International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Pilot Study for Timely Detection and Management of ST-Elevation Myocardial Infarction (STEMI) in the Jammu Division

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Abstract:

Background: Cardiovascular diseases (CVDs), especially ST-Elevation Myocardial Infarction (STEMI), represent a critical public health challenge in India, contributing significantly to premature mortality. In resource-constrained settings like the Jammu Division, delays in diagnosis and limited access to timely care exacerbate the problem. The average delay from symptom onset to treatment exceeds 360 minutes, far beyond the recommended 60-minute window, resulting in avoidable fatalities.

Objective: This pilot study aimed to evaluate the effectiveness of Tricog's InstaECG solution in enabling rapid, AI-assisted ECG interpretation and streamlined care pathways to improve STEMI detection and response in semi-urban and rural public health facilities across the Jammu Division.

Methodology: Approved by the Directorate of Health Services, Jammu Division, the pilot was implemented between January 11 and April 26, 2023, across four government health facilities in Jammu and Samba districts. The intervention included deploying AI-enabled ECG machines, real-time cloud-based data transmission, and mobile app-based feedback to physicians. Pre-implementation diagnostics, training for health staff, and appointment of STEMI coordinators ensured smooth execution.

Outcomes:

- **Screening Reach:** 2,080 patients screened post-implementation, a significant scale-up from 262 during the baseline phase.
- **STEMI Detection Rate:** Increased from 0.3% to 1.8%, reflecting an 85.7% improvement.
- **Diagnosis Turnaround Time:** Reduced from 73 minutes to just 4 minutes, a 94.5% reduction.
- **Timely Intervention:** Thrombolysis was initiated in STEMI patients within an average of 26 minutes post-ECG, well within the golden hour.
- **Clinical Outcomes:** Among 23 critical STEMI patients referred to a tertiary center, 21 survived—reflecting a 5% mortality rate, notably better than the national average.
- **System Strengthening:** Real-time analytics, integrated care protocols, and digital triaging demonstrated scalable and replicable improvements.

Conclusion:

The Jammu STEMI Pilot successfully demonstrated that AI-powered, technology-enabled diagnostic systems can revolutionize acute cardiac care delivery in low-resource public health settings. By drastically reducing diagnostic delays and ensuring structured treatment pathways, the pilot not only improved patient outcomes but also established a replicable model for broader implementation across similar geographies.

The findings support the scale-up of Tricog's InstaECG solution under state and national health missions, particularly in Tier 2 and Tier 3 regions, to bridge the urban-rural cardiac care divide and reduce CVD-related mortality.

Keywords: STEMI, InstaECG, technology-driven diagnosis, Golden Hour, Remote Cardiac Care, Heart Attack

I. Introduction

Cardiovascular diseases (CVDs) represent a **leading global health crisis**, accounting for approximately **32% of all deaths worldwide**—equivalent to **17.9 million lives lost annually**, as per the **World Health Organization (WHO, 2021)**. Among the various manifestations of CVDs, **ST-Elevation Myocardial Infarction (STEMI)** and **stroke** together contribute to **nearly 85% of all CVD-related mortalities**, underscoring their disproportionate impact on global mortality statistics (WHO Fact Sheet, June 2021).

In the Indian context, this burden is even more pronounced. According to the **Global Burden of Disease (GBD) Study**, **India has experienced a marked epidemiological shift**, with non-communicable diseases—especially cardiovascular conditions—surpassing infectious diseases as the leading cause of death and disability. The **age-standardized CVD death rate in India** is among the **highest globally**, standing at **272 per 100,000 population**, significantly above the global average of 235 per 100,000 (IHME GBD 2019). This rising trend is compounded by late diagnosis, poor access to timely care, and limited availability of cardiac diagnostics, particularly in rural areas.

A seminal paper published in **The Lancet Global Health** further reinforced these findings, stating that **CVDs were the single largest contributor to India's total disease burden** by 2016, with **ischemic heart disease and stroke alone accounting for over a quarter of all deaths** (Dandona et al., 2018; *The Lancet Global Health*, Volume 6, Issue 12, PE1339–E1351, December 2018).

