# Impact of Universal Health Insurance on Total Ischemia Time and Door-to-Balloon Time in STEMI: A Single-Center Study from a Geographical Adverse Region

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## Abstract

**Introduction:** We studied the impact of a Universal Health Insurance (UHI) Scheme introduced in India on total ischemia time (an important determinant of ST-elevation myocardial infarction [STEMI] outcome). **Materials and Methods:** This is a retrospective hospital-based comparative study which evaluated the total ischemia time (min) of all the patients presenting with STEMI and undergoing primary angioplasty before (Group A) and after (Group B) implementation of this scheme. **Results:** A total of 221 patients (mean age: 54.18 ± 13.02 years in Group A and 57.59 ± 11.42 years in Group B) were included in the study. Median pain to first medical contact time was 300 and 360 min ($P = 0.49$), whereas the median first medical contact to percutaneous coronary intervention PCI center time was 330 and 210 min ($P = 0.32$), for Groups A and B, respectively. A statistically significant difference was noted in the mean door-to-device time between two groups (67.46 ± 33.10 min in Group A vs. 58.48 ± 12.99 min in Group B; $P = 0.02$). **Conclusions:** A significant difference in door-to-balloon time was found after implementation of UHI, but total ischemia time was no different. It emphasizes the importance of establishing a system of STEMI care that can decentralize the benefits of early reperfusion like hub-and-spoke model.

**Keywords:** Door-to-balloon time, health inequalities, ischemia time, primary angioplasty, universal health insurance scheme

## Introduction

India is in the phase of epidemiological transition from communicable to noncommunicable disease,[1] with cardiovascular diseases being the leading cause of mortality.[2] Most of these deaths occur in patients with ischemic heart disease in the setting of acute coronary syndrome (ACS). In a vast country like India, regional and societal differences exist in the prevalence of risk factors as well as treatment outcomes of cardiovascular diseases.[3]

In previous ACS registries like CREATE and Kerala ACS Registry, 40%–60% of patient presented with ST-elevation myocardial infarction (STEMI) which was proportionately higher compared to data from western countries. Indian STEMI patients had higher in-hospital and 30-day mortality rates.[4,5] The two most important determinants of in-hospital mortality and long-term prognosis in STEMI are total ischemia time (duration from onset of symptom to reperfusion) and selection of reperfusion therapy (pharmacological or mechanical).[6] Prolonged ischemia time due to delayed presentation coupled with underutilization of reperfusion therapy characterized Indian STEMI patients and contributed to high fatality rate in such registries.

In India, rapidly growing population, regional differences, socioeconomical differences, and income inequalities lead to health inequalities.[7] Such inequalities become particularly relevant for STEMI care as treatment is expensive.

*Ayushman Bharat* was a government-sponsored health scheme launched in India in 2018 to improve health outcomes

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stemming from health inequalities by providing universal health coverage.[8] The scheme which covers the economically vulnerable, provides five lakh rupees (~6500 USD/relation to per capita income) per family per year, as financial risk protection arising out of secondary or tertiary hospitalization.[9]

Uttarakhand is a state in North India with geographical peculiarity. According to the last census, the population density of the state was 189 per square kilometer; 65% of its area is covered with forest and 86% is mountainous.[10] Exact prevalence of ischemic heart disease in the state is not known; but it was a predominant cause of year of life lost in 2016 according to IHME survey. Centralized tertiary care health centers (including STEMI care and cardiac catherization laboratories), difficult geographical terrain, and the absence of a systematic STEMI care pose unique challenges in STEMI management in Uttarakhand. Before the introduction of the Ayushman Bharat scheme, the patients had to bear the expenses related to procedures such as angioplasty. This deterred many patients from undergoing the treatment owing to high costs. With the introduction of the scheme which makes these procedures free, the number of people opting for such treatments has increased.

*Ayushman Bharat,* the flagship Universal Health Insurance (UHI) Scheme, was expanded in Uttarakhand in the year 2019 to include every citizen of the state making it truly universal.[11] We studied the impact of this UHI on parameters of STEMI management.

## MATERIALS AND METHODS

This was a single-center cross-sectional comparative study conducted at a tertiary care center. All the STEMI patients presenting to our center between 2017 and 2018 (a year before implementation; Group A) and between 2018 and 2019 (a year after implementation; Group B) were included.

Adults aged >18 years presenting with typical ongoing chest pain >30-min duration, ST elevation >1 mm at j point in two contiguous leads with duration of symptoms <24 h were included. Patients with cardiogenic shock at presentation, prior PCI within last 3 months, prior CABG, unwilling to provide informed consent, and with life expectancy <1 year (such as those with multiple comorbidities in whom the perception of pain may have been delayed due to various reasons) were excluded.

