

## SHORT COMMUNICATION

# STEMI Pakistan; A National Heart Attack Management Program.

Salman S Nishtar 

Kettering General Hospital, NHS Foundation Trust- United Kingdom.

**Copyright** © The Author(s). 2022 This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.



### Citation:

Nishtar S S. STEMI Pakistan; A National Heart Attack Management Program. *PJCVI*. 2022; 2(2): 17-23

### Corresponding Author Email:

snishtar@hotmail.com

**DOI:** 10.58889/PJCVI.3.17.23

### Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Conflicts of Interests:

The authors have declared that no competing interests exist.

**Received** 08/09/2022

**Accepted** 22/11/2022

**First Published** 01/12/2022

## Abstract

Coronary artery disease (CAD) accounts for more than two-thirds of these deaths. It is indicated per the latest information that one in four Pakistani adults over 40 has CAD.

The stable coronary disease has a relatively low annual mortality, while acute myocardial infarction (MI) carries a high mortality and morbidity. Though recent advancements in coronary interventions have however revolutionized the management of acute myocardial infarction, resulting in a significant reduction of cardiovascular morbidity and mortality in the developed world but in Pakistan, the majority of ST-elevation myocardial infarction (STEMI) patients still remain sub-optimally managed. Urban areas are relatively better equipped, but this does not necessarily translate into universal access to quality and timely cardiac care. There is not only substantial variation in accessibility and practices amongst cardiac healthcare facilities between rural and urban areas but also amongst major city hospitals. Such variations clearly indicate an urgent need for a nationwide standardized STEMI management program to ensure that everyone with an acute STEMI will have speedy access to quality and standard acute care without being economically burdened.

## Keywords

Coronary Artery Disease, ST-elevation myocardial infarction, cardiac care, Myocardial Infarction, coronary intervention.

## Introduction

The major cause of death in both the developed and developing globe is cardiovascular disease (CVD). It is estimated that around 16 million deaths occurred due to CVD in 2016 and more than three quarter of these were from low and middle-income countries<sup>1,2,3</sup>. Fortunately, there is a sustained and significant decline in cardiovascular mortality in the developed world over the last two decades due to health education and prevention, development of acute care infrastructure, early disease detection and timely and appropriate coronary interventions<sup>4,5</sup>. However unfortunately, cardiovascular mortality continues to rise in Pakistan<sup>6,7</sup>. According to Pakistan's demographic surveys, CVD mortality has increased to 29% in 2016<sup>8</sup>, which is probably an underestimate. Coronary artery disease (CAD) accounts for more than two thirds of these deaths<sup>9</sup>. Although there are no nationally representative population-based data on the prevalence of coronary artery disease in Pakistan, a recently conducted population-based study in Karachi on individuals above 40 years of age has shown a coronary disease prevalence of 24% in men and 30% in women<sup>10</sup>. This indicates that one in four Pakistani adults over the age of 40 has coronary artery disease. In addition, Pakistanis are more likely to develop coronary disease at a younger age due to genetic predisposition, high incidence of cardiovascular risk factors, poor lifestyle and poverty, resulting in significant loss of productive years. This rapid rise of coronary disease in Pakistan is further compounded by limited and variable access to standardized quality health care as well as health inequality that has adversely impacted the national work force, leading to both health and economic regression.

Stable coronary disease has a relatively low annual mortality of approximately 1%<sup>11</sup>. In contrast, acute MI which carries a high mortality and morbidity. Recent advancement in coronary interventions has however revolutionized the management of acute MI, resulting in significant reduction of cardiovascular morbidity and mortality in the developed world<sup>12,13</sup>. However, in Pakistan, the majority of ST elevation myocardial infarction

(STEMI) patients still remain sub-optimally managed, with only less than 10% of cases being offered gold standard Primary percutaneous coronary Intervention (PPCI), 70% receiving the less-than-optimal pharmacological fibrinolysis, and a further 20% not receiving any targeted treatment either due to missed or delayed diagnosis or treatment<sup>14,15</sup>.

Urban areas are relatively better equipped, but this does not necessarily translate into universal access to quality and timely cardiac care. There is not only substantial variation in accessibility and practices amongst cardiac healthcare facilities between rural and urban areas, but also amongst major city hospitals.

Such variations clearly indicate that there is an urgent need for a nationwide standardized STEMI management program ensuring that everyone with an acute STEMI will have speedy access to quality and standard acute care without being economically burdened. Undoubtedly, legislative policy and regulatory frameworks would need to be put in place to ensure better resource management.