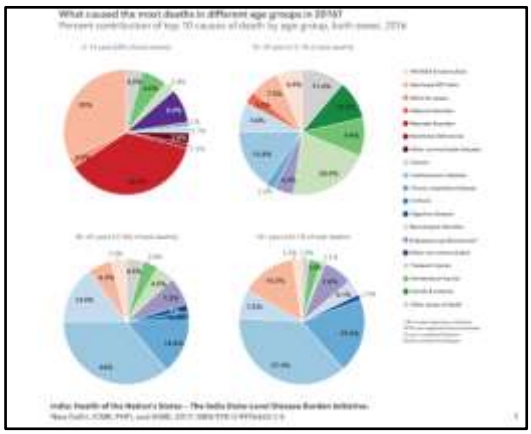


Figure 1*:* CVD burden in Jammu and Kashmir across all age groups.

In a similar context, it has been noted that- Jammu and Kashmir with over 14 million people, has a high burden of cardiovascular diseases (CVDs) due to a combination of environmental, lifestyle, socioeconomic, and healthcare factors. The India State-Level Burden Initiative (2017) reported CVD as the top mortality burden in Jammu and Kashmir– for example, 36.7% of all deaths among ages 40–69 were due to CVD (Figure 1) and 10.7% of the total DALYs (Disability Adjusted Life Years) in Jammu

and Kashmir is due to Ischemic Heart diseases (including ST- elevated Myocardial Infarction/ STEMI)- which peaked in 2016- as per IHME/ICMR data 2017.

These statistics underscore an **urgent need for proactive, technology-enabled, and decentralized cardiovascular screening and intervention models** in India. With early detection and structured care pathways, particularly for high-risk conditions like STEMI, significant reductions in mortality and disability-adjusted life years (DALYs) are achievable.

II. Rationale:

Of all CVD cases**, ST-Elevation Myocardial Infarction (STEMI)** is the most critical and time-sensitive form of CVD/ acute myocardial infarction, resulting from a complete blockage of a coronary artery that leads to irreversible myocardial injury. The principle that **"time is muscle"** emphasizes the urgency of rapid diagnosis and reperfusion therapy to preserve heart function and improve survival outcomes. Despite its urgency, the management of STEMI in **resource-constrained and semi-urban settings like Jammu Division** remains inadequate, contributing to preventable morbidity and mortality.

A study conducted at Government Medical College, Jammu (2011–2013), showed that out of 80 documented AMI cases across 10 districts, **62.5% (50 patients)** were from Jammu district alone—highlighting a **disproportionately high STEMI burden** in the region. This underscores the need for localized, decentralized cardiac care interventions to bridge the accessibility gap.

While **electrocardiography (ECG)** remains the gold standard for early STEMI detection, two major challenges persist in the public health system:

1. **Limited availability of high-quality ECG machines** at primary and secondary facilities due to cost, portability, and maintenance issues.
2. **Lack of real-time ECG interpretation capacity** due to overburdened physicians and the absence of trained cardiology personnel at point-of-care levels.

In India, the **average delay from symptom onset to treatment exceeds 360 minutes**, far beyond the **recommended golden hour of 60 minutes**, contributing to significantly higher fatality rates. Though the Jammu Division initially introduced a **WhatsApp-based STEMI response system**, it was hindered by several operational limitations—such as variable image quality, dependency on manual transmission, staff workload, and unavailability of specialists at critical moments—rendering it suboptimal for consistent, timely care.

Recognizing these systemic gaps, the Jammu STEMI Pilot was conceptualized as a **proof-of-concept intervention** to establish a **decentralized, technology-enabled model for early STEMI detection and management**. The pilot was designed to leverage **AI-powered ECG interpretation**, strengthen **local triage capacity**, and **connect peripheral centers to a nodal PCI facility** in real-time. The overarching goal was to create an integrated care pathway that could dramatically improve patient outcomes while serving as a **scalable template for other semi-urban and remote districts across India**.

This initiative is particularly timely and relevant given the rising CVD burden and aligns closely with national health priorities under the **National Health Mission (NHM)** and **India's vision for universal health coverage**. By embedding diagnostics at the first point of contact and ensuring rapid care coordination, the Jammu STEMI Pilot aims to **bridge the urban-rural cardiac care divide** and demonstrate the impact of proactive, tech-driven public health solutions in resource-constrained environments.

