HEART Score: *Friend of Foe*?

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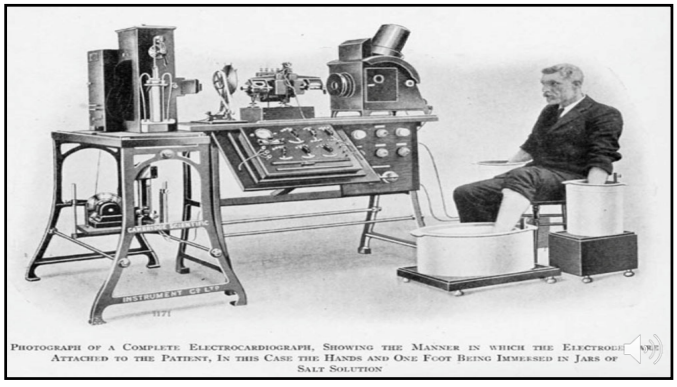

Photograph of a Complete Electrocardiograph, Showing the Manner in which the Electrodes are Attached to the Patient, In this Case the Hands and One Foot Being Immersed in Jars of Salt Solution


BLACKBERRY
2008:
HEART Score
Six et al.


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THE RESUS ROOM


HEART Score

APGAR

122 patients with "chest pain"
29 MACE
<3 = 1 out of 39 patients
~2.5% 95 CI (0%-13%)

History
ECG
Age
Risk Factors
Troponin

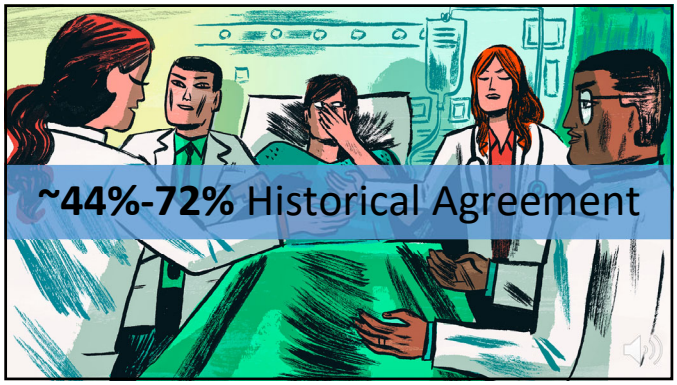
History:

Increased likelihood: +LR

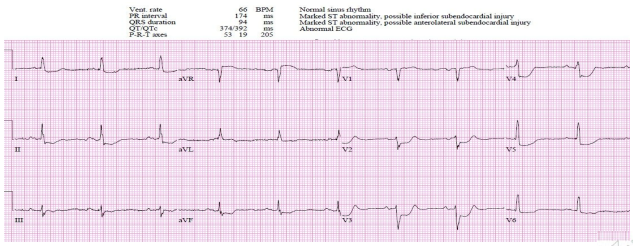
- Radiation: **2.3-4.7**
  - Bilaterally > Right > Left
- Pain with exertion: **2.4**
- Associated diaphoresis: **2**
- Nausea and vomiting with pain: **1.9**

Decreased likelihood: - LR

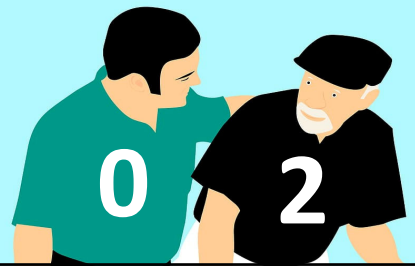
- Pleuritic: **0.2**
- Positional: **0.3**
- Sharp, stabbing: **0.3**
- Reproducible with palpation: **0.3**

