ▶ SENSITIVITY 99%
- ▶ SPECIFICITY 50%
- ▶ MEASURED AS NG/L
- ▶ WE ARE NOT ACCUSTOMED TO THE NORMAL OR ABNORMAL RANGES



# FALSE POSITIVES AND NEGATIVES



# HS-TN - RANGES

- ▶ DEFINITELY NEGATIVE <3NG/L
- ▶ GRAY ZONE 3-54 NG/L
- ▶ ABNORMAL >54 NG/L

# NEW CONCEPT – THE “DELTA”

- ▶ TIME INTERVAL

- ▶ 1 HOUR

- ▶ 3 HOUR

- ▶ MAGNITUDE OF CHANGE

- ▶ CHANGE OF <4 NG/L

- ▶ CHANGE OF 4-10 NG/L

- ▶ CHANGE OF >10 NG/L

BUT.....

- ▶ MUST INCORPORATE CLINICAL FACTORS. SOMETIMES IT IS “ONE AND DONE.”
- ▶ SOMETIMES THERE’S AN INTERVAL TO CONSIDER. IF SO, THERE’S A “DELTA” IN THE EQUATION.

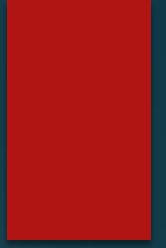
# INTERVALS???

- ▶ WHAT STARTS THE INTERVAL CLOCK?
  - ▶ ONSET OF SYMPTOMS?
  - ▶ THE FIRST LAB DRAW?

# THE BASIC PREMISE

▶ **THERE IS A DIFFERENCE** BETWEEN A TEST WITH 99% SENSITIVITY AND 50% SPECIFICITY AND A TEST WITH 85% SENSITIVITY AND 85% SPECIFICITY!!

# NEW CONCEPTS



# MYOCARDIAL INFARCT

- ▶ TYPE I – ‘TYPICAL’ MI. SPONTANEOUS PLAQUE RUPTURE WITH ST ELEVATION MI DUE TO VASCULAR OCCLUSION



## Differentiation between MI Types according to the Condition of the Coronary Arteries



Plaque rupture with clot



MI Type 1

Vasospasm or endothelial dysfunction



MI Type 2

Fixed Atherosclerosis and Supply-demand imbalance



MI Type 2

Supply-demand imbalance alone



MI Type 2

# MYOCARDIAL INFARCT

- ▶ TYPE IIA – NONSTEMI DUE TO ACTIVE PLAQUE BUT WITHOUT VASCULAR OCCLUSION
- ▶ TYPE IIB – ‘DEMAND’ ISCHEMIA DUE TO SUPPLY/DEMAND MISMATCH FOR OXYGEN DELIVERY TO DOWNSTREAM MYOCARDIUM. ARTERIES NORMAL OR ABNORMAL. SYSTEMIC PHYSIOLOGY SUCH AS ANEMIA/INSUFFICIENT COLLATERALS, LVH, VALVULAR STRAIN, ETC.

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MI Type 2

# FYI ONLY

- ▶ TYPE III – PRESUMED MI – DEATH BY MI; EVIDENT ON EKG OR AUTOPSY BUT LAB NOT AVAILABLE
- ▶ TYPE IV – PROCEDURAL MI DURING PCI
- ▶ TYPE V – MI DURING CABG

# MYOCARDIAL INJURY

- ▶ MYOCARDIAL INJURY – NEW SEPARATE CONCEPT
  - ▶ INJURY TO THE HEART DUE TO OTHER PHYSIOLOGY
    - ▶ EXERCISE
    - ▶ CHILDBIRTH
    - ▶ SEPSIS
    - ▶ TRAUMA
    - ▶ MANY MORE



## Differentiation between MI Types according to the Condition of the Coronary Arteries



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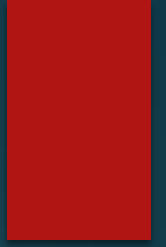
# INJURY PER JAFFE

***An elevated hscTn value in the absence of ischemia (with or without a rising and/or falling pattern) should be designated as myocardial injury and the putative mechanism defined.***

