National Programme for Prevention and Control of Non-communicable Diseases

Guidelines for Management of ST-Elevated Myocardial Infarction

Directorate General of Health Services
Ministry of Health & Family Welfare
Government of India

2022

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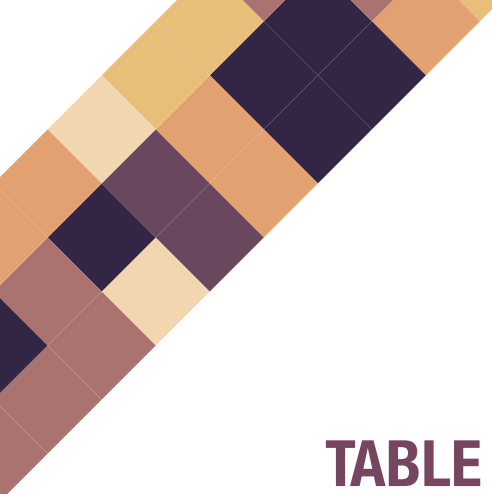Ministry of Health & Family Welfare
Government of India

2022

TABLE OF CONTENTS

डॉ. मनसुख मांडविया
DR. MANSUKH MANDAVIYA

स्वास्थ्य एवं परिवार कल्याण
व रसायन एवं उर्वरक मंत्री
भारत सरकार
**Minister for Health & Family Welfare
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Government of India**

MESSAGE

Cardiovascular Diseases (CVDs) are contributing to the increasing burden of Non-Communicable Diseases (NCDs) as one of such primary causes of death and disability among NCDs accounting for 32.5% of deaths globally and India accounts for 1/5th of these deaths. ST elevation Myocardial Infarction (STEMI) are estimated to occur in about 30 lakh cases in India per year.

Changes in lifestyle, behavioural patterns, demographic profile and socio-cultural milieu, among other factors, are all contributing to an increase in prevalence. The illness and its consequences have a significant long-term impact on the patient, family, community, and, eventually, the health care system and economy.

I am confident that these guidelines will go a long way in enhancing the awareness and bringing the treatment closer to the community.

(Dr Mansukh Mandaviya)

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MESSAGE

The National Programme for Prevention and Control of Non-Communicable Diseases has been strengthened with deep commitment in the recent years keeping in view of growing burden of Non-communicable diseases (NCDs) including cardiovascular diseases (CVDs). Additionally, under Ayushman Bharat population-level interventions for NCD services (prevention, control, screening, and treatment of common NCDs) at Health and Wellness Centres is crucial milestone under NHM.

The programme managers at State/ District NCD division will find these Guidelines useful to successfully implement the interventions for management of STEMI in the country. Strong efforts towards awareness generation and timely protocol-based management will go a long way in reducing the burden of STEMI in India.

The Government of India, under the visionary leadership of Hon'ble Prime Minister Shri Narendra Modi ji, is committed to meet the health needs of the people of India. I wish the programme all the success to win this crucial battle for our country and congratulate all the stakeholders on this important milestone.

सर्वे भवन्तु सुखिनः। सर्वे सन्तु निरामयाः।
(अर्थात सभी सुखी होवें, सभी रोगमुक्त रहें।)

BPw
(Dr. Bharati Pravin Pawar)

"दो गज की दूरी, मास्क है जरूरी"

डॉ. विनोद कुमार पॉल
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16th November, 2022

MESSAGE

The number of ST Elevation Myocardial Infarction (STEMI) cases in India is thought to exceed 3 million annually. The mortality and morbidity brought on by myocardial infarction account for more than 15% of deaths among patients due to STEMI and non-STEMI each year.

The National Program for the Prevention and Control of Cardiovascular Diseases (CVDs), Diabetes, Cancers, and Stroke (NPCDCS) has included the prevention and management to STEMI as well on priority due to the increasing burden of STEMI cases. The program has a strong emphasis on improving infrastructure, developing human resources, promoting health & raising awareness for NCDs prevention, early diagnosis, management, and referral to an appropriate level of healthcare institution for treatment of the NCDs.

The guidance document for Implementation of STEMI Management programme under NPCDCS tries to enhance the awareness regarding the early diagnosis and timely management. The document would facilitate in reducing the delays in providing the reperfusion therapy to STEMI patients due to non-availability required resources or technologies nearby.

Therefore, I am confident that these guidelines will enable healthcare professionals to make the best choices for STEMI treatment and referral to the best quality of healthcare institutions, bringing reperfusion therapy closer to the community and minimising system delays.

These guidelines will also play a pivotal role for building up and managing STEMI care facilities at various levels of healthcare facilities for programme managers at the State and District level as well as medical officers, specialists, and other healthcare providers.

(Vinod Paul)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

राजेश भूषण, आईएएस
सचिव

RAJESH BHUSHAN, IAS
SECRETARY

Azadi Ka
Amrit Mahotsav

MESSAGE

Heart attack is one of the major causes of mortality in the developing countries. The ischemic heart disease/ST Elevation Myocardial Infarction (STEMI) is estimated to account for more than 30 lakh cases annually in India. In view of the accentuating burden of Non-Communicable Diseases (NCDs) with cardiovascular diseases (CVDs) accounting for more than 27% of all deaths in the country, the Sustainable Development Goals (SDGs) to reduce premature mortality from NCDs by a third by 2030 through prevention and treatment assumes specific significance.

Population level interventions for prevention, control, screening, and management of common NCDs, including CVDs, are being implemented under Ayushman Bharat Health and Wellness Centres & Ayushman Bharat Pradhan Mantri Jan Arogya Yojana. Cardiac Care Units (CCUs) are being set up for managing cardiac emergencies under the National Programme for Prevention and Control of Non-Communicable Diseases.

The guidelines for prevention & management of STEMI is a supplement to the existing operational guidelines. I hope that these guidelines would help to reinforce the essential components of health promotion, early detection, timely management and care of STEMI patients.

I am sure these guidelines will be useful for programme managers at State & District level and medical officers, specialists and staff for setting up and managing the STEMI care facilities nearest to the community.

(Rajesh Bhushan)

Place : New Delhi
Date : 26.10.2022

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Government of India
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Directorate General of Health Services

सत्यमेव जयते

PREFACE

Cardiovascular diseases (CVDs) are the leading cause of death globally (32%) as well as India (27%). Of these, 85% were due to heart attack and stroke. India is estimated to have more than 3 million ST Elevation Myocardial Infarction (STEMI) cases per year.

The National Program for Prevention and Control of Non-communicable Diseases (NCDs) has included prevention as well as management of STEMI. The program has strong emphasis on improving infrastructure, developing human resources, promoting health and raising awareness for NCD prevention, early diagnosis, management, and referral to appropriate levels of healthcare institution for treatment.

This document's aims to deliver re-perfusion therapy i.e., thrombolys is to STEMI patients closer to the community, within an acceptable framework, and with appropriate links to referral centers in order to decrease avoidable morbidity and mortality due to STEMI. It also emphasizes the services be provided in a phased manner to ensure optimum utilization of limited resources at medical institutions to achieve maximum output.

The guidance document would also allow States/UTs to put in place necessary elements, including human resources, medicines, equipment, and diagnostics, at all levels of health care delivery system in order to deliver prevention & management of STEMI.

(Atul Goel)

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Roli Singh, I.A.S.
अपर सचिव एवं मिशन निदेशक (रा.स्वा.मि.)
Additional Secretary & Mission Director (NHM)

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FOREWORD

In India Non-Communicable diseases (NCDs) are accounting for more than 63% of total deaths. Cardiovascular diseases (CVDs) are one of the major components of these, posing a public health challenge with 27% overall mortality. Moreover 15% of individuals with STEMI and Non-STEMI experience death and morbidity from myocardial infarction each year.

Under National Programme for Prevention and Control of Non-communicable Disease one of the important components is prevention and management of CVDs including STEMI. The National NCD Programme being implemented under National Health Mission (NHM), envisages to set up infrastructure and provide support for interventions for prevention and control of common NCDs including cardiovascular diseases up to the level of Health & Wellness Centres (HWCs) under Ayushman Bharat.

The guidance document for Implementation of STEMI Management programme tries to enhance the awareness regarding the early diagnosis and timely management. The document would facilitate in reducing the delays in providing the re-perfusion therapy to STEMI patients closer to the community.

Therefore, these guidelines have been developed by incorporating inputs from subject & programme experts with the aim of improving the quality of STEMI care including referral linkages. I am sure that these guidelines would be useful for both program managers and clinicians.

(Roli Singh)

स्वच्छ भारत - स्वस्थ भारत

MESSAGE

Non-Communicable Diseases (NCDs) are estimated to account for 63% of all deaths in the country of which the cardiovascular diseases lead with 27% overall mortality. In terms of years of life lost, ischemic heart disease/ ST Elevation Myocardial Infarction (STEMI) ranks first among causes of early mortality. In India, STEMI is thought to account for more than 30 lakh cases per year.

