Diagnostic Accuracy of the Initial Point-of-Care Troponin Tests for Patients With Chest Pain Who Were Suspected of Acute Myocardial Infarction

— A Systematic Review and Meta-Analysis —

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Background: Point-of-care (POC) cardiac troponin testing, although less sensitive than high-sensitivity cardiac troponin assays, allows for rapid bedside evaluation. This study assessed the diagnostic performance of POC troponin tests for both ruling in and ruling out acute myocardial infarction (AMI) at the time of patient presentation.

Methods and Results: In accordance with PRISMA-DTA guidelines, we conducted a systematic review and meta-analysis using PubMed, Web of Science, and the Cochrane Library from inception through June 17, 2023. We included all studies evaluating the diagnostic accuracy of POC troponin assays for identifying AMI among adult patients. Among the 551 studies initially screened, 6 met the eligibility criteria for inclusion. A meta-analysis of diagnostic accuracy based on these 6 observational datasets demonstrated pooled sensitivity and specificity values of 47% (95% confidence interval (CI) 45–49%) and 90% (95% CI 89–90%), respectively, for AMI detection. In a subgroup meta-analysis of non-ST-segment elevation MI using 4 observational datasets, the pooled sensitivity and specificity were 48% (95% CI 45–50%) and 89% (95% CI 89–90%), respectively.

Conclusions: These findings emphasize that the clinical application of POC troponin assays in AMI diagnosis must consider the test's robust specificity (≈90%) alongside its limited sensitivity (<50%).
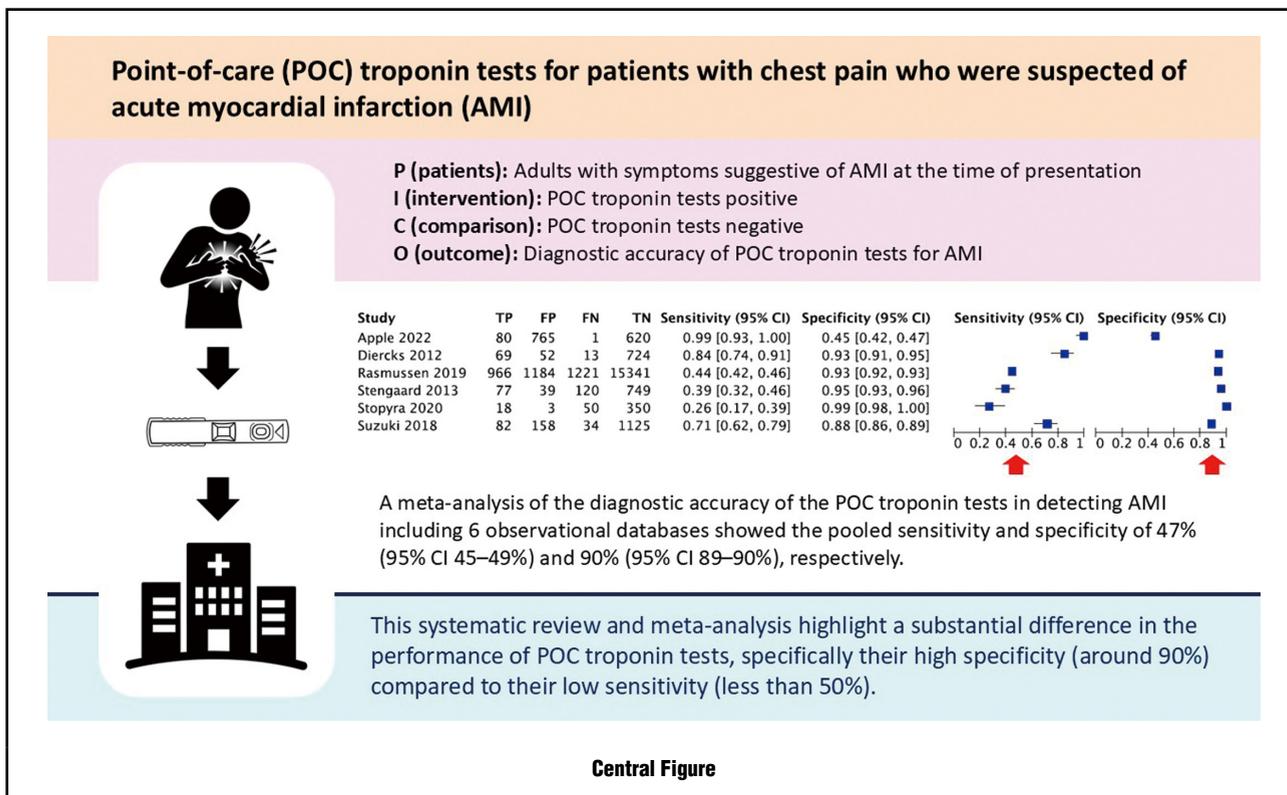
Key Words: Acute myocardial infarction; Cardiac troponin; Point-of-care; Pooled sensitivity; Pooled specificity

