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BRIEF RESEARCH REPORT

Cardiology

Comparison of self-reported EDACS versus physician-reported EDACS for the triage of chest pain patients in the emergency department

Mingwei Ng MBBS, MCEM | Zhenghong Liu MBBS, MMed | Jean Su Ling Tan BSN (Hons) | R. Ponampalam MBBS, FRCSEd

Department of Emergency Medicine, Singapore General Hospital, Singapore

Correspondence
Mingwei Ng, Department of Emergency Medicine, Singapore General Hospital, Outram Road, 169608 Singapore.
Email: ng.mingwei@gmail.com

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Registration number: This study conformed to the principles outlined in the Declaration of Helsinki. This study underwent SingHealth Centralised Institutional Review Board review (CIRB 2018/2786) before commencement.

Abstract

Objectives: Currently, there are no guidelines to help triage nurses identify high-risk emergency department chest pain patients. Patient self-reporting of Emergency Department Assessment of Chest Pain Score (EDACS) could facilitate more reliable triage compared to nursing gestalt, but this novel concept is untested. This study hypothesizes that because EDACS requires minimal clinical gestalt to derive, self-reported EDACS (S-EDACS) at triage is likely to correlate well with traditional physician-reported EDACS (P-EDACS) and have potential application as a triage tool.

Methods: This single-center pilot prospective cohort study analyzed 60 patients who completed a self-reported questionnaire upon triage to determine their S-EDACS. This was matched against P-EDACS, derived from an identical questionnaire completed by the blinded treating physician. Secondary endpoint of major adverse cardiovascular events (MACE) within 30 days (all-cause mortality, myocardial infarction, coronary revascularization) was assessed by 2 blinded emergency physicians who independently reviewed the electronic medical records. S/P-EDACS also were benchmarked against nursing gestalt (based on triage to low/high-acuity areas) and emergency physician gestalt (disposition and admitting/discharge diagnoses).

Results: There was perfect agreement between S/P-EDACS in this study ($K = 1.00$). Fifteen patients (25.0%) had minor discordances in their absolute S/P-EDACS that did not affect risk stratification. Of these, 11/15 (73.3%) had higher S-EDACS, suggesting S-EDACS is more likely to safely overcall MACE risk. S-EDACS outperformed nursing gestalt, triaging a greater proportion of patients (71.7% vs 35.0%) as low risk without compromising patient safety, and demonstrated similar accuracy as emergency physician gestalt.

Conclusion: S-EDACS strongly correlates with P-EDACS with perfect agreement and has potential to be used as a triage tool.

KEYWORDS
chest pain scores, EDACS, emergency department, MACE, triage

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1 | INTRODUCTION

Chest pain is among the leading causes for emergency department presentations.[1] Accurate triage is critical: undertriaging patients with acute coronary syndromes (ACS) delays critical interventions and worsens morbidity; whereas, overtriaging burdens healthcare resources and sacrifices care for other patients. Yet, fewer than half of ACS have diagnostic ECGs at presentation.[2] Without guidelines to sieve out high-risk patients from the worried well, triage nurses invariably rely heavily on gestalt—which is challenging and especially unsafe for less-experienced staff.

Originally developed to aid emergency physicians expedite disposition decisions, clinical decision rules could potentially have their application expanded to triage. However, most rules, such as Vancouver Chest Pain Rule, Accelerated Diagnostic Protocol to Assess Patients with Chest Pain Symptoms Using Contemporary Troponins (ADAPT), Global Registry of Acute Coronary Events (GRACE), and history, ECG, age, risk factors, and troponin (HEART) depend on troponin results, which are unknown at the point of triage. McCord et al devised HEAR, which is calculated from HEART, but omits troponins[3]; even this, however, demands clinical gestalt to subjectively rate if various components are "slightly," "moderately," or "highly" suspicious.