Government of India aims to reduce morbidity and mortality due to all major NCDs including STEMI through implementation of National Programme for Prevention and Control of Non-Communicable Diseases. Population level intervention for primary prevention, early identification, control and management undertaken up to Primary Health Care (PHC) / Health and Wellness Centres (HWCs) level and NCD service delivery package of Health and Wellness Centres under Ayushman Bharat are other major steps taken to meet the SDG targets for 2030.

Given the importance of STEMI management, the guidance document is developed with an objective to provide support to program management, build capacity of healthcare providers at different levels of health care to take protocol-based decisions and reduce the delay in the initiation of treatment. The comprehensive document includes interventions to be adopted at various facility levels, referral linkages to higher centres for further management of patients, health promotion through stakeholder engagement, etc.

These guidelines will be helpful for building up and managing STEMI care facilities at various levels of healthcare facilities for programme managers at the State and District level as well as medical officers, specialists, and other healthcare providers.

(Vishal Chauhan)

स्वच्छ भारत - स्वस्थ भारत

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Message

As per World Health Organisation (WHO) data, the coronary artery disease (CAD) prevalence continues to rise in India with rapid 'epidemiological transition'. The rising incidence of CAD in young Indians is of particular concern. The incidence of CAD in young population in Western countries is 2–5%, whereas it is 11–16% in Asian Indians. The management of acute ST-Elevation Myocardial Infarction (STEMI) has rapidly evolved worldwide during the last two decades with better understanding of the need for early reperfusion and protocol-based pharmacotherapy.

The STEMI program under National Programme for Prevention & Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS) tries to curtail system-related-delays and enables Medical Practitioner at the Community Health Centre level to administer thrombolytic agents. On stabilisation of the STEMI programme at the CHC level it can be implemented at PHC level closer to the community to cut short the system and patient delays. The program would enable States and UTs to develop and effectively run STEMI care programme depending on the local geography and infrastructure.

MoHFW with support from NHSRC and NCD programme Division and taking inputs from subject experts, has prepared a guidance document for implementation of STEMI management programme at the secondary care level, encouraging MOs for recognising STEMI conditions and provide timely intervention, for saving precious lives.

I am sanguine that these guidelines will enable the States/UTs to implement the STEMI programme effectively.

(Maj Gen (Prof.) Atul Kotwal)

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MESSAGE

In India Non-Communicable Diseases (NCDs) are accounting for more than 63% of total deaths of which over 55% are premature. ST Elevation Myocardial Infarction (STEMI) is one of the major components of these, posing a grave public health challenge.

According to estimates, 28.1% of fatalities in India are thought to be caused by cardiovascular diseases (CVDs) under which the contribution of Ischemic Heart Diseases (IHD) and Strokes is the highest (85%). The largest percentage of CVDs, 14.1%, contribute to Disability Adjusted Life Years (DALYs), 8.7% of which are attributable to IHD alone. More than 30 lakh occurrences of STEMI are thought to occur yearly in India, accounting for almost 40% of all myocardial infractions.

National Programme for Prevention and Control of Non-Communicable Diseases (NCDs) being implemented under National Health Mission (NHM) envisages to set up infrastructure and proved support for interventions for the prevention and control of CVDs including STEMI among others, up to District level. Under NPCDCS, 682 District NCD Clinics, 191 District Cardiac Care Units, and 5408 Community Health Centre NCD Clinics has been set up. STEMI is also an integral part of the program.

Under the aegis of National NCD Programme, these guidelines for STEMI have been framed for health care providers involved in management of patients with STEMI and reducing the delays in providing the re-perfusion therapy to them, due to non-availability of a Percutaneous Coronary Intervention (PCI) performing health facility nearby. It would enable the program managers to establish linkages with PCI-enabled facilities for further management and care of STEMI and set up the thrombolytic capacity at all other non-PCI-enabled health facilities. The document would also provide guidance towards ensuring the necessary resources for program's implementation for the management of STEMI patients.

Therefore, I am sure that with these guidelines, healthcare providers will be able to make appropriate decisions regarding STEMI care and referral to appropriate level of healthcare facilities bringing re-perfusion therapy closer to the community.

(Dr Sudarsan Mandal)

1
Introduction

Myocardial infarctions are generally clinically classified into ST elevation MI (STEMI) and non-ST elevation MI (NSTEMI), based on changes in ECG. When blood flow to a part of the heart stops or the heart is injured and fails to receive enough oxygen required for its adequate functioning the condition is termed as STEMI or the 'heart-attack' in laymen language. Patients with elevated cardiac troponin levels but negative CK-MB who were formerly diagnosed with unstable angina or minor myocardial injury are now reclassified as non-ST-segment elevation Myocardial Infarction (non-STEMI) even in the absence of diagnostic changes.[1]

2
Magnitude of STEMI burden

Cardiovascular diseases (CVDs) are the leading cause of death globally, taking an estimated 17.9 million lives (32% of global deaths) each year (WHO, 2022). Heart attacks and Stroke account for 85% of these deaths. The mortality and morbidity due to Myocardial Infarction accounts for more than 15% mortality per year among STEMI and Non-STEMI patients.[2] The ischemic heart disease/ STEMI is the highest-ranking cause of premature death in terms of number of years of life lost.

In India, CVDs are estimated to account for about 28.1% of deaths. Ischemic Heart Diseases and Strokes account for 80% of all CVDs. Contribution of CVDs to Disability Adjusted Life Years (DALYs) is also highest at 14.1%, including 8.7% DALYs caused by Ischemic Heart Diseases (IHD) alone.[3] STEMI is estimated to account for more than 2.5 million cases annually in India (approximately 40% of myocardial infarctions).[4]

3
Risk Factors for STEMI

There are many risk factors leading to STEMI which may be modifiable or non-modifiable. Risk factors are listed below:

1. **Behavioral Risk Factors:**
   a. Harmful consumption of Alcohol
   b. Smoking
   c. Lack of physical activity
   d. Unhealthy diet
   e. Psychological Stressors
2. **Intermediate Risk Factors:**
   2.1. High blood pressure/Hypertension
   2.2. High blood sugar/diabetes
   2.3. High blood cholesterol levels
   2.4. Overweight/obesity
3. **Non – modifiable:**
   a. Age (older age increases risk)
   b. Gender (males are at comparatively greater risk)
   c. Family history
   d. Racial ethnicity
   e. Others

These "intermediate risks factors" can be measured in primary care facilities and indicate an increased risk of heart attack, stroke, heart failure and other complications. Modifiable risk factors account for more than 90% of the risk of MI.

4
Objectives

The guideline for management of STEMI under National Programme for Prevention & Control of Non-Communicable Diseases (NP-NCD) tries to enhance the awareness regarding it. The broad guiding principle of the document is to provide reperfusion therapy closer to the community, within the acceptable framework, with proper linkages with referral centres to reduce preventable morbidity and mortality.

The document emphasizes to provide thrombolysis to STEMI patient close to community with adequate safeguards, in a graded manner as per the availability of required resources at the health facilities. It would enable States/ UTs to develop and effectively run a suitable model of management of STEMI depending on their geography and infrastructure.

It would facilitate in reducing the delays in providing the reperfusion therapy to STEMI patients due to non-availability of a Percutaneous Coronary Intervention (PCI) performing health facility nearby. The document would help to curtail the system related delays by enabling the non-PCI performing health facilities to administer thrombolytic agents as an emergency procedure. It would establish the thrombolytic capacity at non-PCI health facilities (PHCs/CHCs/SDH/DH), fulfilling the criteria for availability of resources as required for the implementation of the programme, with referral linkages with PCI enabled facilities for further management and care.

5
Operational Strategies

To facilitate the provision of thrombolysis to the patients closer to community with adequate safeguards the strategy of the STEMI management services at any public healthcare facility will depend on the infrastructure availability. This can be achieved in a graded manner initially providing thrombolysis at the secondary level healthcare facilities i.e., Sub District Hospital (SDH)/ District Hospital (DH) level where emergency care is well established. The implementation of the services for STEMI is advised in phased manner with gradual expansion to the lower-level health facilities i.e., Community Health Centres (CHCs)/ Primary Health Centres (PHCs) depending upon the availability of required resources.

6

Implementation Details

The healthcare facility level at which to start with the implementation of STEMI management services will depend on the gap analysis* performed by the States/UTs. Facility and HR mapping should be undertaken by the States/UTs for all the health facilities. It includes trained HR (MD Medicine/MBBS, ECG technician & Staff Nurse), essential medical equipment, emergency drugs & capability for undertaking thrombolysis at the health facility. For States/UTs which do not have these services functional as on date, it would be a prudent strategy to pilot the STEMI management services implementation first in 2-3 districts at the DH/CHC level and expand later in all the districts proceeding gradually to include all PHCs under the programme. Each State/UT desirous of starting a STEMI management services is required to be well equipped before employing it state-wide.

