

Recording the Door-To-ECG Time for Patients Presenting with Acute Chest Pain to a Cardiac Emergency Unit: A Clinical Audit and Quality Improvement Project

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ABSTRACT

Objective: To measure the door-to-ECG time of patients presenting with chest pain at a Cardiac Emergency Unit.

Study Design: Descriptive Cross-Sectional.

Place and Duration of Study: Armed Force Institute of Cardiology/National Institute of Heart Disease, Emergency Department (ER) from Feb 2022 to Apr 2022.

Methodology: A total of 170 patients presenting to the ER with chest pain were reported. Their demographics were entered alongside the nature (cardiac/non-cardiac) and duration of their chest pain after which the time the first ECG strip was drawn till the time it was interpreted by a doctor (Door-To-ECG time) was recorded on a questionnaire. The patients were categorized in 4 different groups based on their ECG findings and were followed till their clinical decisions (PCI/Admission/Discharge/Referral) within the ER were made.

Results: Out of 170 patients, 101(59.4%) had a door-to-ECG time within 10 minutes. Amongst these 101 patients, 23(22.7%) patients were diagnosed with STEMI and shifted for PCI, 15(14.8%) had NSTEMI and were admitted for management, 41(40.6%) had cardiac chest pain without ECG changes and were admitted for workup while 22(21.8%) had non-cardiac chest pain and were discharged with out-patient follow-up or referred elsewhere. Non-availability of a bed in the emergency department accounted for the majority (49.3%) of the patients whose door-to-ECG time was more than 10 minutes while a higher ratio of patients that needed to be attended by doctors was identified as the second most common cause of delay (31.9%).

Conclusions: Our findings suggest that the door-to-ECG time recorded for patients at our setup was almost 10 minutes as recommended by the AHA/ACC. A re-audit should also be carried out with a larger sample size or duration.

Keywords: Audit, Chest pain, Electrocardiography, Time.

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INTRODUCTION

Coronary artery disease is at the top of causing worldwide mortality and it accounts for 13% of deaths across the globe.¹ The identification of acute coronary syndrome in an emergency room (ER) is by main parameters which include a history of chest pain, an ECG and levels of troponin in the blood.² sample size was calculated from 10-15% of patients coming to the emergency room with symptoms indicative of an acute coronary syndrome (ACS) such as chest pain are actually experiencing it.³ Chest pressure, chest discomfort, and chest pain have demonstrated the highest sensitivity for ACS in both women and men. The main goal of doctors in any ER is to rule out the sinister diagnosis of ST-elevation myocardial infarction (STEMI) which is ruled out by an ECG.⁴ However, even when patients present with chest pain, the

prompt identification of ACS is an obstacle for health care personnel who primarily encounter these patients.⁵ If there is speculation of MI, modern treatment lines include the decision between thrombolysis or percutaneous coronary intervention (PCI) and also whether or not coronary care unit (CCU) admission is required. Which treatment is to be instituted is based on findings of ECGs to look out for STEMI.⁶ The American Heart Association (AHA) / American College of Cardiology (ACC) guidelines suggest urgent door-to-electrocardiography (ECG) times (less than 10 minutes) for those who come in with chest pain.⁷ This swift identification of STEMI in the emergency is carried out by an ECG on itself and for the most favorable outcomes, it has to be performed within 10 minutes of arrival to an emergency.⁸ The capacity and occupancy of beds inside an ER may hamper performance of an ECG within the ideal time frame which can lead to a delay in patient management.⁹ This clinical audit will focus

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on gathering data on the time taken between patient presentation with chest pain to the first ECG being performed and also suggest and implement changes to meet the AHA / ACC guidelines.

METHODOLOGY

The operational definition used for door-to-ECG time was, "the time interval between a patient presenting to the ER with chest pain to the first ECG strip being drawn and interpreted by a doctor". All time values were recorded in minutes by digital wrist watches worn by the doctors who were part of the investigation team. Operational definition of acute chest pain is a non-traumatic chest pain / discomfort / pressure that is currently present, is of recent duration, associated with any other symptom or etiology and is documented when a patient is presenting to the emergency desk.

