**Name of Journal:** *World Journal of Cardiology*

**Manuscript NO:** 80267

**Manuscript Type:** LETTER TO THE EDITOR

**New scoring system for acute chest pain risk stratification: Is it worth SVEAT-ing it?**

Dasari M *et al*. Comparison of novel risk stratification system

Mahati Dasari, Pramukh Arun Kumar, Yuvaraj Singh, Eddison Ramsaran

**Mahati Dasari, Pramukh Arun Kumar, Yuvaraj Singh,** Department of Internal Medicine, Saint Vincent Hospital, Worcester, MA 01608, United States

**Eddison Ramsaran,** Department of Cardiology, Saint Vincent Hospital, Worcester, MA 01608, United States

**Author contributions:** Dasari M conceptualized the idea and designed the research; Dasari M and Arun Kumar P wrote initial draft of manuscript; Singh Y and Ramsaran E proof-read and suggested changes in manuscript, Singh Y checked for scientific accuracy, plagiarism and table creation; Dasari M, Arun Kumar P, Singh Y, Ramsaran E made further edits and reviewed the final version of the manuscript.

**Corresponding author: Yuvaraj Singh, MD, Chief Physician, Doctor, Staff Physician,** Department of Internal Medicine, Saint Vincent Hospital, 123 Summer Street, Worcester, MA 01608, United States. yuvarajmle@gmail.com

**Received:** January 22, 2023

**Revised:** March 28, 2023

**Accepted:** April 10, 2023

**Published online:**

**Abstract**

The emergency room is a very potent environment in the hospital. With the growing demands of the population, improved accessibility to health resources, and the onslaught of the triple pandemic, it is extremely crucial to triage patients at presentation. In the spectrum of complaints, chest pain is the commonest. Despite it being a daily ailment, chest pain brings concern to every physician at first. Chest pain could span from acute coronary syndrome, pulmonary embolism, and aortic dissection (all potentially fatal) to reflux, zoster, or musculoskeletal causes that do not need rapid interventions. We often employ scoring systems such as GRACE/PURSUIT/TIMI to assist in clinical decision-making. Over the years, the HEART score became a popular and effective tool for predicting the risk of 30-d major adverse cardiovascular events. Recently, a new scoring system called SVEAT was developed and compared to the HEART score. We have attempted to summarize how these scoring systems differ and their generalizability. With an increasing number of scoring systems being introduced, one must also prevent anchorage bias; i.e., tools such as these are only diagnosis-specific and not organ-specific, and other emergent differential diagnoses must also be kept in mind before discharging the patient home without additional workup.

**Key Words:** Chest pain; Acute coronary syndrome; SVEAT score; HEART score; TIMI score; Risk stratification scores

Dasari M, Arun Kumar P, Singh Y, Ramsaran E. New scoring system for acute chest pain risk stratification: Is it worth SVEAT-ing it? *World J Cardiol* 2023; In press

**Core Tip:** Despite several studies, scoring systems, and artificial intelligence -guided tools available to triage symptoms of chest pain, physicians are often struck with the dilemma before discharging patients from the endoplasmic reticulum. The reason is that chest pain etiologies such as acute coronary syndromes (ACS) can present atypically and, when misdiagnosed, can lead to catastrophic consequences. Tools such as the HEART score and recently published SVEAT score are robustly validated methods of triaging this conundrum. However, while we delineate how they differ, one must be mindful that most patients with ACS could present with chest pain, but not every chest pain is due to ACS.

**TO THE EDITOR**

We read with great interest the retrospective cohort study by Antwi-Amoabeng *et al*[1] entitled “SVEAT score outperforms HEART score in patients admitted to a chest pain observation unit.” It is a well-written study that validated that the performance of the Symptoms, history of Vascular disease, Electrocardiography, And Troponin (SVEAT) score is superior as compared to History, Electrocardiography, Age, Risk factors, and Troponin (HEART) score in stratifying acute chest pain in low to intermediate risk patients for 30-d major adverse cardiovascular events (MACE). The study assessed the potential usefulness of the SVEAT score developed by Roongsritong *et al*[2] in a prospective observational study by comparing it with HEART and TIMI (Thrombolysis In Myocardial Infarction) risk scores.