6.1. Mapping & Grading of Health Care Facilities

The Healthcare facilities may be mapped according to the services provided as follows:

Grade	Level of Care	Health facility
L-1	Medical officer with no ECG facility and not capable of Thrombolysis.	PHC-HWC
L-2	Medical Officer (MBBS Doctor) having ECG facility and capable of Thrombolysis.	PHC-HWC, CHC
L-3	Facility with MBBS doctor & MD Medicine, ECG technician, Staff Nurse and having emergency care (ICU/HDU) set-up with Thrombolysis capability	DH, SDH, RH, CHC
L-4	Public Healthcare Facility with ICU/ HDU (Emergency care) setting having MD Medicine/ Cardiologist & CCU setup.	Medical College or District Hospital
L-5	Facility having Cardiac Cath lab/ PMJAY empaneled facility.	Medical College/ Private Cath lab Centre

6.2. Implementation Framework

The resources/ services required at various health facility level for management of STEMI patients are as follows:

a) **Infrastructure:** Chest Pain clinics at levels of healthcare system with ECG facility. The set-up of infrastructure like Cath lab, Critical Care Unit (CCU), etc. and procurement of equipment, dugs & consumables can be done under NP-NCD as per the Operational guidelines for the programme (NP-NCD) or under NHM as per the XV Finance Commission financial norms.

b) **Human Resources:** Availability of MBBS/MD Medicine doctors and paramedical staff (ECG technician & Staff Nurse) trained in diagnosis & treatment of STEMI (including management of post-thrombolysis complications, absolute contraindications to thrombolysis therapy, and follow-up requirements). Engaging service providers for Tele-reporting of ECG by MD Medicine/ Cardiologist can also be done and similarly drugs/consumables (Bolus thrombolytic agents) through Free Drugs Initiative (FDI).

c) **Capacity Building:** It is important to build provider-level education and point of-care interventions for successful outcomes. All MBBS/MD Medicine doctors, who are likely to be the first responder should undergo training in the interpretation of ECG and management protocols of STEMI (remote training can be provided in virtual mode with the state apex hospital/medical college). In this regard AIIMS (or any other similar designated entity) can be a facilitator providing training tools & curriculum to the State Medical Colleges for in STEMI management services. The training would also include familiarization of MBBS doctors/ MOs with the e-Sanjeevni teleconsultation module, ECG transmission and its remote interpretation. States may organize short refresher hands-on training courses for the MOs in ECG recording and interpretation at the nearest DH/SDH under the supervision of MD Medicine/Cardiologist, periodically as per requirement.

Training and capacity building of healthcare staff at different level of health facilities is necessary for the successful implementation of STEMI management services.

- Aim of MO and para medical training at L1 facility: The importance of early reperfusion and emphasize the need to rapidly triage STEMI and refer to a reperfusion-capable nearest spoke/hub facility

- Aim of MO and paramedical training at L2 and L3 facilities: it is to train and re-train the importance of early reperfusion and emphasize the need to rapidly triage STEMI, administer thrombolytic therapy transfer in eligible patients and transfer to a reperfusion-capable hub facility. The MBBS doctor may be trained to build STEMI green channels. This will avoid delays in reopening the occluded coronary artery.

- Aim of cardiologist/MD Medicines training at L4 and L5 facilities: It is to build a network of cardiologist and MD Medicines in the State for interpreting ECGs and providing tele-consultation to MBBS doctors at non-PCI STEMI centers, to train non-PCI STEMI centers in building STEMI green channels, transmit ECG to Central Command centre 24X7 and initiate thrombolysis in consultation with cardiologist/ MD Medicine.

d) **Equipment:** A functional 12-lead ECG machine with PC port, Troponin point of care device, Multi Para Monitor (To consider Biosensors), Defibrillator (Manual & Automatic External Defibrillator mode), GPS enabled smartphone. The indicative list of medical equipment & consumables required is given in Appendix 'D'.

e) **Teleconsultation:** States/UTs are encouraged to use the tele-consultation module of e-Sanjeevni platform for ECG interpretation & tele-consultation. Centralized 24X7 Command Centre to be set up at the State or the District Level with cardiologist and/or MD Medicines for tele ECG support and consultation for STEMI management through e-Sanjeevni portal. This may be required only in a L1 or L2 grade facility, and occasionally in a L3 grade facility for remote interpretation of ECG. To enable every MBBS doctor to thrombolyse patients with STEMI at public healthcare facility, a system of immediate ECG transmission and remote interpretation by a trained MD Medicine or a cardiologist should be established.

For engaging service providers in PPP mode mapping of the district wise health facilities can be done to provide support in digitalizing the ECG recordings and transmitting the same to the nearest PCI capable hospital's MD Medicine/ Cardiologist for reporting ECGs and providing teleconsultation. The tele-consultation can be held using the already established e-Sanjeevni doctor-to-doctor module.

f) **Referral system:** The suspected STEMI cases are referred to higher health facilities for further diagnosis and management. The linkages with 108-ambulance to transport the patients to the nearest secondary/ tertiary level healthcare facility with reperfusion services for further management of the patients as required. Trained paramedical staff (EMT) in ALS ambulance has to be provided while transportation. The facility wise linkages from L1 to L5 grade may be ensured in advance to reduce the referral delays.

The success of the STEMI implementation depends upon the linkages built within the implementation framework. States can implement their own model for building linkages with electronic data communication (Patient data, test results & ECG recording), treatment/ management protocols, Insurance re-imbursement models and dedicated transport system. The existing 104 Health Helpline and

108 Ambulance (National Ambulance Service) Central call center can be linked with the programme.

To have a successful programme it is important to must have a robust ambulance network either (in-house) or PPP model with a 24 X 7 (round the clock) Central Call facility for providing Ambulance support to convey patient to nearest health facility. The Ambulance should be equipped with Vital parameter Monitor, AED, oxygen, and trained Emergency Medicine Technician (EMT). The National Health Mission, MoHFW supports the National Ambulance Services as part of Health systems strengthening.

g) **Supply Chain Management:** Robust system using DVDMS (Drugs and Vaccine Distribution Management System) platform for uninterrupted supply of thrombolytic agents and other listed medications & life-saving drugs; Oxygen Cylinder with oxygen delivery system; emergency medicines for managing cardiac arrest, etc. should be ensured.

h) **Information Education and Communication (IEC):** Public education efforts are the hall mark of any programme including STEMI. Following measures could be taken under the IEC components under NP-NCD to improve the awareness and utilization of the services under the programme:

- Sustained IEC campaign focusing on Behavior Change Communication (BCC) for lifestyle modification & CVDs prevention by creating mass awareness regarding risk factors for STEMI.
- Educating public towards recognizing the symptoms of STEMI/ heart attack e.g., chest discomfort with or without radiation to the arms[s], back, neck, jaw, or epigastrium; shortness of breath; weakness; diaphoresis; nausea; light headedness.
- Educating public about the concept of "Time is Muscle' for early presentation to STEMI-ready healthcare facility nearest to their home/ workplace.
- Awareness efforts should also be directed toward pre-hospital use of soluble/ chewable aspirin before transport to an appropriate healthcare facility.

The facilities available for management of STEMI need to be listed by the State/ district and prominently displayed at common places.

i) Monitoring & Evaluation – State Nodal Officer for NP-NCD will be responsible for implementation of the STEMI services. Regular review meetings should be conducted once in six months at State level. Frequent supervisory visits should be made by NCD officers to various health facilities for supportive supervision of the programme under NP-NCD.

The key metrics that will be collected during the monitoring and evaluation at the facility level. It includes the following –

- Time from symptom onset to doctor at health facility.
- Time from doctor at health facility to ECG (the ECG should have a time stamp enabled)
- Door-to-needle (Thrombolysis) time (if facility is lysis capable)
- For transfers, facility (non-lysis) to lysis/device time (Door into Door Out Time

(DIDO), transfer time, and door to lysis/device time at receiving hospital should be captured separately).

- Complications
- Death & cause of death

j) Recording, Reporting and Data Management - An analysis of the data related to STEMI incidences, morbidity & mortality during the past is required, prior implementing a STEMI program in the State/UTs. A three-to- four-month pre-implementation data collection from the hospitals having Cardiology OPD/ Cath Lab Centre would help to understand the current case load and treatment practices. This would help in planning the program as well as estimating the resource and manpower allocation requirements for the program by the States/ UTs. States/UTs are advised to enter data in CPHC-NCD application.

The programme data and reports should be compiled and analysed at facility, district and state level to generate quarterly reports and send it to national NCD division. Regular review meetings may be conducted at State/UTs on a regular basis, to understand the service delivery requirements and performance assessment of STEMI services.

7
Management of STEMI

Goal is to move towards reducing the time taken from symptom onset to presentation, as much as possible (a 2 hours or less target may be aimed for). The patient should be transferred to a nearby appropriate hospital for further management as soon as possible.

At the non-PCI healthcare facility, key processes should include:

a) Physical examination of patients with chest pain to aid in diagnosis of STEMI.

b) Performing an ECG in patient with acute chest pain suspected of STEMI.

c) Transmission of ECG and vital parameters to Centralized Command Centre.

d) Act as per the interpretation/ decision support based on ECG readings and other vital parameters by Centralized 24X7 Command Centre's MD Medicines/ Cardiologists.

e) Thrombolysis and organizing transport for further care of STEMI at higher PCI capable centre.