The study was performed at the emergency setup of a tertiary care cardiac hospital located in Rawalpindi, Pakistan.

Sample Size: The calculated sample size was n=170 by considering 10-15% prevalence of chest pain in emergency³.

Inclusion Criteria: All Patients presenting to the ER with acute onset chest pain from Feb 2022 to April 2022 for a period of 3-months.

Exclusion Criteria: Patients who presented in a state of cardiac arrest were excluded from the study as part of our exclusion criteria.

Data was collected in the form of questionnaires which included information on patients' demographics, co-morbid conditions, the type of chest pain they presented with, the duration of chest pain, the times at which the first ECG was performed and then interpreted after their arrival at the emergency desk, the provisional diagnosis of the patients based on their clinical presentation and ECG strips, the subsequent decision taken for the patients' management and whether or not there was mortality within the ER.

The factors involved both in delay of the ECG being performed and then being interpreted were observed separately and noted down briefly on the data collection tool and analyzed collectively to see their respective contribution in lessening the door-to-ECG time for patients. The patients were grouped into four broad categories based on their provisional diagnoses after the ECGs were interpreted and there onwards, they were followed up till the point that they were sent for PCI, admitted or discharged.

RESULTS

The total number of patients presenting with acute chest pain that were recorded were 170 during the 3-months (Feb 2022 to Apr 2022) during which this audit was carried out. Out of these, 145(85.3 %) were males and 25(14.7%) were females with the mean age of the population was 56.22±15.69 years. 117(68.8%) of these presented with cardiac chest pain highly suggestive of acute coronary syndrome (ACS) and 53(31.2%) presented with chest pain bearing low suspicion of ACS. Risk factors identified included Diabetes Mellitus in 48(28.2%) patients, Hypertension in 64(37.6%), Previous history of Ischemic Heart Disease (IHD) in 17(10.0%), Past history of Percutaneous Coronary Intervention (PCI) in 25(14.7%), Positive Family History of IHD in 10(5.8%) and lastly other risk factors such as smoking, obesity, asthma etc. in a small number of 5(2.9%) patients respectively showed in Table-I.

Table-I: Demographic Data and Clinical Parameters

Demographic Characteristics	Mean ± SD / n(%)
Age	56.22 ± 15.69
Gender	
Male	145 (85.3%)
Female	25 (14.7%)
Type of Chest Pain at Presentation	
Cardiac / High-suspicion of ACS	117 (68.8%)
Non-cardiac / Low-suspicion of ACS	53 (31.2%)
Co-morbid conditions / Risk factors	
Diabetes Mellitus	48 (28.2%)
Hypertension	64 (37.6%)
Previous History of IHD	17 (10.0%)
Past History of PCI	25(14.7%)
Positive Family History of IHD	10(5.8%)
Other risk factors	5(2.9%)

ACS=Acute coronary syndrome; IHD= Ischemic heart disease; PCI= Percutaneous coronary intervention

The number of patients whose door-to-ECG time was within 10 minutes was 101(59.4%) and those whose door-to-ECG time was beyond 10 minutes was 69(40.6%). It is notable however that the mean door-to-ECG time was found to be 12.06±14.92 minutes. Four reasons for delay in the door-to-ECG were broadly identified; (i) the non-availability of beds in the emergency for performance of an ECG 34(49.3%), (ii) pre-occupation of the ECG staff and doctors in the management of other patients in the emergency 22 (31.9%), (iii) slow registration process at the emergency desk which lead to crowding of patients 10(14.5%), (iv) other reasons such as malfunctioning of ECG machines, lesser quantity of ECG machines in the

emergency setup and incompetency in ECG interpretation 3(4.3%). These data are presented in Figure.

