

Updated HEART Pathway for Early Discharge

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Abstract

The HEART Pathway for Early Discharge in Acute Chest Pain identifies emergency department patients with acute chest pain as low risk for acute coronary syndrome and amenable to early discharge. The HEART Pathway was designed to more efficiently evaluate patients with acute chest pain using the previously validated HEART Score by making key modifications to the scoring rubric and adding a 3-hour troponin into an accelerated diagnostic pathway (ADP).

II. HOW TO USE

When to Use

Patients ≥ 21 years old presenting in the emergency department with acute chest pain concerning for ACS.

Pearls / Pitfalls

- The HEART Pathway was designed to aid in efficiently evaluating patients with acute chest pain using the previously validated [HEART Score](#). The HEART Pathway builds on the HEART Score by including a 3-hour troponin into an accelerated diagnostic pathway (ADP).
- Interobserver variability of the HEART Score is a known issue, and the HEART Pathway adds specificity and slight modifications to the [scoring rubric](#).
- Identifies patients who are safe for early discharge as low risk for acute coronary syndrome versus those who need observation, admission, and/or potentially emergent cardiology assessment.
- While patients with new ischemic changes on EKG may be classified as low risk using the HEART Pathway, the creators *did not* consider those pa-

tients low risk in their validation study. **New ischemic EKG changes require further workup and should not be deemed low risk.**

- Similarly, in their validation study, the creators of the HEART Pathway *did not* rely on this clinical decision tool in patients with known coronary artery disease as their disease state puts them at significantly increased risk of ACS.
- Designed for patients presenting to the emergency department with chest pain, this ADP has not been tested in already-hospitalized patients with chest pain.

Why to Use

- Chest pain is one of the most common and potentially life-threatening chief complaints in emergency medicine. Many patients presenting with chest pain undergo unnecessarily extensive and costly evaluations to rule out ACS. The HEART Pathway can reduce the number of prolonged stays and invasive testing, while maintaining high sensitivity and negative predictive value for ACS.
- Unlike other scoring systems such as [TIMI](#) or [GRACE](#), the HEART Pathway is designed to pre-

dict the likelihood of ACS in the patient presenting to the emergency department with acute chest pain. TIMI and GRACE are used to risk stratify patients who have been already diagnosed with ACS.

III. NEXT STEPS

Advice

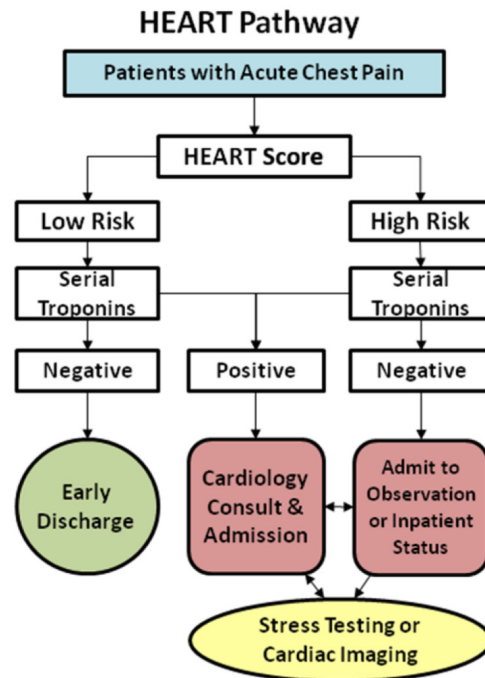
- The HEART Pathway is an ADP. It is not designed to replace clinical judgment.
- Any patient with a concerning presentation or clinical progression should receive workup and treatment based on the clinician's discretion, regardless of the HEART Pathway's predicted risk.
- Shared decision making is a crucial part of further management after ACS risk has been determined, especially in patients with moderate risk who are recommended for observation and comprehensive cardiac evaluation. There is notable risk involved with hospitalization as well as risk of false-positive or non-diagnostic testing that would result in invasive procedures such as cardiac catheterization. The patient should be presented with the risk of both missed ACS and hospitalization for further workup. See the [Chest Pain Choice Decision Aid from Mayo Clinic](#) for risk-specific decision aids.
- Any patient presenting with chest pain and subsequently discharged should be informed that even with a negative workup, there is still a small risk of ACS. However, with a <1% risk of ACS within 30 days, it is important to emphasize that automatic outpatient cardiac risk stratification carries a higher risk of false-positive than a true positive, and could result in unnecessary invasive procedures (such as cardiac catheterization) that carry inherent risks. Instead, patients should be set up with close primary care follow-up and given extensive return precautions prior to discharge.