The registered medical practitioner (MBBS doctor) posted in public healthcare system who is trained to diagnose & manage post thrombolysis complications, relative and absolute contraindications to thrombolysis therapy, and follow-up requirements in consultation can perform thrombolysis. The support from the MD Medicines/Cardiologists at linked Centralized 24X7 Command Centre can be taken to prescribe and perform thrombolysis at the given health facility.

Diagnosis - Early diagnosis of STEMI needs to be established reducing the system delays through STEMI green channels. ECG is often the only investigation required to make a diagnosis of STEMI. STEMI is defined as new ST elevation at the 'J' point in at least 2 contiguous leads of:

- ≥ 2.5 mm (0.25 mV) in men younger than 40 years, ≥ 2 mm (0.2 mV) in men older than 40 years or ≥ 1.5 mm (0.15 mV) in women in leads V2– V3 and/or
- ≥ 1 mm (0.1 mV) in other contiguous chest leads or the limb leads in the absence of left ventricular (LV) hypertrophy or left bundle-branch block (LBBB).

(Details in Appendix B)

Treatment - As per the ICMR's Standard treatment workflow (STW) (Appendix 'A'):
- Thrombolyse STEMI patient at the non-PCI health facility having emergency care capability.
- Transport STEMI patients after thrombolysis to PCI enabled facility for pharmaco-invasive approach.
- Reperfuse the patients at PCI enabled facilities

According to the type of facility grade as per the mapping with the availability of resources, following package of services are recommended for management of STEMI:

A. (L-1) - Facility having medical officer with No ECG facility and not capable of thrombolysis
- Record pulse rate, BP, SpO2 & respiration rate.
- Pain relief by NTG spray (in case angina) and Inj. Morphine Intravenous if available (2-4 mg).
- Supplemental Oxygen inhalation if SpO2 is <90%
- Tab Aspirin 325 mg + Tab Clopidogrel 300 mg + Tab Atorvastatin 80 mg orally
- Transport patient as lying case in ambulance (108) with oxygen accompanied by a MO.
- Inform the higher centre where the patient is being transferred.

B. (L-2) - Facility having Medical Officer with ECG facility and capable of Thrombolysis
- Record pulse rate, BP, SpO2 & respiration rate.
- Take ECG and diagnose ST changes
- Consult MD Medicine/Cardiologist through tele-consultation and transmit ECG
- Quickly check for contra-indications or other risk factors.
- Thrombolyse with a bolus thrombolytic agent after approval by the MD Medicine /Cardiologist
- Repeat ECG at 60-90 min after start of thrombolysis to assess whether thrombolysis is successful (Less than 50% ST settlement with pain relief) or not.
- If ongoing pain even after thrombolysis, transfer immediately.
- Hold at the facility for observation and transfer to nearest facility having MD Medicine/Cardiologist with ICU/HDU facility on stabilization within 24 hours.
- Monitor patient for any complications.
- Transport patient as lysing case in ambulance (108) with oxygen support (SpO2<90%) & defibrillator within 24 hours accompanied by a MO (may not be possible), if possible, upon stabilization.
- Inform the higher center where the patient is being transferred.

C. (L-3) - Facility with Medical Officer & MD Medicine, Technician, Nurse and having emergency care (ICU/HDU) set up with thrombolysis capability

- Admit patient in ICU/HDU equipped with continuous ECG monitoring & De-fibrillation for observation & monitor patient for any complications.
- Conduct routine biochemistry tests and serial cardiac enzymes (Troponin)
- Assessment by MD Medicine/Cardiologist
- Repeat ECG at 60-90 min after start of thrombolysis to assess whether thrombolysis is successful (Less than 50% ST settlement with pain relief) or not.
- Start **Pharmaco-invasive** treatment for patients transferred from L1 or L2 facilities as per STW protocol (Unfractionated heparin - Bolus of 60 U/Kg max up to 5000 Units followed by 12U/kg hourly infusion to maintain APTT at 50-70 sec **alternatively** Inj. Enoxaparin 1mg/kg subcutaneous 12 hourly).
- Echocardiography if available, for mechanical complication if any.
- Inform the PCI capable centre for further management and transfer patient on stabilization within 3-24 hours for angiography.

D. (L4 & L5) - In hospitals where thrombolysis/ PCI for STEMI is already happening

- The data regarding STEMI presentation, treatment strategy and outcomes need to be captured. Protocol for early triage & hospitalization is placed as Appendix 'C'.
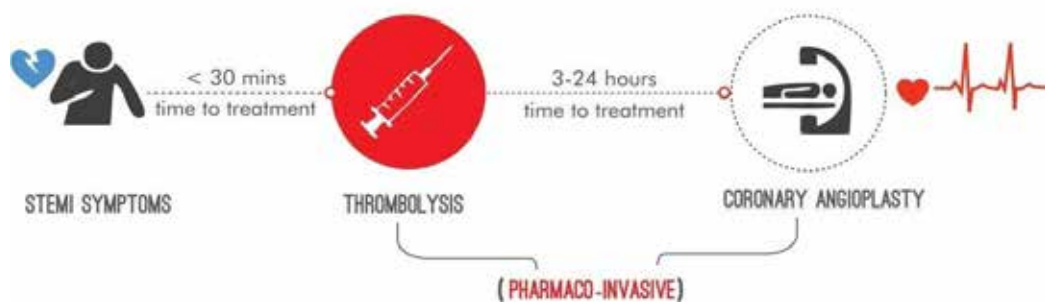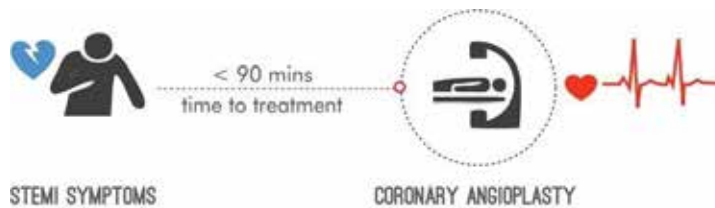
8
Hub & Spoke Model for STEMI Management Services

The Hub and Spoke Model arranges service delivery assets into a network consisting of an anchor establishment (Hub), which offers a full array of services, complemented by secondary establishments (Spokes), which offer more limited-service arrays, routing patients needing more intensive services to the hub for treatment.

Benefits of Hub and Spoke Model in STEMI Care are:

i. Extend quality acute STEMI care to spoke hospitals

ii. Access to the specialist to provide consultation before Initiating thrombolysis (t-PA etc.)

iii. Ability to transfer the patients requiring complex care to the hub

iv. Reduce unnecessary transfers

"Hub & Spoke Model" for STEMI-cardiac patients in the country can be developed in a way where Hub hospitals are established preferably at State Capital and at some of super district administrative divisions (here called Divisions where such divisions exist in States/ UTs)/ big sized districts or group of districts (where division does not exist) according to the choice of the States/ UTs. The spoke hospitals have to be developed at district and CHC hospitals and then may be scaled up to PHCs. This should ensure that one can get access to a spoke hospital at least within 50-60 km of their residence.

To treat the STEMI cases in 'Golden Hours' (within 2 hours or less from the onset of STEMI) the implementation of the STEMI management services may be provided through the Hub and Spoke models. A hub-and-spoke model has to be designed with

thrombolysis arrangements to be provided by the Spoke hospitals throughout 24*7 and cover provided by the Hub hospitals. The Hub hospitals are supposed to provide a 24-hour service at State/ UT capital first and then to be scaled up to Divisions/ Districts as part of a planned rollout of the regional thrombolysis and PCI (Cath lab)/ Mechanical thrombectomy service. An out-of-hours service is to be provided in the spoke hospitals for patients assessed as being potentially eligible for thrombolysis. Patients need to be thrombolysed within 2 hours in case of onset of development of STEMI. Patients are to be transported in ALS ambulance, investigated and treated as appropriate.

Confirmation for the STEMI: After receiving the patient at the spoke hospital doctors seek confirmation for the STEMI case from the MD Medicine/Cardiologists of the hub-hospital. Once the patient reached the spoke hospital, doctors have to take the CT scan or ECG.

Thrombolising: Once the doctors at the hub hospital confirmed the Stroke/STEMI case then the medical officer at the spoke hospital start the intervention by initiating the thrombolising process. The thrombolising process need to get confirmation at the spoke hospital again after considering the medical history of the patient as it is life-threatening process. Patient with previous history of thrombolising and other chronic health conditions/ diseases such as stroke, heart diseases etc. are not thrombolize at spoke hospital instead they are referred to the hub hospital. This whole process of confirmation STEMI from hub hospital takes a maximum of 15-45 min. After thrombolising and stabilizing the patient, the ALS ambulance transfer that patient to the hub hospital for further treatment

Treatment at Hub hospital: The cardiology department proceed for further treatment as per the patient health status and time. Almost all the patient reached the hub hospital with thrombolising undergone with the MRI/ Angiography followed by Angioplasty/ Mechanical Thrombectomy if required.

Follow-up of the patient: The Hub hospital follow-up the patients after angioplasty/ Mechanical Thrombectomy treatment. Few spokes also have their patient follow-up a system where they informed to Auxiliary Nurse Midwives (ANM) in that area to follow-up the patients treated for the STEMI.

