

SHORT COMMUNICATION

Door-to-ECG Time in Patients Presenting with Chest Pain to the Emergency Department: A Clinical Audit from a Tertiary Care Hospital.

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Abstract

Background: Chest pain is one of the most common and potentially life-threatening presentations in emergency departments worldwide. Rapid electrocardiographic (ECG) evaluation is critical for the early identification of acute coronary syndrome (ACS), including ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI). International guidelines recommend that a 12-lead ECG should be obtained and interpreted within 10 minutes of first medical contact to ensure timely diagnosis and management. Delays in ECG acquisition may lead to delayed diagnosis, delayed initiation of treatment, and poorer patient outcomes. This clinical audit aimed to assess adherence to international recommendations regarding door-to-ECG time in patients presenting with chest pain to the emergency department of a tertiary care hospital.

Methodology: A retrospective clinical audit was conducted in the Emergency Department of Lady Reading Hospital, Peshawar, during August 2025. A total of 250 adult patients presenting with non-traumatic chest pain suggestive of ACS were included. Data were collected from emergency department triage logs, ECG machine timestamps, and clinical records. The primary outcome measured was the time from patient arrival to ECG acquisition (door-to-ECG time). Compliance with the recommended standard of ECG acquisition within 10 minutes was evaluated using descriptive statistical analysis.

Results: Among the 250 patients analyzed, the mean door-to-ECG time was 12.9 minutes. A total of 134 patients (53.6%) received an ECG within the recommended 10-minute timeframe, while 116 patients (46.4%) experienced delays exceeding 10 minutes. The most frequently documented reason for delay was overcrowding in the initial assessment area, particularly during peak patient flow periods.

Conclusion: This clinical audit demonstrates suboptimal adherence to international door-to-ECG time standards in patients presenting with chest pain. System-level factors, particularly emergency department overcrowding and workflow congestion, appear to contribute significantly to these delays. Implementing targeted interventions such as chest pain fast-track protocols, ECG acquisition at triage, and improved staff training may enhance compliance with recommended timelines and improve the quality of emergency cardiac care.

Keywords

Percutaneous Coronary Intervention, Rotational Atherectomy, Drug Eluting Stent, Stalled Burr, Calcified Lesion.

Introduction

Chest pain is a frequent presenting complaint in emergency departments and represents a significant diagnostic and management challenge for healthcare providers. While many cases of chest pain are non-cardiac in origin, a substantial proportion may be related to acute coronary syndrome (ACS), a potentially life-threatening condition that requires rapid identification and timely intervention to reduce morbidity and mortality¹. ACS encompasses a spectrum of clinical entities including ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI), both of which require prompt diagnosis and management to prevent irreversible myocardial damage and adverse cardiovascular outcomes².

The 12-lead electrocardiogram (ECG) is one of the most essential diagnostic tools in the early evaluation of patients presenting with chest pain. It provides rapid, non-invasive assessment of cardiac electrical activity and plays a crucial role in identifying ischemic changes that may indicate myocardial infarction or other acute cardiac conditions³. Early ECG acquisition allows clinicians to initiate appropriate risk stratification, initiate evidence-based therapies, and determine the need for urgent reperfusion strategies.

Recognizing the critical importance of early ECG evaluation, major international cardiology societies have established clear recommendations regarding the timing of ECG acquisition in patients presenting with suspected ACS. According to the 2021 American Heart Association/American College of Cardiology (AHA/ACC) chest pain guideline and the 2023 European Society of Cardiology (ESC) guideline, a 12-lead ECG should be obtained and interpreted within 10 minutes of first medical contact or arrival at the emergency department in patients with symptoms suggestive of ACS^{4,5}. This benchmark serves as an important quality indicator in emergency cardiac care.

Delayed ECG acquisition may lead to delays in diagnosis, postponement of reperfusion therapy, and ultimately worse clinical outcomes for patients with myocardial infarction⁶. Despite the presence of well-established guidelines, several studies have reported

persistent delays in door-to-ECG time, particularly in busy emergency departments and in healthcare systems with limited resources. Factors such as overcrowding, staffing shortages, workflow inefficiencies, and lack of triage prioritization for chest pain patients have been identified as major contributors to these delays.