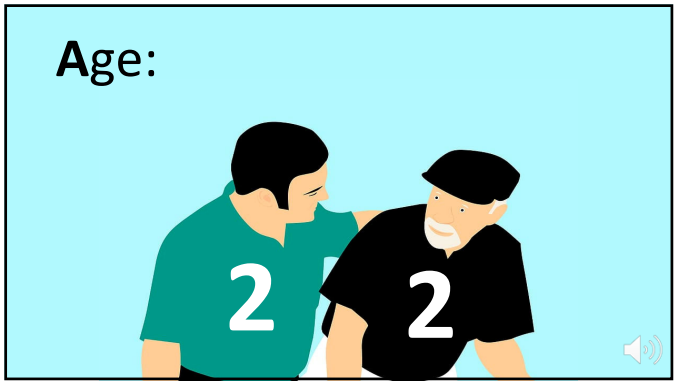

~44%-72% Historical Agreement

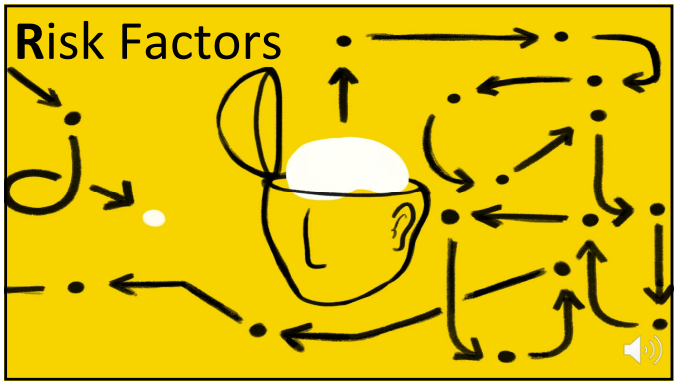
ECG:

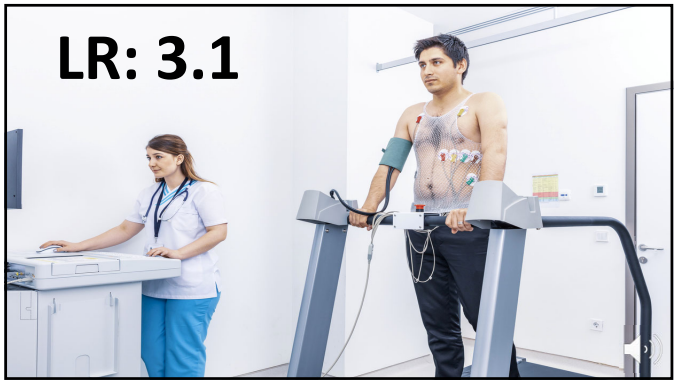

Vent. rate 66 BPM
PR interval 174 ms
QRS duration 374/392 ms
QT/QTc 53 19 205
P-R-T axes
Normal sinus rhythm
Marked ST abnormality, possible inferior subendocardial injury
Marked ST abnormality, possible anterolateral subendocardial injury
Abnormal ECG
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

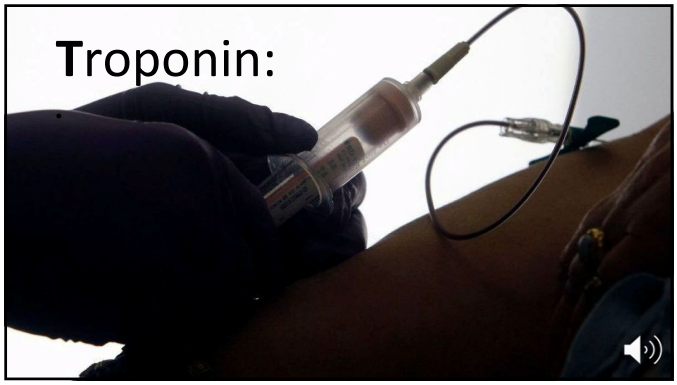
Age:


0
2


Age:
2
2


Risk Factors


LR: 3.1



240 potential calculations

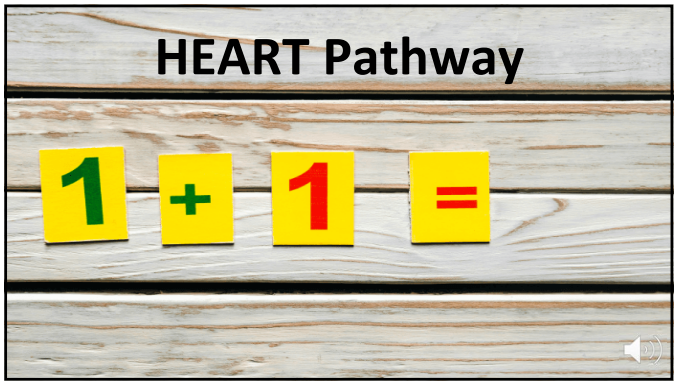
HEART Score 3 = **30**

HEART Score 4 = **45**

Van Den Berg et al. 2018: **12 studies/11,217 pts**.
Fernando et al. 2019: **30 studies / 44,202 pts**.
Laureano-Phillips et al. 2019: **25 studies/ 25,266 pts**.

Sensitivity: **96%-97%**
95% Confidence intervals **(93%,98%)**

<3 vs. **>3** = **28-84%** agreement



- 2 troponins 3 hours apart
  - Mahler 2013: **99%**
  - Mahler 2015: **100%**
  - Tesson 2018: **94%**
- 2 troponins at any time
  - Singer 2017: **93%**
  - Thiruganasambandamoorthy 2020: **100%**

~30,000 patients

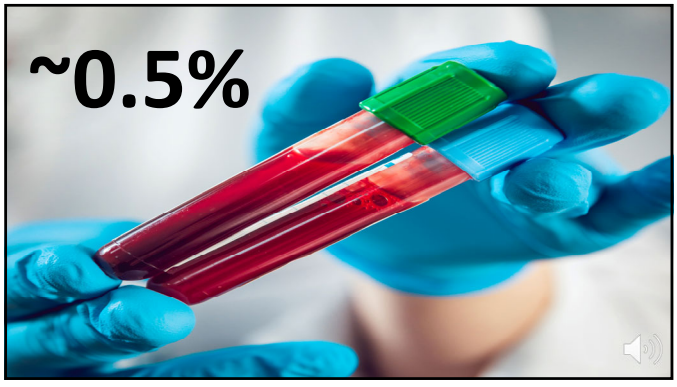
~51% had a single troponin

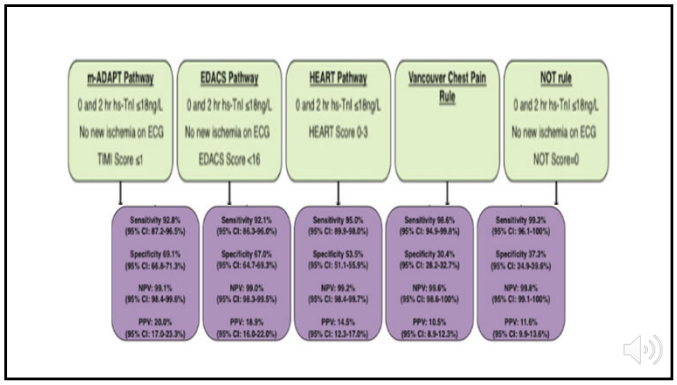
- 30-day MI or cardiac mortality after ED discharge:
  - Single troponin: 0.4%
  - Serial troponin: 0.4%

Wassie et al. 2021

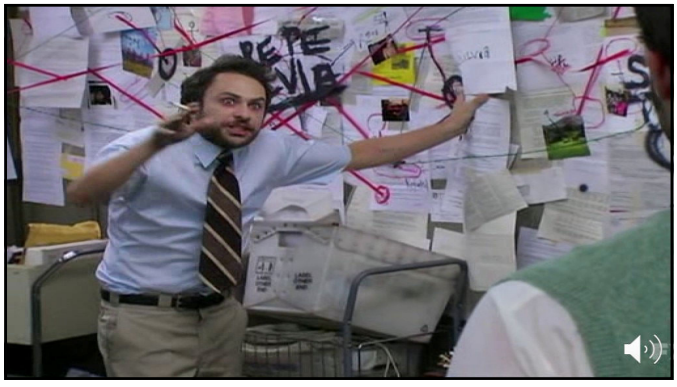
- Time since symptoms onset?
- Single Troponin Group:
  - Lower overall HEART scores
  - Arguably worse mortality