9
Conclusion

STEMI management services in the country will obviously require a robust organized system of care to address the inherent challenges and improve key processes. To achieve the goal of door to needle time (Thrombolysis) within 2 hours, at the community level will require executing and adherence to the guideline-based treatment protocols, with efficient and rapid inter hospital transfer within the designated hub and spokes health facilities, and most importantly capacity building of healthcare staff at the peripheral health facilities (HWCs & PHCs) to interpret ECGs and facilitate early diagnosis for appropriate intervention.

Addressing appropriate STEMI care in the country, is the need of the hour. In addition to patient awareness and education for early symptom identification, extensive education is required for general practitioners and MD Medicines/intensivists to implement early time dependent STEMI management. The STEMI management services needs to be linked with CCUs and Cardiac Cath labs and a graded approach for appropriate management of all patients needs to be planned by all States/ UTs.

References

i. Alexander T, Mullasari A, Kaifoszova Z, Khot U, Nallamothu B, Ramana R et al. Framework for a National STEMI Program: Consensus document developed by STEMI INDIA, Cardiological Society of India and Association Physicians of India. Indian Heart Journal. 2015;67(5):497-502.

ii. Cardiovascular diseases (CVDs) [Internet]. who.int. 2022 [cited 27 September 2022]. Available from: https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

iii. India: Health of the Nation's State. New Delhi: ICMR, PHFI & IHME; 2017.

iv. Salve P, Vatavati S, Hallad J. The hub-and-spoke model of national STEMI programme of India: An investigation of STEMI-Goa project. Indian Heart Journal. 2021;73(4):P424-428.

v. Yunyun W, Tong L, Yingwu L, Bojiang L, Yu W, Xiaomin H et al. Analysis of risk factors of ST-segment elevation myocardial infarction in young patients. BMC Cardiovascular Disorders. 2014;14(1).

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Appendix

STANDARD TREATMENT WORKFLOW
for
Management of ST ELEVATION MYOCARDIAL INFARCTION (STEMI)

Standard Treatment Workflow (STW) for the Management of

ST ELEVATION MYOCARDIAL INFARCTION (STEMI)
ICD-10-I21.3

CONSIDER ANGINA IF
- Diffuse retrosternal pain, heaviness or constriction
- Radiation to arms or neck or back
- Associated with sweating
- Easily reproduced with post-meal exertion
- Consider atypical presentation: Exertional fatigue or breathlessness or profuse sweating or epigastric discomfort/ syncope

More likelihood if known patient of CAD/ multiple risk factors

ACUTE CORONARY SYNDROME:
1. Angina at rest or lasting more than 20 minutes
2. Recent worsening of stable angina (crescendo) to CCS class III
3. New onset effort angina of less than 1 month in CCS class II/ III
4. Post infarction angina

ECG: If ST Elevation: Follow ST Elevation MI (STEMI) protocol If no ST Elevation: UA/NSTEMI

ANGINA UNLIKELY IF:

| Variable location or characteristic | Long lasting (hours to days) or short lasting (less than a minute) | Restricted to areas above jaw or below epigastrium | Localized to a point | Pricking or piercing or stabbing type of pain | Precipitated by movement of neck or arms or respiration |

PATIENT WITH STEMI WITHIN 12 HOURS

ECG REVEALS ST ELEVATION MI*

Refer to primary angioplasty/ thrombolysis capable hospital

*Includes new onset LBBB

GENERAL MEASURES
1. Admit in ICU equipped with continuous ECG monitoring & defibrillation
2. Routine bio-chemistry and serial cardiac enzymes (troponin)
3. Pain relief by opioid
4. O2 if saturation less than 90%
5. Aspirin 325 mg, Clopidogrel 300 mg and Atorvastatin 80 mg
6. Echocardiography, particularly for mechanical complication

PCI CAPABLE HOSPITAL
1. Proceed for PCI
2. Radial route preferred
3. Preferably within 90 minutes

DURING PROCEDURE
1. Use unfractionated heparin
2. No routine thrombosuction
3. Tackle culprit artery only unless shock
4. DES to be preferred

POST PROCEDURE
1. Continue dual antiplatelets for at least 1 year

PCI INCAPABLE CENTRE

A. Transfer to PCI capable hospital if PCI can be performed within 120 min

B. If Transfer to PCI capable hospital not feasible

THROMBOLYSE
1. Within 12 hours of symptom onset, if no contra-indication
2. Preferably with fibrin specific agent Tenecteplase/ TPA/ Reteplase or Streptokinase. If fibrin-specific are unavailable
3. Therapy to be started within 10 min preferably

POST THROMBOLYSIS
1. ECG to be done at 60-90 min after starting thrombolysis to assess whether thrombolysis is successful (>50% ST settlement with pain relief) or not
2. If successful, transfer patient for PCI within 3-24 hours
3. If thrombolysis failed, transfer patient immediately for PCI capable hospital
4. Enoxaparin (preferred over unfractionated heparin) to be continued till PCI OR discharge

LOOK FOR OTHER CAUSES OF CHEST PAIN (ONGOING OR WITHIN 12 HRS)

Unequal or absent peripheral pulses	Dissection of Aorta
Respiratory evaluation	Pleuritis/ Pneumonitis/ embolism/ pneumothorax
	Pericardial rub
	Neuralgia or herpes

PATIENT WITH STEMI IN 12-24 HOURS

| Transfer to PCI capable hospital immediately | If ongoing pain, thrombolysis and transfer immediately |

PATIENT WITH STEMI AFTER 24 HOURS

Angiography with a view to PCI only if any of following/ Contra indications of angiography:

| Recurrent anginal pain not controlled by medical therapy | Cardiogenic shock | Acute LVF | Mechanical complication | Dynamic ST-T changes | Life threatening ventricular arrhythmias |

ABSOLUTE CONTRA-INDICATIONS TO THROMBOLYTIC THERAPY:

| Previous intra-cerebral hemorrhage or stroke of unknown etiology | Ischemic stroke in last 6 months | CNS neoplasm or AV malformation | Recent (within 1 month) major trauma/ surgery/ head injury | Recent (within 1 month) major GI bleed | Known bleeding tendency (except menstrual bleed) | Aortic dissection | Severe uncontrolled hypertension |

DRUGS & DOSAGE

Anti-platelets
1. Aspirin: Loading dose 325 mg followed by 75 mg OD
2. Clopidogrel: Loading dose 300 mg followed 75 mg OD
3. Prasugrel: Loading dose 60 mg followed by 10 mg OD
4. Ticagrelor: Loading dose 180 mg followed by 90 mg BD

Anti-ischemic:
Metoprolol:
Short acting: 25-100 mg BD
Long acting: 25 -100 mg OD
Nitrates:
Isosorbide mono-nitare 20 to 60 mg in 2 divided dose
Nitroglycerine sustained release 2.6 to 6.5 mg BD
Nitroglycerine IV 5-25 mcg/ min Infusion

Statins:
High dose Atorvastatin 80 mg OD

Ace-inhibitor
Ramipril 2.5 -10 mg OD
Enalapril 2.5 -10mg BD

Oxygen:
If oxygen saturation below 90%

Morphine:
Titrated in a dose of 2-4 mg IV every 15 minutes

Beta-blocker:
Oral beta-blocker if LVEF is less than 40%

Anti thrombotics:
1. Unfractionated heparin: Bolus of 60 U/Kg (maximum 5000 U) followed by 12 U/Kg hourly infusion to maintain APTT at 50-70 sec
2. Enoxaparin: 1 mg/Kg SC 12 hrly

Thrombolytic Therapy:
Tenecteplase
35 mg IV bolus if 60-70 Kg
40 mg IV bolus if 70-80 Kg
45 mg IV bolus if more than 80 Kg

Reteplase
10 mg IV bolus, repeat after 30 min

Alteplase
15 mg IV bolus followed by 0.75 mg/Kg over 30 min upto 50 Kg weight, then 0.5 mg/Kg over 60 min up to 35 mg

Streptokinase
1.5 million units IV over 60 min

STEMI DIAGNOSIS*

Primary-PCI capable centre / EMS or non primary-PCI capable centre

PCI possible <120 mins?

Primary PCI — Yes / No

Rescue PCI

Successful fibrinolysis — Immediate fibrinolysis

Coronary angiography

*The time point the diagnosis is confirmed with patient history & ECG study within 10 mins from the First Medical Contact (FMC). All delays are related to FMC.

👉 KEEP A HIGH THRESHOLD FOR INVASIVE PROCEDURES

<p style="text-align:center">Appendix 'B'</p>

DIAGNOSIS OF STEMI

1. Acute chest pain is the most common presenting symptom of acute myocardial ischemia. STEMI encompasses all acute chest pain syndromes resulting from myocardial ischemia. Only 20–30% of patients presenting with acute chest pain are ultimately confirmed to have STEMI upon detailed evaluation. ST segment elevation myocardial infarction (STEMI) is characterized by myocardial ischemia that results in persistent ST segment elevation on electrocardiogram (ECG) and subsequent release of biomarkers of myocardial damage.