Cardiac troponin is a well-established biochemical marker used for diagnosing acute myocardial infarction (AMI) and various other cardiac diseases.[1–4] The clinical application of troponin, particularly high-sensitivity cardiac troponin (hs-cTn), has been extensively evaluated, with emphasis on optimal timing for measurement. The 0-hour/1-hour (0/1-h) algorithm, endorsed by the European Society of Cardiology (ESC), is a widely adopted approach for managing patients with chest pain without persistent ST-segment elevation.[5,6] This strategy integrates initial emergency department (ED) hs-cTn values with 1-h changes to triage patients.[5] Its high sensitivity enables early exclusion of non-ST-segment elevation myocardial infarction (NSTEMI) and facilitates timely dis-

Point-of-care (POC) troponin tests for patients with chest pain who were suspected of acute myocardial infarction (AMI)

P (patients): Adults with symptoms suggestive of AMI at the time of presentation
I (intervention): POC troponin tests positive
C (comparison): POC troponin tests negative
O (outcome): Diagnostic accuracy of POC troponin tests for AMI

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Apple 2022	80	765	1	620	0.99 [0.93, 1.00]	0.45 [0.42, 0.47]
Diercks 2012	69	52	13	724	0.84 [0.74, 0.91]	0.93 [0.91, 0.95]
Rasmussen 2019	966	1184	1221	15341	0.44 [0.42, 0.46]	0.93 [0.92, 0.93]
Stengaard 2013	77	39	120	749	0.39 [0.32, 0.46]	0.95 [0.93, 0.96]
Stopyra 2020	18	3	50	350	0.26 [0.17, 0.39]	0.99 [0.98, 1.00]
Suzuki 2018	82	158	34	1125	0.71 [0.62, 0.79]	0.88 [0.86, 0.89]

A meta-analysis of the diagnostic accuracy of the POC troponin tests in detecting AMI including 6 observational databases showed the pooled sensitivity and specificity of 47% (95% CI 45–49%) and 90% (95% CI 89–90%), respectively.

This systematic review and meta-analysis highlight a substantial difference in the performance of POC troponin tests, specifically their high specificity (around 90%) compared to their low sensitivity (less than 50%).

Central Figure

charge, improving ED resource utilization.[5] Prior meta-analyses have validated the ESC 0/1-h algorithm's effectiveness in ruling in and ruling out AMI.[7] However, the protocol requires additional time and central laboratory processing, limiting its feasibility for bedside use by paramedics or within the ED.

Point-of-care (POC) cardiac troponin testing, although less sensitive than hs-cTn, enables rapid bedside assessment within 15 min.[8,9] Although multiple studies have evaluated the effectiveness of POC troponin testing for diagnosing AMI in individuals presenting with chest pain, the patient populations in these studies varied. Therefore, it is important to synthesize current evidence related to POC cardiac troponin testing to assess its real-world effectiveness. We thus conducted a systematic review and meta-analysis to determine the diagnostic performance of POC troponin testing for ruling in and ruling out AMI at the time of patient presentation.