***If you cannot define the mechanism,  
reconsider whether ischemic heart  
disease is present.***



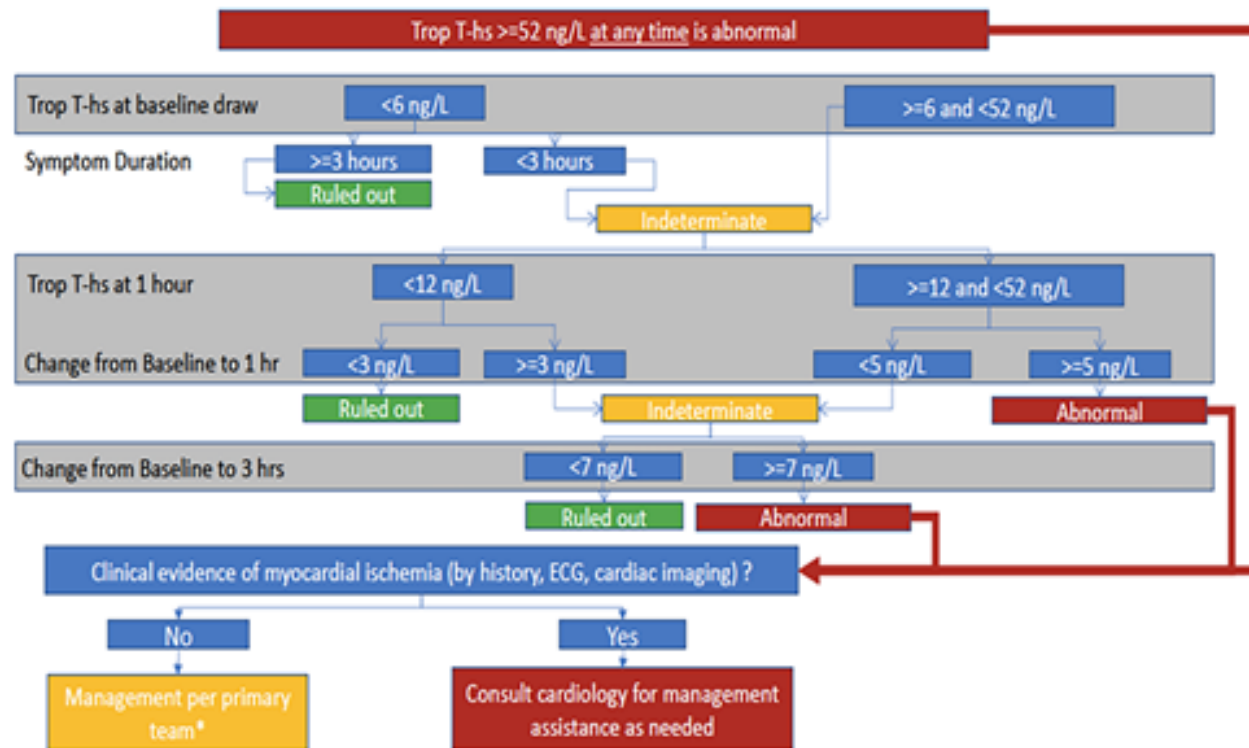
# RESULTS AND HOW TO USE THEM