2. Increased biomarkers alone in the absence of ST segment elevation constitute non- ST segment elevation MI (NSTEMI). NSTEMI may manifest with transient/ persistent ST segment depression and/or T wave inversion in ECG. Prolonged ischemic chest pain without elevation of markers of myocardial necrosis constitutes unstable angina. STEMI is the most common form of STEMI in India, accounting for 40–60% of STEMI cases.

3. For the diagnosis of acute myocardial infarction, the presence of any two of the following three features is essential: characteristic chest pain, ECG changes and elevated cardiac enzymes. However, patient's interpretation of symptoms, availability of ECG and its interpretation, and widespread non-availability of Troponin testing are among the major recognized challenges in the diagnosis of STEMI in India.
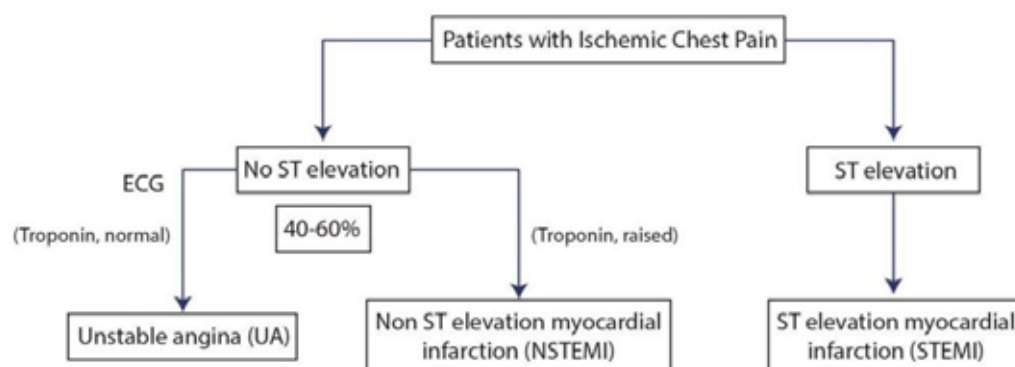
4. The diagnosis and early risk stratification are usually done at the facility having doctor (first responder).

ECG Diagnosis

5. The task force for the universal definition of MI defines "STEMI as new ST elevation at the J point in at least 2 contiguous leads of 2mm (0.2 mV) in men or 1.5mm (0.15mV) in women in leads V2– V3 and/or of 1 mm (0.1mV) in other contiguous chest leads or the limb leads in the absence of left ventricular (LV) hypertrophy or left bundle-branch block (LBBB)". A concordant ST elevation in a lead with the positive QRS complex is the best indicator of STEMI in the presence of LBBB. A score of more than or equal to 3 has a specificity of 98% for diagnosing STEMI.

6. However, STEMI may not be ruled out even when none of the features are identified. Cases of acute ischemic chest pain with LBBB not accompanied by other ECG evidence of STEMI poses serious management challenge. In such

patients Troponin levels and regional wall motion abnormalities may guide reperfusion therapy. If the index of suspicion of STEMI is high, such patients may be taken up for coronary angiogram. Right bundle branch block (RBBB) left anterior fascicular block (LAFB) and left posterior fascicular block do not interfere with the interpretation of ST segment elevation. Cases of acute ischemic chest pain with LBBB not accompanied by other ECG evidence of STEMI poses serious management challenge. In such patients Troponin levels and regional wall motion abnormalities may guide reperfusion therapy. If the index of suspicion of STEMI is high, such patients may be taken up for coronary angiogram.

Table 1: ECG changes at presentation in STEMI

Typical	Atypical
ST Elevation (at least 2 contiguous leads) • 2 mm (0.2mV) in men or 1.5 mm (0.15 mV) in women in leads V2-V3 • 1 mm (0.1 mV) in other contiguous chest leads, or the limb leads	STEMI in Evolution • Hyperacute T-wave changes evolving/ evolved STEMI • Q wave with T wave inversion with variable ST elevation
New or presumably new LBBB	Posterior wall MI • ST depression in 2 precordial leads (V1 V3) + positive T waves in V1
	Left Main or proximal left anterior descending artery occlusion • ST depression in multiple leads with ST elevation in lead aVR and V1 (aVR > V1; left main V1 > aVR: proximal LAD)

Table 2: Criteria to diagnose STEMI in presence of LBBB

Sl. No.	Criteria	Score
1.	ST elevation more than or equal 1 mm and concordant with QRS complex	5
2.	ST segment depression more than or equal 1 mm in Lead V1, V2 or V3.	3
3.	ST elevation more than or equal 5mm and discordant with QRS complex	2

7. Patients may have a first ECG that is not diagnostic of STEMI. In such a situation, a repeat ECG must be obtained at 10–15 min, and at 30 min intervals (Table 3). The ECGs should be carefully looked for even subtle changes. Cardiac biomarkers and echocardiogram may be useful guides to reperfusion therapy in such patients. If the suspicion of ongoing serious myocardial ischemia is high, the patient should be taken for a coronary angiogram to demonstrate coronary artery occlusion or intracoronary thrombus. A CT angiogram is usually reserved for patients with persistent symptoms with low to intermediate likelihood of ischemia or in patients with suspected aortic dissection or pulmonary embolism.

Table 3: Recommendation for ECG

Indication	Recommendation	Recommendation
1. Chest pain 2. Acute pain anywhere from jaw to umbilicus (beyond 20 years of age) 3. Atypical symptoms of STEMI 4. Unexplained acute breathlessness, hypotension, and hemodynamic collapse	1. A 12-lead ECG to be performed in all patients with suspected STEMI 2. Presentation to ECG diagnosis of STEMI – < 10 min 3. A low threshold for performance of ECG in patients likely to present with atypical symptoms 4. Continuous ECG monitoring should be started as soon as possible 5. Right precordial leads (V3R, V4R) must be recorded in patients with inferior wall MI 6. True posterior wall MI may be diagnosed as ST elevation (>1 mm) in additional lateral chest leads V7 – V9	1. Repeat ECG – 10 min, 30 min and as needed 2. Compare with previous ECGs for even subtle changes 3. Troponin I or T to guide therapy 4. Echocardiogram for regional wall motion abnormalities. 5. Emergency coronary angiography if high index of suspicion of STEMI 6. CT angiogram only if aortic dissection or pulmonary embolism to be ruled out

8. The lack of availability of standardized cardiac biomarker assays across the country is a major limitation in the early diagnosis and risk stratification of STEMI. Availability of point-of-care Troponin assays across India is even more limited, which results in overreliance on symptoms and repeated ECGs for diagnosing STEMI in doubtful cases. Often only semi-quantitative and qualitative assays of Troponin are available even in referral hospitals. These tests have varying standards and cut offs. A thorough understanding of the Troponin assay available at each centre is essential.

Diagnosis of STEMI in India: Challenges

9. All the Indian STEMI registries report that less than 50% of patients with STEMI have received thrombolysis or PCI. Most of the non-reperfusion resulted from late presentation of patients beyond the therapeutic window of reperfusion. Lack of awareness among patients, relatives, paramedics and even doctors is a major factor responsible for suboptimal acute care of STEMI in India.

10. NSTEMI is diagnosed in patients determined to have symptoms consistent with STEMI and troponin elevation but without ECG changes consistent with STEMI. Unstable angina and NSTEMI differ primarily in the presence or absence of detectable troponin leak. Findings suggestive of NSTEMI include transient ST elevation, ST depression, or new T wave inversions. ECG should be repeated at predetermined intervals or if symptoms return.

EARLY TRIAGE AND HOSPITALIZATION

1. Timely delivery of reperfusion therapy (whether pharmacological or mechanical) in patients with STEMI is more important than the choice of therapy and the entire emphasis should be to deliver reperfusion therapy to a patient of STEMI as rapidly as possible. Efficient protocols of early triage of patients with STEMI should primarily aim to reduce time delays in patient care since these are associated with adverse outcomes. Delay in patient care in our country often occur at the following levels of care.

2. The time delay from the patient side may be due to delay in recognizing symptoms and therefore in seeking timely medical help. On reaching the hospital, financial issues, lack of consensus amongst patient relatives and consent regarding procedure, system delays in hospitals (e.g. registration, transport to emergency department, coronary care units, cardiac catheterization lab etc.) are the common cause of delay associated with adverse outcomes.

Aim of Triage protocol

3. The aims should be to develop a smooth continuum of care including:

   (a) Early recognition of symptoms of STEMI

   (b) Activation of efficient emergency medical services (EMS)

   (c) Pre-hospital management

   (d) Pre-determined hospital destination protocols and

   (e) Timely establishment of reperfusion.

Proposed Triage Plan

4. Once a diagnosis has been made, the patient and his family should be taken into confidence and a reperfusion strategy should be planned. In case it is possible to shift the patients to a PCI capable center while maintaining the doctor to Balloon time of thrombolysis the patients and shift to a PCI capable center for a PI approach whenever possible and feasible.

