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The Comparison of the Diagnostic Value Between the Modified Heart Score and The Emergency Severity Index Triage in Elderly Patients with Chest Pain

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Abstract

Background: Diagnostic triage using the Emergency Severity Index (ESI) in elderly patients with cardiac complaints is associated with significant triage errors.

Objective: This study aimed to compare the diagnostic value of the Modified HEART Score, the overall Clinical Classification, and the Emergency Severity Index in identifying clinical deterioration in patients presenting with chest pain.

Methods: This cross-sectional descriptive-analytical study was conducted in 2023 on 178 patients. Patients presenting with chest pain were triaged using two methods: the Modified HEART Score and the ESI. The outcomes of ward admission and length of stay were compared with the triage level using Fisher's exact test. The diagnostic accuracy and triage error for the Modified HEART Score and ESI were calculated based on admission outcomes to the Cardiac Care Unit (CCU) and low-risk outcomes, including admission to the internal cardiology ward or discharge from the emergency department. Data were analyzed using SPSS software version 21. A p-value of less than 0.05 was considered statistically significant.

Results: For the Modified HEART Score, the total triage error based on the ward admission outcome was 12.9%, comprising 1.7% under-triage and 11.2% over-triage. The total triage error for the Emergency Severity Index was 41%, comprising 3.4% under-triage and 37.6% over-triage. There was no significant difference in under-triage error between the two methods, regardless of ward admission (p=0.26). However, a significant difference was found in over-triage error between the two methods (p<0.001). The sensitivity and specificity of the Modified Cardiac Triage Score were 91.89% and 85.82%, respectively. At the same time, for the ESI triage, they were 83.78% and 43.91%, respectively.

Conclusion: The findings suggest that Cognitive-Analytic Therapy can be an effective therapeutic approach for enhancing psychological functioning and interpersonal skills among individuals with ASPD.

Keywords: Triage, Chest Pain, Cardiac Disease, Ischemic Heart Disease.

1. Background

Chest pain is one of the most common reasons for emergency department (ED) presentations, accounting for approximately 6-10% of all ED admissions (1). In Iran, cardiovascular diseases are also one of the

major leading causes of mortality (2). Age is the most significant risk factor for myocardial infarction (3). In elderly individuals over 65 years old, ischemic heart disease accounts for 81% of mortality. However, chest pain in older patients can also have non-cardiac origins or cardiac causes other than coronary artery disease (4).

Elderly patients are more likely than younger patients to experience a myocardial infarction in the absence of chest pain or to present to the hospital ED with atypical clinical manifestations of chest pain. The absence of typical symptoms of ischemic heart disease can lead to delays in treatment and increased complications and mortality in the elderly (4).

When a patient presents to the ED with chest pain symptoms, triage nurses typically treat them as high-risk and assign them a triage level 2. This results in many patients with non-cardiac-related chest pain complaints also being assigned to level 2, leading to significant over-triage (5). Studies conducted in Iranian hospitals on ESI triage error in patients with chest pain complaints have reported over-triage rates ranging from 23.7% to 88% (6-10). Therefore, it can be concluded that ESI triage faces serious limitations. Consequently, using a rapid assessment tool with high efficacy, high sensitivity, and high specificity could be very useful and practical for diagnosing patients with chest pain and dyspnea (7).

To minimize this problem, numerous tools have been developed in recent years to stratify risk and identify acute coronary syndrome. One such tool is the HEART score. This tool is applicable for patients presenting to the ED with chest pain complaints (1). The HEART score is a simple scoring system that determines the risk of ischemic events in patients with chest pain presenting to the ED (11, 12). The HEART score consists of patient History, Electrocardiogram, Age, Risk factors, and Troponin level. Patients with a score of zero have the lowest risk, while patients with higher scores have the highest risk (10).

The Killip classification is a simple, independent, and robust clinical tool for all-cause mortality, previously studied in patients with myocardial infarction and acute coronary syndrome. In-hospital mortality rates are 6% for class I, 17% for class II, 38% for class III, and 81% for class IV (13). Given its high accuracy, this classification can serve as an indicator of patient deterioration in elderly patients with cardiac complaints, rather than troponin. It is because a significant proportion of elderly patients have heart failure, and troponin is not readily available during triage. Even when available, performing a troponin test is time-consuming, which poses a problem for the aforementioned triage results. In other studies, a modified HEART score has been used by substituting another variable for troponin (9).