III. Objective of the Pilot

This pilot aims to address these systemic and operational challenges by implementing a **technology-enabled, AI-assisted ECG screening and referral system** that enables:

- **Real-time ECG acquisition and interpretation** with minimal human intervention
- **Rapid triage and referral coordination** with PCI or thrombolysis-capable centers
- **Capacity building of frontline providers** for early STEMI recognition and response
- A scalable model for **reducing STEMI-related mortality and improving system responsiveness** in regions with similar infrastructural constraints

This strategic shift from manual, ad hoc processes to an **automated, standardized, and scalable model** represents a critical step toward strengthening acute cardiac care systems in India's Tier 2 and Tier 3 regions.

IV Project Details *(Duration: Jan 11, 2023- April 26, 2023)*

A. Project Approval

In response to persistent challenges in timely cardiovascular diagnostics and the pressing need for effective intervention strategies in public health systems, the Director General Health Services, Jammu Division, approved a pilot implementation of Tricog's InstaECG Solution. This initiative aimed at bolstering early STEMI (ST-Elevation Myocardial Infarction) detection and streamlining care coordination through technology-enabled diagnostics. The pilot was conducted in four key public health facilities, strategically selected from two districts:

In Jammu District, Sub-District Hospital (SDH), Bishna, and Government District Hospital, Gandhinagar, were chosen for the pilot from January 11, 2023- April 26, 2023. In Samba District, District Hospital (DH), Samba, and Community Health Center (CHC), Vijaypur, were the designated sites for the pilot. This distribution ensured representation across secondary and tertiary healthcare levels, facilitating robust evaluation of the solution's efficacy across varied operational contexts.

B. Pre-Implementation Findings

To establish a foundational understanding of the cardiovascular disease burden and diagnostic landscape, a pre-implementation study was conducted between January 11 and January 24, 2023.

During this period, 262 detailed ECG records and associated patient details (with due consent) were collected from the four sites: 55 from AH Vijaypur, 80 from DH Gandhinagar, 45 from DH Samba, and 82 from SDH Bishna.

FACILITY NAME	PATIENT RECORDS COLLECTED
AH Vijaypur	55
DH Gandhinagar	80
DH Samba	45
SDH Bishna	82
Grand Total	**262**

Table 1: Patient records collected across the 4 pilot centers, prior to pilot implementation in Jammu.

The data highlighted significant symptomatic presentation among patients, with common complaints being chest pain, breathlessness, fatigue, hypertension, palpitations, and radiating pain—each suggestive of potential underlying cardiac pathology.

Alarmingly, **only one STEMI case was diagnosed among the 262 patients**, indicating a detection rate of merely 0.3%. This underscored a systemic issue of underdiagnosis or delayed diagnosis. Furthermore, the average turnaround time for an ECG interpretation was recorded at 1 hour and 13 minutes, a timeline incompatible with optimal STEMI management, where international standards recommend diagnosis within 10 minutes and treatment initiation within 90 minutes of first medical contact (Ibanez et al., 2018).

C. Inclusion and Exclusion Criteria

The study followed rigorous criteria to define the patient cohort for intervention. Adults aged 18 and above presenting with symptoms indicative of cardiac distress were included, provided informed consent was obtained.

Exclusion criteria ruled out patients with a recent history of acute coronary syndrome (within the past month), those with non-cardiac-related complaints, and individuals who declined consent.

This framework ensured that only clinically relevant cases contributed to the evaluation, preserving the integrity of outcomes and aligning with standard clinical research protocols.

D. Ethical Permissions

Before implementation, the study secured permission from the State Health Department. All aspects of the project adhered to ethical guidelines set forth by the Indian Council of Medical Research (ICMR, 2017), including principles of informed consent, patient confidentiality, and secure data handling. Patient identities were anonymized, and data transmission was encrypted to comply with digital health data protection norms.

E. Methodology of Implementation

The methodology employed for the pilot was comprehensive, spanning infrastructure setup, training, remote diagnosis, and real-time monitoring.

Clinical-grade, AI-enabled 12-lead ECG machines were deployed in the participating facilities. These devices were integrated with mobile communication technology for real-time transmission of ECG data to a cloud-based server.

Traditional 12-lead ECG machines and Tricog's Communicator-based 12-lead digital ECG platforms differ significantly in terms of **technology, connectivity, workflow integration, and clinical decision support**. The key differences are:

Data Acquisition and Transmission

- **Traditional ECG Machines**

Traditional ECG machines are standalone devices that capture and print ECGs on thermal paper. In most cases, they do not have integrated connectivity features, meaning that **ECG data remains localized**—either printed for manual interpretation or stored in device memory requiring physical transfer for sharing or archival. This **limits real-time access**, especially in peripheral or remote settings.