Emergency Department Assessment of Chest Pain Score (EDACS) stands out for its simplicity and objectivity. EDACS has been extensively validated as a reliable predictive tool for major adverse cardiovascular events (MACE)—Body et al found that EDACS outperformed thrombolysis in myocardial infarction, HEART, and Troponin-only Manchester Acute Coronary Syndromes (T-MACS).[4] EDACS relies solely on the responses to 10 yes/no questions that evaluate the patient's chest pain characteristics and cardiovascular risk-factors. Given that no further interpretation of clinical symptoms, physical examination findings or troponins are required, EDACS can in fact be self-reported by untrained laypersons like patients. This concept is untested and it is unclear if self-reported EDACS (S-EDACS) is reliable enough compared to traditional physician-reported EDACS (P-EDACS) for application as a triage tool.

1.1 | Objectives

This study aims to evaluate the correlation between S/P-EDACS as the primary outcome. S-EDACS is hypothesized to correlate strongly with P-EDACS. S-EDACS was also benchmarked against nursing gestalt, emergency physician gestalt, and eventual MACE as secondary outcomes. It is hypothesized that S-EDACS would be superior to nursing gestalt in discriminating chest pain patients at high risk for MACE.

2 | METHODS

This was a prospective single-center cohort study conducted over 3 months (June 2019 to August 2019) in Singapore General Hospital, a tertiary hospital with dedicated cardiology and cardiothoracic specialties. Only English-literate patients with a presenting complaint of chest pain or tightness were recruited as the questionnaire used was in English (Figure 1). Subjects had to be > 21 years old with capacity to provide written informed consent. Patients with non-cardiac symptoms as their chief complaint, high-risk features (unstable hemodynamic parameters or ischemic ECG changes), and life expectancy under a year were excluded. Convenience sampling was used for recruitment.

The Bottom Line

Triage nurses may find it challenging to identify chest pain patients at high risk for poor outcomes as there are currently no developed triage guidelines for chest pain patients. This prospective cohort study of 60 adults found strong agreement between patient self-reported ED Assessment of Chest Pain Score (EDACS) and physician determination of EDACS. Self-reported EDACS could potentially be used as a chest pain triage tool to help triage staff attain similar diagnostic accuracy as emergency physician gestalt.

Eligible patients were administered a short self-reported questionnaire at triage. No clarification or help was rendered by study investigators to avoid interviewer bias. No time limit was given to complete the questionnaire. The treating physician was subsequently tasked to independently fill in an identical questionnaire that was blinded to the patient's responses, as part of the initial physician consultation (after initial ECGs had been performed, but before laboratory and radiological testing). Study investigators did not influence or intervene in clinical management. The final disposition decision remained at the discretion of the attending emergency physicians.

2.1 | Outcome Assessment

The questionnaire responses from patient and physician were analyzed using the scoring formula and cutoff (EDACS ≥16) proposed by Than et al in his original landmark study[5] to derive these scores. The secondary outcome of MACE within 30 days was assessed by two independent blinded emergency physicians who reviewed each patient's electronic medical records. Disagreements were resolved by consensus. MACE was defined as a composite of all-cause mortality, need for coronary revascularization, and acute myocardial infarction (MI) as defined by the Third Universal Definition of Myocardial Infarction.[6] The cardiac biomarker used was the high-sensitivity troponin-T assay.

For the purposes of this study, nursing gestalt was defined by triage-siting: patients triaged to the low-acuity ambulatory area were deemed low risk; triage to the high-acuity trolley area were constituted as high risk. Emergency physician gestalt was defined

Circle "yes" or "no"

My chest pain comes together with cold sweats.	Yes	No
My chest pain also goes to my shoulder, arm, neck, or jaw (either left or right).	Yes	No
My chest pain is worse when I breathe in.	Yes	No
My chest pain is worse when I press over that area of the chest.	Yes	No
My chest pain is worse whenever I try to exert myself.	Yes	No
I can no longer walk as far, or exert as much as previously, because of breathlessness or chest pain.	Yes	No

Do you have the following: (can circle >1)

Previous heart attack, heart ballooning, or bypass surgery	Yes	No
Immediate family member (parent or sibling) with early heart attack before he/she was 65 years old	Yes	No
Smoker, or ex-smoker stopped < 3 months ago	Yes	No
Diabetes	Yes	No
High blood pressure	Yes	No
High cholesterol	Yes	No

FIGURE 1 Modified ED Assessment of Chest Pain Score (EDACS) Questionnaire

by admitting diagnosis and disposition: Cardiology admission with a provisional diagnosis of ACS constituted high risk; whereas, discharge from ED (including after extended observation protocol) or admission to medical with non-cardiac diagnoses was deemed low risk.

