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## Original Article

## The hub-and-spoke model of national STEMI programme of India: An investigation of STEMI-Goa project



Pradeep S. Salve\*, Shrikanta Vatahati, Jyoti Hallad

Population Research Centre, JSS Institute of Economic Research, Dharwad, Karnataka, 580004, India

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## ABSTRACT

**Introduction:** Government of Goa initiated **ST Elevation Myocardial Infarction (STEMI)** – Goa project for achieving the objectives of Ayushman Bharat and Sustainable Development Goals to reduce the premature mortality from non-communicable diseases by one-third with adopting advanced health practices and modern technology. The project handles the escalating STEMI cases in Goa since December 2018.

**Methods:** Mix-method was used for data collection in this study and service statistics was collected from the hub and spoke hospitals. Additionally, staff engaged in the implementation of STEMI model were interviewed. We have visited 13 public health facilities including Goa Medical College where the ‘Hub-and-Spoke’ model of STEMI has institutionalized. The data was collected during October 2019 by employing the pre-designed checklist.

**Results:** All patients who reached the hub-hospital undergone with angiography followed by angioplasty if required. Since the initiation of the project total of 546 patients were diagnosed with the STEMI and 85 percent of patients admitted with a STEMI were thrombolized, – subsequently, 64 percent of them undergone for angiography. Considering the mortality, around 6 percent of deaths have occurred during the past six months. Our study highlights the positive effect of the Hub-and-Spoke model on the treatment of patients with STEMI. The hub-and-spoke model is functioning effectively under the continuous monitoring of expert cardiologists. Additionally, the model has a review committee to investigate deceased cases, advanced cardiac care ambulances and modern ECGs technology.

**Conclusion:** The model can be implemented at a larger scale in other parts of India with the required human resource and advanced technology.

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## 1. Introduction

Non-Communicable Diseases (NCDs) accounts for the largest share of disease burden in India, including cancer, cardiovascular disease, diabetes, respiratory conditions like asthma and chronic obstructive pulmonary disease (COPD) and mental disorder. Nearly, 80% of death attributed to NCDs occur in low-and middle-income countries. The burden of NCDs is escalating and the onset of NCDs shifting as early as the age of  $\geq 45$  years among Indian which is considerably alarming.<sup>1</sup> According to the India Global Burden of Disease collaborators, the Cardiovascular Diseases (CVDs) – particularly ischaemic heart disease and stroke tolling majority of

deaths and significantly contributing to the total burden of mortality in India – 2016.<sup>2</sup> The CVDs is now the leading cause of mortality and expected to increase in coming years with rapid population ageing in India. The determinants of CVDs are high systolic blood pressure, high cholesterol, high fasting plasma glucose and high body-mass index. Altogether, CVDs, respiratory disease and diabetes kill around 4 million Indians annually and most of these deaths are premature i.e. aged 30–70 years.<sup>1–4</sup> The ischemic Heart Disease/STEMI is the highest-ranking cause of premature death in terms of number of years of life lost. The ST-Elevation Myocardial Infarction (STEMI) occurs when blood flow stops to a part of the heart and the heart is injured and fail to receive enough oxygen. It is also known as the heart-attack in laymen language. It is estimated that there are over 2.5 million cases of STEMI in India annually, translating to 1500 to 2000 per million of the population affected annually.<sup>4–6</sup> Most of the patients in developing countries are poor, less likely to get evidence-based

\* Corresponding author.

E-mail addresses: [pradeep\\_salve@biari.brown.edu](mailto:pradeep_salve@biari.brown.edu) (P.S. Salve), [shrikanta.vatahati@gmail.com](mailto:shrikanta.vatahati@gmail.com) (S. Vatahati), [jshallad@rediffmail.com](mailto:jshallad@rediffmail.com) (J. Hallad).

treatment; reducing delays in access to health care and ensuring the provision of affordable treatment could reduce morbidity and mortality.<sup>5,7</sup>

To treat the STEMI cases in ‘Golden Hours’ (within <90 min from the onset of STEMI) the government of India has initiated the implementation of the STEMI India Model through the **Hub-and-Spoke** hospitals. This model has made a successful and significant improvement in the treatment of STEMI cases in Tamil Nadu.<sup>8</sup> The similar model has been implemented in Goa under the STEMI India Programme – National Health Mission (NHM), Govt. of India (GoI) (Fig. 1). Further, GoI intended to replicate the present model throughout the country. Hence, to implement this model successfully throughout India at large scale need continuum empirical studies as India have state-wise demographic and socio-cultural heterogeneity. In this context, the present study was aimed to understand the preparedness of the **hub-and-spoke** model for STEMI intervention before enlarging it to other states and additionally, to understand STEMI Goa model.