Management

- Low risk patients with a follow-up troponin at 3 hours after ED presentation can be considered for safe discharge home with appropriate follow-up.
- High risk patients require admission, observation, serial cardiac biomarkers and EKG, and/or cardiology consult.

Critical Actions

- Clinician judgment should prevail, even if patients are deemed low risk by the HEART Pathway. If there is some other cause for concern of acute cardiac syndrome, workup should be individualized to the patient.



From [Mahler 2015](#).

- All patients presenting to the ED with chest pain concerning for ACS should receive aspirin unless there is an absolute contraindication (known allergy, active bleeding, or the patient has received a therapeutic dose prior to arrival).

IV. EVIDENCE

Evidence Appraisal

The HEART Pathway was developed by [Mahler et al](#) in 2015 in a randomized controlled single-center trial.

- Control arm was managed at the discretion of care providers encouraged to follow American College of Cardiology/American Heart Association guidelines for acute chest pain.
- The use of the HEART Pathway in this study was designed to mimic the real world in that it was used as an ADP. Patient care was at the discretion of the health care provider and not mandated by the outcome of the HEART Pathway.
- $n = 282$, with 141 patients in each treatment group.
- Primary outcome: rate of objective cardiac testing (stress test, coronary CTA, or invasive coronary angiography) within 30 days of presentation.
- Secondary outcomes: early discharge rate, index length of stay, cardiac related recurrent ED visits, and nonindex hospitalization at 30 days.
- The rate of objective cardiac testing in the HEART Pathway group was 12% less than the usual care group.

- The rate of early discharge in the HEART Pathway was 21% higher than the usual care group.
- The index length of stay was 12 hours shorter using the HEART Pathway.
- There was no significant difference between the two groups for cardiac related recurrent ED visits or nonindex hospitalization at 30 days.
- No patients identified for early discharge in either group had missed MACE during the first 30 day follow up period.
- Study was not powered to adequately detect difference in major adverse cardiac event (MACE) between the two study groups.

[Mahler and colleagues \(2017\)](#) also published a secondary analysis looking at high sensitivity cardiac troponin (hs-cTnI and hs-cTnT).

- Compared risk stratification using cardiac troponin I (cTnI) vs. high sensitivity cardiac troponin (hs-cTnI and hs-cTnT) in calculating the HEART Pathway score.
- $n = 133$, patients had blood samples sent for cTnI, hs-cTnI, and hs-cTnT.
- All of the troponin assays had poor sensitivity for predicting MACE when used separately from the HEART Score.
- There was no difference in the predicted risk of MACE between the use of serial cTnI and 3-hour hs-cTnI in the HEART Pathway.
- Using hs-cTnT in the HEART Pathway led to one patient with an NSTEMI to be misclassified as low risk.
- The study found the HEART Pathway using serial cTnI or 3-hour hs-cTnI to have sensitivity and NPV of 100% for 30-day MACE.
- Although hs-cTnT use in the HEART Pathway caused an NSTEMI to be misclassified as low risk, the reduction in sensitivity was not statistically significant, given the small study population. The authors recommend further appropriately-powered studies to determine small differences in the accuracy of the high sensitivity troponin assays.