Acute chest pain is the second most common reason for adults presenting to the emergency department after trauma, of which only 5.1% of cases are caused by acute coronary syndrome (ACS)[3,4]. Patients with ACS symptoms with less than a 1% probability of 30-d MACE or death are classified as low-risk chest pain[5]. High-sensitivity troponins are used to diagnose myocardial infarction and detect myocardial injury[6].

Before 2008, widely used risk scores for ACS like GRACE, PURSUIT, and TIMI mainly focused on high-risk patients[7-10]. In 2008, Six *et al*[11] developed the HEART score in a single-centric study to better guide ER physicians to triage acute chest pain in low-risk patients aiding in safe early discharge, which was further validated by Backus *et al*[12] in a multicentric study stating that low HEART scores had a low likelihood of an ACS and high HEART score predicted higher MACE in 6 wk. Of the currently available risk stratification scores commonly used, the HEART score clinical decision pathway is the most widely employed[13]. Head-to-head comparison studies between GRACE, TIMI, and HEART scores showed that HEART scores had better predictability of MACE in low-risk patients[14]. It is also proven to reduce objective cardiac testing in 30 d, reduce the length of hospital stay and increase early discharges compared to usual care as per ACC/AHA[15].

However, the HEART score includes traditional cardiac risks factors, such as hypertension, diabetes, smoking, and obesity, which have limited value in diagnosing ACS, especially in patients older than 40[16]; hence, these have been eliminated from the SVEAT score. Instead, the history of vascular events was included in the SVEAT score, as shown in Table 1[2]. Using more objective data in the SVEAT score reduces uncertainty and inter-rater variability inherent to other scores caused by arbitrary, subjective criteria. In addition, as stated by the authors, the SVEAT score incorporates more points for factors with higher risk association and negative points for factors with a lower risk associated with acute coronary events, ranging from +5 to -2. This, in turn, provides a broader range of cumulative scores, helping achieve superior stratifications between subgroups.

The HEART score has a threshold of 3 for stratifying as low risk, while the SVEAT score of 4 was chosen as a cut-off for low risk to achieve a 30-d MACE of 0.8%, calculated retrospectively in the index article. The HEART score identified less than 60% of the low-risk patients, whereas an additional 28% of low-risk patients were identified using the SVEAT score as compared to the HEART score[2,11,12]. Moreover, the HEART score allocates the highest score of ‘2’ for troponins, while the cut-off for low-risk stratification is 3. Hence, with the HEART score, there is a disclaimer that if there is positive high sensitivity troponin despite the score being less than or equal to 3, *i.e.*, low-risk score, experts recommend further workup and admission[13]. However, a score of ‘5’ with the SVEAT score system is allocated if the troponin level is over 0.7 ng/mL. This, by default, ensures that the patient is not in the low-risk group if troponin is significantly elevated. Also, vascular disease has one of the most quantifiable associations with cardiac mortality, which was given a higher individual score in the SVEAT score system[17].

Both scores examine the risk stratifying of patients presenting with chest pain due to coronary artery disease. They do not consider other life-threatening illnesses in patients with chest pain, such as aortic dissection, pulmonary embolism, or esophageal rupture. This is important to note since chest pain can cause anchorage bias, and a low score can create a false sense of security, leading to premature discharge. While promising, the SVEAT score has several limitations, as mentioned by the authors, including the need for further validation in multicentric studies with diverse populations. Additionally, we need comprehensive follow-up data regarding prognostication for a longer duration. As the authors state, the individual scores are assigned rather arbitrarily than using a more formally weighted logistic regression model. Further studies could also be performed to validate if a combination of scores can increase reliability and precision in identifying low-risk patients with acute chest pain.