### 2. Methods and materials

The study used mix-methods for data collection, where services statistics was collected from the hub and spoke hospitals and additionally, we have interviewed hospital staff engaged in the implementation of the STEMI model in Goa. The official data including the services statistics and staff registered acquired to understand the success and failure of the STEMI cases in the given reference period. The study covered one hub hospital i.e., Medical College or Tertiary Hospital and 12 spoke hospitals which includes public health facilities such as District Hospital (DH)/Sub-Divisional Hospital (SDH)/Community Health Centre (CHC)/Primary Health

Centre (PHC) and Urban Health Centre (UHC) located in Goa. The data was collected during October 2019 by employing the pre-designed checklist.

### 3. Discussion

#### 3.1. Establishment of STEMI

The project is implemented under the Public-Private Partnership (PPP) using the Corporate Social Responsibility (CSR) fund in Goa. Recently, GoG has a memorandum of understanding with the private hospital which is capable of providing Percutaneous Coronary Intervention (PCI) services. As far as concerned with the spokes there is no additional infrastructure is needed but at the same time, the cost to establish a hub hospital is considerably high. It is revealed that the spokes can be established with the existing infrastructure at DH, SDH, CHC or PHC level. The spoke facility can be established in casualty as such there is no exclusive space is required. All health services and treatment is free of cost under the STEMI-Goa Project including empanelled private hospitals.

#### 3.2. Monitoring of STEMI

The program has been extensively monitor at different stages from the state program coordinator and representatives of Non-Communicable Disease Cell (NCDC) and Directorate of Health Services (DHS). All spoke hospitals have weekly and monthly reporting scheduled where they have to reports to the NCDC. In case of death occurred at the spoke hospital then the spoke hospital has to provide the detailed report of death cases within 24 hrs of the event. Similarly, every month all spoke hospitals have to provide

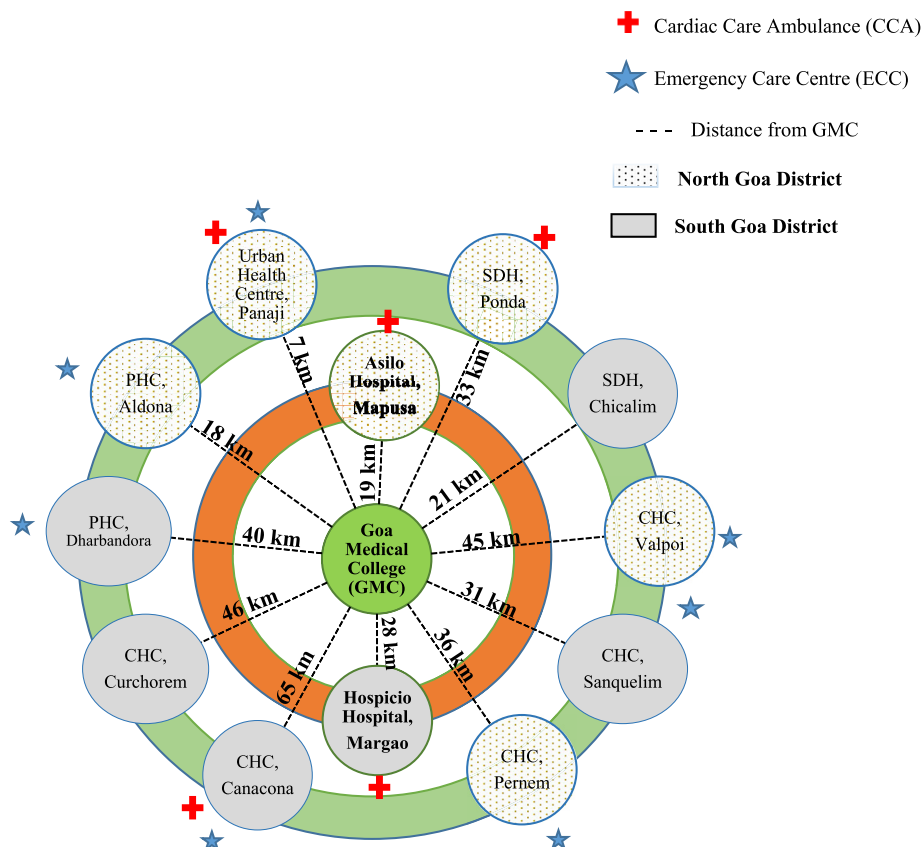


Fig. 1. The STEMI ‘hub-and-spoke’ model of – Goa.

the monthly reporting to the NCDC and DHS. Further, all the nodal officers from the spoke hospitals have to attend the quarterly review meeting for retrospection of the reported death cases. The last supervisory team of the NCDC of the state visited the selected facilities for physical monitoring.