Methods

The Japan Resuscitation Council (JRC) Acute Coronary Syndrome (ACS) Task Force, established by the Japanese Circulation Society, the Japanese Association of Acute Medicine, and the Japanese Society of Internal Medicine, developed the JRC 2025 guidelines.[10] This review aimed to formulate a statement on POC troponin testing within these guidelines. A systematic review and meta-analysis of studies assessing the diagnostic accuracy of POC troponin testing for identifying AMI in adult patients at presentation was conducted. This systematic review and meta-analysis was reported in accordance with the Preferred Reporting Items of Systematic Reviews and Meta-Analyses statement, registered in the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42024560174), and performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses of Diagnostic Test Accuracy (PRISMA-DTA) guidelines.[11]

Patients
Studies involving individuals presenting with symptoms suggestive of AMI at the time of evaluation were included in the analysis.

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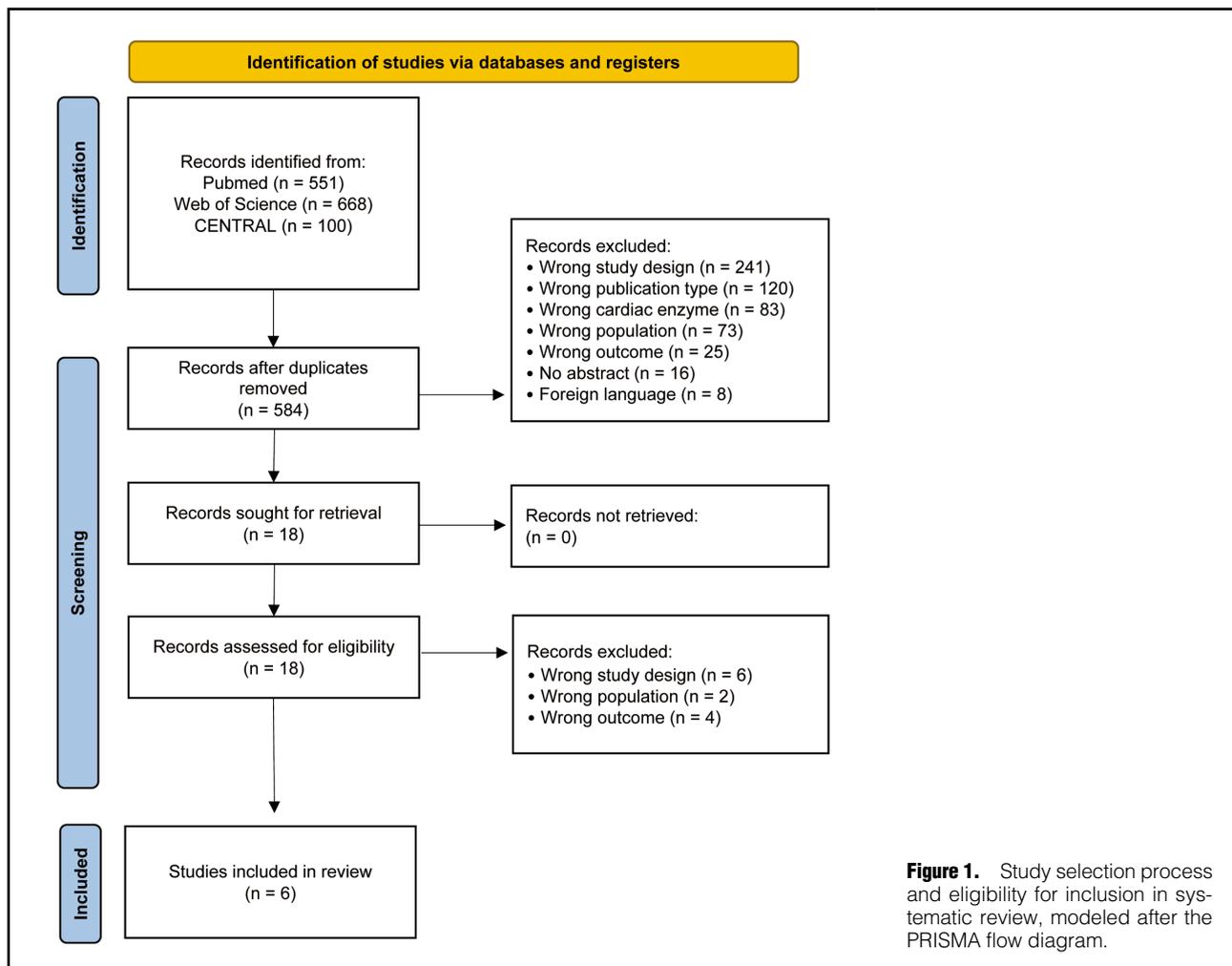
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Figure 1. Study selection process and eligibility for inclusion in systematic review, modeled after the PRISMA flow diagram.