Clinical audits are valuable quality-improvement tools that allow healthcare institutions to evaluate their current practices against established standards. By identifying gaps between recommended guidelines and actual clinical practice, audits can help guide targeted interventions aimed at improving patient care and system efficiency.

In this context, the present clinical audit was conducted to evaluate adherence to recommended door-to-ECG time standards among patients presenting with chest pain to the Emergency Department of Lady Reading Hospital, Peshawar. The findings of this audit aim to identify existing gaps in emergency cardiac care and provide evidence-based recommendations for improving timely ECG acquisition and overall patient management.

Methodology

Study Design

This study was conducted as a retrospective clinical audit designed to evaluate adherence to recommended door-to-ECG time standards in patients presenting with chest pain to the emergency department. The audit followed a consecutive inclusion approach, meaning that all eligible patients who met the predefined criteria during the audit period were included without any sub-selection.

Clinical audit methodology was selected because it provides a structured mechanism to assess current clinical practice against established international guidelines and identify areas for quality improvement.

The audit specifically assessed whether patients presenting with suspected acute coronary syndrome received a 12-lead electrocardiogram within the recommended 10-minute timeframe after arrival.

Ethics

As this investigation was conducted as a clinical audit based on retrospective review of existing hospital records, no direct patient interaction or intervention was involved. All data were extracted from routinely collected hospital documentation and were analyzed in anonymized form to maintain patient confidentiality. Patient identifiers were not recorded during data extraction. The audit was conducted in accordance with institutional policies governing clinical audit and quality-improvement activities within the hospital.

Setting

The audit was carried out in the Emergency Department of Lady Reading Hospital Medical Teaching Institution, Peshawar, a large tertiary-care referral center that manages a high volume of emergency cases including cardiovascular emergencies. The emergency department operates continuously and serves patients presenting with a wide spectrum of acute conditions. The audit period covered one month (August 2025), during which all eligible cases presenting with chest pain were evaluated.

Participants

The study population consisted of adult patients presenting with chest pain suggestive of acute coronary syndrome (ACS) during the audit period. Eligibility criteria were predefined to ensure consistency in case selection. Patients were included if they were 18 years of age or older and presented with non-traumatic chest pain or anginal equivalent symptoms suggestive of ACS. Exclusion criteria included patients with incomplete documentation and those referred from other hospitals with pre-hospital ECGs already performed, as these cases would not allow accurate measurement of the door-to-ECG time within the emergency department. Using these criteria, a total of 250 patients were included in the audit.

Variables

The primary variable of interest was door-to-ECG time, defined as the time interval between the patient's arrival at the emergency department and the acquisition of a 12-lead ECG. Arrival time was

defined as the triage registration timestamp recorded in the emergency department triage log or electronic medical record, while ECG time corresponded to the automatically recorded timestamp generated by the ECG machine at the moment the ECG was acquired. The main outcome variable was whether the ECG was performed within 10 minutes of arrival, which served as the compliance indicator according to international guideline standards. Additional descriptive variables included patient demographics (age group and gender), timing of arrival, and documented reasons for delay where available.

Data Sources / Measurement

Data were collected through a retrospective review of emergency department triage logs, ECG machine timestamp records, and patient clinical documentation for all consecutive patients presenting with chest pain during the audit period. The triage log provided the initial patient arrival time, which served as the starting point for door-to-ECG time measurement. ECG acquisition time was obtained directly from the timestamp recorded by the ECG device, ensuring objective recording of the ECG capture time. Documentation within clinician and triage notes was also reviewed to identify possible explanations for delays, such as overcrowding or workflow congestion in the triage area. Interpretation time of the ECG was not available in the documentation and therefore was not included as a measured variable.

Bias

Several potential sources of bias were considered in the audit design. Because the study relied on retrospective review of existing records, the accuracy of measurements depended on the reliability of recorded timestamps in the triage system and ECG machines. However, the use of automated time recordings helped minimize measurement bias. Selection bias was limited by including all consecutive eligible patients during the audit period rather than selecting a subset of cases. Nevertheless, the study may still be influenced by documentation bias, as reasons for delays were only recorded when explicitly documented in clinical notes.