### 3.3. STEMI cases

Since the initiation of the project total of 2364 patients have been identified with critical ECGs taken at the spoke facilities. Subsequently, a total of 546 out of 2364 patients were diagnosed with STEMI in the past 8 months from January to August 2019 (Table 1). As per the discussion with nodal officials of STEMI, the majority of them confirmed that they thrombolized the patient after diagnosis and as per the advice of STEMI consultant cardiologists at the cardiology department at Medical College. In some cases, patients were not thrombolized due to the medical complications at the time of treatment at spokes or due to the previous medical history of patients.

On the other hands, the official data provided by the hub hospital depicted that from May 2019, total of 288 cases of STEMI were admitted to the hub hospital. Subsequently, 85 percent of patients admitted with STEMI were thrombolized and 64 percent (157 cases) of them undergone for angiography at the hub hospital. Apart from angiography, 235 STEMI patients have been treated through rescue, primary, elective PCI and PCI during the past six months.

Considering the mortality attributed to the STEMI in Medical College, around 6 percent of deaths have occurred during the past six months (Table 2). In addition to the Medical College data, we have also analysed STEMI data of all spoke hospitals separately. Altogether, a total of 21 deaths were reported (3.84%) in Goa since the implementation of the STEMI-Goa project (Table 1). Our study highlights the positive effect of the hub-and-spoke model on the treatment of patients with STEMI.

### 3.4. Human resources

As such, there was no exclusive manpower deployed in either spokes or hub under the STEMI project. However, the existing health staff had being utilized for the functioning of STEMI by providing adequate training. It was observed that medical officer at PHC, all casualty doctors at CHC, physicians and all casualty doctors and staffs were trained for Basic Life Support (BLS) and Advanced Life Support (ALS) including the practical demonstrations at the cardiology department of Medical College before the initiation of the project in Goa.

**Table 1**  
STEMI cases managed at the spokes hospitals in Goa.

Months 2019	No. of Critical ECG diagnosed	No. of STEMI diagnosed	Percent of STEMI	No. of STEMI's Thrombolized	% Thrombolized	Deaths <sup>S</sup>
January	607	85	14.0	56	65.9	3
February	430	44	10.2	34	77.3	0
March	334	62	18.6	46	74.2	8
April	221	52	23.5	44	84.6	3
May	174	67	38.5	37	55.2	0
June	276	66	23.9	46	69.7	2
July	153	87	56.9	68	78.2	2
August	169	83	49.1	72	86.7	2
<b>Total</b>	<b>2364</b>	<b>546</b>	<b>23.1</b>	<b>403</b>	<b>73.8</b>	<b>21*</b>

Number of ECGs done on hospital ECG machines are also included, S - Deaths are calculated here as per the data provided by Spokes. The STEMI data of Medical College is excluded.