The disposition/admitting diagnoses are likely to closely represent the emergency physician's unstructured clinical impression as no provocative/invasive cardiac stress tests are done in this ED. Department guidelines recommended that patients with symptoms concerning for ACS should be admitted to cardiology, patients with cardiovascular risk factors and atypical symptoms should be offered an extended 8-hour observation protocol (comprising 3 sets of serial troponins/ECGs), and patients with non-cardiac chest pain should be discharged. Most emergency physicians did not inherently use chest pain scores as department guidelines, did not mandate, or advocate the calculation of these then.

2.2 | Statistics

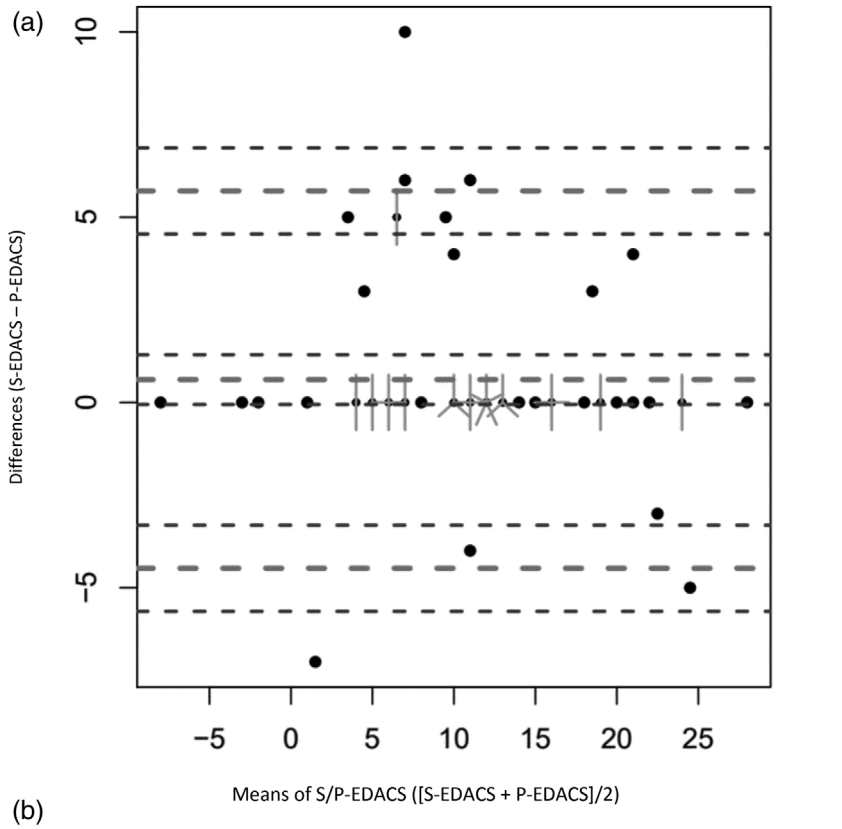
R software version 4.0.3 (2020-10-10) was used for statistical computing analysis. The Bland-Altman plot was generated using the BlandAltmanLeh package, and Cohen's Kappa statistical values were derived using the interrater-reliability package.

3 | RESULTS

Of 68 patients assessed for eligibility, only 60 were suitable for analyses. Two patients initially triaged as chest pain were eventually found to have left hypochondriac pain. Four patients withdrew consent, and 2 more were excluded for insufficient information (incomplete physician-rated forms). Although 3 patients declined extended observation in ED and discharged against medical advice, there was no loss to follow-up as all 3 attended the cardiology clinic follow-up.

