Economic and Prognostic Value of High-Sensitivity Cardiac Troponin I in Emergency Department Chest Pain Triage

EE104

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Background

Chest pain is among the most common reasons for emergency department (ED) visits in the United States, accounting for >10 million annual encounters and billions in direct costs.[1-4] Most patients with suspected acute coronary syndromes (ACS) do not have an acute myocardial infarction AMI when evaluated with guideline-endorsed high-sensitivity troponin (hs-cTn) pathways that combine the assay-specific 99th percentile with serial changes and clinical assessment[5]. While these algorithms excel at rule-in/rule-out for AMI [6-8], they leave a large population of non-AMI chest pain patients in whom disposition is variable and frequently conservative, driving admissions, resource use, and cost. We asked whether sub-99th percentile hs-cTn values, combined with a simple clinical risk score, can improve risk-aligned admission decisions after AMI has been excluded without compromising 30-day safety.

We conducted a secondary analysis of the HIGH-US study, which prospectively enrolled 2,505 suspected ACS patients presenting to 29 U.S. EDs.[9,10] Our objective was to evaluate the prognostic and economic value of incorporating sub-99th percentile hs-cTnI with established risk scores to guide admission decisions among patients in whom AMI has been ruled out.

Methods

- **Source trial**: HIGH-US; prospective, multicenter (29 U.S. EDs); adults with suspected ACS who self-presented to 29 US hospital EDs between 04/2015 and 04/2016. [9,10]
- **Analytic cohort**: To focus on prognosis (no diagnosis), we excluded patients with an adjudicated index AMI and those with missing key data (n=1,853 included) (**Figure 1**).
- **Troponin I measurement**: Baseline blood draw median 93 minutes after ED arrival (IQR: 68-122), with additional samples at +1 hour and +3 hours after baseline. Hs-cTnI measurement, using the investigational (at the time) Siemens Healthineers Atellica IM TnIH assay.[9]
- **Outcomes**: Follow-up to 365 days; present analysis focuses on 30-day death or MI (events = 16). Index AMI adjudication used the Third Universal Definition of Myocardial Infarction with independent reveiwers.[11] (**Table 1**).
- **Costing framework (U.S. payer, index encounter, 2026 USD, no discounting)**:
  - **Scenario 1**: Noninvasive testing only (assumed outpatient)
  - **Scenario 2**: Scenario 1 plus potential inpatient admission and invasive procedures (inpatient costs approximated by national average Medicare Severity Diagnosis-Related Group (MS-DRG) payments.

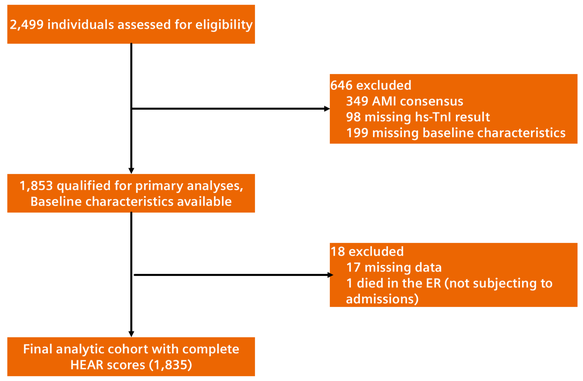

Figure 1. Consort diagram for enrolled patients and patients included in the final analysis.

Table 1. Baseline characteristics of the final analytic cohort of patients without index AMI and with no missing data relevant to this analysis (n=1,835).

	All patients (n=1,835)	Death or MI within 30 days		p-value
		No (n=1,819)	Yes (n=16)	
Age, median (IQR)	56 (48-65)	56 (48-64)	64 (61-68)	*
Male sex, n (%)	1,014 (55)	1,002 (55)	12 (75)	>0.05
Race, n (%)				>0.05
White	994 (54)	983 (54)	11 (69)	
Black	770 (42)	766 (42)	4 (25)	
Other	71 (4)	70 (4)	1 (6)	
Risk factors, n (%)				
Obesity	905 (49)	898 (49)	7 (44)	>0.05
Hypertension	1275 (69)	1263 (69)	12 (75)	>0.05
Diabetes	538 (29)	529 (29)	9 (56)	*
Current smoker	482 (26)	479 (26)	3 (19)	>0.05
History, n (%)				
Prior MI	359 (20)	352 (19)	7 (44)	*
Prior revascularization	497 (27)	489 (27)	8 (50)	>0.05
Prior HF hospitalization	374 (20)	367 (20)	7 (44)	>0.05
Coronary artery disease	675 (37)	667 (37)	8 (50)	>0.05

Abbreviations: HF, heart failure; IQR, interquartile range; MI, myocardial infarction.