Data were collected from medical records of the patient diagnosed with STEMI who underwent percutaneous coronary intervention (PCI). Demographic profile of all patients was evaluated. The total ischemia time (min), i.e., total duration from symptom onset to reperfusion was divided into three components as follows: symptom/pain onset to first medical contact time (time taken for the patient to reach the medical center after the onset of ischemia). If the first medical contact was not our center, then transport delay was calculated as first medical contact to PCI center time (min) (total time taken for the patient to be shifted from the initial medical center to the PCI center). Door-to-device time (min) was defined as the total time taken for the patient to be shifted from the medical center to the insertion of the device/angioplasty). The symptom/ pain to first medical contact time is generally specified in the discharge summary of all patients undergoing PCI, to assess the efficiency of the STEMI program Figure 1.

Patients being transported to our center were assessed whether they received correct loading doses of antiplatelet or whether thrombolytic was administered at first medical contact. Location of myocardial infarction was evaluated based on ECG and ECHO, whereas ejection fraction by echocardiography was assessed using Simpson's method. Severity of coronary artery disease (single, double, or triple vessel disease) was also assessed during coronary angiography.

### Ethical compliance

This study was conducted in compliance with the ethical standards of the responsible institution on human subjects as well as with the Helsinki Declaration. Permission from the institutional ethical committee was obtained before conducting the study.

### Statistical analysis

SPSS Software, (Version 27.0. Armonk, NY: IBM Corp) was used for statistical analysis. Mann–Whitney $U$ test was done for comparing pain to first medical contact time. Chi-square test was used to compare the proportion of patients presenting directly to PCI centers in both the groups. Mann–Whitney $U$ test was done to compare first medical contact to PCI center time for transported patient. Independent sample $t$-test was used to compare door-to-device time.

## RESULTS

A total of 250 patients were screened, and 221 patients were included in the study which includes 142 patients in Group A and 79 patients in Group B. The demographic, clinical and angiographic features were as shown in Table 1.

The mean age of the patient was $54.18 \pm 13.02$ years in Group A and $57.59 \pm 11.42$ years. Proportionately more male patients presented to our center than females [Table 1].

### Pain to first medical contact time

The median pain to first medical contact time was 300 min for Group A and 360 min for Group B with $P = 0.49$. 54.9% of patients in Group A and 54.4% patients in Group B presented directly to PCI center. 45.1% of patients in Group A and 45.6% patients in Group B were transported to PCI center from first medical contact. The median delay in transportation was 330 min (60–5760) for Group A patients and 210 min (20–8640) for Group B patients with a $P = 0.32$ [Figure 2]. Statistically significant difference in mean door-to-device time was present between two groups ($67.46 \pm 33.10$ min in Group A and $58.48 \pm 12.99$ min in Group B; $P = 0.02$) [Figure 2].

## DISCUSSION

The expenditure on health in India is 1% of gross domestic product creating gross inadequacies in workforce, infrastructure, and quality of health care. It is estimated that about 85% of people in India are not covered under any health insurance scheme. Although there are many state and central level schemes such as Employees' State Insurance Scheme and Central Government Health Scheme, the coverage and treatment options are limited and vary across different states in India.

Pain to first medical contact time was more in insured group compared to noninsured group, although the difference was not statistically significant. Plausible explanation could be patients from remote areas coming to medical attention as they were empowered by UHI.

Proportion of STEMI patients being referred for PCI from a non-PCI center did not change significantly after the implementation of universal insurance as there is no existing system of STEMI care in the state.

Transportation delay measured by first medical contact to PCI center was less in insured group as destination hospitals for insured group were empanelled hospital under *Atal Ayushman* scheme. However, the difference was not significant. Statistically significant reduction in door-to-device time was noted for insured patient as there were no financial constraints.

Longest delay was pain to first medical contact time in insured group, whereas in uninsured group, longest delay was noted in first medical contact to PCI center transportation. Time to recognize symptom is usually the longest delay in window period.[12] However, the time taken by patient to recognize the symptom could not be calculated independently, and it was included in pain to first medical time.

Door-to-balloon time was significantly less in insured group, but there was no difference in total ischemia time even after universal insurance. Mortality and infarct size in STEMI relates more to total ischemia time than door-to-balloon time.[13]
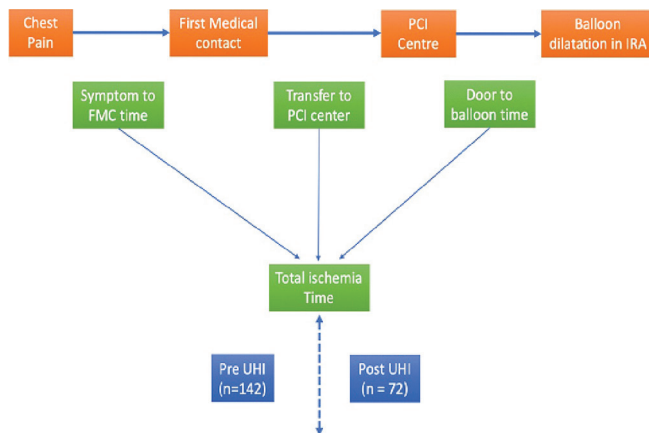


**Figure 1:** Central illustration of the study showing composition of total ischemia time compared between two groups before and after application of universal health insurance

One striking finding of our study was that <5% of patient received fibrinolysis in both the groups. In Indian ACS Registry, about 35%–58% of patient received thrombolysis, most commonly by streptokinase.[14] Fibrinolytic facilities are virtually nonexistent in distant hilly areas where such types of facilities are needed the most! We call it STEMI-UK paradox. Lack of STEMI care facilities and physician inertia could be the reason for this observation. Difficult geographical terrain poses challenges for timely transportation of patient, and transport delay is a rule rather than exception from remote areas of hilly states.