MACE incidence rate within 30 days was 10.0% (Table 1), similar to that from a large cohort study from this same institution (11.3%)[7] and the 9%–17% quoted in most studies.[8] S-EDACS correlated well with P-EDACS with perfect agreement ($K = 1.00$) (Table 2): only 15/60 (25.0%) patients had discordant absolute S/P-EDACS, all of which were minor and did not affect risk stratification. Of the discordant patients, the majority (11/15, 73.3%) gave themselves higher S-EDACS as the mean of differences on the Bland-Altman plot was positive (Figure 2A). Patients with discordant S/P-EDACS were likely to be younger: the mean age of those with discordant scores was 53.9 years old; whereas, mean age for those with identical scores was 56.6 years old. (Table 1)

S-EDACS outperformed nursing gestalt in diagnostic accuracy. Triage nurses seemed to favor a highly conservative strategy, triaging 39/60 patients (65.0%) as high risk with resultant poorer accu-



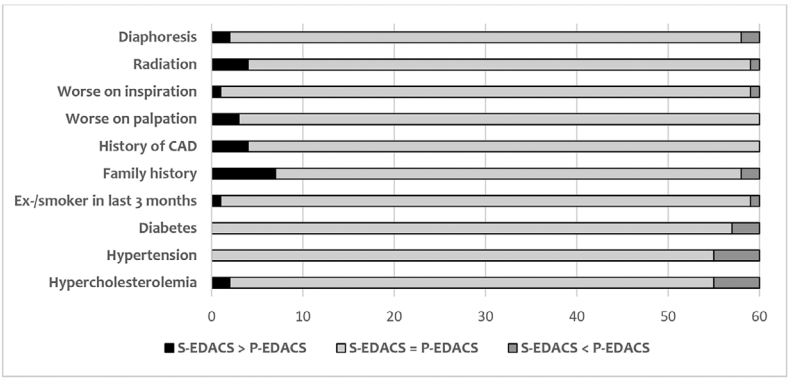


FIGURE 2 (A) Bland-Altman Plot of S-EDACS and P-EDACS. (B) Discordances between S/P-EDACS by components. CAD, coronary artery disease; P-EDACS, physician-reported ED Assessment of Chest Pain Score; S-EDACS, self-reported ED Assessment of Chest Pain Score

	Discordances in S/P-EDACS	S-EDACS > P-EDACS
Diaphoresis	4 (6.7%)	2/4 (50.0%)
Radiation	5 (8.3%)	4/5 (80.0%)
Worse on inspiration	2 (3.3%)	1/2 (50.0%)
Worse on palpation	3 (5.0%)	3/3 (100.0%)
Cardiovascular risk factors		
• History of coronary artery disease	4 (6.7%)	4/4 (100.0%)
• Family history of premature CAD	9 (15.0%)	7/9 (77.8%)
• Ex/smoker in last 3 months	2 (3.3%)	1/2 (50.0%)
• Diabetes	3 (5.0%)	0/3 (0.0%)
• Hypertension	5 (8.3%)	0/5 (0.0%)
• Hypercholesterolemia	7 (11.7%)	2/7 (28.6%)

TABLE 1 Patient demographics

	N	(%)	Discordant S/P-EDACS	Identical S/P-EDACS
N	60		15	45
Mean age (years ± SD)	55.9	(±13.5)	53.9 (±17.2)	56.6 (±12.2)
Sex				
• Male	36	(60.0)	9	27
• Female	24	(40.0)	6	18
Race				
• Chinese	37	(61.7)	7	30
• Malay	15	(25.0)	6	9
• Indian	8	(13.3)	2	6
Comorbidities				
• Ischemic heart disease	20	(33.3)	5	15
• Diabetes mellitus	16	(26.7)	3	13
• Hypertension	30	(50)	7	23
• Hypercholesterolemia	37	(61.7)	9	28
Disposition				
• Discharge directly from ED	11	(18.3)	3	8
• Discharge after observation in ED	22	(36.7)	5	17
• Discharge against medical advice	3	(5.0)	0	3
• Admission to Medical	7	(11.7)	4	14
• Admission to Cardiology	17	(28.3)	3	
Outcomes				
Major Adverse Cardiovascular Events	46	(10.0)	0	6
• Percutaneous coronary intervention	2	(6.7)	0	4
• Coronary artery bypass graft	1	(3.3)	0	2
• Acute myocardial infarction	0	(1.7)	0	1
• All-cause mortality		(0.0)	0	0

EDACS, ED Assessment of Chest Pain Score.

racy (41.7%). S-EDACS would have deemed significantly fewer patients (22/60, 36.7%) as high risk and attained the same diagnostic accuracy as emergency physician gestalt (78.3%) (Table 2).