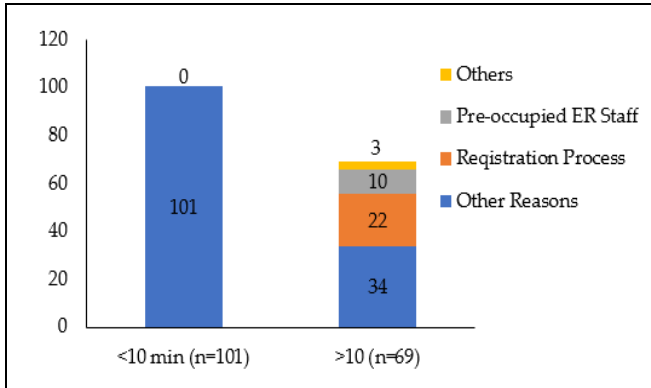


Figure: Number of patients plotted and reasons for delay in ECG plotted against the Door-to-ECG time (minutes)

Upon prompt diagnosis following interpretation of all the ECGs regardless of the door-to-ECG time, 33(19.4%) patients with STEMI were urgently transferred to the catheterization lab for PCI, 26(15.3%) were admitted for further management of NSTEMI in the coronary care units of the institute. 69(40.5%) were admitted for workup for cardiac chest pain of new onset after normal sets of cardiac biomarkers and ECGs were obtained that excluded STEMI and NSTEMI and lastly, 42(24.7%) had been discharged from the ER or referred to other medical specialties for management after a low suspicion of ACS. Table-II represents this data as follows:

Table-II: Provisional Diagnoses based on ECG and Clinical Interpretation

Provisional Diagnosis of Patient	Number of Patients with Door-to-ECG time/n(%)		p-value
	< 10 minutes	> 10 minutes	
STEMI	23 (22.8%)	10 (14.5%)	0.375
NSTEMI	15 (14.9%)	11 (15.9%)	
Cardiac chest pain not suggestive of STEMI or NSTEMI (Unstable Angina?)	41 (40.6%)	28 (40.6%)	
Non-cardiac chest pain(Respiratory / Gastroesophageal / Musculoskeletal)	22 (21.8%)	20 (28.9%)	

ECG= Electrocardiogram; STEMI=ST elevation myocardial infarction; NSTEMI= Non ST elevation myocardial infarction

The p-value is 0.375 which suggest that our results were not statistically significant. None mortality was found during this audit.

DISCUSSION

The performance of an ECG is the most urgent and vital task when a patient presents to any emergency setting with chest pain. International guidelines formulated by the AHA/ACC stress on the importance of performance of an ECG within 10 minutes of arrival at an emergency setting so as to minimize the door-to-balloon time for STEMI. In our study, among the 33(19.4%) patients who were diagnosed with a STEMI, 23(69.7%) had the ideal door-to-ECG time of within 10 minutes as recommended by international guidelines published by the AHA/ACC. The number of 'missed' cases of STEMI whose door-to-ECG time was prolonged beyond 10 minutes due the factors discussed in Graph-I, was lower at 10(31.3%). Although, this fraction of missed cases is bound to be higher still if this audit is carried out with a larger sample size, in a longer duration and in a range of cardiac emergency units.

This can possibly contribute significantly to post-PCI results as it improves the 'door-to-balloon time' within the catheterization suite as well. However, as our study was limited to an emergency setting, the affect of the door-to-ECG time on the door-to-balloon time could not be measured. Regarding this, Bradley *et al.* carried out a study into reducing door-to-balloon times in acute MIs and wrote that prior research has established that door-to-balloon times can be shortened if an ECG is performed on the way to the hospital.¹⁰

The administrative framework of our setup involved a 20+ bedded cardiac emergency unit adjacent to a PCI-lab where patients were transferred in an expedited manner in the event a STEMI was diagnosed. However, a lack of demarcation of beds specifically for ECG performance hindered our setup from achieving more than approximately 60% of the benchmark door-to-ECG time of 10 minutes. Additionally, patients were not routinely triaged at the emergency desk at our setup. Coyne *et al.* performed a similar clinical audit as ours which was followed by an interventional study into how door-to-ECG time influences door-to-balloon time. His study involved setting up a 'cardiac triage' to filter potential STEMI patients and it concluded that steps taken to improve door-to-balloon time for STEMI patients includes rapid ECG performance, interpretation and urgent catheterization lab response.¹¹

Furthermore, the presence of other pathologies that warrant an urgent ECG by emergency staff cannot be underestimated. These included the prompt

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identification of potentially-fatal arrhythmias such as ventricular fibrillation in patients presenting with palpitations or other symptoms. Glickman *et al.* suggested in his study that an ordinary ECG-prioritization rule depending on the patients' age and symptoms in an emergency unit can point out those during triage that have a higher suspicion of STEMI and thus should urgently have an ECG done before being attended by a doctor.¹²

Targeted guidelines by the AHA/ACC to meet the ideal door-to-ECG time of 10 minutes however, do not exist yet.¹³ This increases the reliance on quality improvement projects by hospitals to explore where their emergency departments stand on door-to-ECG time and what obstacles can possibly be overcome in meeting the milestone of 10 minutes.