Wassie et al. 2021

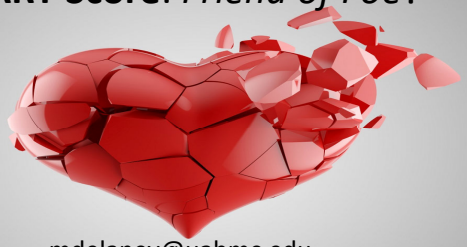



m-ADAPT Pathway
0 and 2 hr hs-TnI ≤18ng/L
No new ischemia on ECG
TIMI Score ≤1
EDACS Pathway
0 and 2 hr hs-TnI ≤18ng/L
No new ischemia on ECG
EDACS Score <16
HEART Pathway
0 and 2 hr hs-TnI ≤18ng/L
HEART Score 0-3
Vancouver Chest Pain Rule
NOT rule
0 and 2 hr hs-TnI ≤18ng/L
No new ischemia on ECG
NOT Score=0
Sensitivity 92.8% (95% CI: 87.2-96.5%)
Specificity 69.1% (95% CI: 66.8-71.3%)
NPV: 99.1% (95% CI: 98.4-99.6%)
PPV: 20.8% (95% CI: 17.0-23.3%)
Sensitivity 92.1% (95% CI: 86.3-96.0%)
Specificity 67.0% (95% CI: 64.7-69.3%)
NPV: 99.0% (95% CI: 98.3-99.5%)
PPV: 18.9% (95% CI: 15.0-22.0%)
Sensitivity 95.0% (95% CI: 89.8-98.0%)
Specificity 53.5% (95% CI: 51.1-55.9%)
NPV: 99.2% (95% CI: 98.4-99.7%)
PPV: 14.5% (95% CI: 12.3-17.0%)
Sensitivity 98.6% (95% CI: 94.9-99.8%)
Specificity 30.4% (95% CI: 28.2-32.7%)
NPV: 99.6% (95% CI: 98.6-100%)
PPV: 10.5% (95% CI: 8.9-12.3%)
Sensitivity 99.3% (95% CI: 96.1-100%)
Specificity 37.3% (95% CI: 34.9-39.8%)
NPV: 99.8% (95% CI: 99.1-100%)
PPV: 11.6% (95% CI: 9.9-13.6%)


YIELD TO
COMMON
SENSE



HEART Score: *Friend of Foe*?



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- We need to know the pitfalls of the HEART score if we are going to use it:
- History matters to some extent, look for specific features, probably not reliable to rule anything out.
- Think about the real impact of risk factors
- Age/Gender should be considered.
-

Wassie et al.

- Wassie M, Lee MS, Sun BC, et al. Single vs serial measurements of cardiac troponin level in the evaluation of patients in the emergency department with suspected acute myocardial infarction. JAMA Netw Open. 2021;4(2):e2037930. doi:10.1001/jamanetworkopen.2020.37930
- ArticleGoogle Scholar
- **Methods:** This was a retrospective analysis of prospectively collected data from 15 community EDs between January 1, 2015 to December 31, 2017 in Southern California (All sites used the same conventional troponin-I (cTnI) assay (Access AccuTnI+3 assay from Beckman-Coulter, Brea, California))
- **Results:**
- 27,918 patients included in the final analysis
    - 14,459 patients (51.8%) with a single troponin order
    - 13,459 patients (48.2%) with serial troponin orders
- 30-day myocardial infarction or cardiac mortality after ED discharge (Primary Outcome):
    - Single troponin group: 0.4%
    - Serial troponin group: 0.4%
    - Adjusted odds ratio 1.41, 95% confidence interval (0.96-2.07)
        - 30-day acute myocardial infarction: OR 1.28, CI 0.85-1.92
        - 30-day cardiac mortality: OR 3.02, CI 0.97-12.08
            - Single Troponin: 0.07%
            - Serial Troponin: 0.02%
            - Absolute Difference 0.05%
- **Editors' comments:**
- The dataset used in this analysis lacks the details available in trials and registries, particularly they cannot assess the timing of symptom onset which may be the key variable in determining which patients benefit most from serial testing.
- In Table 2 of the study by Wassie et al,[1] the authors reveal that the patients who were discharged after a single blood test had a lower HEART score than those who underwent serial testing. Thus, the single troponin group had a lower risk of ACS or major adverse cardiac events (MACEs)
- Over 50% of patients in this large study are already using a low risk HEART score and a single troponin test before discharging patients with chest pain home. This implies that 50% of physicians are already only getting a single contemporary troponin test and, of note, only 66 patients (0.5%) with serial troponin testing had a subsequent positive troponin test (which is still below the 1% acceptable threshold).