# USING THE HSTNT RESULTS

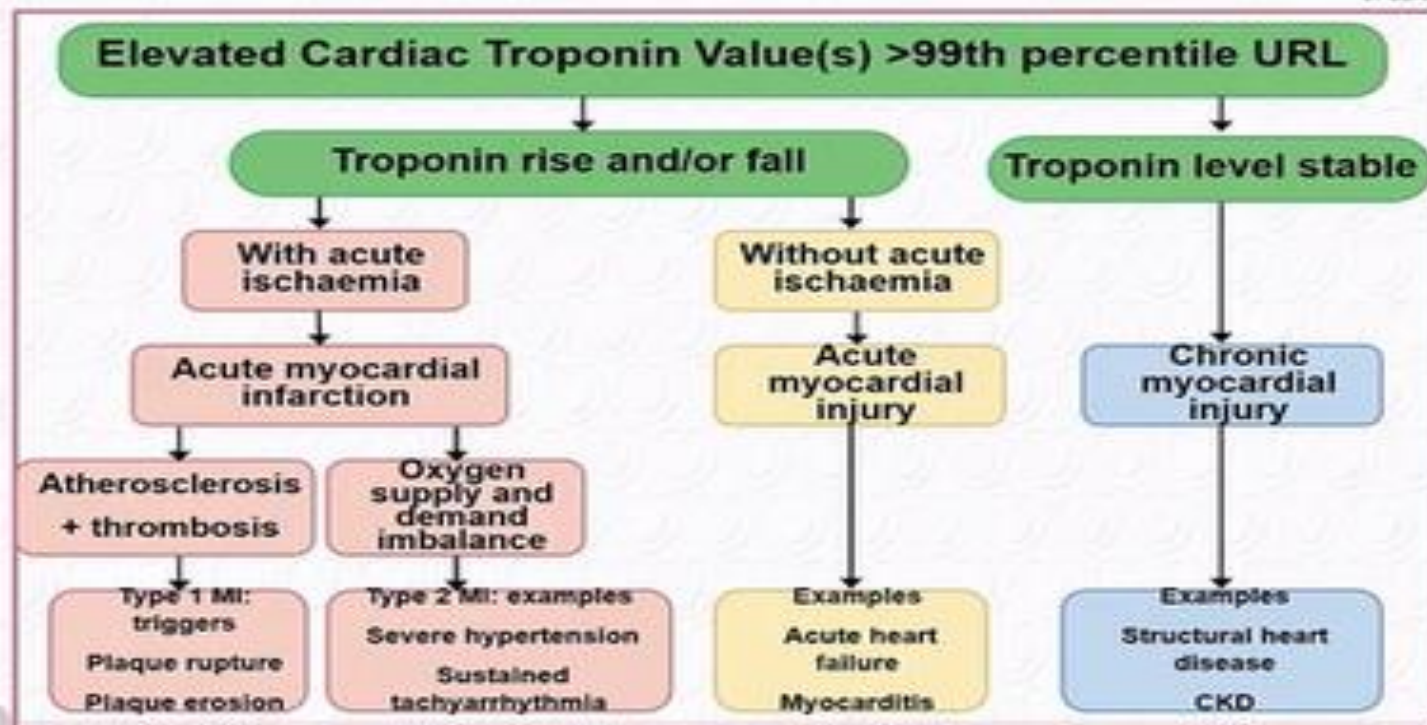
- ▶ ADVANCED DIAGNOSTIC PATHWAYS (ADP)
  - ▶ A DECISION TREE
  - ▶ A FLOW CHART USED AS A DECISION AID