1. **High risk features of chest pain:** Retrosternal pain, pressure, radiation to jaw/left shoulder/arms, duration 5–15 min, initiated by exercise/cold/emotion, perspiration, nausea/vomiting, reaction on nitrates within mins, patient recognizes symptoms. **Low risk features:** well localized, sharp, non-exertional, no diaphoresis, no nausea or vomiting, and reproducible with palpation.
2. Repolarization abnormalities, non-specific T wave changes, non-specific ST-segment depression or elevation, bundle branch blocks, pacemaker rhythms, LVH, early repolarization, or digoxin effect.
3. Ischemic ST-segment depression or new ischemic T-wave inversions.

4. HTN, hypercholesterolemia, DM, obesity (BMI >30 kg/m²), smoking (current, or smoking cessation ≤ 3 mo), positive family history (parent or sibling with CVD before age 55).
5. Use local assays and corresponding cutoffs.

Facts & Figures

Interpretation:

HEART Score	Initial troponin	Recommendation	Risk
≤ 3	0 points	If no new ischemic EKG changes or history of CAD , repeat troponin at 3 hours and if negative, discharge home with outpatient follow-up.	Low (<1% 30-day MACE)
	1–2 points	Cardiology consultation and admission recommended. Further testing indicated.	High
≥ 4	0 points	Admit to hospital or observation. Further testing indicated.	
	1–2 points	Cardiology consultation and admission recommended. Further testing indicated.	

Validation study:

Citation	https://pubmed.ncbi.nlm.nih.gov/30571347/ Mahler SA, Lenoir KM, Wells BJ, Burke GL, Duncan PW, Case LD, Herrington DM, Diaz-Garelli JF, Futrell WM, Hiestand BC, Miller CD. Safely Identifying Emergency Department Patients With Acute Chest Pain for Early Discharge. <i>Circulation</i> . 2018 Nov 27;138(22):2456-2468. doi: 10.1161/CIRCULATIONAHA.118.036528. PMID: 30571347; PMCID: PMC6309794.
Type of study	Prospective multicenter RCT
Funding source	Foundation
Number of patients	4761
Inclusion criteria	Adult ED patients (≥21 years of age) with a chief complaint of chest pain and at least 1 troponin ordered
Exclusion criteria	Evidence of a ST-segment–elevation MI on ECG
Study findings	The HEART Pathway identified 30.7% as low risk; 0.4% of these patients experienced death or MI within 30 days.
Strengths	Much larger study population, pragmatic validation study,
Criticisms	HEART pathway criteria are slightly different than derivation study: not-low risk criteria of CAD history and new ischemic changes were new for the validation study (but these changes were used in most future validation studies)

Additional validations:

Citation	Summary
Sharp AL, Baecker AS, Shen E, Redberg R, Lee MS, Ferencik M, Natsui S, Zheng C, Kawatkar A, Gould MK, Sun BC. Effect of a HEART Care Pathway on Chest Pain Management Within an Integrated Health System. <i>Ann Emerg Med</i> . 2019 Aug;74(2):171-180.	35.2% (12,267 of 34,871) of encounters had documented HEART scores. Overall, increasing HEART scores showed higher-risks of this secondary outcome (low-risk 0.2%, and high-risk 2.6%).
Stopyra J, Snively AC, Hiestand B, Wells BJ, Lenoir KM, Herrington D, Hendley N, Ashburn NP, Miller CD, Mahler SA. Comparison of accelerated diagnostic pathways for acute chest pain risk stratification. <i>Heart</i> . 2020;106:977–984.	5799 patients presenting to the emergency department were accrued, of which HEART Pathway assessments were completed on 4399. Overall, major adverse cardiac events at 30 days occurred in 449/4399 (10.2%). Major adverse cardiac events occurred in 0.4% (95% CI 0.2% to 0.9%) of patients classified as low-risk by the HEART Pathway.
Mark DG, Huang J, Kene MV, Sax DR, Cotton DM, Lin JS, Bouvet SC, Chettipally UK, Anderson ML, McLachlan ID, Simon LE, Shan J, Rauchwerger AS, Vinson DR, Ballard DR, Reed ME; Kaiser Permanente CREST Network Investigators. Prospective Validation and Comparative Analysis of Coronary Risk Stratification Strategies Among Emergency Department Patients with Chest Pain. <i>J Am Heart Assoc</i> . 2021 Apr 6;10(7):e020082.	There were 13,192 patient encounters included with a 60-day major adverse cardiac event incidence of 3.7%. HEART pathway had a low negative likelihood ratios (0.07, 95% CI, 0.04–0.11) and 0.3% risk of MACE in 60 days.