### STEMI Care – Structure

Early Revascularization is the hallmark of STEMI management. Coronary revascularization for myocardial infarction historically started with streptokinase (SK) and subsequently with tissue Plasminogen Activators (tPA), with variable rates of coronary reperfusion between 40-70% and an associated bleeding risk. However Primary PCI has completely revolutionized the management of acute STEMI care in the last decade, achieving close to 100% coronary revascularization of the culprit artery quickly and safely, preventing cardiac muscle loss, complications and death. This is now the gold standard and has not only led to reduced morbidity and mortality but also reducing length of stay (LOS), favoring early patient discharge from hospital<sup>16,17</sup>. The developed world has firmly established this as standard of acute STEMI care. Although these systems are effective, they are resource intensive and require coordination,

efficient teamwork, skill and expertise. In addition, it requires the availability of a modern well-equipped infrastructure and an even distribution of cardiac catheter laboratories based on geography and population. These in turn need to be supported by an efficient and trained emergency ambulance and outreach services, that coordinate in real time with patients and the heart attack units, ensuring early detection, acute stabilization, timely transportation and appropriate management with immediate coronary revascularization at the nearest heart attack center. It is clear that although this is a well-established and evidence-based system for acute heart attack in the developed world, firmly supported by successful clinical and economic outcomes, its implementation would be a major challenge in Pakistan without strong government, medical and public commitment. Therefore, one can initially adopt a system, which is suitable for the current infrastructure, which is evidence based and provides best acute cardiac care with a view to 24/7 PPCI implementation, covering the entire population.

A number of studies have shown the benefits of early thrombolysis followed by early cardiac catheterization based on evidence of ongoing ischemia in patients who cannot reach an interventional Heart attack center in time for PPCI treatment<sup>18,19,20</sup>. In order to minimize such delays in coronary reperfusion a pharmaco-invasive strategy is suggested. A prompt pharmaco-invasive technique compared favourably with primary PCI in terms of reducing morbidity and death in STEMI patients, according to numerous research from close by nations<sup>21,22,23</sup>.

Considering this evidence, a hybrid model combining Primary PCI and a pharmaco-invasive strategy would be the most appropriate system to provide the best STEMI care in Pakistan. This would have two arms:

- i) Primary PCI for patients near heart attack facilities with 24/7 PPCI capabilities; these would typically be in urban regions with quick access to the units.

- ii) Pharmaco-invasive strategy for patients in rural or more remote areas or for patients with long transportation times to a 24/7 PPCI unit. The pharmaco-invasive strategy-of thrombolysis would be offered first followed by early transfer for coronary catheterization and PCI in a PPCI capable heart attack unit.

This system's architecture is a subset of the "hub and spoke" design, with a STEMI cluster designating each component. A hub Class "A" hospital and a spoke Class "B" hospital make up each cluster.

Class A hospital would offer 24/7 primary PCI (Main Heart Attack Centre). The goal of these units would be to directly receive acute MI patients for gold standard primary PCI within 150 minutes call to balloon time (CTB) and aiming for a door to balloon (DTB) time of less than 90 minutes for mechanical coronary reperfusion in order to achieve the best outcomes. In addition, these hospitals would also receive patients transferred from a linked spoke 'Type B' hospital offering the initial pharmaco-invasive therapy for subsequent cardiac catheterization and PCI based on clinical priority between 3 – 72 hours after thrombolysis.

For a successful STEMI management framework every major city must initially have at least two class 'A' hub hospitals or heart attack centers.

Class 'B' hospital is a spoke hospital where the primary PCI facility is not available but offers accredited standardized acute cardiac services, offering thrombolysis and early diagnostics, these hospitals will closely coordinate with the main PPCI heart attack class 'A' unit.

Cardiac care at all these specialized cardiac units would be standardized, offering best evidence-based practice. Protocols and management pathways between cardiac centers should be simple in order to reduce complexity or delay during emergency situations and excellent coordination should exist with the 24/7 PPCI capable heart attack units.

Paramedics, nurses, and doctors would gain greatly from adopting new technology to enhance the performance and transmission of real-time clinical data and ECGs across the network of hospitals. This would help to reduce treatment delays and prioritize patients for urgent cardiac catheterization<sup>24</sup>. With widespread availability of Internet and smart phones, a dedicated mobile application can be used to transfer ECGs and other clinical data to the receiving acute heart attack unit by the paramedical team at first medical contact (FMC) and during subsequent transportation for both medical guidance and in preparation by the receiving type 'A' or 'B' hospital.