"Radiation" was the most difficult concept for patients to comprehend, with 8.3% (5/60) patients discordant. Among the cardiovascular risk factors, the components that were most likely to differ were the family history (9/60, 15.0%) and hypercholesterolemia (7/60, 11.7%). There was least ambiguity for pain worse on inspiration, with nearly all patients (57/60; 95.0%) having identical scores (Figure 2B).

4 | DISCUSSION

This pilot study found that S-EDACS correlates strongly with traditional P-EDACS ($K = 1.00$) and could potentially prove useful as a triage tool for chest pain patients. Seventy-five percent of patients had identical absolute S/P-EDACS, and the rest had only minor discordances that did not alter risk stratification. Most of the discordant patients (11/15; 73.3%) had higher S-EDACS, suggesting that S-EDACS was more conservative and more likely to safely overcall MACE risk where S/P-EDACS did differ. Interestingly, because the EDACS algorithm takes into account cardiovascular risk factors only for patients < 50 years old, more components are assessed for younger age groups, and, thus, more discordances between S-EDACS/P-EDACS are seen in younger patients.

Some plausible explanations for why EDACS had more interobserver subjectivity than hypothesized can be put forth. Some patients had several episodes of chest pain—the first might be associated with diaphoresis, but subsequent episodes might not, making it difficult for patient and physician to concur. Some patients had concurrent longstanding shoulder pain, which would not qualify as radiation. Most of the discordances for "family history" arose because patients did not heed the caveat that it had to be premature cardiovascular disease. Notably, all of the discordances for "coronary artery disease" were because of self-reported false-positives. Some patients believed they had undergone revascularization when they had undergone coronary angiography without angioplasty, or other cardiac-related procedures such as valvular repair instead.

On the contrary, virtually all of the discordances for hypertension, diabetes, and dyslipidemia resulted from patients not recognizing they had these comorbidities—presumably because their comorbidities were well-controlled or only on dietary modification. These discor-

TABLE 2 Test characteristics of S/P-EDACS versus Nursing Gestalt/Emergency Physician Gestalt

	P-EDACS$^+$	P-EDACS$^-$	
S-EDACS$^+$	17	0	$K = 1.000$ ($P \leq 0.001$)
S-EDACS-	0	43	
	Emergency Physician Gestalt$^+$	**Emergency Physician Gestalt$^-$**	
S-EDACS$^+$	10	7	$K = 0.425$ ($P = 0.001$)
S-EDACS-	7	36	
P-EDACS$^+$	10	7	$K = 0.425$ ($P = 0.001$)
P-EDACS-	7	36	
Nursing Gestalt$^+$	14	25	$K = 0.174$ ($P = 0.076$)
Nursing Gestalt$^-$	3	18	
	MACE$^+$	**MACE$^-$**	
S-EDACS$^+$S-EDACS-	51	1242	Sensitivity: 83.3% Specificity: 77.8% Accuracy: 78.3%
P-EDACS$^+$P-EDACS-	51	1242	Sensitivity: 83.3% Specificity: 77.8% Accuracy: 78.3%
Nursing Gestalt$^+$Nursing Gestalt$^-$	51	3420	Sensitivity: 83.3% Specificity: 37.0% Accuracy: 41.7%
Emergency Physician Gestalt$^+$ Emergency Physician Gestalt$^-$	51	1242	Sensitivity: 83.3% Specificity: 77.8% Accuracy: 78.3%

P-EDACS, physician-reported ED Assessment of Chest Pain Score; S-EDACS, self-reported ED Assessment of Chest Pain Score; +, high-risk; -, low-risk.

dances would have less impact on EDACS because cardiovascular risk factors are not scored for patients < 50 years old.