Systematic Reviews/Meta-analyses	Summary
Hu Z, Miao L, Wang M, Cheng S, Jin S. A meta-analysis on the safety and accuracy of the HEART pathway for risk stratification in patients with acute chest pain. <i>BMC Cardiovasc Disord</i> . 2025 May 27;25(1):407.	The meta-analysis of 22,037 subjects from 10 studies of the HEART Pathway with considerable heterogeneity were included. Within this cohort, 9,476 cases (43%) were classified as low-risk, with 43 cases (0.45%) experiencing 30-day MACE.

Clinical Practice Guidelines	Summary
American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Suspected Non–ST-Elevation Acute Coronary Syndromes; Tomaszewski CA, Nestler D, Shah KH, Sudhir A, Brown MD. Clinical Policy: Critical Issues in the Evaluation and Management of Emergency Department Patients With Suspected Non-ST-Elevation Acute Coronary Syndromes. <i>Ann Emerg Med</i> . 2018 Nov;72(5):e65-e106.	Level C Recommendation (before validation studies published)
https://pubmed.ncbi.nlm.nih.gov/34709879/ Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, Blankstein R, Boyd J, Bullock-Palmer RP, Conejo T, Diercks DB, Gentile F, Greenwood JP, Hess EP, Hollenberg SM, Jaber WA, Jneid H, Joglar JA, Morrow DA, O'Connor RE, Ross MA, Shaw LJ. 2021 AHA/ACC/AASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. <i>Circulation</i> . 2021 Nov 30;144(22):e368-e454.	Level B-NR Recommendation

Impact Analyses	Summary
https://www.ncbi.nlm.nih.gov/pubmed/27765481 Riley RF, Miller CD, Russell GB, et al. Cost analysis of the History, ECG, Age, Risk factors, and initial Troponin (HEART) Pathway randomized control trial. Am J Emerg Med. 2017;35(1):77-81.	Riley et al, 2017 published a cost analysis of the HEART Pathway compared to usual care using the same dataset as the original HEART Pathway trial. $n = 270$, missing billing data of 12 patients from the original study. - Cost metrics considered in each group were index visit cost, total cost at 30 days, cardiac related health care cost at 30 days, cardiac and noncardiac diagnostic testing cost, ED cost, inpatient cost for index visit, and outpatient cost. - HEART Pathway patients had a significantly lower mean and median cost for both index visit and 30 day follow up. - There was not a significant difference in cost between the median and mean costs of the other metrics. - Average savings per patient was \$216 using the HEART Pathway. On a larger scale, this would mean approximately \$2 billion in savings per year for undifferentiated chest pain.

Evidence rating	5
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Key:

1	Derived but not validated OR validated only in split samples, large retrospective databases, or by statistical techniques.
2	Validated in one narrow prospective cohort.
3	Validated with good accuracy in at least one large prospective cohort including a broad spectrum of patients and clinicians OR in ≥ 2 smaller cohort that differ from each other.
4	Validated with good accuracy in >1 large prospective cohort and/or several smaller cohorts that differ from each other.
5	Same as 4, plus at least one impact analysis demonstrating change in clinician behavior with resulting beneficial effect.

Formula

Addition of the selected points:

	0 points	1 point	2 points
History¹	Mostly low-risk features	Mixture of high-risk and low-risk features	Mostly high-risk features
EKG	Normal	Non-specific changes ²	New ischemic changes ³
Age (years)	<45	45–65	≥ 65
Risk factors⁴	No known risk factors	1–2 risk factors	≥ 3 risk factors or history of atherosclerotic disease (CAD, CVA, PAD)
Initial troponin⁵	$\leq$ normal limit	1–2 $\times$ normal limit	$>2\times$ normal limit

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