Acute chest pain etiology also differs in a gender-specific manner, with conditions such as coronary artery spasm, subacute coronary artery dissection, and takotsubo being significantly more prevalent in women, unlike obstructive CAD, which is more prevalent in men[18-21]. However, given the absence of conventional risk factors and ECG changes in the conditions mentioned above, screening and specific stratification remain challenging with any available scoring system, including the SVEAT system.

In conclusion, we would like to reiterate that using a well-validated scoring system is crucial to educate patients about chest pain, its implications, and key management measures. Before discharging someone with a low HEART or SVEAT score, patients must be asked if they live alone, have access to phones, are ambulatory, and how far they are from a tertiary medical facility. If these resources are unavailable, the patient should be considered a non-low risk and admitted to the hospital for further workup.

**REFERENCES**

1 **Antwi-Amoabeng D**, Roongsritong C, Taha M, Beutler BD, Awad M, Hanfy A, Ghuman J, Manasewitsch NT, Singh S, Quang C, Gullapalli N. SVEAT score outperforms HEART score in patients admitted to a chest pain observation unit. *World J Cardiol* 2022; **14**: 454-461 [PMID: 36160811 DOI: 10.4330/wjc.v14.i8.454]

2 **Roongsritong C**, Taha ME, Pisipati S, Aung S, Latt H, Thomas J, Namballa L, Al-Hasnawi HJ, Taylor MK, Gullapalli N. SVEAT Score, a Potential New and Improved Tool for Acute Chest Pain Risk Stratification. *Am J Cardiol* 2020; **127**: 36-40 [PMID: 32418720 DOI: 10.1016/j.amjcard.2020.04.009]

3 National Hospital Ambulatory Medical Care Survey: 2020 Emergency Department Summary Tables. Available from:https://www.cdc.gov/nchs/data/nhamcs/web\_tables/2020-nhamcs-ed-web-tables-508.pdf

4 **Hsia RY**, Hale Z, Tabas JA. A National Study of the Prevalence of Life-Threatening Diagnoses in Patients With Chest Pain. *JAMA Intern Med* 2016; **176**: 1029-1032 [PMID: 27295579 DOI: 10.1001/jamainternmed.2016.2498]

5 **Twerenbold R**, Boeddinghaus J, Nestelberger T, Wildi K, Rubini Gimenez M, Badertscher P, Mueller C. Clinical Use of High-Sensitivity Cardiac Troponin in Patients With Suspected Myocardial Infarction. *J Am Coll Cardiol* 2017; **70**: 996-1012 [PMID: 28818210 DOI: 10.1016/j.jacc.2017.07.718]

6 **Apple FS**, Jesse RL, Newby LK, Wu AH, Christenson RH; National Academy of Clinical Biochemistry; IFCC Committee for Standardization of Markers of Cardiac Damage. National Academy of Clinical Biochemistry and IFCC Committee for Standardization of Markers of Cardiac Damage Laboratory Medicine Practice Guidelines: Analytical issues for biochemical markers of acute coronary syndromes. *Circulation* 2007; **115**: e352-e355 [PMID: 17384332 DOI: 10.1161/CIRCULATIONAHA.107.182881]

7 **Boersma E**, Pieper KS, Steyerberg EW, Wilcox RG, Chang WC, Lee KL, Akkerhuis KM, Harrington RA, Deckers JW, Armstrong PW, Lincoff AM, Califf RM, Topol EJ, Simoons ML. Predictors of outcome in patients with acute coronary syndromes without persistent ST-segment elevation. Results from an international trial of 9461 patients. The PURSUIT Investigators. *Circulation* 2000; **101**: 2557-2567 [PMID: 10840005 DOI: 10.1161/01.cir.101.22.2557]

8 **Granger CB**, Goldberg RJ, Dabbous O, Pieper KS, Eagle KA, Cannon CP, Van De Werf F, Avezum A, Goodman SG, Flather MD, Fox KA; Global Registry of Acute Coronary Events Investigators. Predictors of hospital mortality in the global registry of acute coronary events. *Arch Intern Med* 2003; **163**: 2345-2353 [PMID: 14581255 DOI: 10.1001/archinte.163.19.2345]