The simplicity of S-EDACS could markedly affect how chest pain patients are triaged in the future. Patients could fill up their presenting complaints electronically en route or while awaiting triage, and triage nurses then can use the S-EDACS to promptly identify higher-risk patients who need expedient medical attention. Secondary triage also can be performed as follows: 1) among the lower-risk patients and 2) with those patients with relatively higher S-EDACS being assigned priority and assessed first. Self-reporting of symptoms also might empower patients and engage patients in the decision-making process, improving patient health literacy.

5 | LIMITATIONS

A limitation of this exploratory study is its relatively small sample size. Sample size calculation was not performed as this was a pilot study and the strength of correlation between S/P-EDACS was unknown. The sequential study design meant that patient screening, study enrollment, and self-reporting of EDACS had to be compressed into the short time window between triage when patients first declare their symptoms to physician consultation. This was compounded by highly conservative overtriaging—nearly two-thirds (65.0%) of patients were triaged as high acuity and received fast-tracked care. Although the actual time taken for patients to self-report EDACS was short (less than a minute for most patients), the lengthier-than-anticipated study enrollment process, coupled with the ethical need to avoid delaying physician consultation for research purposes, hampered recruitment of more patients.

Although attempts were made to keep the wording of the questionnaire as similar to the original EDACS study as possible, medical jargon likely beyond the comprehension of laypersons had to be altered. "Diaphoresis" was replaced with "cold sweat," "radiation" with "goes to," and "dyslipidemia" was substituted with the more commonly used "high cholesterol." Concepts like "family history of premature coronary artery disease" had to be carefully rephrased. It is not possible to gauge if the meanings were distorted in the process.

Linguistic considerations also led to the decision to exclude patients illiterate in English, because there are no validated iterations of EDACS in other languages and the accuracy of EDACS would be in doubt once translated. As Singapore uses English as its primary working language, patients who understand only mother tongues and dialects tend to belong to the older generation. This study would therefore likely have captured a younger subset of patients with lower cardiovascular risk.

Population health literacy is also affected by confounders, such as educational level and healthcare exposure, which were not sought for in the questionnaire to keep it as abbreviated as possible. As Singapore has a low prevalence of health literacy even among those who can read English (31.6%),[9] it is postulated that the correlation between S/P-EDACS would be even closer for predominantly English-speaking Western populations with higher health literacy.

Age, cultural aspects, and value systems might also affect self-reporting of symptoms. Suggestible patients with dementia may report specific symptoms only with prompting (recall bias); whereas, elderly patients may deny or downplay symptoms to avoid admission. Caution must be exercised when framing binary yes/no questions—for instance, patients are known to deny "chest pain" because of the vague nature of cardiac symptoms while complaining of chest discomfort,[10] emphasizing why self-reported questionnaires can supplement but never replace physician evaluation.

6 | CONCLUSION

S-EDACS had perfect agreement with P-EDACS ($K = 1$) in this study and outperformed unstructured nursing gestalt (78.3% accuracy vs 41.7%). Self-reported EDACS has the potential to be used as a triage tool to help nurses attain similar diagnostic accuracy as emergency physician gestalt and sharply reduce the burden from overtriage without compromising patient safety.

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CONFLICT OF INTEREST

The authors do not report any conflict of interests. No funding or sponsorships were received for this study.

AUTHOR CONTRIBUTIONS

MN and RP conceived the study concept and design. NM, ZL, and JT were involved in data collection. MN and ZL analyzed and interpreted the data, while MN, ZL, and RP were involved in the drafting and critical revision of the manuscript.

DATA AVAILABILITY STATEMENT

The data sets generated and/or analyzed during the current study are not publicly available owing to patient confidentiality issues but are available from the corresponding author on reasonable request.

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AUTHOR BIOGRAPHY

Mingwei Ng, MMed, NUS, is an Associate Consultant with the Department of Emergency Medicine, Singapore General Hospital who aspires to improve clinical care through evidence-based medicine.

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