### Partnership

For a successful STEMI program there has to be partnership between the Government, various key stakeholders and the public.

- 1) **The government:** The STEMI programme needs the full backing and participation of the government. Establishing a social insurance scheme to assist those living below the poverty line and including all government hospitals in the programme. The Government should be in regular consultation with the key stakeholders such as national cardiac societies, college of physicians, paramedical society, PMDC and other relevant organizations so to ensure quality assurance, standardization and successful seamless implementation of the program:

There should be

- a. Legislation to certify STEMI cluster hospitals, provide them with resources, and specify the minimal infrastructure and staffing needs for treating STEMI patients.
- b. Legislation to develop ambulance services and move patients away from non-STEMI institutions and towards PPCI-capable or STEMI-accredited facilities for treatment.
- c. Create new STEMI hospitals (hubs and spokes) to ensure that these facilities are evenly distributed across a specific geographic area based on population density. This may

resemble the "certificate of need" law in the United States.

- 2) **Pakistan Cardiac and Interventional Societies:** should be the key stakeholders after the government for planning and development, accreditation and quality assurance of the STEMI program. They would in turn be held accountable for the standardization, accreditation, data collection and quality assurance to the government.
- 3) **Nationwide modern ambulance system:** It is crucial that a well-equipped ambulance system with trained paramedical staff should be available for transportation of STEMI patients from the primary location to the nearest heart attack unit.
- 4) **Physician's society:** Not interventional cardiologists, but physicians supervise a sizable number of the spoke hospitals. Involvement of the physician's society is therefore essential in terms of both infrastructure and clinical development.
- 5) **An overseeing body to coordinate this with the government or a "STEMI Pakistan task force"** should be established to lead the national program, by setting the national vision, strategy and advising on implementation, this should include national and international experts with government and other key stakeholder suitably represented on the panel.
- 6) **Public:** Public should be educated regarding cardiovascular risk factor, heart attack symptoms, basic life support and made aware of emergency contact helpline numbers and the location of nearest heart attack centers. These should be widely publicized on social media, newspapers, billboards etc. Regular cardiovascular health awareness programs should run with public involvement in all areas of the country in regional languages and dialects.

### Infrastructure Requirements

For successful implementation of the STEMI program a modern well-tailored standardized infrastructure has to be in place across the country.

- 1) **Facility and personnel mapping:** This is a requirement to determine the number of centers with PCI or thrombolysis facilities. Data on the number of cardiologists with PCI abilities, cardiac doctors, 24/7 cardiac catheterization laboratories, and the number of intensive coronary care beds in each facility are also crucial.
- 2) **Geographic mapping:** To determine the size of each STEMI cluster and to map out the linkages, this is crucial. The number of spoke hospitals assigned to a hub hospital would depend on the number of qualified cardiologists available at that hub, the facilities for primary PCI, and the population serviced by those spoke hospitals. Smaller hubs would be a smaller STEMI cluster and would have fewer spoke hospitals connecting to them. Although it would be ideal to specify a certain number of interventional cardiologists and a minimum number of PCIs annually for a heart attack center to qualify and receive accreditation from a hub hospital, these requirements might need to be eased in underserved locations. A governing authority in each area should decide how to allocate resources according to the local need.
- 3) **Real time STEMI incidence and management national database:** This is crucial knowledge that is necessary for putting a STEMI programme into practice. Understanding the present caseload and treatment practices would be aided by a 3- to 4-month pre-implementation data collection from the hub and spoke hospitals. This would be beneficial for strategic planning, assessing the program's resource and human requirements, spotting departures from best practices, and auditing local and national results.

- 4) There is a **national health insurance programme** available to help the population's most financially challenged groups. The costs of thrombolysis, pharmaco-invasive treatment, primary PCI up to the moment of discharge, and the initial follow-up should at least be covered by this insurance.
- 5) Investment in a **modern, well-equipped national ambulance service** with trained and qualified paramedical staff that is able to recognize and manage STEMI at the first point of care.
- 6) Every province should establish a **project management group** in charge of running the state's programme on a daily basis. The project management team should be multidisciplinary and comprise representatives from the provincial government, medical professionals, nurses, paramedics, and other specialists as necessary for the field. The team in charge of project management is in charge of programme administration, execution of the STEMI protocol, identification of regional operational difficulties, data gathering, and reporting of performance and results to the national cardiac society. The project management team will assist the program's adoption and operation with an emphasis on making it accessible to the general public. In addition to teaching the public about the programme and primary prevention in local languages, this may also entail outreach services in both urban and rural regions.

