Systems of care for ST-elevation myocardial infarction in India

Thomas Alexander,[1] Sameer Mehta,[2] Ajit Mullasari,[3] Brahmajee K Nallamothu[4]

[1]Kovai Medical Center and Hospital, Coimbatore, Tamil Nadu, India
[2]University of Miami, Miami, Florida, USA
[3]Madras Medical Mission, Chennai, Tamil Nadu, India
[4]University of Michigan Medical School, Ann Arbor, Michigan, USA

Correspondence to
Dr Thomas Alexander, Kovai Medical Centre and Hospital, P.B.3209, Avanashi Road, Coimbatore, 641014, India; tomalex41@gmail.com
Dr Brahmajee K Nallamothu, University of Michigan, Cardiovascular Center, SPC 5869, Ann Arbor, MI 48109-5869, USA; bnallamo@umich.edu

ABSTRACT
The prevalence of coronary artery disease and ST-elevation myocardial infarction (STEMI) are increasing in India. Although recent publications have focused on improving preventive measures in developing countries, less attention has been placed on the acute management of STEMI. Recent policy changes in India have provided new opportunities to address existing barriers but require greater investment and support in the coming years.

Coronary artery disease (CAD) is currently the most common, non-infectious disease in India and will affect over 65 million of its people by the year 2015.[1] One of the gravest complications of CAD is ST-elevation myocardial infarction (STEMI), a life-threatening medical emergency that results from a sudden, occlusive thrombus in the coronary artery. When STEMI patients are treated promptly with reperfusion therapy, significant reductions in mortality and morbidity are possible.[2] [3] Unfortunately, the overall use and quality of acute reperfusion therapy in India lags significantly behind North America and Europe.

In this paper, we discuss the current state of STEMI care in India and argue for greater investment in acute reperfusion therapy. Although recent publications have focused appropriately on improving preventive measures for CAD in India,[4–6] less attention has been placed on the acute management of STEMI, or in particular, how 'systems of care' approaches, popularised in North America and Europe, may be implemented.[7] [8] We specifically highlight recent policy changes that provide new opportunities to address existing barriers and briefly describe a 'real-world' example of a STEMI systems of care programme initiated in the southern Indian state of Tamilnadu.

WHY FOCUS ON REPERFUSION THERAPY IN INDIA?
Despite all its recent and substantial economic advances, many people in India remain poor. Over 450 million Indians currently live at or below the poverty line, earning less than US$1.25 a day.[9] Developing countries such as India, therefore, have many urgent public health needs to address for their populations, such as nutrition, sanitation and housing, as well as childhood vaccination and other preventive services. On the surface, these challenges make acute reperfusion therapy in STEMI patients appear less of a priority—a concern more relevant for affluent countries and healthcare systems.

However, CAD is a major contributor of death and disability in India, and its overall prevalence has risen dramatically over the past two decades. Approximately 3—4% of Indians in rural areas and 8—10% in urban areas have CAD.[10] Moreover, Indians are more likely to develop CAD at younger ages during an individual's working years, and as a result, there is an extremely high loss of potentially productive years of life in India. Among working-age adults (35—64 years old), nearly 18 million productive years of life are expected to be lost from CAD by 2030—a number more than nine times higher than expected in the USA.[11] This pattern of disease has substantial implications for India's growing workforce and economy.

Another reason for concern is the growth of CAD among poor and middle-class Indians, when once it was considered a disease of the wealthy.[12] Reasons for this include the potential relationship between fetal or childhood undernutrition and the subsequent development of cardiovascular risk factors;[13] a disproportionate use of tobacco products among the poor;[14] and less access to preventive services and medical care when compared with wealthier patients.[15] Not surprisingly, recent studies suggest that poor patients with CAD in India appear to be at greater risk of acute presentations of CAD and have worse outcomes following such events.

The most complete data about contemporary trends in STEMI patients come from CREATE, a large clinical registry of acute coronary syndrome patients from 89 large hospitals in 10 regions and cities across India.[16] Among the more than 20 000 patients enrolled in CREATE, over 60% had STEMI—a proportion that is substantially higher than in North American and European registries.[17] [18] STEMI patients also were younger and had a lower socioeconomic status when compared with non-STEMI patients. The median time from the onset of symptoms to hospital arrival was 300 min in STEMI patients, again more than double the delay reported in developed countries. Finally, approximately 60% received fibrinolytic therapy and only 8% underwent percutaneous coronary intervention (PCI) during their hospitalisation, suggesting substantial room for improvement in the use of acute reperfusion therapy.