Therefore, this study aimed to determine the diagnostic value of the modified HEART score and ESI triage in reducing triage errors among elderly patients presenting with chest pain.

2. Objective

This study aimed to compare the diagnostic value of the Modified HEART Score, the overall Clinical Classification, and the Emergency Severity Index in identifying clinical deterioration in patients presenting with chest pain.

3. Methods

The present study is a descriptive, analytical, cross-sectional study. The study sample consisted of 178 elderly patients presenting with chest pain or a sensation of chest discomfort and pressure who visited the emergency departments of Rezavi Hospital, Mashhad, Iran, and Allameh Behlool Gonabadi Hospital, Gonabad, Iran. Sampling was conducted via convenience sampling, with quota allocation from

patients presenting to emergency departments with chest pain who met the inclusion criteria.

For data collection, a demographic/ therapeutic information form, the modified HEART score instrument, and the ESI triage form were used.

3.1. Modified HEART Score Instrument:

The HEART score form is an instrument consisting of five items, each scored from 0 to 2. The items in this instrument are: Patient History, Electrocardiogram, Patient Age, Risk Factors, and Troponin levels. Based on this scale, patient history includes: chest pain pattern; time of onset and duration of pain; relation of pain to exercise, stress, or cold; location and radiation of pain; associated symptoms; and response to sublingual nitrates. Accordingly, if a patient describes highly specific features in their history, they are classified as highly suspicious and receive a score of 2. If a patient describes both non-specific and specific features, they are classified as moderately suspicious and receive a score of 1. If a patient describes completely non-specific symptoms, they receive a score of zero (14, 15).

The patient's electrocardiogram (ECG) is scored as follows: specific ST-segment depression receives a score of 2, non-specific ECG changes receive a score of 1, and an ECG without changes receives a score of zero.

Patient age is scored as follows: age ≥65 years receives a score of 2, age 45-65 years receives a score of 1, and age ≤45 years receives a score of 0.

Risk factors include patients with treated diabetes mellitus, smoking, diagnosed or treated hypertension, high cholesterol, family history of coronary artery disease, and obesity (BMI>30). Having three or more risk factors receives a score of 2; having one or two risk factors, a score of 1; and having no risk factors, a score of 0.

In the modified HEART score, the Killip class replaces troponin and is scored as follows: Killip class III/IV receives a score of 2, class II receives a score of 1, and class I receives a score of zero. Patients in Killip class I have no signs of heart failure. In Killip class II, patients have mild heart failure with crackles in less than one-third of the lung bases and blood pressure above 90 mmHg. Killip class III indicates pulmonary edema with crackles in more than one-third of the lung bases and blood pressure below 90 mmHg. Killip class IV is defined by systolic blood pressure below 90 mmHg, the presence of crackles, and being in cardiogenic shock.

Based on this scale, patients with a total score of 0-3 are classified as low-risk (triage level 4), patients with a score of 4-6 as medium-risk (triage level 3), and patients with a score of 7-10 as high-risk, further categorized as level 1 if blood pressure is <90 mmHg or level 2 if blood pressure is ≥90 mmHg (13-15).

The validity of the HEART score has been examined in several studies. A study by Backus et al. showed that patient outcomes can be accurately predicted by the HEART score (12). Furthermore, in a study by Leite et al., using the HEART score classified most patients with chest pain complaints into the low-risk group (56%). The rate of major cardiac outcomes at 6 weeks was 2% in the low-risk group, 15.6% in the medium-risk group, and 76.9% in the high-risk group (P<0.001). Therefore, the HEART score correctly predicts major and advanced cardiac events at 6 weeks in patients with chest pain (c-statistic 0.880; P<0.001) (1). Panteghi ni et al., in a study assessing the reliability of the HEART score, reported an overall kappa coefficient of 0.63, which was good, and this coefficient was similar between senior physicians (0.65) and other physicians (0.60). There was also good agreement in the low-risk (0.72) and high-risk (0.70) categories, whereas it was lower

in the medium-risk group (0.51) (16). Additionally, for test-retest reliability in this study, percentage agreement and kappa coefficient were calculated between two triage nurses for 10 patients presenting to the emergency department with chest pain complaints. The kappa coefficient for calculating this scale was 0.9.

To assess the validity of the modified HEART score in this study, the items were presented to an expert panel, and content validity was quantified (17). This instrument was presented to 7 members of the expert panel, consisting of emergency medicine faculty members (2), emergency nursing faculty members (3), and cardiology faculty members (2), and the content validity index was calculated based on the modified kappa score. The content validity coefficient based on the mean was 0.85.