Outcomes

The primary outcome was the diagnostic accuracy of POC troponin testing for AMI. The pooled sensitivity, specificity, false positive rate, false negative rate, and positive and negative predictive values were calculated with 95% confidence intervals (CI).

Study Selection Criteria

Studies published in English that investigated the diagnostic accuracy of POC cardiac troponin testing in diagnosing AMI were included in the review and meta-analysis. Case reports or case series, letters to the editor, animal studies, and studies without original data were excluded.

Search Methods

We conducted a comprehensive electronic search of the PubMed, Web of Science, and Cochrane Library databases from inception to June 17, 2023, using keywords such as "acute coronary syndrome", "myocardial infarction", "chest pain", "troponin", "rapid diagnostic tests", and "point of care". The full search strategy is presented in the **Supplementary Appendix**. We included English-language studies and manually searched the reference lists of eligible articles to identify additional relevant studies. As studies were identified, we also reviewed cited and related articles. Studies on both POC cardiac troponin T (POC-cTnT) and

POC cardiac troponin I (POC-cTnI) were evaluated, and the diagnostic performance of both biomarkers was examined.

Data Extraction

Two reviewers (M.A., Y.M.) independently screened the titles and abstracts of all retrieved bibliographic records. Inclusion and exclusion criteria were applied throughout the screening process. When no abstract was available, the full text was obtained unless the title clearly indicated exclusion. Articles with uncertain eligibility were examined in full to reduce the risk of excluding relevant studies. The 2 reviewers independently retrieved the full text of potentially eligible studies (**Figure 1**).

Decision Process

Two independent reviewers (M.A., Y.M.) determined eligibility, assessed quality, and extracted data. Any discrepancies were resolved through discussion with or adjudication by a third reviewer (J.Y.).