In a state with highly centralized PCI facilities and a larger population of patient living in difficult geographical terrain where fibrinolytic facilities are nonexistent, we could not find any significant difference in total ischemia time for STEMI patients even after implementation of UHI scheme.

A system of STEMI care with existing health infrastructure and available resources like the hub-and-spoke model is urgently

**Table 1: Baseline demographic clinical and angiographic features of the study population**

| Baseline characteristics | Group 1 (*n*=142) | Group 2 (*n*=79) |
|---|---|---|
| Age, mean±SD | 54.18±13.02 | 57.59±11.42 |
| Sex | | |
|   Male | 115 (81.0) | 67 (84.8) |
|   Female | 27 (19.0) | 12 (15.2) |
| Diagnosis | | |
|   Anterior wall MI | 57 (40.1) | 38 (48.1) |
|   Inferior wall MI | 69 (48.6) | 33 (41.8) |
|   Anterolateral wall MI | 4 (2.8) | 2 (2.5) |
|   Posterior wall MI | 2 (1.4) | 1 (1.3) |
|   NSTEMI | 10 (7.0) | 5 (6.3) |
| Killip stage | | |
|   I | 54 (38.0) | 17 (21.5) |
|   II | 58 (40.8) | 42 (53.2) |
|   III | 9 (6.3) | 6 (7.6) |
|   IV | 21 (14.8) | 14 (17.7) |
| SBP, mean±SD | 128.04±30.44 | 129.44±26.83 |
| LVEF, mean±SD | 43.23±8.47 | 41.65±8.81 |
| Outcome | | |
|   Discharged | 138 (97.2) | 79 (100.0) |
|   Died | 4 (2.8) | 0 (0.0) |
| Thrombolysis received | | |
|   Yes | 7 (4.9) | 3 (3.8) |
|   No | 135 (95.1) | 76 (96.2) |
| Loading dose | | |
|   FMC | 51 (35.9) | 28 (35.4) |
|   Emergency | 91 (64.1) | 51 (64.6) |
| Severity of disease | | |
|   SVD | 104 (75.4) | 58 (73.4) |
|   DVD | 31 (21.8) | 20 (25.3) |
|   TVD | 4 (8.0) | 1 (1.3) |

SD: Standard deviation, TVD: Triple vessel disease, DVD: Double vessel disease, SVD: Single vessel disease, FMC: First medical contact, MI: Myocardial infarction, LVEF: Left ventricular ejection fraction, SBP: Systolic blood pressure, NSTEMI: Non-ST-elevation myocardial infarction
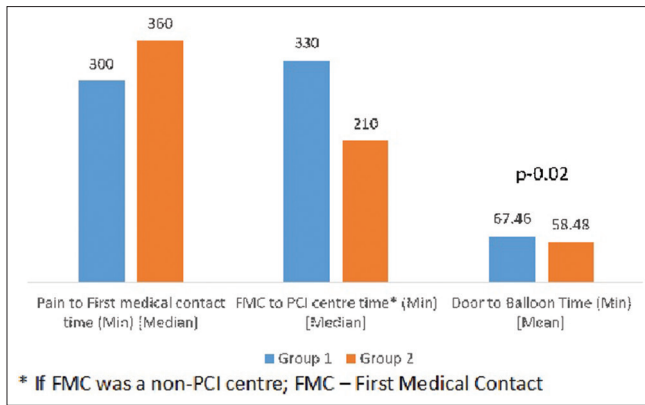
**Figure 2:** Comparison of various parameters between Group 1 and 2

needed for state like Uttarakhand to improve outcome for such patients.[15]

The study had a few limitations. The patients were not followed up to record the outcomes of the procedure. In addition, the sample size included in the study was small.

## Conclusions

There was a significant difference in door-to-balloon time after implementation of UHI, whereas the total ischemia time remained similar. It can hence be suggested that there is an immediate need to establish a system of STEMI care like hub-and-spoke models that can help decentralize the benefits of early reperfusion.

### Acknowledgment
We would like to thank BioQuest Solutions for their editorial assistance.

### Institutional Review Board Approval
The study was a retrospective by design. Hence, ethical committee approval was not taken.

### Data availability
Available on request.

### Financial support and sponsorship
Nil.

### Conflicts of interest
There are no conflicts of interest.

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