HEART Pathway

Table 5. HEART studies with 2 troponin measurements*.

Study	HEART Coding	Cardiac outcome prevalence	Sensitivity (95% Confidence Intervals)
HEART Pathway (2 Troponin Measurements 3 Hours Apart).			
Mahler et al, 2013[50]	Processed, see text	22%	198/200=99% (96%, 100%)
Mahler et al, 2015[12]	Prospective	6%	8/8=100% (63%, 100%)
Mahler et al, 2018[10]	Prospective	7%	341/353=97% (94%, 98%)
Hyams et al, 2018[57]	Chart review	6%	25/25=100% (86%, 100%)
Oliver et al, 2018[32]	Chart review	6%	25/25=100% (86%, 100%)
Tesson et al, 2018[58]	Chart review	8%	64/68=94% (86%, 98%))
HEART-2 (2 Troponin Measurements Regardless of Their Timing)			
Mahler et al, 2011[59]	Chart review	1%	12/12=100% (74%, 100%)
Singer et al, 2017[13]	Prospective	18%	347/374=93% (90%, 95%)
Thiruganasambandamoorthy et al, 2020[18]	Chart review	5%	88/88=100% (96%, 100%)

*All studies used major adverse cardiac events, except as follows: Mahler et al, 2013[50] acute coronary syndrome, Mahler et al, 2018[10] death or acute myocardial infarction, Singer et al, 2017[13] acute myocardial infarction. We have recalculated the confidence intervals using the binomial exact method (Stata 15.1) and rounded to integers, and accordingly these results may differ slightly from that reported in the original studies. This table excludes studies missing sensitivity data, eg, Halder et al, 2021,[60] Allen et al, 2018.[61] Hyams et al, 2018,[57] and Oliver et al, 2018[32] are studies from the same authors of the same data with the same results.

How good is gestalt?

Table 4. Studies contrasting the HEART score or its variants with gestalt or baseline clinical practice.

Study	Study Format	Score	Size Without/ With HEART	Safety Outcomes	Efficacy Outcomes
Mahler et al, 2013[50]	Database contrast of Likert scale gestalt vs calculated HEART	HEART Pathway	1,005 with both measures	Similar 30-day major adverse cardiac events	More frequent early discharge
Mahler et al, 2015[12]	Randomized controlled trial	HEART Pathway	141 vs 141	Similar 30-day major adverse cardiac events	More frequent early discharge, less later cardiac testing
Visser et al, 2015[51]	Prospective contrast of physician low / medium / high gestalt vs HEART	HEART	255 with both measures	Similar 6-week major adverse cardiac events	Not studied
Poldervaart et al, 2017[17]	Prospective before-and-after	HEART	1,827 vs 1,821	Similar MACE at 6 weeks	Similar early discharge, hospitalization
Singer et al, 2017[13]	Database contrast of low/ medium/high gestalt vs calculated HEART	HEART-2	434 with both measures	Similar acute myocardial infarction	Not studied
Mahler et al, 2018[10]	Prospective before-and-after	HEART Pathway	3,713 vs 4,761	Similar death or acute myocardial infarction	More frequent early discharge, fewer hospitalizations
Ljung et al, 2019[52]	Prospective before-and-after	HEART-2	612 vs 621	Similar 30-day major adverse cardiac events	Fewer admissions
Sharp et al, 2019[16]	Prospective before-and-after	HEART Pathway	30,522 vs 34,871	Similar death or acute myocardial infarction	Fewer hospitalizations and objective testing
Stopyra et al, 2020[11]	Prospective before-and-after	HEART Pathway	3,713 vs 4,761	Similar death or acute myocardial infarction at 12 months	Fewer hospitalizations over 12 months
Trent et al, 2020[53]	Prospective before-and-after	HEART	521 vs 649	Similar major adverse cardiac events at 6 weeks	More frequent hospitalizations and stress testing
Wang et al, 2020[54]	Theoretical application of HEART to usual care sample	HEART	2,185 with both measures	Similar 30-day major adverse cardiac events	Less frequent early discharge