Quality Assessment

We assessed the reporting quality of included studies using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS)-2 tool. This instrument evaluates 4 domains: patient selection, index test, reference test, and flow and timing. Two independent reviewers (M.A., Y.M.) com-
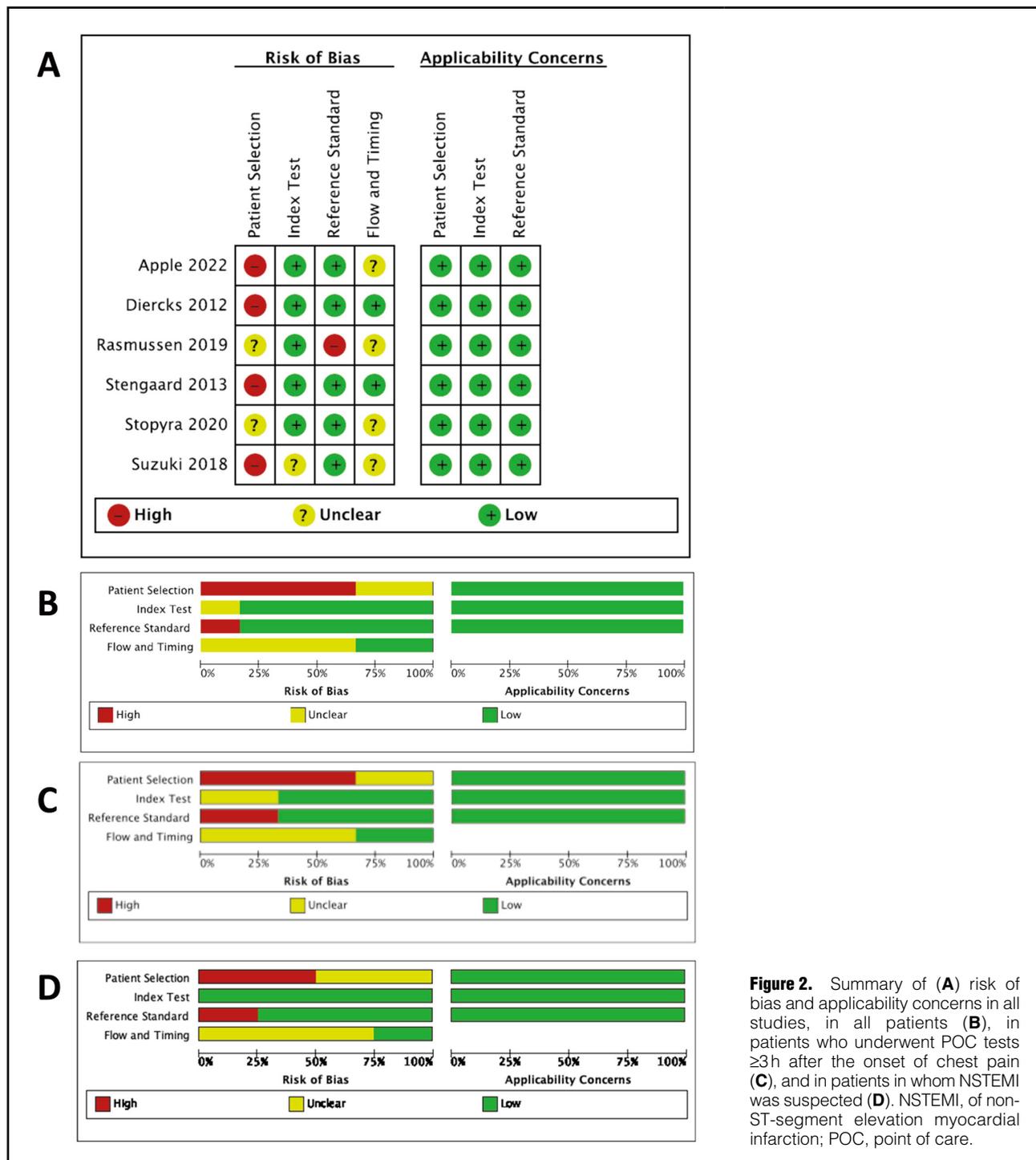
Figure 2. Summary of (**A**) risk of bias and applicability concerns in all studies, in all patients (**B**), in patients who underwent POC tests ≥3 h after the onset of chest pain (**C**), and in patients in whom NSTEMI was suspected (**D**). NSTEMI, of non-ST-segment elevation myocardial infarction; POC, point of care.

pleted the assessments, and the QUADAS-2 scoring is presented in **Figure 2**.

Certainty of Evidence
The Grading of Recommendations Assessment, Development, and Evaluation tool was used to rate the certainty of evidence on the diagnostic accuracy of POC troponin testing for AMI. Certainty was classified as "high", "moderate", "low" or "very low" based on assessments of risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Strategy for Data Synthesis
Meta-analysis was performed to calculate pooled sensitivity, specificity, and positive and negative predictive values, along with corresponding 95% CIs. Heterogeneity among studies was evaluated graphically using forest plots. Statistical analyses were performed using RevMan version 5.4.1 (The Nordic Cochrane Centre, Copenhagen, Denmark). A two-tailed P value <0.05 was considered statistically significant.

Table 1. Characteristics of the 6 Studies Evaluating the Performance of Point-of-Care Troponin Tests

Study	Year	Sample size	Age (years)	Prevalence	Marker	Diagnostic performance
Apple et al.[12]	2022	1,486	60	5.5	Atellica VTLi	Sen: 98.8% NPV: 99.8% Spe: 44.8% PPV: 9.5%
Stopyra et al.[16]	2020	421	58.8	16.2	i-STAT	Sen: 26.5% NPV: 87.5% Spe: 99.2% PPV: 85.7%
Suzuki et al.[17]	2018	1,399	70	8.3	AQT System	Sen: 70.7% NPV: 97.1% Spe: 87.7% PPV: 34.2%
Stengaard et al.[15]	2013	985	ND	20.0	Cobas h232	Sen: 39.0% NPV: 86.0% Spe: 95.0% PPV: 68.0%
Diercks et al.[13]	2012	858	57	9.6	Cardio3	Sen: 84.1% NPV: 98.2% Spe: 93.4% PPV: 57.5%
Rasmussen et al.[14]	2019	18,712	ND	11.7	Cobas h232	Sen: 44.2% NPV: 92.6% Spe: 92.8% PPV: 44.9%

NPV, negative predictive value; PPV, positive predictive value; Sen, sensitivity; Spe, specificity.