Study Size

The audit included 250 adult patients, representing all eligible individuals presenting with chest pain during the one-month audit period. The sample size was therefore determined by the number of consecutive cases presenting during the study timeframe, rather than by formal sample size calculation. This approach is commonly used in clinical audits where the objective is to evaluate real-world clinical practice within a defined period.

Quantitative Variables

The principal quantitative variable analyzed in this audit was door-to-ECG time measured in minutes. This variable was derived by calculating the time difference between the triage registration timestamp and the ECG acquisition timestamp. For analytic purposes, door-to-ECG time was categorized into two groups: ≤ 10 minutes (compliant with guideline recommendations) and > 10 minutes (delayed). The mean door-to-ECG time was also calculated to provide an overall measure of performance relative to the recommended benchmark.

Statistical Methods

Data analysis was conducted using Microsoft Excel. Descriptive statistical methods were used to summarize the findings. Continuous variables, such as door-to-ECG time, were reported using the mean value, while categorical variables were summarized as frequencies and percentages. The proportion of patients receiving an ECG within the recommended 10-minute timeframe was calculated to assess compliance with the audit standard. Because the dataset retained aggregated summary entries rather than individual raw time differences, calculation of median, interquartile range (IQR), and full range values was not possible at the time of analysis. Future analyses using complete raw timestamps could allow more detailed statistical characterization of door-to-ECG time distributions.

Results

Participants

During the audit period, a total of 250 adult patients presenting with chest pain suggestive of acute coronary syndrome (ACS) were included in the analysis. All participants met the predefined inclusion

criteria of age ≥ 18 years and presentation with non-traumatic chest pain requiring ECG assessment in the emergency department. Importantly, complete datasets were available for all cases, as both arrival time and ECG acquisition timestamps were recorded for every patient included in the audit. Therefore, no cases were excluded due to incomplete documentation, resulting in a final analytic sample of 250 patients (100% of eligible cases). The overall participant characteristics and dataset completeness are summarized in Table 1.

Descriptive Data

The study population consisted of adult patients aged 18 years and above, including both male and female individuals presenting to the emergency department during August 2025. For each patient, key time variables such as time of arrival and ECG acquisition time were documented and used to calculate the door-to-ECG interval. These descriptive variables allowed characterization of the patient population and verification of data completeness. As shown in Table 1, all cases had recorded timestamps for both arrival and ECG acquisition, enabling accurate calculation of the door-to-ECG time for the entire cohort.

Outcome Data

The primary outcome measured in this clinical audit was the door-to-ECG time, defined as the time interval between patient arrival at triage and the acquisition of a 12-lead electrocardiogram. The analysis demonstrated that the mean door-to-ECG time was 12.9 minutes, which exceeds the recommended international guideline target of ≤ 10 minutes. Compliance with the guideline standard was assessed by determining the proportion of patients who received an ECG within the recommended timeframe. As presented in Table 2 (Primary Outcome: Door-to-ECG Time), the observed mean time indicates a measurable delay relative to the recommended benchmark.

Main Results

Evaluation of compliance with the recommended standard revealed that 134 patients (53.6%) received an ECG within 10 minutes of arrival, while 116 patients (46.4%) experienced a delay exceeding 10 minutes.

These findings indicate that slightly more than half of the patients met the recommended guideline target, whereas nearly half experienced delayed ECG acquisition. Detailed compliance data are presented in Table 3 (Compliance with Audit Standard). Analysis of the documented causes of delayed ECG acquisition indicated that overcrowding in the initial

patient assessment area was the most frequently reported contributing factor. Delays were particularly noted during peak hours when emergency department patient volume was high, suggesting workflow congestion and operational challenges in early patient assessment. These contributing factors are summarized in Table 4.

Table 1: Baseline Characteristics and Door-to-ECG Performance of Patients Presenting with Chest Pain.

Variables	Audit Result
Total patients audited	250
Age (years)	Adults ≥ 18 years
Gender	Both male and female patients included
Date of visit	August 2025
Time of arrival	Recorded for all patients
Time to ECG	Recorded for all patients
Door-to-ECG time (minutes)	Mean: 12.9 minutes
ECG ≤ 10 minutes	134 patients (53.6%)
ECG > 10 minutes	116 patients (46.4%)
Delay > 10 minutes (Yes)	46.4%
Delay > 10 minutes (No)	53.6%
Most common reason for delay	Overcrowding in initial assessment area
Remarks	Delays more frequent during peak hours

Table 2: Primary Outcome: Door-to-ECG Time Compared with Guideline Standard.