5. The following is the proposed triage plan which can be modified based on local setting and the geographical area. The following flow chart is recommended for arriving to a decision for thrombolysis at the health facility.
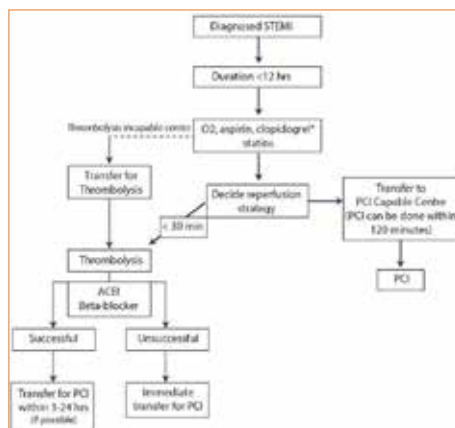

Fig. 4. Proposed Triage plan for patients of STEMI, Rural and Urban.

Identification of Patients at Risk of STEMI

6. Cardiovascular diseases result from a complex interplay of multiple genetic, environmental, and lifestyle factors. Primary care providers should evaluate the presence and status of control of major risk factors for coronary heart disease (CHD) for all patients at regular intervals (approximately every 3 to 5 years). **Patients with established CHD should be identified for secondary prevention, and patients with a CHD risk equivalent** (e.g., diabetes mellitus, chronic kidney disease, or 10-year risk greater than 20% as calculated by Framingham equations) should receive equally intensive risk factor intervention as those with clinically apparent CHD.

7. Many methods for CVD screening have insufficient evidence to currently recommend use in a general, asymptomatic adult population. This corresponds well with a 2012 Cochrane Review evaluating the impact of general health checks (including screening measures) that found general health checks did not improve either overall health or cardiovascular morbidity and mortality. Nonetheless, there is good evidence for some specific CVD screening modalities when used in the proper risk setting. Lipid measurement and abdominal aortic ultrasound, for example, are two screening techniques with strong data regarding who benefits from screening and the impact of screening on outcomes. While current evidence does not support the use of other newer screening modalities for primary prevention of CVD, this may very well change as more high-quality trials are completed in the future.

Patient Education for Early Recognition and Response to STEMI

8. Patients with symptoms of STEMI (chest discomfort with or without radiation to the arms[s], back, neck, jaw, or epigastrium; shortness of breath; weakness; diaphoresis; nausea; light headedness) should be transported to the hospital by ambulance rather than by friends or relatives. Healthcare providers should actively address the following issues regarding STEMI with patients and their families:

9. The patient's heart attack risk profile (Risk factors like – smoking, hypertension, Diabetes Mellitus, high lipid counts, sedentary lifestyle, family history etc). Importance of early presentation and reperfusion strategies including availability of treatment for AMI at nearby hospitals. Encourage the patients to carry baseline ECG during transfer to PCI/Non- PCI Hospitals

MD Medicine Education

10. The doctor must be aware/trained for the following:
    - Time dependent decision taking.
    - Immediate ECG in patients of suspected AMI and confirmation of STEMI.
    - To avoid delay in reperfusion and importance of early reperfusion.
    - Systematic protocol, guideline adherence and knowledge of newer fibrinolytic agents and their advantages.
    - Pharmaco-invasive concept in STEMI management

TIMI risk scoring tool

11. The thrombolysis in myocardial infarction (TIMI) risk score is a tool used to predict the chances of having or dying from a heart event for people with:
    - Unstable Angina, a heart condition that causes chest pain
    - Non-ST-segment elevation myocardial infarction (NSTEMI).

12. The TIMI risk score is calculated by taking seven factors into account. Some of these are determined by performing specialized heart tests or asking about a person's medical history. One point is given for each of the following trusted source:
    - Age more than 65 years.
    - Using aspirin within the last week.
    - Having at least two angina episodes in the last 24 hours
    - Having elevated serum cardiac biomarkers
    - Having ST-segment deviation on an electrocardiogram
    - Having known coronary artery disease
    - Having at least three risk factors for heart disease, which include:
        o high blood pressure (greater than 140/90)
        o smoking (being a current smoker)
        o low HDL cholesterol (less than 40 mg/dL)
        o Diabetes Mellitus.
        o Family history of heart disease

13. TIMI score can help doctors to accurately assess the chances of having or dying from a heart-related event in the next 14 days. The scores are calculated and matched with a predicted risk. A study published in JAMA found that TIMI risk scores are useful and accurate at predicting a future heart event. The following chart includes possible scores and their corresponding risk percentages:

Score	Risk of Heart Event
0-1	4-7%
2	8.3%
3	13.2%
4	19.9%
5	26.2%
6-7	At least 40.9%

14. The **TIMI risk score** for a heart-related event can be lowered, by lifestyle modification as follows:
    - Eating healthy, whole foods
    - Exercising daily
    - Maintaining a healthy weight

- Avoiding cigarette smoking and limiting alcohol consumption
- Keeping cholesterol and blood pressure levels in check
- Managing diabetes (if you're diabetic)
- Lowering stress levels

15. Several tools and scores have been developed to assist in the workup of STEMI. These tools must be used with caution and in the appropriate context as none have been definitively shown to be superior to clinician judgment. Some common tools available are the TIMI (Thrombolysis in Myocardial Infarction) risk score as discussed above, the **GRACE** (Global Registry of Acute Coronary Events) risk score, the **SANCHIS** score, the **Vancouver rule, HEART** (History, ECG, Age, Risk Factors, and Troponin) score, HEARTS3 score, and Hess prediction rule. The **HEART score** was specifically developed for emergency department patients and has gained popularity in this setting.

How to recognize symptoms of STEMI.

16. The advisability of calling 108 ambulance services, if symptoms are unimproved or worsening after 5 minutes, despite feelings of uncertainty about the symptoms and fear of potential embarrassment. A plan for appropriate recognition and response to a potential acute cardiac event that includes the phone number to access emergency medical services (EMS), generally 108 or Central call centre ambulance services. Morbidity and mortality due to STEMI can be reduced significantly if patients and bystanders recognize symptoms early, activate the EMS system, and thereby shorten the time to definitive treatment. Patients with possible symptoms of STEMI should be transported to the hospital by ambulance rather than by friends or relatives because there is a significant association between arrival at the emergency department (ED) by ambulance and early reperfusion therapy.

Onset of STEMI (Out-of-Hospital Cardiac Arrest)

17. All communities should create and maintain a strong "Chain of Survival" for out-of-hospital cardiac arrest that includes early access (recognition of the problem and activation of the EMS system by a bystander), early cardiopulmonary resuscitation (CPR), early defibrillation for patients who need it, and early advanced cardiac life support (ACLS).

18. Family members of patients experiencing STEMI should be advised to take CPR training and familiarize themselves with the use of an automated external defibrillator (AED). In addition, they should be referred to a CPR training program that has a social support component for family members of post-STEMI patients. The links in the chain include early access (recognition of the problem and activation of the EMS system by a bystander), early CPR, early defibrillation for patients who need it, and early ACLS.

Need for Pharmaco-invasive approach

19. In the Indian context, even small towns are densely populated, traffic congestions and transfer to hospitals take a long-time causing delay in time to treatment.

Initial delay is by the patient due to lack of awareness. Next delay is due to lack of transfer facilities or unavailability of hospital with PCI capabilities. The third delay is possible within a tertiary care PCI capable hospital were reaching from casualty/ emergency department to establishing Thrombolysis In Myocardial Infarction (TIMI) grade 3 flow has delays due to various factors viz. finances, obtaining consent, round the clock man power (cardiologist and staff) and availability of PCI lab in busy hours. However, early patient presentation, rapid diagnosis and early reperfusion in patients presenting with acute chest pain constitute the pillars of success in STEMI management.

20. Fibrinolytic therapy and primary PCI are two commonly used reperfusion strategies in its management, and they are conventionally viewed as mutually exclusive alternative therapeutic modalities". However, well established principles and a great deal of recently acquired clinical evidence support the view that the two in combination are synergistic and their combination is referred as "pharmaco-invasive therapy".

21. Pharmaco-invasive therapy means first administering early fibrinolysis and then systematically performing an angiography (and a PCI if needed) within 3 to 24 hours after the start of fibrinolytic therapy, regardless of whether fibrinolysis results in successful reperfusion or not. In the event of fibrinolytic failure, a rescue PCI should be immediately performed where one need not wait for the initial 3-hour window.

22. Outcome of patients with STEMI is strongly influenced by the time from symptom onset to successful re-perfusion. A study has found that 1 year mortality is increased by 7.5% for each 30 min delay in treatment. Early fibrinolytic therapy can compensate for PCI related delay. PI approach could possibly improve myocardial salvage and ultimately improve clinical outcomes. Prompt fibrinolytic treatment improved the likelihood of aborted myocardial infarction and the greatest incidence occurred in those patients treated within 1 hour of symptom onset, with a sharp drop off after 3 hours.