Results

Of the 584 studies initially identified as potentially eligible for inclusion, 6 were deemed suitable after applying the inclusion and selection criteria. These 6 studies included a total of 6 databases for comprehensive analysis (**Figure 1**, **Table 1**).[12–17] **Figure 2** displays the results of the QUADAS-2 quality assessment for the included studies. The quality assessment indicated generally low concerns regarding applicability across most domains. However, with respect to risk of bias, patient selection showed high risk in 4 studies, and the reference standard domain demonstrated high risk in 1 study.

The meta-analysis including 6 observational databases with a total of 23,841 patients evaluated the diagnostic accuracy of POC troponin testing in detecting AMI. The pooled sensitivity and specificity were found to be 47% (95% CI 45–49%) and 90% (95% CI 89–90%), respectively (**Figure 3A**). Assuming a 10% AMI prevalence (based on typical ED data), the false-positive rate was 90/1,000 patients (95% CI 90–101). Conversely, with a 5% prevalence (representing estimates in primary care), the false-negative rate was 27/1,000 patients (95% CI 26–28). The positive and negative predictive values were 34.3% (95% CI 32.2–35.3) and 94.2% (95% CI 93.8–94.6), respectively.

The sensitivity meta-analysis, including 3 observational databases with a total of 1,614 patients who underwent POC tests ≥3 h after the onset of chest pain, evaluated the diagnostic accuracy of POC troponin testing in detecting AMI.[13,16,17] The pooled sensitivity and specificity were found to be 66% (95% CI 59–72%) and 95% (95% CI

93–96%), respectively (**Figure 3B**). An additional sensitivity meta-analysis, including 4 observational databases with a total of 20,671 patients in whom NSTEMI was suspected, evaluated the diagnostic accuracy of POC troponin testing in detecting AMI.[12–14,16] The pooled sensitivity and specificity were found to be 48% (95% CI 45–50%) and 89% (95% CI 89–90%), respectively (**Figure 3C**).

This meta-analysis included only 6 observational studies, starting with a low level of evidence. We identified a significant disparity in the number of cases across databases and judged this inconsistency to be a risk. From these findings, we determined the overall level of evidence to be very low (**Table 2**).