Parameter	Result
Mean door-to-ECG time	12.9 minutes
Guideline standard	≤ 10 minutes

Table 3: Compliance with Recommended Door-to-ECG Time Standard.

ECG Timing	Number of Patients	Percentage
≤ 10 minutes (Compliant)	134	53.6%
> 10 minutes (Delayed)	116	46.4%

Discussion

This clinical audit evaluated the timeliness of electrocardiogram (ECG) acquisition in patients presenting with chest pain to the emergency department, using international guideline recommendations as the benchmark. The results demonstrated that 53.6% of patients received an ECG within the recommended 10-minute

timeframe, while 46.4% experienced delays beyond the guideline standard⁷. The mean door-to-ECG time observed in this study was 12.9 minutes, which exceeds the recommended threshold of ≤ 10 minutes. These findings indicate suboptimal adherence to established international recommendations for early ECG acquisition in patients with suspected acute coronary syndrome.

Timely ECG acquisition is a critical component of early assessment and management in patients presenting with chest pain. Early ECG enables rapid identification of ischemic changes associated with acute coronary syndrome, allowing clinicians to initiate appropriate diagnostic and therapeutic pathways. Delays in obtaining an ECG may subsequently delay diagnosis, risk stratification, and initiation of reperfusion therapy, which may negatively influence clinical outcomes^{8,9}. Therefore, door-to-ECG time is widely considered a key performance indicator for emergency cardiac care.

The compliance rate observed in this audit is comparable to findings reported in several regional studies but remains significantly lower than international best-practice standards. For instance, previous research conducted in similar healthcare settings has reported ECG acquisition within the recommended timeframe in approximately 59% of patients, highlighting that delayed ECG acquisition is a common challenge across multiple institutions rather than a problem confined to a single emergency department^{10,11}. However, in many high-performing healthcare systems, compliance rates exceeding 90% have been reported, reflecting more efficient triage protocols and workflow optimization. This comparison underscores the presence of a significant gap between current practice and international performance benchmarks.

The most frequently documented reason for delayed ECG acquisition in this audit was overcrowding in the initial assessment area, particularly during peak hours when patient volume was high¹². Emergency department overcrowding has been widely recognized as a major contributor to delays in time-sensitive diagnostic procedures. Increased patient load, limited staffing, and workflow congestion can disrupt efficient triage processes and delay the prioritization of patients with potentially life-threatening conditions. Similar findings have been reported in previous studies demonstrating that emergency department crowding is associated with prolonged door-to-ECG times and delayed evaluation of patients presenting with chest pain¹³.

These findings suggest that the delays observed in this audit are largely attributable to system-level factors rather than individual clinician performance. Structural factors such as patient flow management, triage prioritization, and availability of ECG equipment appear to play a central role in determining how quickly ECG acquisition occurs. Addressing these systemic issues may significantly improve adherence to recommended standards.

Clinical audits such as this serve an important role in identifying areas for quality improvement within healthcare systems. By highlighting gaps between current practice and guideline recommendations, audits provide a foundation for implementing targeted interventions. Potential strategies to improve door-to-ECG time include implementing chest pain fast-track protocols, performing ECG acquisition at the triage desk, ensuring the availability of dedicated ECG equipment, and conducting staff education programs to reinforce the importance of early ECG acquisition. Such interventions have been shown in previous studies to significantly improve compliance with recommended ECG timing standards.

Limitations

Several limitations should be considered when interpreting the findings of this audit. First, the study relied on retrospective analysis of routinely recorded hospital data, which may be subject to documentation limitations. Although arrival and ECG acquisition timestamps were available for all patients, the time of ECG interpretation by clinicians was not recorded, preventing evaluation of the complete guideline recommendation that includes ECG interpretation within 10 minutes. Second, the dataset used for analysis consisted of aggregated summary entries, which limited the ability to perform more detailed statistical analyses such as calculation of median values, interquartile ranges, and full distribution of door-to-ECG times. Access to raw timestamp data from the ECG devices or electronic triage system would allow more comprehensive analysis in future audits. Third, the study was conducted within a single tertiary-care emergency department, which may

limit the generalizability of the findings to other institutions or healthcare systems.