3.2.ESI Triage Form:

This system is a five-level hospital triage method that separates patients who need immediate care from those who can wait for services. In this system, patients are categorized into five priority levels from immediate to delayed based on the severity of their condition and illness (18).

According to various studies on different groups over the years, the validity and reliability of ESI triage in hospital emergency departments have been proven (19). In the study by Mirhaghi et al., the reliability kappa coefficient for ESI triage was 0.812 (20).

3.3. Data Collection Procedure:

After approval of the proposal by the Ethics Committee of Gonabad University of Medical Sciences (code: IR.GMU.REC.1402.075) and the issuance of permits and referral letters for Rezavi Hospital in Mashhad and Allameh Behlool Gonabadi Hospital in Gonabad, data collection was conducted. Patients were directed to the triage room upon arrival in the emergency department, and sampling began with a question about the patient's chief complaint. If the patient met the inclusion criteria, they were enrolled in the study.

Data collection was performed by a single trained triage nurse with over 5 years of experience in the emergency department to ensure consistent application of the Modified HEART Score and Killip classification. This trained triage nurse obtained an electrocardiogram and assigned the appropriate triage level. Prioritization was based on the nurse's knowledge and experience regarding high-risk patients and the required equipment. Patient demographic information was recorded on the triage sheet and also on the demographic information form.

To mitigate potential bias, the triage nurse assigning the Modified HEART Score and the ESI level was blinded to the patient's final disposition (admission, discharge, or length of stay). The outcome data (admission to CCU/ward, length of stay) were collected separately by a different member of the research team who was not involved in the initial triage process.

Simultaneously, the researcher scored each research unit based on the modified HEART score instrument, and the appropriate triage level was assigned. In this group, the patient's vital signs were checked; while taking vital signs, the patient's history was obtained and recorded on the data collection form. Then, lung sounds were auscultated to assess for pulmonary rales, and the Killip class score and the modified HEART score were calculated and recorded.

After 6 hours, outcomes, including discharge, admission to the cardiac ward, admission to the cardiac intensive care unit (CCU), and total length of stay, were extracted. Patients were followed up in the emergency department for up to 6 hours to

determine disposition, and their final status was recorded.

3.4. Data Analysis:

Data from this study were analyzed using SPSS software version 21. First, the normality of the variable distributions was examined using the Shapiro-Wilk test. Descriptive statistics indices, including mean, standard deviation, and percentages, were used to describe the research units' information. Qualitative variables were tested using the Chi-square test, exact Chi-square test (for tables larger than 2x2 and low expected frequency), and Fisher's exact test (for 2x2 tables and low expected frequency) for both methods. Sensitivity, specificity, and positive and negative predictive values were examined. In all tests, a significance level of 5% or less was considered.

4. Results

In this study, 178 samples were analyzed, each assessed and classified by both the modified HEART score triage method and the ESI triage method. The mean age of the study units was 65 ± 4.65 years. The minimum age of the study samples was 60 years, and the maximum was 84 years.

Also, in this study, 78 women (43.8%) and 100 men (56.2%) were examined. Sixty-eight individuals (38.2%) had a final cardiac diagnosis. In the study group, 37 individuals (20.8%) were admitted to the intensive care unit (CCU), 61 individuals (34.2%) were admitted to the cardiology or pulmonary wards, and 80 individuals (44.9%) were discharged from the emergency department. Among these, 116 patients (65.2%) reported a history of previous hospitalization.

In the modified HEART method, 6.2% of patients were assigned to level 1, 24.2% to level 2, 53.4% to level 3, and 16.3% to level 4. In the ESI triage method, 18.6% of patients were assigned to level 1, 75.9% to level 2, 2.8% to level 3, and 2.8% to level 4.

The frequency of the discharge outcome across the levels of both the modified HEART and ESI triage methods was significant ($\chi^2 = 15.113$, df = 2, $p < 0.001$). Furthermore, the outcome of admission to the internal medicine ward across the levels of both the modified HEART and ESI triage methods showed significant findings ($\chi^2 = 10.006$, df = 4, $p = 0.040$). In examining the frequency of admission to the cardiac intensive care unit (CCU) across the levels of both the modified HEART and ESI triage methods, the findings were significant ($\chi^2 = 17.443$, df = 4, $p = 0.020$).

