Critical Review Form
Diagnostic Test

Carvalho PEP, Belzer W, Pollmann DL, et al. AI-Enhanced Electrocardiogram for Detection of Occlusive Myocardial Infarction in High-Risk Non-ST-Segment Elevation Acute Coronary Syndrome. JACC Adv. 2026 Apr;5(4):102663.

Objectives: **"to evaluate an AI-enhanced ECG model for detecting OMI on the initial ECG among patients with suspected high-risk NSTE-ACS [non–ST-segment elevation acute coronary syndrome] using ICA [invasive coronary angiography] as the reference standard." (p. 2)**

Methods: **This retrospective observational study was conducted at the Allina Health Minneapolis Heart Institute (Abbott Northwestern Hospital) between 2022 and 2024. Consecutive adult patients with suspected NSTE-ACS who were referred for emergent ICA under a high-risk "level 2" Heart Attack Protocol were eligible for inclusion. The level 2 protocol is activated for patients with ongoing ischemic symptoms plus at least one high-risk feature (ischemic ECG changes, troponin elevation, unstable arrhythmia, hemodynamic instability, or recent stress-test ischemia). Patients with STEMI (managed under a separate level 1 protocol), those requiring emergent pericardiocentesis, and those needing transvenous pacing for significant bradyarrhythmia were excluded.**

Occlusive myocardial infarction (OMI) was defined angiographically as a culprit lesion with TIMI 0–2 flow, or TIMI 3/unknown flow with markedly elevated peak cardiac troponin before revascularization, or a presumed new regional wall motion abnormality when troponin thresholds were not met or unavailable.

The first 12-lead ECG was analyzed using an investigational AI-enhanced system (PMcardio, API v2.5; Powerful Medical). The Queen of Hearts ischemia module generates two outputs: "STEMI/STEMI equivalent detected" (aOMI v1) and "Signs of Reperfused STEMI detected" (mACS v1), aimed at identifying active coronary occlusion and high-risk NSTEMI or transient STEMI patterns. For this study, an AI-ECG was considered positive for OMI if either aOMI or mACS produced a score > 0.5. All ECGs were independently interpreted by two trained physicians, blinded to the AI output but aware of ICA findings; disagreements were resolved by a third physician. The primary outcome was the diagnostic accuracy of the AI-ECG to classify patients as having OMI or no OMI on the initial ECG, using ICA as the reference standard.

Between 2022 and 2024, 378 level 2 activations occurred; 224 patients (59%) underwent emergent catheterization and formed the study cohort. Of these, 129 (58%) had OMI on ICA and 95 (42%) did not. Among OMI cases, the culprit vessel was most commonly the left anterior descending (38.8%), followed by the left circumflex (34.1%),

right coronary (21.7%), and left main (5.4%). TIMI flow grades in OMI patients were 0 (37%), 1 (16%), 2 (37%), and 3 (10%); most with TIMI 3 met troponin or wall-motion criteria for OMI. Chest pain was present in 75% of patients; 24% presented within 3 hours of symptom onset and 34% after >12 hours.

Critical Review Form: Diagnostic Test

Guide	Comments
Are the results valid?	
Did clinicians face diagnostic uncertainty?	Somewhat. Only patients with ongoing ischemic symptoms plus at least one high-risk feature were eligible for inclusion. This population would be at higher risk of OMI than a cohort of patients presenting to the ED with chest pain (spectrum bias).
Was there a blind comparison with an independent gold standard applied similarly to all patients? (Confirmation Bias)	Mostly yes. All patients included in the study underwent ICA, which was used as the gold standard. The authors applied specific criteria for ICA findings (paired with troponins and ECHO findings) to determine whether OMI was present or not. It is unclear if AI-interpretation occurred prior to ICA and whether cardiologists performing ICA were blinded to this interpretation.
Did the results of the test being evaluated influence the decision to perform the gold standard? (Ascertainment Bias)	No. Patients were only eligible for inclusion after the decision to perform emergent ICA was made based on the high-risk "level 2" Heart Attack Protocol. AI-interpretation of ECGs was not performed until this decision had been made.
What are the results?	