## Discussion

### Audit and Quality Improvement

Each center taking part in the STEMI programme must be dedicated to reliable, transparent data collection and reporting. Real-time data gathering and digital transmission to the main national database should start as soon as the patient is receiving acute treatment. Aggregate data reports should be submitted on time for system-wide evaluation as well as local review at each care location. Each center should pledge to provide

accurate data that accurately reflects the type of service actually provided. The ideal use of data results is to motivate performance, quality, and punitive actions. (Similar to UK BCIS AUDIT)

A quality improvement (QI) committee for heart attack units would be in charge of local quality improvement initiatives and hold regular reviews and meetings at set intervals to evaluate the program's efficacy as a continuous process. The datasets that would be used for the evaluation of quality improvement should be predefined and accomplish the program's intended objectives. The overall level of care, the results, and any room for development would be evaluated and addressed. Any faults found must be addressed, audited, and given recommendations for a corrective action plan.

### Timelines for Implementation

Implementation should be done methodically and sequentially, paying close attention to the necessary processes. Clinical deployment can be done in stages, starting with 4 clusters as a pilot and subsequently adding more clusters to cover the full population over the course of 5–10 years.

### Acknowledgment

None.

### References

- 1) Turin TC, Shahana N, Wangchuk LZ, Specogna AV, Al Mamun M, Khan MA, Choudhury SR, Zaman MM, Rumana N. Burden of Cardio- and Cerebro-vascular Diseases and the Conventional Risk Factors in South Asian Population. *Glob Heart*. 2013;8(2):121-30.
- 2) WHO. Global status report on noncommunicable diseases 2014. 2017. Available from URL: <https://www.who.int/nmh/publications/ncd-status-report-2014/en/>
- 3) Lozano R, Naghavi M, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380(9859):2095-128.
- 4) Gaziano TA, Bitton A, Anand S, Abrahams-Gessel S, Murphy A. Growing epidemic of coronary heart disease in low- and middle-income countries. *Curr Probl Cardiol*. 2010;35(2):72-115.
- 5) Celermajer DS, Chow CK, Marijon E, Anstey NM, Woo KS. Cardiovascular disease in the developing world: prevalence's, patterns, and the potential of early disease detection. *J Am Coll Cardiol*. 2012;60(14):1207-16.
- 6) Barolia R, Sayani AH. Risk factors of cardiovascular disease and its recommendations in Pakistani context. *J Pak Med Assoc*. 2017;67(11):1723-1729.
- 7) Yusuf S, Rangarajan S, Teo K, Islam S, Li W, Liu L, Bo J, Lou Q, Lu F, Liu T, Yu L, Zhang S, Mony P, Swaminathan S, Mohan V, Gupta R, Kumar R, Vijayakumar K, Lear S, Anand S, Wielgosz A, Diaz R, Avezum A, Lopez-Jaramillo P, Lanus F, Yusoff K, Ismail N, Iqbal R, Rahman O, Rosengren A, Yusufali A, Kelishadi R, Kruger A, Puoane T, Szuba A, Chifamba J, Oguz A, McQueen M, McKee M, Dagenais G; PURE Investigators. Cardiovascular risk and events in 17 low-, middle-, and high-income countries. *N Engl J Med*. 2014;371(9):818-27.
- 8) WHO. (nd). Pakistan: the risk of premature deaths due to NCDs (%). WHO. 2020. Access Via: [https://www.who.int/nmh/countries/pak\\_en.pdf](https://www.who.int/nmh/countries/pak_en.pdf)
- 9) National Institute of Population Studies (Pakistan), Macro International. Institute for Resource Development. Demographic, Health Surveys. Pakistan demographic and health survey. National Institute of Population Studies; 2012.
- 10) Jafar TH, Qadri Z, Chaturvedi N. Coronary artery disease epidemic in Pakistan: more electrocardiographic evidence of ischaemia in women than in men. *Heart*. 2008;94(4):408-413.
- 11) Mensah GA, Wei GS, Sorlie PD, Fine LJ, Rosenberg Y, Kaufmann PG, Mussolino ME, Hsu LL, Addou E, Engelgau MM, Gordon D. Decline in Cardiovascular Mortality: Possible Causes and Implications. *Circ Res*. 2017;120(2):366-380.
- 12) Salim L. Community awareness on Coronary Heart Disease in northern areas of Pakistan (Process evaluation of healthy heart program). *Int. J. Endorsing Health Sci. Res*. 2013;1(1):43-6.
- 13) Kayani WT, Ballantyne CM. Improving Outcomes After Myocardial Infarction in the US Population. *J Am Heart Assoc*. 2018;7(4):e008407.
- 14) Farman MT, Sial JA, Khan NU, Rizvi SN, Saghir T, Zaman KS. Outcome of primary percutaneous coronary intervention at public sector tertiary care hospital in Pakistan. *J Pak Med Assoc*. 2011;61(6):575-81.
- 15) Zeb S, Hafizullah M, Jan H, Adil M, Zeb R. ST Elevation Myocardial Infarction: An Experience at Lady Reading Hospital Peshawar, Pakistan. *KMUJ*. 2017;9(2).
- 16) Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio AL, Crea F, Goudevenos JA, Halvorsen S, Hindricks G. 2017 ESC Guidelines for