# ADP - EXAMPLE



# ADP FOR POSITIVE RESULTS

## Model for interpreting Myocardial Injury and Myocardial Infarction



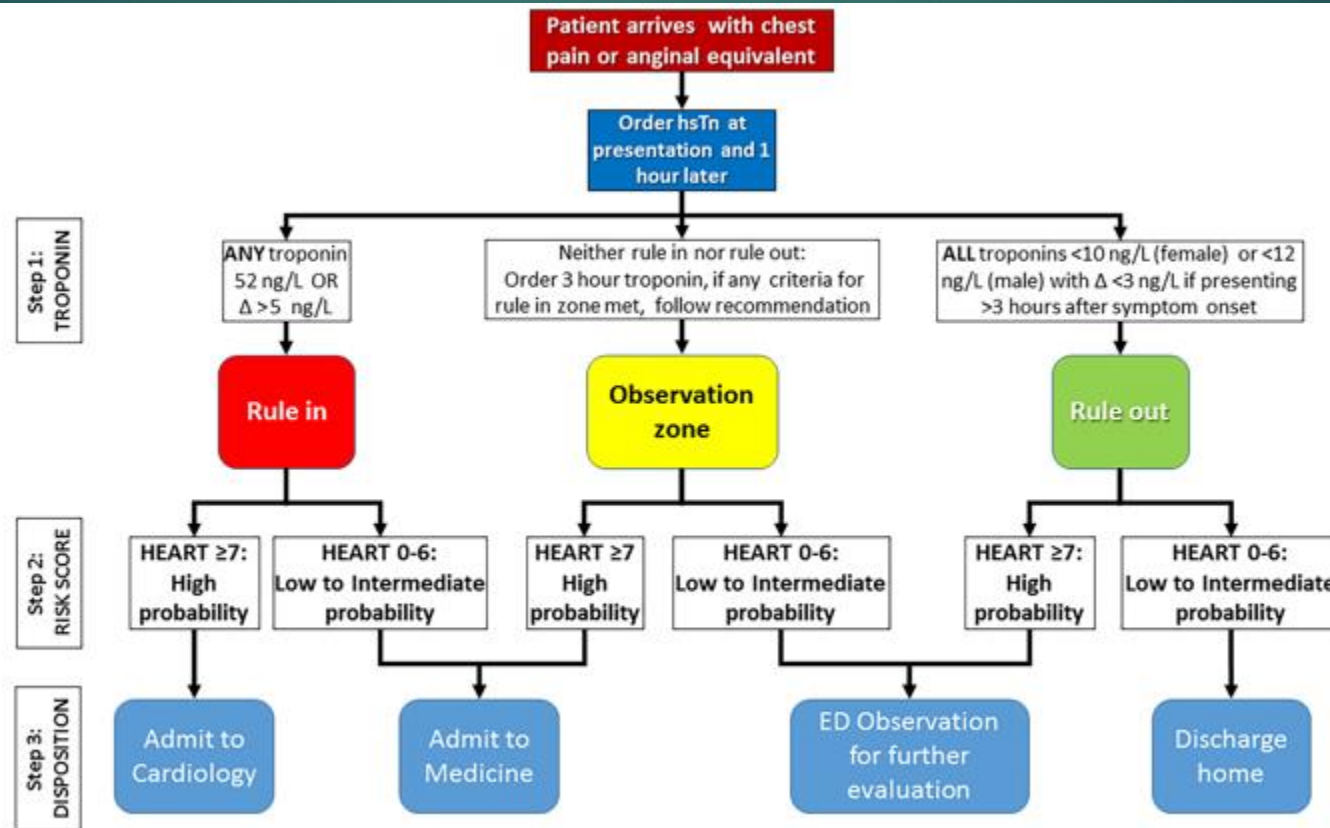
# THE HEARTSCORE

The HEART Score for Chest Pain Patients in the ED		
<b>History</b>	<ul style="list-style-type: none"> <li>Highly Suspicious</li> <li>Moderately Suspicious</li> <li>Slightly or Non-Suspicious</li> </ul>	<ul style="list-style-type: none"> <li>2 points</li> <li>1 point</li> <li>0 points</li> </ul>
<b>ECG</b>	<ul style="list-style-type: none"> <li>Significant ST-Depression</li> <li>Nonspecific Repolarization</li> <li>Normal</li> </ul>	<ul style="list-style-type: none"> <li>2 points</li> <li>1 point</li> <li>0 points</li> </ul>
<b>Age</b>	<ul style="list-style-type: none"> <li>≥ 65 years</li> <li>&gt; 45 - &lt; 65 years</li> <li>≤ 45 years</li> </ul>	<ul style="list-style-type: none"> <li>2 points</li> <li>1 point</li> <li>0 points</li> </ul>
<b>Risk Factors</b>	<ul style="list-style-type: none"> <li>≥ 3 Risk Factors or History of CAD</li> <li>1 or 2 Risk Factors</li> <li>No Risk Factors</li> </ul>	<ul style="list-style-type: none"> <li>2 points</li> <li>1 point</li> <li>0 points</li> </ul>
<b>Troponin</b>	<ul style="list-style-type: none"> <li>≥ 3 x Normal Limit</li> <li>&gt; 1 - &lt; 3 x Normal Limit</li> <li>≤ Normal Limit</li> </ul>	<ul style="list-style-type: none"> <li>2 points</li> <li>1 point</li> <li>0 points</li> </ul>
<b>Risk Factors:</b> DM, current or recent (<one month) smoker, HTN, HLP, family history of CAD, & obesity		
Score 0 – 3: 2.5% MACE over next 6 weeks → Discharge Home		
Score 4 – 6: 20.3% MACE over next 6 weeks → Admit for Clinical Observation		
Score 7 – 10: 72.7% MACE over next 6 weeks → Early Invasive Strategies		