What likelihood ratios were associated with the range of possible test results?	• The AI-ECG model correctly identified 58% of OMI cases and 78% of non-OMI cases on the initial ECG, classifying 43% of patients overall as OMI.
	• For active OMI detection, the AI-ECG had an AUC of 0.72 (95% CI 0.66–0.79), while the reperfused OMI algorithm had an AUC of 0.60 (95% CI 0.52–0.68).
	• On the initial ECG, the AI-ECG showed specificity 78%, PPV 78%, sensitivity 58%, NPV 57%, and overall accuracy 66%.
	  o The LR+ was 2.6 and LR- was 0.54.
	• Compared with the standard-of-care level 2 protocol, the AI-enhanced triage pathway reduced false-positive rates from 42% to 22% (P < 0.001), although 54 false negatives remained, nearly all of whom underwent revascularization.
	• In multivariable logistic analysis, AI-ECG output was independently associated with OMI (OR 5.18; 95% CI 2.58–10.84), and covariate-adjusted AUC improved to 0.78 (95% CI 0.71–0.85).
	• Incorporating serial ECGs increased sensitivity from 58% to 66%, with specificity 71%, overall accuracy 68%, PPV 76%, NPV 60%, and a reduced false-negative rate (42% to 34%).
	  o LR+ 0.23, LR- 0.48
	• Performance did not differ significantly by time from admission to angiography (≤ 12 vs > 12 hours) in terms of sensitivity, specificity, or accuracy.
	• Sensitivity analyses using alternative OMI definitions or excluding paced rhythm and bundle branch blocks yielded diagnostic accuracy similar to the primary analysis.

How can I apply the results to patient care?	
Will the reproducibility of the test result and its interpretation be satisfactory in my clinical setting?	Uncertain. This was a single study conducted at one site using a specific, proprietary AI-model on a very particular patient population. It is unclear how this model would perform at other institutions or in populations with different inclusion criteria. Artificial intelligence in general is known for its ability to learn and improve performance, and it is possible that over time this technology's performance would continue to improve and be more useful.
Are the results applicable to the patients in my practice?	No. We do not currently have a protocol similar to the Heart Attack Protocol involved in this study. Were we to implement such a protocol we would likely identify a patient population similar to that included in this study, as this was conducted at a large hospital in a large, midwestern US city (external validity).
Will the results change my management strategy?	No. In this study, AI did not perform very well in terms of ruling in or ruling out OMI, with a positive likelihood ratio of 2.6 and negative likelihood ratio of 0.54, neither of which significantly change disease probability.
Will patients be better off as a result of the test?	No. As noted above, the diagnostic accuracy of AI interpretation of ECGs was not very impressive. The authors note that the AI-enhanced pathway would reduce false-positive rates from 42% to 22%, but do not comment on the impact on false-negative rates.

Limitations:

1. **This was a retrospective, observational study subject to several potential sources of bias (confounding, recall bias).**

2. **Only patients with ongoing ischemic symptoms plus at least one high-risk feature were eligible for inclusion. This population would be at higher risk of OMI than a cohort of patients presenting to the ED with chest pain (spectrum bias).**

3. **This was a single study conducted at one site using a specific, proprietary AI-model on a very particular patient population. It would be difficult to generalize these results to other institutions (external validity).**

4. **The authors note that the AI-enhanced pathway would reduce false-positive rates from 42% to 22%, but do not comment on the impact on false-negative rates.**

Bottom Line:

This single center, retrospective observational study found that in patients without STEMI but with ongoing ischemic symptoms plus at least one high-risk feature, AI-enhanced ECG interpretation demonstrated poor diagnostic accuracy (LR+ was 2.6 and LR- was 0.54) and hence would not significantly change disease probability.