Overall, in the modified HEART method, 54.3% were assigned to level 3, whereas in the ESI triage method, 51.7% were assigned to level 2. The Chi-square test showed that the frequency of the admission outcome across the levels of both the modified HEART and ESI triage methods was significant ($\chi^2 = 146.322$, df = 9, $p < 0.001$). Ultimately, it can be concluded that, overall, the triage levels in the two groups are independent of each other.

Based on the ward admission outcome, the overall triage error in the modified HEART method was calculated to be 12.9% (n=23), of which 1.7% (n=3) was under-triage, and 11.2% (n=20) was over-triage. Also, the overall triage error in the ESI triage method was 41% (n=73), of which 3.4% (n=6) was under-triage, and 37.6% (n=67) was over-triage.

Comparative analysis of triage error at the ward admission outcome level showed that the two methods, ESI triage and modified HEART, differed significantly in both under-triage ($p = 0.004$) and over-triage ($p < 0.001$).

Based on the length-of-stay outcome, the overall triage error in the modified HEART method was 29.7% (n=51), all of which were under-triage, with no over-triage. Also, the overall triage error in the ESI triage method was 28.5%, of which

16.3% (n=28) was under-triage, and 12.2% (n=21) was over-triage. Comparative analysis of triage error at the level of length of stay outcome showed that the two methods, ESI triage and modified HEART, differed significantly in both under-triage ($p < 0.001$) and over-triage ($p < 0.001$).

Based on the ward admission outcome, the sensitivity and specificity of the modified HEART method for identifying critically ill patients requiring admission to the cardiac intensive care unit (CCU) versus other patients not requiring CCU admission were 91.89% and 85.82%, respectively. Also, the method's accuracy was 87.08%. On the other hand, for the ESI triage instrument, the sensitivity and specificity were 83.78% and 52.48%, respectively. Also, the accuracy of this method was 58.99% (Table 1).

Regarding the length-of-stay outcome, the sensitivity and specificity of the modified HEART method for identifying patients with a hospital stay of 24 hours or more versus those with a stay of less than 24 hours were 100% and 58.87%, respectively. Also, the method's accuracy was 70.35%. On the other hand, the sensitivity and specificity of the ESI triage method for identifying patients with a hospital stay of more than 24 hours versus those with a hospital stay of less than 24 hours were 77.17% and 65%, respectively. Also, the accuracy of this method was 71.51% (Table 2).

Table 1: The diagnostic value according to the hospitalization outcome in the modified heart triage score and the emergency severity index score

Variable	Modified HEART Score	Emergency Severity Index
Sensitivity	91.89 (78.09 – 98.30)	83.78 (67.99 – 93.81)
Specificity	85.82 (78.95 – 91.12)	52.48 (43.91 – 60.95)
Positive Predictive Value	6.48 (4.27 – 9.83)	31.63 (27.00 – 36.66)
Negative Predictive Value	0.09 (0.03 – 0.28)	92.50 (85.36 – 96.31)
Positive Odds Ratio	6.48 (4.27 – 9.83)	1.76 (1.41 – 2.21)
Negative Odds Ratio	0.09 (0.03 – 0.28)	0.31 (0.15 – 0.65)
Accuracy	87.08 (81.24 – 91.63)	58.99 (51.38 – 66.29)

Table 2: The diagnostic value according to the hospital's length of stay in the modified heart triage score and the emergency severity index score

Variable	Emergency Severity Index	Emergency Severity Index
Sensitivity	100 (92.60 – 100.00)	77.17 (67.25 – 85.28)
Specificity	58.87 (49.68 – 67.63)	65 (53.52 – 75.33)
Positive Predictive Value	48.48 (43.26 – 53.74)	71.72 (64.84 – 77.71)
Negative Predictive Value	100 (95.07 – 100.00)	71.23 (62.20 – 78.84)
Positive Odds Ratio	2.43 (1.97 – 3.00)	2.20 (1.60 – 3.03)
Negative Odds Ratio	0	0.35 (0.23 – 0.53)
Accuracy	70.35 (62.92 – 77.06)	71.51 (64.14 – 78.12)

5. Discussion

This study aimed to compare the diagnostic accuracy of the Modified HEART Score and the Emergency Severity Index (ESI) in triaging elderly patients presenting to emergency departments with chest pain.