9 **Fox KA**, Dabbous OH, Goldberg RJ, Pieper KS, Eagle KA, Van de Werf F, Avezum A, Goodman SG, Flather MD, Anderson FA Jr, Granger CB. Prediction of risk of death and myocardial infarction in the six months after presentation with acute coronary syndrome: prospective multinational observational study (GRACE). *BMJ* 2006; **333**: 1091 [PMID: 17032691 DOI: 10.1136/bmj.38985.646481.55]

10 **Antman EM**, Cohen M, Bernink PJ, McCabe CH, Horacek T, Papuchis G, Mautner B, Corbalan R, Radley D, Braunwald E. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision making. *JAMA* 2000; **284**: 835-842 [PMID: 10938172 DOI: 10.1001/jama.284.7.835]

11 **Six AJ**, Backus BE, Kelder JC. Chest pain in the emergency room: value of the HEART score. *Neth Heart J* 2008; **16**: 191-196 [PMID: 18665203 DOI: 10.1007/BF03086144]

12 **Backus BE**, Six AJ, Kelder JC, Mast TP, van den Akker F, Mast EG, Monnink SH, van Tooren RM, Doevendans PA. Chest pain in the emergency room: a multicenter validation of the HEART Score. *Crit Pathw Cardiol* 2010; **9**: 164-169 [PMID: 20802272 DOI: 10.1097/HPC.0b013e3181ec36d8]

13 **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/ASE/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. *Circulation* 2021; **144**: e368-e454 [PMID: 34709879 DOI: 10.1161/CIR.0000000000001029]

14 **Poldervaart JM**, Langedijk M, Backus BE, Dekker IMC, Six AJ, Doevendans PA, Hoes AW, Reitsma JB. Comparison of the GRACE, HEART and TIMI score to predict major adverse cardiac events in chest pain patients at the emergency department. *Int J Cardiol* 2017; **227**: 656-661 [PMID: 27810290 DOI: 10.1016/j.ijcard.2016.10.080]

15 **Mahler SA**, Riley RF, Hiestand BC, Russell GB, Hoekstra JW, Lefebvre CW, Nicks BA, Cline DM, Askew KL, Elliott SB, Herrington DM, Burke GL, Miller CD. The HEART Pathway randomized trial: identifying emergency department patients with acute chest pain for early discharge. *Circ Cardiovasc Qual Outcomes* 2015; **8**: 195-203 [PMID: 25737484 DOI: 10.1161/CIRCOUTCOMES.114.001384]

16 **Han JH**, Lindsell CJ, Storrow AB, Luber S, Hoekstra JW, Hollander JE, Peacock WF 4th, Pollack CV, Gibler WB; EMCREG i\*trACS Investigators. The role of cardiac risk factor burden in diagnosing acute coronary syndromes in the emergency department setting. *Ann Emerg Med* 2007; **49**: 145-152, 152.e1 [PMID: 17145112 DOI: 10.1016/j.annemergmed.2006.09.027]

17 **Feringa HH**, Bax JJ, Hoeks S, van Waning VH, Elhendy A, Karagiannis S, Vidakovic R, Schouten O, Boersma E, Poldermans D. A prognostic risk index for long-term mortality in patients with peripheral arterial disease. *Arch Intern Med* 2007; **167**: 2482-2489 [PMID: 18071171 DOI: 10.1001/archinte.167.22.2482]

18 **Safdar B**, D'Onofrio G. Women and Chest Pain: Recognizing the Different Faces of Angina in the Emergency Department. *Yale J Biol Med* 2016; **89:** 227-238 [PMID: 27354848]

19 **Sharma SP**, Manintveld OC, Budde RPJ, Hirsch A, Lenzen MJ, Galema TW. Gender Differences in Patients With Stable Chest Pain. *Am J Cardiol* 2022; **171:** 84-90 [PMID: 35277254 DOI: 10.1016/j.amjcard.2022.01.054]