Results

Current Practice (SOC) in the Cohort. Among non-AMI chest pain patients (n=1,835):

- **Observed admission rate**: 54% (997/1835)
- **30-day performance vs death/MI**: Sensitivity 88% (14/16); Specificity 46% (836/1,819); NPV 99.8% (836/838).
- **Per-patient cost**: $1,108 (Scenario 1) and $3,302 (Scenario 2)

Interpretation: Contemporary practice maintains very high short-term safety (NPV ~100) but at the expense of many admissions among patients who do not experience events, reflected in modest specificity and higher spend.

Admission Pathways Using hs-cTnI and/or HEAR score. We evaluated counterfactual pathways that admit based on:

- Baseline hs-cTnI (below the 99th percentile) plus a non-low HEAR score
- Thresholds included a conservative hs-cTnI ≤5 ng/L (cohort median)

Key Findings vs SOC (Table 2):

- **Admissions**: Reduced to 7-37% (p<0.05) across hs-cTnI/HEAR strategies
- **Specificity**: Increased to ≥63% (p<0.05), indicating fewer low-risk admissions
- **NPV**: Maintained ≥99.2%, preserving the safety profile
- **Costs**: Lower per-patient to $818-$1,002 (Scenario 1) and $1,102-$2,501 (Scenario 2) (p<0.05 for all vs SOC). These pathways also increased specificity for 30-day death/MI to ≥63% while maintaining a high NPV (**Table 2**).

Sensitivity Trade-offs:

- With hs-cTnI ≤5 ng/L + non-low HEAR, sensitivity remained 88% (14/16), matching SOC.
- Higher hs-cTnI cutoffs reduced sensitivity below 88%, indicating some events admitted under SOC might be discharged under more restrictive thresholds.
- A HEAR-only pathway (without hs-cTnI) produced admission, cost, and diagnostic performance similar to SOC, underscoring that hs-cTnI drive the efficiency gains.

Conclusions

- Sub-99th percentile hs-cTnI concentrations offer clinically meaningful prognostic information that should be leveraged, in conjunction with risk scores, to guide admission decisions among patients with chest pain in whom AMI has been excluded.
- Capacity + Cost benefits: Lower admission (7-37%) can free ED/inpatient capacity and lower spending under both conservative (testing-only) and broader (including admission/procedures) costing scopes.
- A risk-aligned strategy integrating hs-cTnI into admission decisions has the potential to reduce unnecessary hospitalizations and associated costs while maintaining high sensitivity for short-term adverse events.

Table 2. Detailed breakdown of the cost components, cost values, associated CPT/DRG codes and source, and frequency of resource utilization stratified by patients' discharge disposition: ED-based care versus hospitalization.

	Cost[2], $ Average (range)	Frequency of resource utilization^, %		CPT code(s)
		ED-based care	Hospitalization	
Outpatient[1] payment				
ED visit	187	100	100	99285
Blood draw	50	319	442	84484
ECG	12 (8-17)	150	184	93000,05,10
Chest X-ray	144 (125-171)	93	96	71045-48
Echocardiogram	875 (859-925)	6	41	93303,06,12
Exercise stress test	80	5	3	93015
Myocardial perfusion imaging	771 (680-862)	9	22	78472-73,81,83
Stress echocardiography	862 (828-895)	8	7	93350-51
Computed tomography coronary angiography	774 (687-823)	9	7	75571-74
Coronary angiography	959	1	19	93454
Inpatient[3] payment				
Percutaneous coronary intervention	10,884	-	6	250-251
Chest pain	3,586	-	94	313

[1]Outpatient payments included the cost of the ED visit itself and all noninvasive diagnostic tests, which were assumed to have happened in an outpatient setting in this study.
[2]Source: national Medicare Physician Fee Schedule payments and Outpatient Prospective Payment System facility payments mapped to the corresponding CPT code(s).
[3]Inpatient payments included cost of the admission inferred based on the invasive procedures received.
[4]Source: national Medicare Severity Diagnosis-Related Group payments.
^Estimated based on the observed resource utilization frequency stratified by actual disposition decisions in the study cohort. A value greater than 100% entails that a resource (e.g., ECG) was used multiple times.

References

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