- **Tricog's Digital Communicator-Based ECG System**

Tricog's ECG Communicator is a **connected medical device** that acquires high-quality 12-lead ECGs and **immediately transmits the data via cellular or internet connectivity** to Tricog's cloud-based backend. There, ECGs are analyzed by AI- algorithm and verified by expert cardiologists within minutes. This **real-**

time transmission and review mechanism allows for urgent diagnosis and triage—vital in time-sensitive conditions like STEMI or Heart Failure.

Tricog's central command center, staffed by experienced cardiologists and experts, reviewed the ECG data using a proprietary AI-enabled platform. This ensured an accurate diagnosis within five minutes, operating continuously 24x7 (Tricog Health: Real-time ECG Interpretation Platform).

Diagnoses were relayed back to the primary healthcare facilities through Tricog's Cardionet Mobile Application, which enabled attending medical officers to access patient reports on their mobile devices in real time. This mobile accessibility significantly reduced lag time in clinical decision-making.

To ensure optimal use of the technology, facility staff were provided comprehensive training on device usage, report interpretation, app navigation, and patient communication. Training was interactive and hands-on, equipping personnel with both technical and procedural proficiency.

A dedicated STEMI coordinator was stationed at each facility to manage patient registration, ensure timely ECG acquisition, liaise with Tricog's command center, and facilitate patient movement across the care continuum. In parallel, a live analytics dashboard tracked system performance, case metrics, and diagnostic timeliness. This enabled real-time quality assurance and dynamic adjustments to workflow (Hsia et al., 2021).

Tricog's ECG solution transforms the traditional ECG into a connected, intelligent diagnostic ecosystem, making high-quality cardiac care accessible, real-time, and expert-led, even at the last mile. It significantly augments clinical capacity in low-resource settings and aligns with the needs of public health programs aiming for early detection and timely intervention.

i. Tricog STEMI Solution Overview

The InstaECG system was designed to provide rapid, round-the-clock ECG interpretation and STEMI detection in resource-constrained public health settings. The system's AI engine allowed ECGs to be processed and diagnosed within 10 minutes—far faster than the baseline average.

In addition to rapid detection, the platform offered integrated decision support tools that guided physicians on the next steps, including thrombolysis initiation or patient referral to higher centers. This structured approach reduced ambiguity and enhanced care pathway adherence.

The inclusion of real-time alerts and robust communication features meant that even remote facilities could be brought into the loop quickly, thus minimizing systemic delays and supporting adherence to evidence-based care pathways (Ibanez et al., 2018).

ii. Treatment Plan and Care Pathway

A Steering Committee composed of senior cardiologists, public health specialists, and program managers was constituted to oversee clinical governance. This committee was responsible for drafting the STEMI Protocol—a treatment and referral guideline tailored for the pilot.

Key responsibilities included the design of clinical workflows, training of healthcare providers, ongoing review of patient data, and coordination with state-level health administrators to ensure seamless integration with public health policies. The protocol was grounded in national cardiology standards and customized to local infrastructural capacities.

iii. Outcome Tracking and Evaluation

To quantify clinical and operational outcomes, a dedicated digital tool was employed to capture patient data at every stage of the treatment journey. This included:

- The first point of medical contact
- Time and location of STEMI detection

- Time to administration of thrombolysis
- Ambulance dispatch and arrival
- Hospital admission, catheterization, and discharge details
- Clinical history and post-discharge follow-ups up to one year

This robust tracking system ensured longitudinal evaluation of each patient's journey and allowed for the identification of bottlenecks in the treatment pathway. The software tool facilitated automated analytics and produced dashboards for internal audits and feedback loops (McClellan et al., 2020).

F. Results: Post-Implementation Findings

Data collected between January 24, 2023, and April 26, 2023, revealed significant improvements compared to the baseline. A total of 2,080 patients were screened, demonstrating a substantial scale-up in diagnostic outreach.

SPOKE/HOSPITAL	NORMAL ECG	ABNORMAL ECG	OTHER CRITICALS	STEMI	GRAND TOTAL
Accidental Hospital Vijaypur	38	77	13	2	130
Sub Dist. Hospital Bishna	60	105	9	7	181
District Hospital Samba	191	206	15	9	421
Govt. District Hospital Gandhinagar	597	662	68	21	1348
Total	**886**	**1050**	**105**	**39**	**2080**

Table 2: Distribution of Normal, Abnormal, Critical and STEMI detections across the 4 pilot centers in Jammu- post-implementation of the pilot.