- the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018;39(2):119-177.
- 17) O'Gara PT, Kushner FG, Ascheim DD, Casey DE Jr, Chung MK, de Lemos JA, Ettinger SM, Fang JC, Fesmire FM, Franklin BA, Granger CB, Krumholz HM, Linderbaum JA, Morrow DA, Newby LK, Ornato JP, Ou N, Radford MJ, Tamis-Holland JE, Tommaso CL, Tracy CM, Woo YJ, Zhao DX, Anderson JL, Jacobs AK, Halperin JL, Albert NM, Brindis RG, Creager MA, DeMets D, Guyton RA, Hochman JS, Kovacs RJ, Kushner FG, Ohman EM, Stevenson WG, Yancy CW. American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines 2013. ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;127(4):e362-425.
  - 18) Helal AM, Shaheen SM, Elhammady WA, Ahmed MI, Abdel-Hakim AS, Allam LE. Primary PCI versus pharmacoinvasive strategy for ST elevation myocardial infarction. *Int J Cardiol Heart Vasc*. 2018;21:87-93.
  - 19) Rashid MK, Guron N, Bernick J, Wells GA, Blondeau M, Chong AY, Dick A, Froeschl MP, Glover CA, Hibbert B, Labinaz M, Marquis JF, Osborne C, So DY, Le May MR. Safety and Efficacy of a Pharmacoinvasive Strategy in ST-Segment Elevation Myocardial Infarction: A Patient Population Study Comparing a Pharmacoinvasive Strategy with a Primary Percutaneous Coronary Intervention Strategy Within a Regional System. *JACC Cardiovasc Interv*. 2016;9(19):2014-2020.
  - 20) Shavadia J, Ibrahim Q, Sookram S, Brass N, Knapp D, Welsh RC. Bridging the gap for nonmetropolitan STEMI patients through implementation of a pharmacoinvasive reperfusion strategy. *Can J Cardiol*. 2013;29(8):951-9.
  - 21) Raja DC, Subban V, Victor SM, Joseph G, Thomson VS, Kannan K, Gnanaraj JP, Veerasekar G, Thenpally JG, Livingston N, Nallamothu BK. The impact of systems-of-care on pharmacoinvasive management with streptokinase: the subgroup analysis of the TN-STEMI programme. *Indian Heart J*. 2017;69(5):573-9.
  - 22) Victor SM, Subban V, Alexander T, G BC, Srinivas A, S S, Mulasari AS. A prospective, observational, multicentre study comparing tenecteplase facilitated PCI versus primary PCI in Indian patients with STEMI (STEPP-AMI). *Open Heart*. 2014;1(1):e000133.
  - 23) Faslur Rahuman MB, Jayawardena JB, Francis GR, et al. A comparison of rescue and primary percutaneous coronary interventions for acute ST elevation myocardial infarction. *Indian Heart J*. 2017;69 Suppl 1(Suppl 1):S57-S62.
  - 24) Studencan M, Alusik D, Plachy L, et al. Significant benefits of new communication technology for time delay management in STEMI patients. *PLoS One*. 2018;13(11):e0205832.