

STEMI Care in LMIC Obstacles and Opportunities

Karthik Murugiah*, Sudhakar V. Nuti*, Harlan M. Krumholz*[†]

New Haven, CT, USA

Over the past few decades, there has been an intense focus on improving health systems in developed countries, with a particular focus on cardiovascular disease (CVD). However, low- and middle-income countries (LMIC), with their rapid economic growth, increasingly sedentary lifestyles, and calorie-rich diets, are now experiencing a growing burden of CVD. In India, for example, CVD already accounts for more than one-fourth of all deaths in those over 25 years of age [1].

ST-segment elevation myocardial infarction (STEMI)—the common presentation of acute myocardial infarction in many LMIC—presents a particular challenge for these countries. In India, STEMI accounts for >60% of acute myocardial infarction hospitalizations [2]. In China, the number of patients with STEMI quadrupled over the past decade and accounts for 80% of acute myocardial infarction hospitalizations [3,4].

STEMI care requires timely intervention and coordination of systems and people, but there are distinctive challenges to implementing effective systems in resource-poor settings [5–7]; it is not possible to simply transport successful strategies from more economically advanced countries [8–11]. These challenges include inadequate emergency medical services [12], a paucity of specialists [13], inadequate access to percutaneous coronary intervention (PCI)-capable facilities, which are largely limited to cities [14], and, perhaps most importantly, a large number of patients who cannot afford vital treatments. These structural issues, among others, conspire against the delivery of rapid and effective care for patients with STEMI.

India is a prototypical country that experiences these challenges. Patients with STEMI in India take a median of 300 min to reach a hospital, far longer than in the West, with only 5% of patients arriving via ambulance. Ultimately, only two-thirds receive reperfusion therapy, and only 8% of patients with STEMI are able to receive PCI [2].

Addressing these aspects, in this issue, Alexander et al. [15] describe a hub-and-spoke model for STEMI care in India combining 2 strategies: 1) primary PCI for patients in the vicinity of a PCI-capable facility; or 2) a pharmacoinvasive strategy for those with long transit times to a PCI-capable facility, where patients would first receive fibrinolytic therapy followed by PCI within 3 to 24 h. This model was successfully implemented, by the investigators, in a pilot program in 4 clusters in the state of Tamil Nadu, India—in itself a laudable achievement. The program was able to increase the receipt of pharmacoinvasive therapy among patients presenting to spoke hospitals from 13% to

58%. Their model seeks to overcome several challenges by forging a unified STEMI network with the involvement of leading physician societies, state governments, ambulance agencies, and hospitals. However, as the investigators note, universal health insurance is critical to the success of such a STEMI program at a national level.

India is heavily reliant on the private sector for health care, where payments are almost entirely out-of-pocket [16]. Three-quarters of patients with acute coronary syndrome in India pay the expenses on their own [2]. The cost of PCI with a drug-eluting stent at a private hospital can cost more than \$2,000 [17], which is higher than the per capita income in India [18]. Given that 75% of patients with STEMI are from either poor or low-middle-income families [2], STEMI can be financially devastating. It is this fear that prevents many patients from seeking care, and even if they do present seeking acute care, poor patients face disparities in the provision of life-saving therapies; rates of PCI are 7 times lower among poor patients than among the affluent [2]. Another single-center study [19] reported that 50% of the door-to-balloon time was spent in sorting out the financial process, which demonstrates the enormity of this problem. Given cost constraints, poor patients frequently present to government hospitals where care is provided at a nominal charge; yet, except in large cities, care at government hospitals is often substandard due to deficient infrastructure and manpower [16].