20 **Templin C**, Ghadri JR, Diekmann J, Napp LC, Bataiosu DR, Jaguszewski M, Cammann VL, Sarcon A, Geyer V, Neumann CA, Seifert B, Hellermann J, Schwyzer M, Eisenhardt K, Jenewein J, Franke J, Katus HA, Burgdorf C, Schunkert H, Moeller C, Thiele H, Bauersachs J, Tschöpe C, Schultheiss HP, Laney CA, Rajan L, Michels G, Pfister R, Ukena C, Böhm M, Erbel R, Cuneo A, Kuck KH, Jacobshagen C, Hasenfuss G, Karakas M, Koenig W, Rottbauer W, Said SM, Braun-Dullaeus RC, Cuculi F, Banning A, Fischer TA, Vasankari T, Airaksinen KE, Fijalkowski M, Rynkiewicz A, Pawlak M, Opolski G, Dworakowski R, MacCarthy P, Kaiser C, Osswald S, Galiuto L, Crea F, Dichtl W, Franz WM, Empen K, Felix SB, Delmas C, Lairez O, Erne P, Bax JJ, Ford I, Ruschitzka F, Prasad A, Lüscher TF. Clinical Features and Outcomes of Takotsubo (Stress) Cardiomyopathy. *N Engl J Med* 2015; **373:** 929-938 [PMID: 26332547 DOI: 10.1056/NEJMoa1406761]

21 **Hayes SN**, Kim ESH, Saw J, Adlam D, Arslanian-Engoren C, Economy KE, Ganesh SK, Gulati R, Lindsay ME, Mieres JH, Naderi S, Shah S, Thaler DE, Tweet MS, Wood MJ; American Heart Association Council on Peripheral Vascular Disease; Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Genomic and Precision Medicine; and Stroke Council. Spontaneous Coronary Artery Dissection: Current State of the Science: A Scientific Statement From the American Heart Association. *Circulation* 2018; **137:** e523-e557 [PMID: 29472380 DOI: 10.1161/CIR.0000000000000564]

**Footnotes**

**Conflict-of-interest statement:** All the authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: https://creativecommons.org/Licenses/by-nc/4.0/

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review started:** January 22, 2023

**First decision:** March 15, 2023

**Article in press:**

**Specialty type:** Cardiac and cardiovascular systems

**Country/Territory of origin:** United States

**Peer-review report’s scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): B

Grade C (Good): C

Grade D (Fair): D

Grade E (Poor): 0

**P-Reviewer:** Ghannam WM, Egypt; Horowitz JD, Australia; Moshref RH, Saudi Arabia **S-Editor:** Liu JH **L-Editor:** A **P-Editor:**

**Table 1 Summarizing differences between the HEART and SVEAT scores**

|  |  |  |
| --- | --- | --- |
| **Scoring variables** | **HEART score**  | **SVEAT score**  |
| Symptom- Chest pain | Stratifies symptoms subjectively, *i.e.*, based on level suspicion. (This is open to bias based on the provider) | Stratifies symptoms more objectively by using well-defined terminologies for chest pain, hence being less open to bias |
| Risk factor | Includes hyperlipidemia, hypertension, diabetes mellitus, smoking, and a family history of obesity, and scoring is based on their frequency. Does not take recent coronary disease into account | Includes recent myocardial infarction, PCI/CABG, or any prior vascular event |
| EKG | Positively scores any EKG changes. If none are present, score 0. No negative scores | Gives a score of 3 for dynamic ST or T wave changes, higher than HEART (2). It also assigns a negative score when there are no EKG changes in the presence of ongoing chest pain |
| Age | Assigns a score of 2 for all patients over 65 yr | Assigns a score of 2 for all patients over 75 yr. It also assigns a negative score when the patient is < 30 yr |
| Troponin | Is applicable for both Troponin I and T assays. No negative scores for a normal Troponin | Validated for the 4th generation ultra-sensitive Troponin I assay only. Assigns negative scores for normal Troponin levels after > 4 h of chest pain |

CABG: Coronary artery bypass grafting; EKG: Electrocardiographic; PCI: Percutaneous interventions; ST: Subthemes.