Moreover, as stated in a study published in Cambridge journal there are multiple interventions that show potential for reducing emergency department door-to-ECG times. Effective bundled interventions include having a dedicated ECG technician, triage education, and better triage disposition. These changes can help institutions attain best practice guidelines. Emergency departments must first understand their local context before adopting any single or group of interventions.¹⁴

Similar to a study conducted by Chih Kuo Lee *et al.* the sources of delays in door-to-ECG times could be classified into 2 types: failed recognition or delayed performance.¹⁵ Other confounding factors contributing to a delay in door-to-ECG time/ STEMI diagnosis could also include sex, race, language, and diabetes as previously suggested by Maame Yaa *et al.* in his study published in Journal of American Heart Association.¹⁶

Apart from STEMI, our data also identified 26(15.3%) patients which were suffering from an NSTEMI and subsequently were thrombolysed within the ER and admitted in a coronary care unit for further management. The majority of these patients 15(57.8%) had rapid 10 minute ECGs done that showed features such as T-wave inversions that were suggestive of NSTEMI and were managed well before troponin levels could come back from the lab. The remainder 11(43.2%) of the patients had bypassed the time frame within which ECG changes of ischemia could have been identified and therefore were awaiting results of cardiac biomarkers which consumed ample time during which a potential STEMI could have been identified in another patient.

Takakuwa KM *et al.* suggested in his study that where it is already established that ECG delays can in themselves delay PCI or thrombolysis, ECG changes of ST-elevation and new Q-wave appearance suggest a higher chance of ACS while normal ECG results decrease the likelihood of ACS. Changes recommended by the National Heart Attack Alert Program Coordinating Committee of the United States to meet the ideal door-to-ECG time can include standing orders on the performance of ECGs, having ECG machines within emergency settings and prompt arrival of ECG technicians within 5 minutes of paging.

Lastly, hardly any studies on door-to-ECG time have been carried out at a regional or national level which highlights the significance of our study. Other hospitals could conduct a research on door-to-ECG time in their settings and compare it with the results from our study to potentially formulate local guidelines on door-to-ECG time similar to international guidelines.

RECOMMENDATIONS

1. A re-audit is recommended in the same setting and time frame and with the same sample size.
2. More studies on door-to-ECG time should be carried out in different hospitals, with larger sample sizes and over larger durations at a regional or national level.
3. A few beds should separately be allocated solely for performance of an ECG (ECG beds) and a separate group of doctors and technicians should only tend to those particular beds so as to promptly identify a STEMI and accordingly shift the patient to the catheterization lab for PCI (STEMI teams).
4. Lastly, registration processes should be more organized where patients presenting with chest pain would have an ECG drawn before their demographics are entered at a crowded registration desk.

LIMITATIONS OF STUDY

Sample size as well as study duration was small. Data for 24-hour period was not collected. Trained ECG staff was short to perform ECG

CONCLUSION

Based on previous literature on door-to-ECG time and comparing them to our own results, we suggest that the door-to-ECG time at our setup needs to be improved in order to meet the AHA/ACC guidelines.

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Author's Contribution:

Following authors have made substantial contributions to the manuscript as under:

AS: Manuscript writing, drafting and editing

SM: Manuscript writing, drafting and editing

UI: Intellectual contribution, concept and final approval

HS: Study design, concept and critical review

HK: Analysis, manuscript writing and proof reading

SBY: Formatting, critical review and data collection/entry

AK: Analysis, manuscript writing and proof reading

HMS: Proof reading, Intellectual contribution, final approval

RJ: Review of article, formatting and critical review

AS: Review of article, formatting and critical review

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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