In an ideal world, the choice between primary PCI versus fibrinolytic therapy would be influenced by the transit time; in reality, the cost of PCI is prohibitive for a majority of patients. In their pilot study, Alexander et al. leveraged the social insurance system available in the state of Tamil Nadu, but given that universal health care in India is not on the immediate horizon, fibrinolytic therapy alone may be the only viable reperfusion strategy for most patients. However, as with PCI, the benefit conferred by fibrinolytic therapy declines rapidly with time since symptom onset, and timely transport to the hospital remains vital. Investments to develop an organized emergency medical services system with rapid identification and transport can pay immediate dividends and ensure that millions receive timely reperfusion therapy. At the same time, parallel efforts must be made to improve awareness regarding cardiac disease and the importance of seeking timely care.

In another article in this issue, Gupta et al. [20] present results of the implementation of an electronic intensive care unit system on STEMI care at a single hospital. The

Dr. Krumholz is the recipient of research grants from Medtronic and Johnson & Johnson, through Yale University, to develop methods of clinical trial data sharing and chairs a cardiac scientific advisory board for UnitedHealth. He is supported by grant U01 HL105270-05 (Center for Cardiovascular Outcomes Research at Yale University) from the National Heart, Lung, and Blood Institute. The other authors report no relationships that could be construed as a conflict of interest. From the *Center for Outcomes Research and Evaluation, Yale—New Haven Hospital, New Haven, CT, USA; and the †Section of Cardiovascular Medicine and the Robert Wood Johnson Foundation Clinical Scholars Program, Department of Internal Medicine, Yale University School of Medicine; Department of Health Policy and Management, Yale School of Public Health, New Haven, CT, USA. Correspondence: H. M. Krumholz (harlan.krumholz@yale.edu).

GLOBAL HEART
© 2014 World Heart Federation (Geneva).
Published by Elsevier Ltd.
All rights reserved.
VOL. 9, NO. 4, 2014
ISSN 2211-8160/\$36.00.
<http://dx.doi.org/10.1016/j.jheart.2014.08.010>

intervention resulted in a dramatic increase in administration of fibrinolytic therapy from 50% to 100% and reductions in mean door-to-needle time from 3 h to <30 min, which translated to a 70% reduction in mortality. These findings highlight how provision of specialist supervision from a remote location can elevate care at facilities lacking such expertise. These findings are especially pertinent to a setting like India where the quality of care and the expertise available at hospitals is highly variable. However, with the remarkable changes post-intervention, the study raises questions about what truly is the level of expertise and training required to identify patients appropriately and deliver fibrinolytic therapy. Given the adverse doctor-patient ratio in India [1], in the face of the ever-growing burden of STEMI, it is imperative that every physician who could be in a position to care for a STEMI patient be able to identify STEMI and deliver fibrinolytic therapy.

Nationalized programs have successfully reduced morbidity from infectious diseases such as tuberculosis and malaria in India. These programs incorporate training and support for healthcare professionals, and in addition provide clear guidelines for identifying and treating patients experiencing these illnesses. Given that coronary artery disease and STEMI is the next epidemic in India, it calls for a similar nationalized program, which, apart from providing guidelines tailored for different healthcare settings, would incorporate training of healthcare professionals such that even small hospitals without a cardiologist on call would be able to identify appropriate patients and deliver fibrinolytic therapy. In parallel, we must ensure that the health system is poised to support these decisions, with readily available ECGs, drugs in the emergency department, and checklists to review contraindications.

It is commendable that these studies are beginning to develop systems of care to confront the STEMI epidemic, but there are fundamental problems in infrastructure and cost underlying the effective, timely treatment of patients with STEMI in India, as well as other LMIC, that need to be addressed. Although these obstacles are many, they are not insurmountable. Ultimately, the solutions need to be attentive to the unique restrictions and challenges present in India and other LMIC in order to try to achieve the same results as seen in the West after investments in improved systems.