In evaluating the diagnostic value of the Modified HEART Score for triaging elderly patients with chest pain based on hospital admission outcome and length of stay, our findings indicated that this method possesses relatively high sensitivity, specificity, and accuracy. In line with this, Gharaee et al. reported that the HEART score index demonstrates high sensitivity and specificity (21), consistent with our findings. On the other hand, Agul Gur et al.

suggest that incorporating a visual analog scale could further improve the score's performance. They also maintain that troponin is the most stable indicator of myocardial ischemia and is a fundamental component of the emergency workup for patients with chest pain, included in all major risk classification tools (22). Sajed et al. state that using the HEART score is highly effective for identifying patients with acute coronary syndrome, with high sensitivity and specificity. However, these metrics can be further enhanced by employing high-sensitivity troponin kits (23).

In contrast, Tolsma et al. argue that access to troponin testing is not feasible in all emergency settings (24). Furthermore, elevated troponin levels (>1 µg/L) are observed in only a subset of heart failure patients (6.2%), while a significant proportion present with dyspnea (87%), pulmonary edema (88%), and crackles (72%) (25).

Regarding the diagnostic evaluation of ESI triage for elderly patients with chest pain, our results showed that based on admission outcome, ESI had high sensitivity and moderate specificity. Based on the length of stay, ESI demonstrated moderate-to-high sensitivity and specificity. Gharaii et al. note that ESI triage has high sensitivity but low specificity and, despite its widespread use, performs poorly in classifying patients with chest pain (21). Other studies on the diagnostic value of ESI in the elderly have reported an Area Under the Curve (AUC) of 0.77 and a sensitivity of 73.3% for hospital admission (26, 27), findings that align with ours.

Conversely, Golzari et al. concluded in their study that ESI triage effectively predicts and classifies patients (28). Also, Fazel Asgharpour et al. believe that using a specific HEART tool is more efficacious than ESI (9). These discrepancies may stem from the generalist nature of ESI or the fact that patient disposition within the first six hours can impact triage nurse judgment, potentially leading to ED overcrowding.

In comparing the diagnostic accuracy of the Modified HEART Score and ESI for triaging elderly patients with chest pain based on admission outcome and length of stay, our findings revealed that the Modified HEART Score performed better than ESI, with higher sensitivity, specificity, and accuracy. Correspondingly, Pouya Mehr et al. reported that a heart failure-specific triage system has fewer shortcomings compared to ESI for triaging heart failure patients (6). Gharaii et al. also contend that the HEART diagnostic score triage performs more robustly than ESI triage, although the time required for troponin testing can be a limiting factor and contribute to ED congestion; nonetheless, its use can be highly beneficial (21).

Considering the aforementioned diagnostic limitations of troponin, the Killip class may possess greater predictive power for mortality than troponin alone. In this study, patients with Killip class 3 or 4 received a score of 2 on the Modified HEART Score. More extensive studies might be needed to determine the appropriate weighting of this subscale within the HEART score or to identify which subscales it should replace. Other subscales, such as risk factors or patient history, may have stronger predictive power.

The ESI triage error rate was 32.2% in the study by Sax et al. (29). In the current study, the triage error rate was higher, likely because we included only patients with the critical complaints of chest pain and dyspnea. Conversely, the Modified HEART Score, utilizing structured history, ECG, and lung physical examination, was associated with a lower triage error rate (12.9%).

The Modified HEART Score yielded results comparable to those of other triage scales that use acuity tools. The diagnostic evaluation of four triage scales (ESI, Manchester Triage Scale, Australian Triage Scale, and Canadian Triage Acuity Scale)

showed their sensitivity ranged from 91% to 93%, and specificity from 34% to 41% (30), which is similar to our findings. It indicates that in the absence of diagnostic aids, nurses using triage scales for patients with chest pain operate with high sensitivity and low specificity to minimize mistriage as much as possible. However, the overall accuracy of these scales has been reported to range from 64% to 69% (30). It is noteworthy that using diagnostic aids, which typically increase specificity and reduce undertriage, may slightly increase overtriage, as nurses might over-rely on these tools and overlook other risk factors.

Nevertheless, employing diagnostic aids can significantly enhance triage scale accuracy. Hence, further studies are needed to define diagnostic criteria in triage. Another factor contributing to ESI overtriage and lower sensitivity is non-specific patient complaints, which can increase error by up to 25% (31). However, because this study included only patients with chest pain and dyspnea, the triage error did not exceed 16.22%.