23. Pharmaco-invasive approach is appropriate for patients with STEMI who are eligible for treatment with fibrinolytic drugs and in whom "transfer time" ≥ 30 min or door- balloon time > 90 min [Door into Door out time is ≥ 120 min]. The other indication being PCI related delay: (door-to-balloon) minus (door to needle) > 60 minutes. The key characteristics of various thrombolytic agents in use is as follows:

Characteristics	Streptokinase	Alteplase	Reteplase	Tenecteplase
Allergic reactions	Yes	No	No	No
Plasminogen activation	Indirect	Direct	Direct	Direct
Fibrin specificity	-	++	+	+++
Dose /administration	1.5 MU infusion over 60 min	15 mg bolus plus 90-min infusion up to 85mg	10 + 10 units double bolus given over 2 min with 30 minutes apart	0.53 mg/kg single bolus given over 5 seconds
Plasma half life	18	5	18	20
Resistance to PAI-I	No	No	No	Yes

Characteristics	Streptokinase	Alteplase	Reteplase	Tenecteplase
Activity on platelet rich clot	-	++	+	+++
Patency at 90 min	+	+++	+++(+?)	+++ (+?)
TIMI grade 3 flow (%)	32	54	60	63
Systemic fibrinogen	marked	mild	moderate	minimal

Choice of Fibrinolytic agent

First Generation

24. Streptokinase: It is still a commonly used thrombolytic agent in India. Streptokinase is isolated from bacteria and hence is antigenic. Potential disadvantages also include IV infusion needed, low fibrin specificity, shorter half-life, risk of anaphylactic reactions and hemorrhage.

Second Generation

25. Tissue Plasminogen Activator (t-PA, alteplase): It is a second generation fibrinolytic and produces only mild systemic fibrinogen depletion. t-PA is administered in an accelerated dose regimen over 90 minutes. Although a fibrin specific agent (++), the use may be limited since an IV infusion is required.

Third Generation

26. They have increased fibrin specificity, increased resistance to inhibition by plasminogen activators and longer half-life.

    (a) **Reteplase** is a third-generation variant of the t-PA molecule. It is a fibrin specific agent (+) and administered as a double bolus; each dose consists of 10 units given over two minutes 30 minutes apart.

    (b) **Tenecteplase:** Tenecteplase, most recently approved for the treatment of STEMI, is a third-generation variant of the t-PA molecule. Unlike its predecessors, Tenecteplase can be administered as a single bolus over five seconds. It has highest fibrin specificity (+++) and resistance to inactivation by plasminogen activator inhibitor-1 (PAI-1), desirable in a fibrinolytic agent. It has an advantage of ease of administration, weight- adjusted, single-bolus administration.[31] Thus administration of third generation agents (Tenecteplase/ Reteplase) could be crucial in early fibrinolysis and transfer of a STEMI patient to a tertiary care hospital.

Prehospital Fibrinolysis

27. Establishment of a prehospital fibrinolysis protocol is reasonable in (1) settings in which MD Medicines are present in the ambulance or in (2) well-organized EMS systems with full-time paramedics who have 12-lead ECGs in the field with transmission capability, paramedic initial and ongoing training in ECG interpretation and STEMI treatment, online medical command, a medical director with training/experience in STEMI management, and an ongoing continuous quality-improvement program.

28. **Prehospital fibrinolysis is reasonable in those settings in which MD Medicines are present in the ambulance or prehospital transport times are more than 60 minutes in high-volume** (more than 25,000 runs per year) EMS systems. Other considerations for implementing a prehospital fibrinolytic service include the ability to transmit ECGs, paramedic initial and ongoing training in ECG interpretation and myocardial infarction (MI) treatment, online medical command, a medical director with training/experience in management of STEMI, and full-time paramedics.[27]

29. Almost all of the pharmaco-invasive strategies have been clinically evaluated with IV bolus agents only. Fibrinolytic therapy with contemporary adjunctive medical therapy is recommended in patients presenting with symptom onset less than 6 hours. The fibrinolytic agents recommended as per level of evidence (LOE) is as follows:

LOE	Fibrinolytic Agent	Recommended Dosage
Grade 1A	Tenecteplase	0.53 mg/kg single bolus IV over 5 seconds.
Grade 1B	Reteplase	10-MU bolus-30 min + 10-MU bolus 30 min later.
Grade 1C	Alteplase	15mg IV bolus, 0.75 mg/kg over 30 min then 0.5 mg/kg over 60 min IV.
Grade 2B	Streptokinase	1.5 million units over 30-60 min. To be considered only in those patients where newer fibrin specific fibrinolytics are unaffordable or unavailable.

Contraindications for Thrombolytic Therapy

30. The absolute & relative contraindication for the thrombolytic therapy is tabulated below:

ABSOLUTE CONTRAINDICATIONS FOR THROMBOLYTIC THERAPY

- Recent intracranial hemorrhage (ICH)
- Structural cerebral vascular lesion
- Intracranial neoplasm
- Ischemic Stroke within 3 months
- Possible aortic dissection
- Active bleeding or bleeding diathesis
- Head injury or facial trauma within 3 months
- Recent intracranial or spinal surgery
- Severe uncontrolled hypertension
- History of taking Streptokinase injection within six months

> **RELATIVE CONTRAINDICATIONS FOR THROMBOLYTIC THERAPY**
>
> - History of severe and poorly controlled hypertension
> - Severe hypertension at presentation (systolic blood pressure more than 180 mm Hg
>   or diastolic blood pressure more than 110 mmHg
> - Prolonged (>10 min) cardiopulmonary resuscitation (CPR) or major surgery within
>   three weeks
> - History of Ischemic Stroke
> - Dementia
> - Internal bleeding within 2 to 4 weeks
> - Noncompressible vascular punctures
> - Pregnancy
> - Active peptic ulcer
> - Current therapy of anticoagulant associated with an elevated international normalized ratio higher than 1.7 or a prothrombin time (PT) longer than 15 seconds.

Monitoring of Patients after Thrombolytic Therapy

31. Patients receiving thrombolytic therapy must undergo a constant neurologic and cardiovascular evaluation with blood pressure monitoring every 15 minutes during and after tPA infusion for at least 2 hours, then half hourly for 6 hours and hourly for the next 16 hours after injection. Strict BP monitoring is essential to prevent complications. Thrombolytic therapy should be stopped urgently with any signs of neurologic deterioration, and the patient should receive emergency computed tomography (CT). Fibrinolytic agents or any anticoagulants must be stopped immediately with any evidence of bleeding complications in a patient with ongoing fibrinolytic therapy. In the next step, supportive measures should be instituted, including volume correction and blood factor transfusion.

Appendix 'D'

STEMI MEDICAL EQUIPMENT LIST

Categories	Remarks
Equipment (Capex)	Gap Analysis is recommended for procurement planning of medical equipment for STEMI based on the Availability of Equipment at the public health facility to avoid duplication.
Equipment Maintenance (Opex) (7% of Capex) applicable after warranty period	
ECG Training per Facility for MOs per facility (Lump sum per annum)	
IT Dashboard per Facility per annum (Capex + Opex)	
Total Cost-Capex One Time (INR) (@Funding from XVFC PHC Health Grant)	
Total Cost-Opex per Annum (INR)	

DRUGS FOR STEMI MANAGEMENT

Sl. No.	Name of the Drug	A/U	Strength
1.	Tab Aspirin Soluble/Chewable	No.	325 mg
2.	Tab Aspirin Soluble/Chewable	No.	75 mg
3.	Tab Clopidogrel	No.	75 mg
4.	Tab Metoprolol	No.	25 mg
5.	Tab Metoprolol	No.	50 mg
6.	Tab Ramipril	No.	2.5 mg
7.	Tab Ramipril	No.	5 mg
8.	Tab Enalapril	No.	10 mg
9.	Tab Enalapril	No.	5 mg
10.	Tab Atorvastatin	No.	20 mg
11.	Tab Atorvastatin	No.	40 mg
12.	NTG Spray 0.4mg	Can	14.7 ml
13.	Inj Morphine sulphate	Amp	10 mg/ml
14.	Inj Heparin (LMWH)	ml	1000IU
15.	Inj Heparin (LMWH)	ml	5000IU
16	Inj Tenecteplase	Amp	40 mg
17.	Inj Tenecteplase	Amp	20 mg
18.	Inj Streptokinase	Amp	750000IU
19.	Inj Streptokinase	Amp	1500000IU
20.	Inj Enoxaparin	Amp	40mg/0.4 ml
21.	Inj Enalapril	Amp	1.25mg/ml
22.	Inj Metoprolol	Amp	1mg/ml

MINIMUM MEDICAL EQUIPMENT SUGGESTED FOR STEMI MANAGEMENT

Sl. No.	Name of the Equipment	Level of Health care
1.	ECG machine Single Channel with PC compatibility	PHC
2.	12 Channel ECG Machine with all accessories PC compatible	CHC, SDH/DH
3.	Multipara Monitor (with 5 parameter)	CHC, SDH/DH
4.	Automatic External Defibrillator (AED)	At all levels
5.	SpO2 (Finger probe)	PHC
6.	Syringe infusion pump	At all levels
7.	Crash Cart Trolley	At all levels
8.	Suction machine (Foot & Electric operated)	At all levels
9.	Oxygen Cylinder	At all levels
10.	Hospital Bed (Fowler)	At all levels

CONSUMABLES

Sl. No.	Name of the Drug	A/U
1.	Troponin-I rapid test kit (10 piece)	Kit
2.	ECG Paper Roll	Roll
3.	ECG gel 250 ml	Tube
4.	Disposable ECG Electrodes	Piece