REFERENCES

1. Ministry of Home Affairs. Report on Causes of Death in India 2001–2003. New Delhi, India: Office of the Registrar General, Ministry of Home Affairs; 2009.
2. Xavier D, Pais P, Devereaux PJ, et al., for the CREATE Registry Investigators. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. *Lancet* 2008; 371:1435–42.
3. Gao R, Patel A, Gao W, et al., for the CPACS Investigators. Prospective observational study of acute coronary syndromes in China: practice patterns and outcomes. *Heart* 2008;94:554–60.
4. Li J, Li X, Wang Q, et al., for the China PEACE Collaborative Group. ST-segment elevation myocardial infarction in China from 2001 to 2011 (the China PEACE-Retrospective Acute Myocardial Infarction Study): a retrospective analysis of hospital data. *Lancet* 2014 Jun 23 (E-pub ahead of print).
5. Du X, Gao R, Turnbull F, et al., for the CPACS Investigators. Hospital quality improvement initiative for patients with acute coronary syndromes in China: a cluster randomized, controlled trial. *Circ Cardiovasc Qual Outcomes* 2014;7:217–26.
6. Ranasinghe I, Rong Y, Du X, et al., for the CPACS Investigators. System barriers to the evidence-based care of acute coronary syndrome patients in China: qualitative analysis. *Circ Cardiovasc Qual Outcomes* 2014;7:209–16.
7. Solla DJ, Paiva Filho Ide M, Delisle JE, et al. Integrated regional networks for ST-segment-elevation myocardial infarction care in developing countries: the experience of Salvador, Bahia, Brazil. *Circ Cardiovasc Qual Outcomes* 2013;6:9–17.
8. Bradley EH, Herrin J, Wang Y, et al. Strategies for reducing the door-to-balloon time in acute myocardial infarction. *N Engl J Med* 2006; 355:2308–20.
9. Glickman SW, Lytle BL, Ou FS, et al. Care processes associated with quicker door-in-door-out times for patients with ST-elevation-myocardial infarction requiring transfer: results from a statewide regionalization program. *Circ Cardiovasc Qual Outcomes* 2011;4: 382–8.
10. Jollis JG, Granger CB, Henry TD, et al. Systems of care for ST-segment-elevation myocardial infarction: a report from the American Heart Association's Mission: Lifeline. *Circ Cardiovasc Qual Outcomes* 2012; 5:423–8.
11. Krumholz HM, Bradley EH, Nallamothu BK, et al. A campaign to improve the timeliness of primary percutaneous coronary intervention: Door-to-Balloon: An Alliance for Quality. *J Am Coll Cardiol Intv* 2008;1:97–104.
12. Joshipura MK, Shah HS, Patel PR, Divatia PA, Desai PM. Trauma care systems in India. *Injury* 2003;34:686–92.
13. Deloitte, Touche Tohmatsu India Private Limited (DTTIPL). Cardiovascular diseases in India. Challenges and Way Ahead, International Heart Protection Summit; September 28, 2011.
14. Ramakrishnan S, Mishra S, Chakraborty R, Chandra KS, Mardikar HM. The report on the Indian coronary intervention data for the year 2011–National Interventional Council. *Indian Heart J* 2013;65: 518–21.
15. Alexander T, Mulasari AS, Narula J. Developing a STEMI system of care for low- and middle-income countries: the STEMI-India model. *Glob Heart* 2014;9:419–23.
16. Jha P, Laxminarayan R. Choosing Health: An Entitlement for All Indians. Toronto, Ontario: Centre for Global Health Research; 2009.
17. Rajagopal S. When the stent pricing could give a heartache. *The Hindu*. August 13, 2013. Available at: <http://www.thehindu.com/news/cities/Kochi/when-the-stent-pricing-could-give-a-heartache/article4982734.ece>. Accessed August 26, 2014.
18. World Bank. Data: India. [Online data sheets.] Available at: <http://data.worldbank.org/country/india>. Accessed August 26, 2014.
19. Victor SM, Gnanaraj A, S V, Pattabiram S, Mulasari AS. Door-to-balloon: where do we lose time? Single centre experience in India. *Indian Heart J* 2012;64:582–7.
20. Gupta S, Dewan S, Kaushal A, Seth A, Narula J, Varma A. eICU reduces mortality in STEMI patients in resource-limited areas. *Glob Heart* 2014;9:425–7.