CHALLENGES AND OPPORTUNITIES FOR STEMI SYSTEMS OF CARE IN INDIA
Although developing countries have many barriers to improving STEMI care in general, we see several challenges as particularly unique to India. These largely arise due to the distinctive structure of its healthcare system, which is one of the most privatised in the world. As such, specialised centres in urban areas offer world class, cutting-edge treatment (which has promoted medical tourism as

an industry), while much of the population still relies on its inadequately funded public health systems and hospitals. The first concern is, India's low overall healthcare spending per person—approximately half that of Sri Lanka, and a third of China and Thailand[19]—has led to poor infrastructure for managing medical emergencies at the population level, especially in rural districts. This gap has been most apparent for prehospital emergency medical systems (EMS), which until recently were almost non-existent. Second, inadequate public and private health insurance programmes places STEMI patients and their families at great personal financial risk from treatments, contributing to the underutilisation of evidence-based therapies. Third, India maintains high rates of communicable diseases, such as respiratory and gastrointestinal infections. India's healthcare future will depend partly on how it balances between multiple priorities rather than a singular focus on one. Finally, public education on the early signs of myocardial infarction is a substantial challenge given India's low rates of literacy and diverse society.

Despite these challenges, recent clinical advances and policy changes have created new opportunities for improving STEMI care in India:

Better acute reperfusion therapy

Approval of generic versions of two drugs—tenecteplase and reteplase—by the Drug Controller of India is a major step towards developing viable STEMI systems of care in the country. These newer, second-generation drugs for fibrinolytic therapy improve reperfusion rates and outcomes in STEMI patients.[20] Their bolus administration also makes it possible to consider prehospital treatment in certain settings. New data on adjunctive therapy with clopidogrel may also expand the benefits of fibrinolytic therapy.[21] Finally, an improved understanding of the role of the pharmacoinvasive approach, ie, the combination of immediate pharmacological reperfusion with invasive cardiac procedures, suggests the possibility of targeting PCI in high-risk patients.[22] As with drugs, the availability of newer generation and less expensive generic Indian stents will significantly expand PCI to broader populations.

Emergence of EMS

During recent years, a remarkable healthcare success in India has been the development of the GVK EMRI ambulance system. At present, it covers a population of 372 million across 11 states and reaches both rural and urban regions. GVK EMRI has approximately 2800 ambulances in active service, making 4.5 trips per day with a cost per trip of Rs 600 (or approximately US$12; G.V. Ramana Rao, GVK Emergency Management and Research Institute, personal communication). In the next few years, it will expand to 15 000 ambulances and provide coverage for up to 1 billion people. Some areas have already incorporated chest pain algorithms into their protocols, begun prehospital electrocardiography and even delivered standard 'cocktails' to initiate treatment. Further standardising care may also include having STEMI patients bypass smaller hospitals in favour of direct transfer to larger centres with catheterisation laboratories. However, the low overall rates of utilisation of EMS services in India remain a large challenge. For example, approximately 5% of STEMI patients in CREATE used ambulance services.[16]

Expanded social insurance programmes

Although still under development, the recent and rapid introduction of social health insurance has potentially profound effects on STEMI care in India.[23 24] In general, these programmes have involved public—private partnerships with premiums provided by state governments while claims are administered by private companies. Two recent models have been the Arogyasree insurance programme in Andhra Pradhesh and the government insurance programme in Tamilnadu. Both programmes allow for emergency treatments and procedures through 'fast-track' approval—for example, STEMI patients can get immediate approval for primary PCI any time of day or night. In addition, their large size and influence has already pushed for the standardisation of treatments and accountability of care in these regions. Yet many challenges remain. Until recently, for example, fibrinolytic therapy was not reimbursed in Tamilnadu, despite coverage for PCI. Another limitation is the significant proportion of uninsured people that remains despite such programmes, as current subsidises largely exist only for families below the poverty threshold. Finally, sustainable funding remains a challenge given the early nature of these programmes and their susceptibility to political changes.

Kovai Erode Pilot STEMI initiative

To assess the feasibility of developing a model for STEMI systems of care in India, we recently launched the Kovai Erode Pilot STEMI initiative within a large rural district of Tamilnadu. This quality improvement programme utilised both fibrinolytic therapy and PCI as acute reperfusion therapy, involved numerous providers and hospitals, and focused on a population-level approach, rather than care delivered at a single hospital. It also directly leveraged recent policy changes, such as the GVK EMRI ambulance system and the government insurance programme in Tamilnadu.