Notable key observations in the post-implementation phase of the pilot are-

1. Screening Reach

The Jammu STEMI Pilot demonstrated a substantial scale-up in diagnostic reach. During the pre-implementation baseline period, only 262 patients were screened across four facilities. Post-implementation, this number rose to 2,080 patients, indicating around eight-fold increase in reach. This expansion reflects improved accessibility, awareness, and system efficiency enabled by AI-powered ECG deployment.

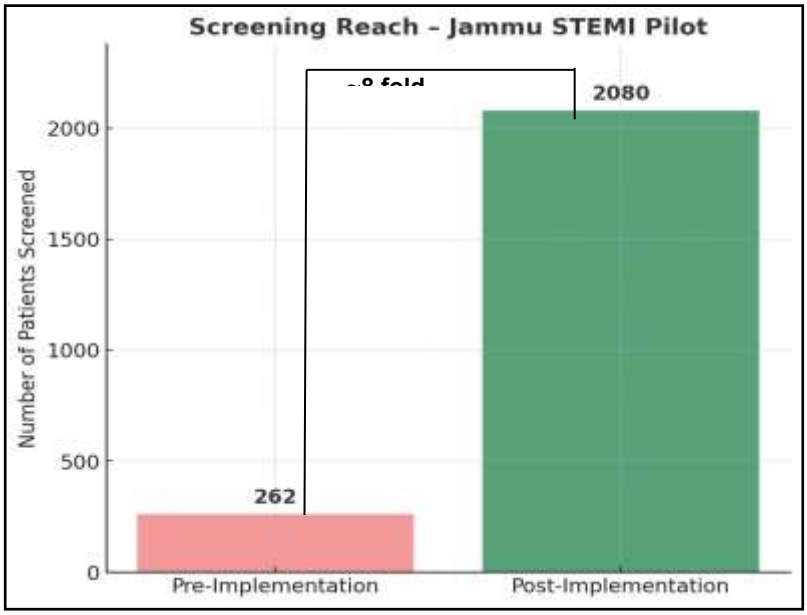
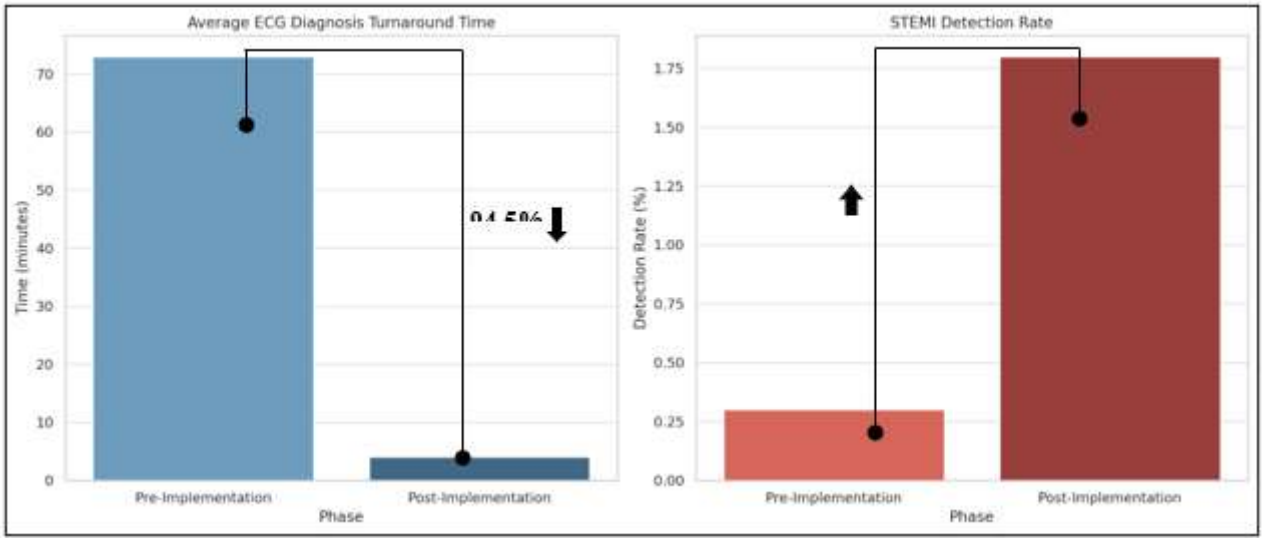


Figure 1: Screening reach of the Jammu-STEMI pilot increased ~8 folds, post-implementation.