### 3.5. Treatment system under the hub-and-spoke model

- i) *Cardiac Care Ambulance (CCA) receive the patient:* The concept of establishing spoke hospitals at the peripheral areas of the city is to stabilize patients within the golden time (<90 min) of treatment. The patient with STEMI diagnosed need to be stabilized before receiving advanced treatment such as PCI in hub hospital. To provide the time-bound basic stabilizing treatment the project has incorporated advanced health service facilities including the introduction of Emergency Care Centre (ECC) and CCA. Compared to the other ambulances CCAs are fully equipped with advanced technology (Tricog ECG machine, Defibrillator, Ventilator, Pulse Oximeter monitor, Oxygen, first AID) and 1-MBBS doctor, 1- Emergency Medical Technician, 1 patient helper and first aid treatment for patients with STEMI symptoms. CCAs are significantly contributing in saving the time of patient during the treatment so cases of the late presentation can be subjugated. CCAs have a centralized calling centre where people can make a call in-case of the onset of chest pain and according to the area of the patient nearby CCA reach to the spot to receive the patient and transfer the patient to the nearer spoke hospital.
- ii) *Confirmation for the STEMI:* After receiving the patient at the spoke hospital doctors seek confirmation for the STEMI case from the physicians and STEMI expert of the hub-hospital. Once the patient reached the spoke hospital, doctors have to take the ECG in the Tricog-ECG machine which shares the patient ECG with the Tricog centre based in Bangalore for further verification. Once the Tricog confirmed STEMI for the patient, doctors' update the patients' ongoing treatment on the CardioApp which has a connection with the cardiology department at the hub hospital. The cardiologists at the Medical College go through the ECG updated on the CardioApp. The mobile phones also have the system where CardioApp set on the alarm for STEMI phone at the hub hospital once the Tricog team at Bangalore confirmed the STEMI case.
- iii) *Thrombolising:* Once the doctors at the hub hospital confirmed the 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 min. After thrombolising and

**Table 2**  
STEMI cases managed in the Medical College/Tertiary Hospital from May 2019 to October 2019.

Months 2019	STEMI cases admitted to Medical College	STEMI cases transferred to Medical College from Spokes	Thrombolysis % Thrombolized	Angiography of all STEMI patients who did not undergo primary or rescue PCI	Patients treated with PCI excluding primary or rescue PCI	Number who went rescue/primary/elective PCI	Deaths
May	54	31	44	81.5	25	32	7
June	48	34	41	85.4	29	19	3
July	73	48	63	86.3	47	41	4
August	58	31	52	89.7	36	28	2
September	55	30	46	83.6	20	17	1
<b>Total</b>	<b>288*</b>	<b>174</b>	<b>246</b>	<b>85.4</b>	<b>157</b>	<b>98</b>	<b>17</b>

The data is provided by Medical College. \* including referral cases.

stabilizing the patient, the CCA transfer that patient to the hub hospital for further treatment.

- iv) *Treatment at hub hospital:* The cardiology department proceeded for further treatment as per the patient health status and time. Almost all the patient reached the hub hospital with thrombolising undergone with the Angiography followed by Angioplasty if required.
- v) *Follow-up of the patient:* The hub hospital follow-up the patients after angioplasty treatment. Few spokes are 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.

### 3.6. Drugs and diagnostics

Presently, the STEMI-Goa project is using two injectable drugs that is Inj. Tenecteplase and Inj. Reteplase which cost around 27,000 and 20,000 respectively under the governmental drug supplies. The cost of this medicine is considerably high to buy from the open market. The service statistics shows that the thrombolising drugs are sufficiently available with all the spoke hospitals.

### 3.7. Outreach activities

The awareness of symptoms of STEMI is relatively important and informative to people along with the curative treatment. The outreach activities not only help to reduce the fatality due to chronic diseases but at the same time increase the demand for health care services in the public sector. Considering the initiation and implementation of the STEMI-Goa project, there is substantial scope for developing IEC displays and improving the outreach activities for STEMI.

## 4. Conclusion

Overall, the programme is functioning effectively but the same time considering the implementation at the national level it needs to improve on the preparation of registers for record maintenance, improvement in network connections, proper monitoring and strong guidance during treatment procedures. The STEMI intervention program contributes in reducing the deaths by providing the intensive medical treatment with advanced technology between maximum of 15 min against the 'Golden Hours' (90 min).

### 4.1. Policy recommendations

Pre-printed registers should be provided to all the facilities for proper record maintenance. The uniformity in reporting and maintaining service statistics is important for the preservation of empirical data. There should be an establishment of centralized

data management information system at the hub hospital. Refresher training is required to enhance the confidence level of medical officers to handle STEMI cases. The mobile network can be strengthened for better communication. ECCs should be established in each spoke or it may establish in NCDs clinics by providing all the necessary infrastructure. CCAs need to be located as per the requirement from the spoke.

### 4.2. Limitations

The study presents empirical evidence on the Hub-and-Spoke model in India; however, the study has some limitations which needs to be considered while understanding the model. As this model was in the initial phase, the system of proper data management was not developed in the state. Therefore, the socioeconomic and demographic characteristics data was not maintained systematically. The unavailability of patient's socioeconomic, demographic characteristic and other unit-level data restricts authors from advanced analysis in the study.

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### Declaration of competing interest

Authors declare 'no conflict of interest'.

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