Erode district is located in the northern part of Tamilnadu. It has a population of over 2 million people and covers an area of 5714 km^2. Since February 2009, the GVK EMRI ambulance service has operated in this district and is supplemented by ambulances belonging to various private hospitals. The Erode district has one hospital with a cardiac catheterisation laboratory and cardiac surgical services. This hospital was designated as the 'hub' for a network across several referral hospitals in the district. In constructing protocols for STEMI patients at different locations in this initiative, we considered the acuity of the presentation, contraindications to fibrinolytic therapy in the patient, and travel times to the hub hospital from referral hospitals, largely classified as in an inner or outer grid based on estimated ground transport times of 30 min or less (details available from the authors on request).

The Kovai Erode Pilot STEMI initiative involved voluntary participation by referring physicians and cardiologists who were advised to follow one of two strategies based on distances from the referring to the hub hospital:

► Fibrinolytic therapy and pharmacoinvasive approach: Patients presenting to outer grid hospitals with longer transport times would receive fibrinolytic therapy and then be transferred to the hub hospital for definitive care, which often meant diagnostic catheterisation and revascularisation, when indicated. The goal for fibrinolysis was a first medical contact to drug of 30 min or less. Transfers were referred for diagnostic catheterisation 3—24 h after fibrinolytic therapy.

► Primary PCI: STEMI patients presenting to inner grid hospitals, including the hub hospital were referred for primary PCI with a goal for first medical contact to balloon time of between 90 and 120 min.

During approximately the first 6 months, 84 patients received care within this quality improvement programme. A total of 45 (54%) patients travelled from the outer grid hospitals. The mean

time of arrival from symptom onset was 170 min, with 77% of patients arriving by ambulance with a mean transport time of 44 min (5—99 min). The mean time from hospital arrival to PCI was 69 min for patients undergoing primary PCI while the mean time to PCI after fibrinolytic therapy with the pharmacoinvasive strategy was 480 min.

LESSONS LEARNT

Several practical lessons were learnt from this initiative. First, building partnerships between hospitals is critical with transport time only one of many factors under consideration. For example, the GVK EMRI ambulance system currently provides no mechanism for interhospital transfer between private hospitals (although this is being addressed). Financial mechanisms also need to be worked for partnerships to develop, even with the availability of social health insurance. Affordability of treatment is not only a critical issue for patients, but for hospitals. Implementing explicit, shared compensation agreements between referring and hub hospitals is clearly needed. Third, audit and quality control issues need to be addressed at every level. Finally and perhaps most importantly, it is clear that STEMI guidelines need to be contextualised to India. Relying on North American and European standards is problematical for providers in India-—especially in regions with smaller and rural hospitals.

Based on the Kovai Erode Pilot STEMI initiative, plans are underway for an expanded, statewide STEMI systems of care programme in Tamilnadu. Key partners will be the government insurance programme (and its administrative private partners) and the GVK EMRI ambulance system. This expanded programme will cover over 80% of the state's population and involve potentially 700 hospitals in the state. To participate in the programme, hospitals will commit to minimum auditing and reporting standards. Furthermore, the Kovai Erode Pilot STEMI initiative has been used to establish a 'not-for-profit' national organisation—STEMI INDIA—that is devoted to improving STEMI care in India. Its purpose will be to review scientific literature, educate and train STEMI teams in hospitals, develop STEMI guidelines and systems of care approaches relevant for India, and finally provide public education to reduce delays.