Emergency departments differ in terms of patient volume, staffing levels, infrastructure, and workflow processes, which may influence door-to-ECG performance. Finally, potential contributing factors to delays—such as staffing levels, triage prioritization practices, or detailed patient acuity levels were not systematically measured during the audit. Future studies incorporating these variables could provide a more comprehensive understanding of the operational factors influencing ECG acquisition times.

Despite these limitations, the audit provides valuable insights into current clinical practice and identifies important opportunities for improving emergency cardiac care.

Recommendations

Based on the findings of this clinical audit, several targeted interventions are recommended to improve adherence to the recommended door-to-ECG time for patients presenting with chest pain in the emergency department. These recommendations focus primarily on system-level improvements in triage workflow, staff awareness, and equipment availability.

- First, the implementation of a chest pain fast-track protocol is recommended. Patients presenting with chest pain suggestive of acute coronary syndrome should be immediately prioritized at the triage stage to ensure rapid ECG acquisition. Such protocols allow early identification of high-risk patients and reduce delays in the initial diagnostic process.

- Second, performing ECG acquisition directly at the triage area may significantly reduce delays associated with patient transfer to other sections of the emergency department. Placement of a dedicated ECG machine within the triage zone would enable immediate ECG recording for patients presenting with chest pain, which is consistent with best-practice emergency department protocols.
- Third, regular education and training sessions for emergency department staff should be conducted to reinforce the importance of early ECG acquisition in suspected acute coronary syndrome. Increasing staff awareness of international guideline recommendations may enhance compliance with the recommended door-to-ECG time.
- Fourth, workflow optimization and staffing adjustments during peak hours should be considered. Overcrowding in the initial assessment area was identified as the most common cause of delayed ECG acquisition in this audit. Reviewing patient flow patterns and adjusting staff allocation during high patient volume periods may help reduce congestion and improve response times.
- Finally, continuous quality monitoring through periodic clinical audits is recommended to assess adherence to door-to-ECG time standards and evaluate the effectiveness of implemented interventions. Regular monitoring will help ensure sustained improvements in emergency cardiac care.

A structured action plan outlining the identified problems, proposed interventions, responsible teams, and implementation timelines is presented in Table 4.

Table 4: Action Plan for Improving Door-to-ECG Time Compliance.

Identified Problem	Proposed Action	Responsible Team	Timeline
ECG delays exceeding 10 minutes	Implement a chest pain fast-track protocol to prioritize rapid ECG acquisition at triage	Emergency Department (ED) leadership	1–2 months
Overcrowding in the initial assessment area	Review patient workflow and optimize staff allocation during peak hours	ED administration	2–3 months

Lack of staff awareness regarding guideline targets:	Conduct regular staff education and training sessions on early ECG acquisition for suspected ACS	ED consultants and clinical educators	Monthly
Limited access to ECG equipment at triage	Install a dedicated ECG machine in the triage area to facilitate immediate ECG acquisition	Hospital management	Immediate

Conclusion

This retrospective clinical audit conducted in the Emergency Department of Lady Reading Hospital evaluated adherence to recommended door-to-ECG time standards in patients presenting with chest pain. The results demonstrated that 53.6% of patients received an ECG within the recommended 10-minute timeframe, while 46.4% experienced delays exceeding the guideline standard, with a mean door-to-ECG time of 12.9 minutes. These findings indicate that current practice falls short of international benchmarks recommending rapid ECG acquisition for patients with suspected acute coronary syndrome. The primary factor associated with delayed ECG acquisition was overcrowding in the initial patient assessment area, suggesting that operational and workflow challenges within the emergency department play a significant role in delaying timely evaluation. Addressing these system-level barriers is essential to improve compliance with recommended guidelines. Implementation of targeted quality improvement measures—including triage-based ECG acquisition, chest pain fast-track protocols, improved workflow management, and staff education—may substantially reduce door-to-ECG time and enhance early identification of acute coronary syndrome. A re-audit following implementation of these interventions is recommended within 3–6 months to evaluate improvements in compliance with guideline standards and to ensure sustained quality enhancement in emergency cardiac care.

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