The HEART score's accuracy in predicting patient acuity has been confirmed in numerous studies (1, 12, 32). If a patient receives a low HEART score, the likelihood of a post-discharge cardiac event is less than 0.2%. Therefore, the score's accuracy in predicting acuity for low-risk individuals is remarkable. This capability reduces undertriage rates for high-acuity patients. In this study, the undertriage rate was 14.18%, which is lower than rates reported in other similar studies (7).

Undertriage in cardiac patients has been reported as high as 88%, as mentioned, due to nurses' tendency to err on the side of caution, given the low specificity of myocardial ischemia symptoms. However, the undertriage rate for the Modified HEART Score was higher than that for scales developed explicitly for heart failure patients. Undertriage rates in studies by Pouya Mehr et al. (1.4%) and Talebpour et al. (10%) were higher (6, 8). It could be because the heart failure triage scale used by Pouya Mehr et al. was explicitly developed for heart failure patients, and possibly lower patient volume and more experienced triage nurses in that study also contributed to reduced undertriage.

Heart failure patients have other characteristics that are not captured by the HEART score. For instance, end-tidal CO_2 in heart failure patients can predict up to 40.8% of acuity changes, and ejection fraction can predict 67.5% (33). The Heart Failure Triage Scale includes vital signs and other heart failure-specific risk factors, such as ejection fraction, thereby increasing its diagnostic accuracy compared to other scales. Additionally, ECGs in heart failure patients often show ischemic sequelae from prior cardiovascular events. They are not sensitive to new ischemic changes (34).

In the study by Talebpour et al., using end-tidal CO_2 measurement also reduced triage error compared to the ESI (31%) (8). Adding disease-specific physiological criteria can significantly improve triage accuracy and reduce error. This study used hospital admission as the gold standard. While admission often reflects patient acuity, hospital policies can also play a role and may introduce bias. Patients might be admitted for reasons other than acuity; for example, some hospitals have protocols to admit stable patients to the Cardiac Care Unit for elective diagnostic angiography, increasing the undertriage rate. Full capacity of the Cardiac Care Unit is another reason why critically ill patients might be admitted to general internal wards, again increasing the undertriage rate. Sometimes, full CPR room capacity leads to transferring critically ill patients to other ED areas, increasing the overtriage rate. Thus, local protocols can affect diagnostic accuracy results, reduce the precision of triage scales, and should be considered a study

limitation. However, overall, this gold standard is reliable and has been used in numerous studies. Increasing the sample size can partly compensate for this flaw and is recommended for future studies.

Length of stay was also selected as a standard indicator in this study. However, neither scale achieved adequate sensitivity or specificity. Only the cardiac diagnostic score triage achieved 100% specificity, indicating that patients who received a low HEART score (classes 3 and 4) had shorter hospital stays. The HEART score's high accuracy in identifying low-risk patients has been confirmed in other studies (35). In this study, all patients in HEART score classes 3 and 4 were discharged within 24 hours. The HEART score's comprehensive assessment of age, history, and risk factors enables it to identify low-risk patients with high precision. The average length of stay in this study was short, due to local hospital policies on admitting non-urgent cases, which may have biased the indicator's sensitivity and specificity. Nevertheless, there was a significant difference in length of stay between admitted patients and those discharged from the ED.

The use of hospital admission and length of stay as the reference standard, rather than hard clinical outcomes like 30-day Major Adverse Cardiac Events (MACE), is a significant limitation. Admission decisions can be influenced by the triage score itself, hospital capacity, and physician preferences, which may not always reflect the patient's true underlying acuity. Therefore, our estimates of diagnostic accuracy may be overestimated. Future research should prioritize prospective designs with blinded outcome assessment and follow-up for MACE to provide a more definitive evaluation.

On the other hand, the use of convenience sampling limits the generalizability of our findings. Patients were enrolled based on availability and the presence of the research team, which may have introduced a selection bias. We were unable to systematically compare the characteristics of included and excluded patients, which is a further limitation.

6. Conclusion

The Modified HEART Score, utilizing Killip classification, ECG, and structured history, demonstrated greater accuracy than ESI triage in determining the acuity of heart failure patients presenting with chest pain and dyspnea. Incorporating the Killip class helped compensate for the score's initial lack of integration of vital signs. However, the Modified HEART Score has lower accuracy than scales that use diagnostic aids such as troponin, capnometry, or peak flowmetry. Therefore, the Modified HEART Score's independence from troponin testing could make it a more widely applicable and accurate tool than ESI for triaging heart failure patients. However, integrating clinical signs, such as oxygen saturation, remains essential. Further studies are necessary to improve triage scales for this specific patient subgroup.

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