2. STEMI Detection Rate & Diagnostic Reach:

The STEMI detection rate rose from 0.3% (1 case out of 262 screened) at baseline to 1.8% (39 cases out of 2,080 screened) post-implementation. This represents an 85.7% relative improvement in detection efficiency. The increase highlights the capacity of the InstaECG solution to identify STEMI cases that may have previously gone undetected.

Similarly, before implementation, the average turnaround time (TAT) for ECG interpretation was 73 minutes, far exceeding international benchmarks. Post-implementation, the TAT was reduced to just 4 minutes, reflecting a 94.5% reduction. This remarkable efficiency gain directly reflects the impact of real-time AI-assisted ECG analysis and cloud-based reporting.



(a) **(b)**

Figure 2: (a) Average ECG diagnosis turnaround Time improved by 94.5% post-implementation. **(b)** STEMI Detection has improved by 85.7% post-implementation of pilot.

Therefore- key take-aways from the post implementation of the pilot entails-

- 1.8% of the total screened patients were identified as STEMI cases, increasing the STEMI detection rate by 85.7% post implementation- in comparison to baseline statistics.
- Average turnaround time for diagnosis was reduced to 4 minutes for all cases which is a significant improvement of around 94.5% (in terms of performance) over the baseline diagnosis TAT of 73 mins.
- Timely thrombolytic therapy was administered to 7 STEMI patients within 26 minutes of ECG recording.
- The critical STEMI patients were referred to the GMC, Jammu after administering the initial loading dose and underwent treatment. Out of the 23 patients that can be traced there were
- Angiography - 8
- PCI - 6
- Other procedures/ medical management - 8
- Out of 23 traced critical STEMI patients, only 2 deaths were reported (5%), surpassing the national average.
- The screening also improved considerably recording much more data for analytical assessments.

G. Discussions:

The pilot implementation of Tricog's InstaECG Solution in the Jammu Division yielded noteworthy improvements in both clinical outcomes and system efficiency. A central achievement was the dramatic reduction in the average turnaround time for ECG interpretation—from a pre-implementation baseline of 73 minutes to just 4 minutes post-implementation. This sharp decline can be directly attributed to the integration of AI-driven rapid ECG analysis and cloud-based communication technologies. Such acceleration in diagnostic timelines is critical in STEMI care, where "time is muscle," and aligns well with internationally recommended benchmarks advocating treatment initiation within 90 minutes of symptom onset (Ibanez et al., 2018).

A significant observation across the pilot was the administration of thrombolytic therapy to seven STEMI patients within 26 minutes of ECG recording. This level of responsiveness demonstrates not only technological efficacy but also the effectiveness of training initiatives directed at facility staff and STEMI coordinators. Achieving such rapid intervention is central to minimizing myocardial injury and aligns with global best practices for acute cardiac care.

Referral patterns further underscore the strength of the care continuum established through the pilot. Of the 23 critical STEMI patients who were referred to GMC Jammu post-thrombolysis, 8 underwent angiography, 6 received percutaneous coronary intervention (PCI), and 8 were managed conservatively or through alternative interventions. The mortality rate among this cohort was recorded at 5%, markedly lower than the national average reported for public health settings (Gupta et al., 2020). This highlights the critical role early diagnosis and efficient escalation pathways play in improving survival, even in resource-constrained environments.

Beyond individual patient outcomes, systemic healthcare capabilities improved significantly. The volume of ECG screenings more than quadrupled compared to baseline figures, reflecting greater awareness, better access to diagnostic facilities, and improved operational workflows. Additionally, the collection of larger datasets enabled real-time analytics through digital dashboards, promoting continuous performance monitoring and adaptive management strategies.

Finally, the high degree of acceptability among healthcare providers, administrators, and frontline workers indicates a strong potential for scalability. The success of the STEMI Jammu Pilot validates the feasibility of digital transformation in acute cardiac care and establishes a compelling case for replicating such technology-driven models across other underserved and rural regions. If scaled nationally, this model could contribute significantly toward reducing cardiovascular mortality rates and bolstering India's broader non-communicable disease (NCD) management framework.

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