REFERENCES

1. **National Commission on Macroeconomics and Health.** Burden of Disease in India. Delhi, India: Ministry of Health and Family Welfare, Government of India, 2005. http://www.who.int/macrohealth/action/NCMH_Burden%20of%20disease_(29%20Sep%202005).pdf (accessed 20 Jul 2011).
2. **Boersma E,** Maas AC, Deckers JW, et al. Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. Lancet 1996;**348**:771—5.
3. **Nallamothu BK,** Bradley EH, Krumholz HM. Time to treatment in primary percutaneous coronary intervention. N Engl J Med 2007;**357**:1631—8.
4. **Reddy KS.** India wakes up to the threat of cardiovascular diseases. J Am Coll Cardiol 2007;**50**:1370—2.
5. **Patel V,** Chatterji S, Chisholm D, et al. Chronic diseases and injuries in India. Lancet 2011;**377**:413—28.
6. **Wood A,** Pell J, Patel A, et al. Prevention of cardiovascular disease in a rural region of India and strategies to address the unmet need. Heart 2011;**97**:1373—8.
7. **Jacobs AK.** Regional systems of care for patients with ST-elevation myocardial infarction: being at the right place at the right time. Circulation 2007;**116**:689—92.
8. **Saia F,** Marrozzini C, Ortolani P, et al. Optimisation of therapeutic strategies for ST-segment elevation acute myocardial infarction: the impact of a territorial network on reperfusion therapy and mortality. Heart 2009;**95**:370—6.
9. Revised Poverty Estimates: What does this mean for India? http://www.worldbank.org.in/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/INDIAEXTN/0,,contentMDK:21880804~pagePK:141137~piPK:141127~theSitePK:295584,00.html (accessed 20 Jul 2011).
10. **Ghaffar A,** Reddy KS, Singhi M. Burden of non-communicable diseases in South Asia. BMJ 2004;**328**:807—10.
11. **Leeder S,** Raymond S, Greenberg H, et al. A Race Against Time: The Challenge of Cardiovascular Disease in Developing Economies. New York, USA: Columbia University, 2004. http://www.earthinstitute.columbia.edu/news/2004/images/raceagainsttime_FINAL_051104.pdf (accessed 20 Jul 2011).
12. **Jeemon P,** Reddy KS. Social determinants of cardiovascular disease outcomes in Indians. Indian J Med Res 2010;**132**:617—22.
13. **Gillman MW.** Developmental origins of health and disease. N Engl J Med 2005;**353**:1848—50.
14. **Rani M,** Bonu S, Jha P, et al. Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey. Tob Control 2003;**12**:e4.
15. **Ramaraj R,** Alpert JS. Indian poverty and cardiovascular disease. Am J Cardiol 2008;**102**:102—6.
16. **Xavier D,** Pais P, Devereaux PJ, et al. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet 2008;**371**:1435—42.
17. **Peterson ED,** Roe MT, Chen AY, et al. The NCDR ACTION Registry — GWTG: transforming contemporary acute myocardial infarction clinical care. Heart 2010;**96**:1798—802.
18. **Herrett E,** Smeeth L, Walker L, et al. The myocardial ischaemia national audit project (MINAP). Heart 2010;**96**:1264—7.
19. **Kumar AKS,** Chen LC, Choudhury M, et al. Financing health care for all: challenges and opportunities. Lancet 2011;**377**:668—79.
20. **Armstrong PW,** Collen D, Antman E. Fibrinolysis for acute myocardial infarction. Circulation 2003;**107**:2533—7.
21. **Sabatine MS,** Cannon CP, Gibson CM, et al. Addition of clopidogrel to aspirin and fibrinolytic therapy for myocardial infarction with ST-segment elevation. N Engl J Med 2005;**352**:1179—89.
22. **Antman EM,** Van de Werf F. Pharmacoinvasive therapy. Circulation 2004;**109**:2480—6.
23. **Reddy KS,** Patel V, Jha P, et al. Towards achievement of universal health care in India by 2020: a call to action. Lancet 2011;**377**:760—8.
24. **Mallipedi R,** Pernefeldt H, Bergkvist S. Andhra Pradesh Health Sector Reform: A Narrative Case Study. Hyderabad, India: ACCESS Health Initiative, 2009. http://www.rockefellerfoundation.org/uploads/files/f9850c94-5c05-4025-b47d-1b206cb95ccf-7.pdf (accessed 19 Jul 2011).

Systems of care for ST-elevation myocardial infarction in India

Thomas Alexander, Sameer Mehta, Ajit Mullasari, et al.

Updated information and services can be found at:

http://heart.bmj.com/content/98/1/15.full.html

These include:

References	This article cites 20 articles, 9 of which can be accessed free at: **http://heart.bmj.com/content/98/1/15.full.html#ref-list-1** Article cited in: **http://heart.bmj.com/content/98/1/15.full.html#related-urls**
Email alerting service	Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.
Topic Collections	Articles on similar topics can be found in the following collections Drugs: cardiovascular system (7488 articles) Acute coronary syndromes (2379 articles)

Notes

To request permissions go to:

http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:

http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:

http://group.bmj.com/subscribe/