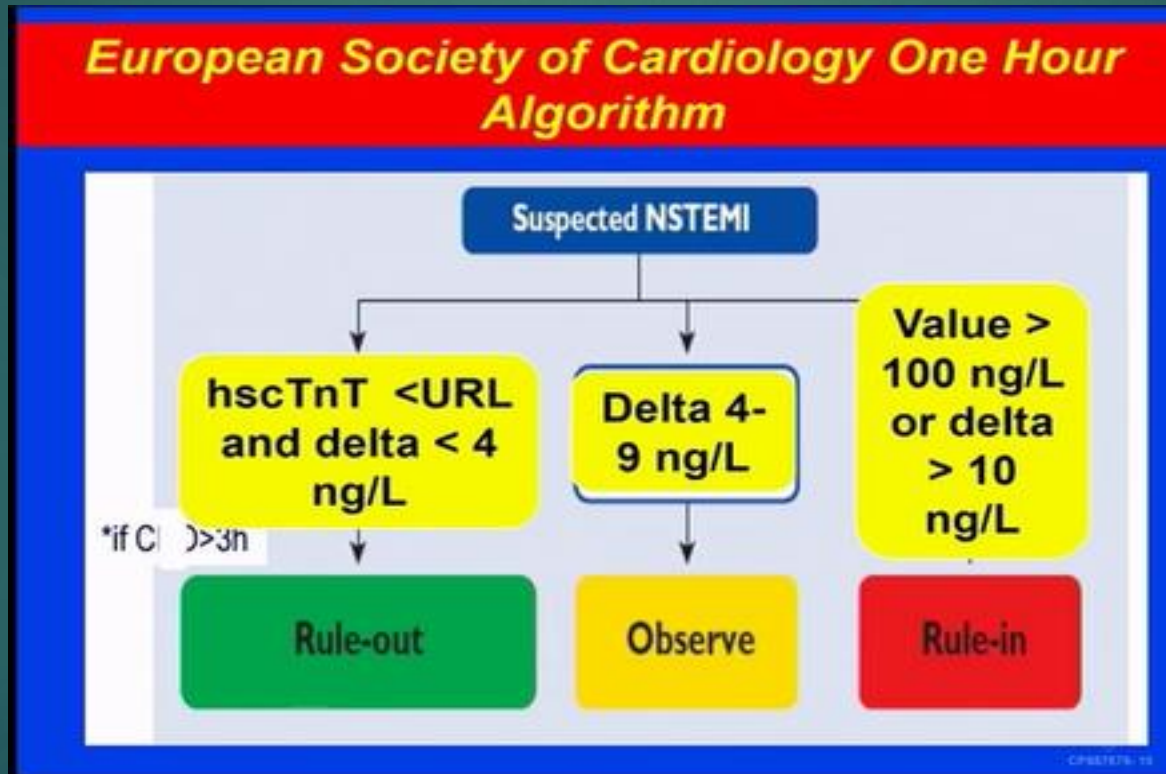
Six et al. Neth Heart J 2008



# ADP USING THE HEARTSCORE TOOL



# MAYO CLINIC SIMPLIFICATION



# APPLYING RESULTS TO A PATIENT DEPENDS ON

- ▶ SITE OF RESULT ACQUISITION
- ▶ SITE OF RESULT REVIEW
- ▶ CLINICAL CHARACTERISTICS OF THE  
UNIQUE PATIENT



# ADVANCED DIAGNOSTIC PATHWAYS

- ▶ WHAT FLOW CHART WILL WE USE HERE?
- ▶ IN ED
- ▶ ON THE WARDS
- ▶ IN THE CLINICS

# DECISIONS, DECISIONS...

- ▶ SHOULD WE MANUFACTURE OUR OWN CHART OR USE SOMEONE ELSE'S?
- ▶ WHERE HAS HS-CTN BEEN IMPLEMENTED?
- ▶ WHAT'S BEEN THE EXPERIENCE?