Gestalt?

- The HEART score was not derived or initially validated with any reference to baseline clinical practice or unstructured clinical judgment
- When this has been looked at the results are mixed at best:
- Probably similar rates of adverse events (most of these studies were underpowered)
- Debatable impact on resource utilization
-

Age:

- If you are 65 with 3+ risk factors your lowest possible score is 4
- Does a patient who is 45 have the same risk as someone who is 64?
- *"A 35-year-old male with 50-pack-year smoking history, hypertension, diabetes, and obesity is given 0 points in the age category, while a 70-year-old who exercises daily with no risk factors receives two points just for age."*

Risk Factors

- No mention of gender despite men having almost twice the risk of women.
- Poor connection between risk factors and the risk of ACS
- Do patients know if they have risk factors?
- ≥3 risk factors or history of atherosclerotic disease gets you 2 points automatically.
- Initial studies talked about potential manifestations of atherosclerotic disease (MI, revascularization, stroke) but subsequent studies and online tools don't necessarily list these.
- *Simply counting up the number of cardiac risk factors is misleading given that these risk factors are not each similarly predictive. Their positive likelihood ratios range from unhelpful (LR≈ 1.0 for family history) to potentially helpful (LR≈ 3.1 for an abnormal prior stress test.*Ignore specific historical features that we know are associated with increased risk
-

But it's in the guidelines

- Thought to be helpful from a medicolegal standpoint
- Double edged sword medicolegally
- Good on a chart, easy to attack in court based largely on history.
-

Table 8. Definition Used for Low-Risk Patients With Chest Pain

	Low Risk (<1% 30-d Risk for Death or MACE)
hs-cTn Based	
T-0	T-0 hs-cTn below the assay limit of detection or "very low" threshold if symptoms present for at least 3 h
T-0 and 1- or 2-h Delta	T-0 hs-cTn and 1- or 2-h delta are both below the assay "low" thresholds (>99% NPV for 30-d MACE)
Clinical Decision Pathway Based	
HEART Pathway[20]	HEART score ≤3, initial and serial cTn/hs-cTn < assay 99th percentile
EDACS[14]	EDACS score ≤16; initial and serial cTn/hs-cTn < assay 99th percentile
ADAPT[21]	TIMI score 0, initial and serial cTn/hs-cTn < assay 99th percentile
mADAPT	TIMI score 0/1, initial and serial cTn/hs-cTn < assay 99th percentile
NOTR[15]	0 factors

ADAPT indicates 2-hour Accelerated Diagnostic Protocol to Access Patients with Chest Pain Symptoms Using Contemporary Troponins as the Only Biomarkers; cTn, cardiac troponin; EDACS, Emergency Department Acute Coronary Syndrome; HEART Pathway, History, ECG, Age, Risk Factors, Troponin; hs-cTn, high-sensitivity cardiac troponin; MACE, major adverse cardiovascular events; mADAPT, modified 2-hour Accelerated Diagnostic Protocol to Access Patients with Chest Pain Symptoms Using