Discussion

This systematic review and meta-analysis evaluated the diagnostic performance of POC troponin testing with both troponin T and troponin I. A key finding of this study is the marked disparity between the specificity (≈90%) and sensitivity (<50%) of POC troponin testing. Consistent with the typical trade-off between sensitivity and specificity inherent in clinical diagnostic assays, the implementation of POC troponin testing in clinical practice requires a nuanced approach that acknowledges the test's high specificity but relatively lower sensitivity. The high specificity of POC troponin testing demonstrates its ability to accurately identify individuals with AMI when the test result is positive. These findings suggest that the test can be a valuable tool for ruling in AMI and may aid in clinical decision-making. Conversely, the low sensitivity implies that a neg-
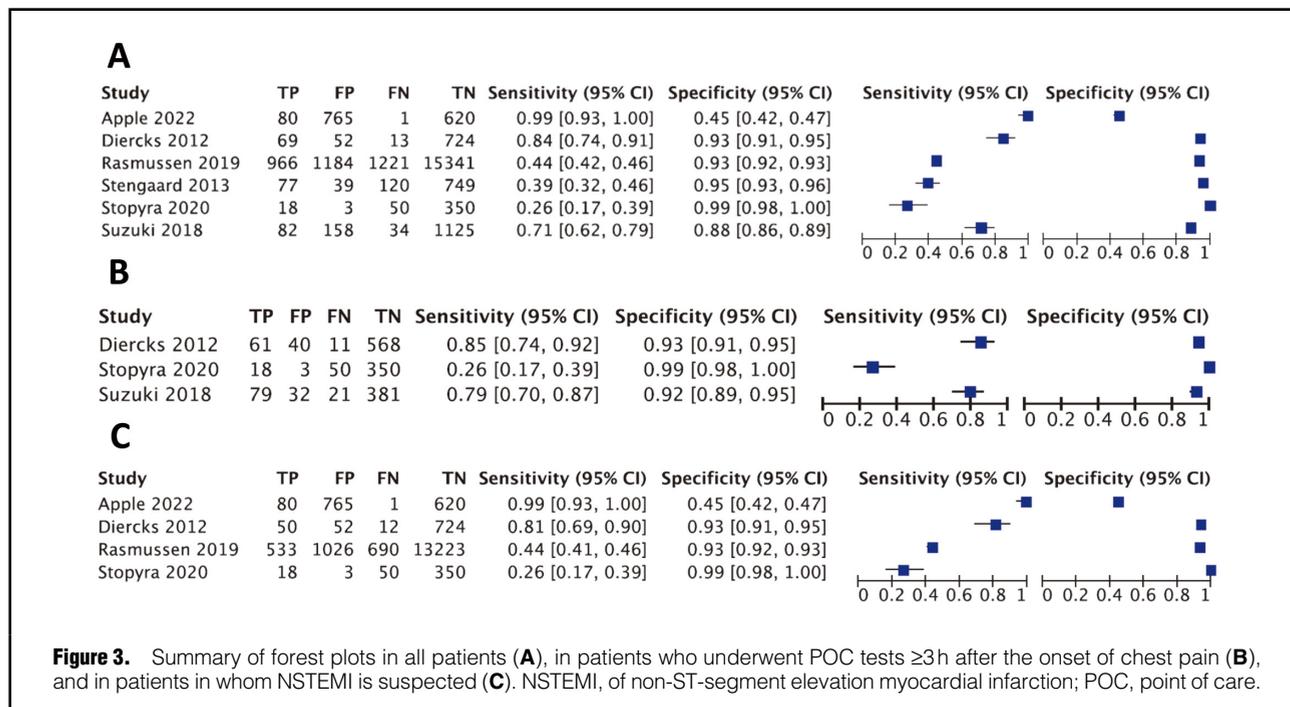
Figure 3. Summary of forest plots in all patients (**A**), in patients who underwent POC tests ≥3h after the onset of chest pain (**B**), and in patients in whom NSTEMI is suspected (**C**). NSTEMI, of non-ST-segment elevation myocardial infarction; POC, point of care.

Table 2. Evidence Profile

No. of studies (no. of patients)	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Test accuracy class of evidence
True positives and false negatives							
6 (23,841)	Observational study	Not serious	Serious	None	Serious	Not serious	Very low
True negatives and false positives							
6 (23,841)	Observational study	Not serious	Serious	None	Serious	Not serious	Very low

ative POC troponin test result cannot definitively exclude the possibility of AMI in an individual presenting with chest pain, thereby limiting its utility for ruling out this diagnosis.

Among the proposed troponin-based strategies, the 0/1-h algorithm using hs-cTn testing, recommended by the ESC, is widely used to manage individuals presenting to the ED with chest pain.[5] Numerous previous studies have confirmed the ESC 0/1-h algorithm's effectiveness in ruling in and ruling out AMI.[18] A meta-analysis of the diagnostic accuracy of the 0/1-h algorithm using hs-cTnI with 6 observational databases showed a pooled sensitivity of 99.3% (95% CI 98.5–99.7%) and a pooled specificity of 90.1% (95% CI 80.7–95.2%).[7] The meta-analysis of POC troponin testing in the present study revealed a significantly lower sensitivity compared to previous meta-analyses of the ESC 0/1-h algorithm, but the specificity remained comparable. These findings may indicate a new avenue for differentiating the application of the ESC 0/1-h algorithm and POC troponin testing in the initial care of individuals presenting with chest pain. For instance, if specificity and rule-in performance are comparable to some extent, it might be reasonable to initiate AMI management immediately following