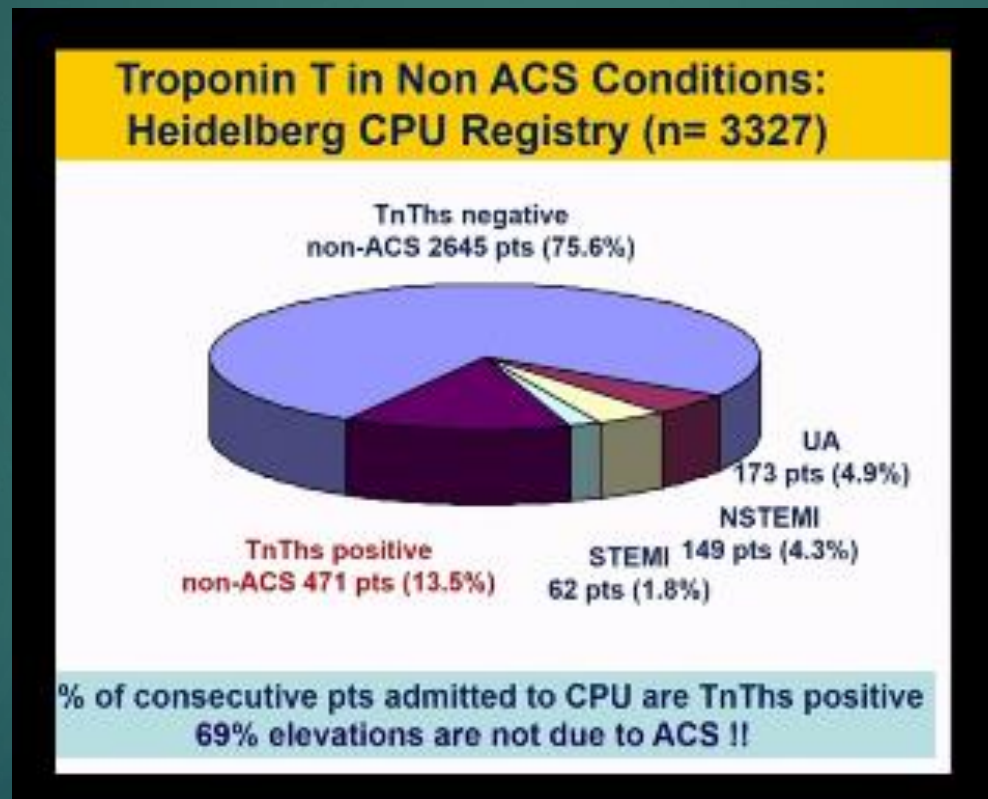
## Mild troponin elevations (< 3x ULN)

- 1** What is the pre-test probability for MI based on chest pain onset, signs and ECG findings?  
E.g., typical pain, CPO 2h, ST-segment ↓ (resulting in a PPV for MI ≈ 90%)
- 2** Does my patient have a readily identifiable non-MI cause for low level cTn elevations?  
E.g., age, heart failure, aortic stenosis, pulmonary embolism.  
The more plausible the alternative cause for low level cTn elevations, the less likely that any immediate further diagnostic work-up for MI is justified and/or necessary.
- 3** What other diagnostic test is useful?  
1h/3h cTn re-measurement, echo, stress-echo, CMR, MPI-SPECT.

Raphael Twerenbold et al. JACC 2017;70:996-1012



# DISTRIBUTION OF TROPONIN RESULTS SWEDEHEART TRIAL



# MY OPINION

## ▶ LET'S KEEP IT SIMPLE AT THIS FACILITY

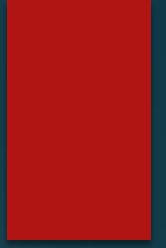
- ▶ DEFINITIVE POSITIVE – HIGH UPPER NORMAL
- ▶ DEFINITIVE NEGATIVE – LOW DEFINITE EXCLUSION
- ▶ 3 HOUR INTERVALS AND HIGHER “DELTAS”

# OUR MACHINE

▶ SIEMENS

▶ WE WILL BE MEASURING HS-C  
TROPONIN T

# FACILITY IMPLEMENTATION



# SO – HOW TO TRAIN A FACILITY IN THE IMPLEMENTATION OF HIGH SENSITIVITY TROPONIN

- ▶ STAKEHOLDERS
- ▶ EDUCATION
- ▶ CAPACITY
- ▶ MONITORING



# STAKEHOLDERS

- ▶ Admin
- ▶ Lab
- ▶ IT
- ▶ ED
- ▶ Outpatient
- ▶ Inpatient
- ▶ SUPPORT

# SUPPORT

- ▶ AVAILABILITY OF CLINIC FOLLOWUP FOR “GRAY ZONE” PATIENTS
  - ▶ PRIMARY CARE
  - ▶ CARDIOLOGY
  - ▶ “OBS” ADMISSIONS

# TESTING RESOURCES

- ▶ PROVOCATIVE TESTING
- ▶ IMAGING
- ▶ INVASIVE PROCEDURES AND INTERVENTION

# OBSTRUCTIONS

- ▶ ANXIETY AND UNCERTAINTY
- ▶ WILLINGNESS TO UNDERTAKE
- ▶ APPLICATION AT MANY LEVELS
- ▶ LIMITATIONS OF A SMALL FACILITY WITH FEWER AVAILABLE RESOURCES
- ▶ FACILITY EXPERIENCE WITH SIMILAR PROJECTS

# RESOURCES TO OPTIMIZE THE PROCESS

- ▶ OTHERS' EXPERIENCES
- ▶ UNDERSTANDING GUIDELINES AND RECOMMENDATIONS
- ▶ KNOWLEDGE OF OUR OWN ASSAY AND ITS LIMITATIONS
- ▶ SUBJECT MATTER EXPERTS

# SUBJECT MATTER EXPERTS

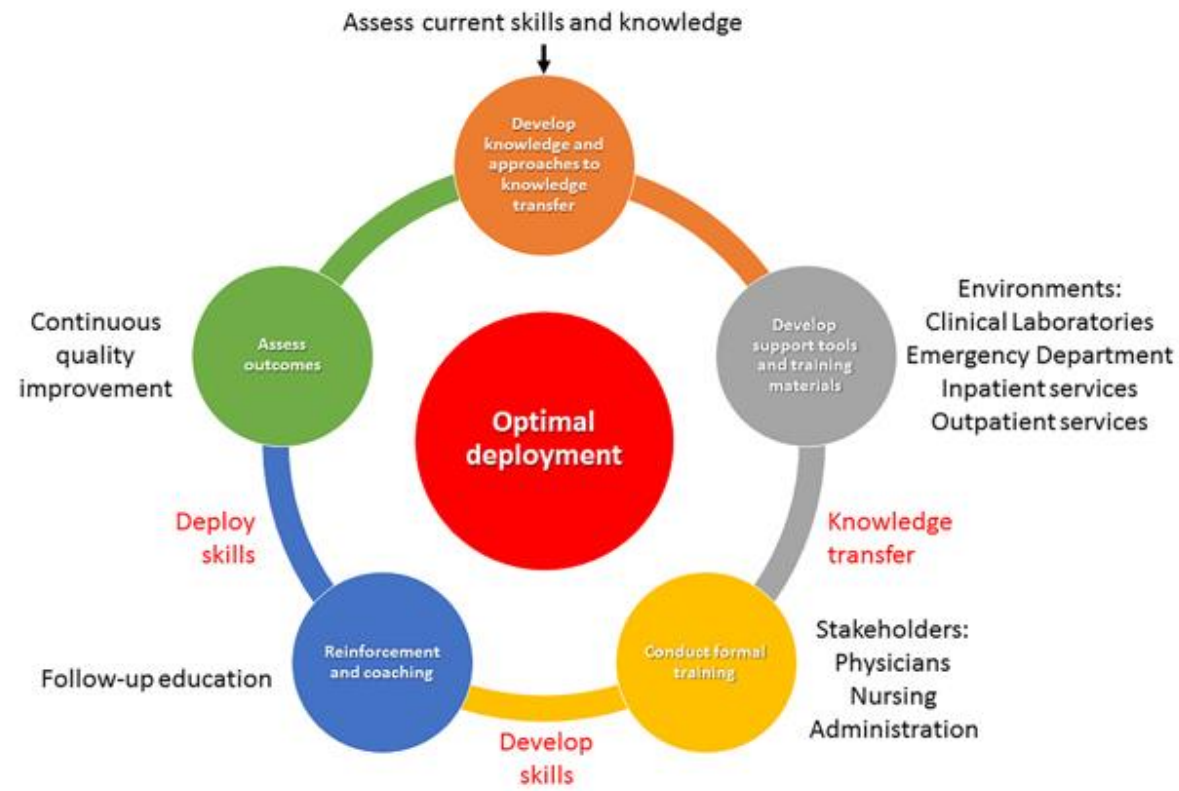
- ▶ IDENTIFIED INDIVIDUALS WHO ASSIST WITH INTERPRETATION OF RESULTS
- ▶ AVAILABLE TO CLINICIANS FOR DECISION MAKING AS TO HOW TO PROCEED
- ▶ FAMILIAR WITH FLOW CHARTS, OUR MACHINERY AND ITS IDIOSYNCRACIES



# SMALL FACILITY SOLUTIONS

- ▶ DESIGNATED CHAMPIONS – 2-3 PROVIDERS BROUGHT UP TO SPEED ON THE UNIQUE FEATURES OF THIS NEW MODALITY
- ▶ CLINICAL PATHWAY LEADER-ENDOSCOPY MODEL
- ▶ LAB PERSONNEL

# PARKLAND HOSPITAL METHODOLOGY



# WHAT WE DISCUSSED

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THE END

▶ QUESTIONS?