a positive initial POC result, rather than awaiting results from the 0/1-h algorithm using hs-cTn testing. This approach could potentially reduce door-to-reperfusion time for individuals with chest pain.[19,20] However, the POC test's sensitivity and rule-out performance are notably inferior to the 0/1-h algorithm. Therefore, a negative POC result upon initial presentation should not be interpreted as definitively ruling out AMI, and it might be prudent to defer a final decision until the 0/1-h algorithm results become available. This hybrid strategy, combining POC troponin testing and the ESC 0/1-h algorithm, may lead to a new flowchart for the initial treatment of individuals with chest pain, enabling the rapid treatment of AMI while appropriately excluding low-risk individuals.

Generally, troponin levels tend to increase as time passes from the onset of chest pain.[5] Consequently, the sensitivity and specificity of POC troponin testing for AMI may improve as the time from symptom onset increases. Thus, in this meta-analysis, we conducted a sensitivity analysis limited to individuals who underwent POC testing ≥3h after symptom onset. The results showed an increase in both sensitivity and specificity, with the latter reaching 95%. These findings suggest that the utility of POC testing

for ruling in AMI may be further enhanced. On the other hand, although sensitivity increased, it remained at only 66%. Therefore, the use of POC troponin testing for rule-out remains limited, and it is likely that its application should be restricted to facilities unable to measure hs-cTn for the ESC 0/1-h algorithm. However, POC platforms are continuously evolving, and it is conceivable that further development of kits will lead to improved sensitivity in the future. Continued evaluation of the utility of POC troponin testing is warranted.

Compared to STEMI, NSTEMI is more difficult to diagnose because of interpretation challenges on ECG.[5] Therefore, effective use of diagnostic tools such as POC troponin testing is desired. In this meta-analysis, we performed a sensitivity analysis limited to NSTEMI cases. The results were almost the same as those for overall AMI in terms of both sensitivity and specificity. Therefore, in diagnosing NSTEMI, the ESC 0/1-h algorithm should remain the foundation, but effective use of POC troponin testing for rule-in may be considered. On the other hand, it is reasonable to conclude that its use in rule-out remains limited. Establishing an optimized AMI diagnostic algorithm and flowchart that reflects patient-specific factors, such as time from symptom onset and the presence or absence of ST elevation on ECG, remains a future challenge, and it is hoped that POC platforms will be used more appropriately in this process.[21]

Study Limitations
First, we used the PubMed, Web of Science, and Cochrane Library databases and restricted the language to English owing to limited resources for this systematic review. Therefore, it is possible that we missed relevant reports on this topic that were written in other languages or listed in other databases. Second, most of the studies included in this review were conducted in Western countries; hence, it is unclear whether the findings are applicable to Japan, where cardiologists sometimes provide initial care. Further studies with ethnically diverse populations are thus needed. Hence, additional verification of the effectiveness of POC troponin testing in Japan is awaited. Third, the POC troponin testing strategies used across studies in this meta-analysis involved different kits, troponin types, and cutoff values. This heterogeneity inherently limits the generalizability of our findings. Nevertheless, a focused analysis stratified by kit and cutoff threshold is not currently feasible because of an insufficient sample size. Therefore, this remains an important area for future research.

Conclusions
This systematic review and meta-analysis highlighted a substantial difference in the performance of POC troponin testing, specifically its high specificity ($\approx$90%) compared to its low sensitivity (<50%). This suggests that POC testing is useful for identifying individuals with AMI, but its effectiveness for excluding the diagnosis is limited.

Disclosures
T. Matoba is a member of the Editorial Team for *Circulation Reports* and received research grants from Amgen. T. Mano received research grants from Abbott Medical Japan. The other authors declare no conflicts of interest with regard to this article.

Ethical Approval
This study is a systematic review and meta-analysis of previously published data and did not involve the collection of new data from human participants. Therefore, ethics approval was not required.

Data Availability
No new data were generated or analyzed in this study. All data used are available from the corresponding publications referenced in the manuscript.

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Supplementary Files

Please find supplementary file(s);
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