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EDITORIAL

Improving Integrated Care in Low- and Middle-Income Countries: The Final STEMI Frontier?

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Cardiovascular disease is the number one cause of death globally, primarily due to coronary heart disease, including myocardial infarction as the acute manifestation. In 2011, the World Health Organization reported that over 80% of deaths from cardiovascular disease occurred in low- and middle-income countries.[1] This report cites factors such as increased exposure to risk factors, lack of prevention programs, and lack of access to effective and equitable health services as possible reasons for the disproportionate amount of deaths. Registry data show that patients in these countries fail to receive adequate reperfusion therapy for ST-segment elevation myocardial infarction (STEMI) as compared to patients in developed countries.[2] With many low- and middle-income countries undergoing rapid economic growth and with selected hospitals providing care that is as sophisticated and high quality as in the best Western centers, there is an opportunity to improve care to patients with STEMI.

Due to financial and health system barriers, primary percutaneous intervention (PCI) cannot be performed in a timely fashion in many low- and middle-income countries; therefore, the foundation of STEMI care includes fibrinolysis, PCI, and pharmacoinvasive therapy strategies. Figure 1 summarizes the benefits of fibrinolytic therapies and primary PCI, showing that the first-generation fibrinolytic therapy reduces mortality (for patients presenting within 6 hours) by about 22%, accelerated t-PA or tenecteplase by an additional 14%, and primary PCI by an additional 30%. Primary PCI is estimated to reduce morality by about 50% compared to no reperfusion when administered reasonably quickly (within 90–120 minutes) and in experienced centers. With a combined early pharmacoinvasive strategy, a pooled analysis of seven randomized trials including 1,996 patients showed a relative risk of 0.59 (95% CI 0.39–0.88) for reinfarction with immediate or early PCI following fibrinolysis as compared with delayed, ischemia-driven or routine PCI, with no significant reduction in mortality.[3] Thus, when primary PCI is not available, fibrinolytic or pharmcoinvasive therapy is the preferred reperfusion strategy (Figure 1).[4–7]

Regional networks of PCI-capable hospitals, non-PCI-capable hospitals, and EMS systems have shown benefit in STEMI care by including more eligible patients treated with reperfusion therapy and providing faster treatment after first medical contact.[8–10] As outlined by Mehta and colleagues, in low- and middle-income countries where these networks have not yet been established, telemedicine has the potential to enhance diagnosis, extend expert advice, and provide guidance outside of tertiary care centers. Telemedicine is a key element of any regional STEMI system since information needs to be shared among hospitals and EMS systems. Telemedicine involves the delivery of remote clinical services and, in this program, encompasses devices capable of obtaining and delivering EKGs for expert interpretation. The role of telemedicine in developing a regionalized integrated network in Latin America was previously described in Salvador, Bahia, and Brazil.[11] In the Brazil study, EKGs were

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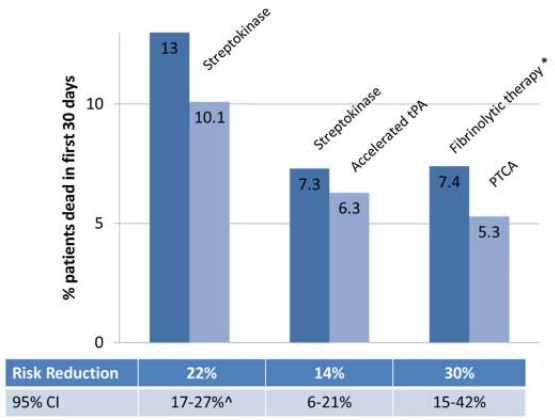

Figure 1. Percent of patients dead in first 30 days after STEMI by reperfusion strategy. *Mostly fibrin-specific agents. ^95% CI estimated from patients with LBBB and ST elevation within 12 hours of symptom onset. tPA, tissue plasminogen activator; PTCA, primary percutaneous transluminal coronary angiography.

sent to a regionalized STEMI alert team composed of seven medical students under the supervision of a cardiologist. This provided EKG interpretation 24 hours a day, 7 days a week and also provided a communication link between the EMS regulation center and clinical sites. While this study did not have preintervention time intervals to compare with time intervals after implementation of the network, they found their primary reperfusion rates after the intervention were comparable to international data from developed countries, suggesting the network to be effective.

As described by Mehta, development of STEMI systems has proceeded through stages, beginning with protocols at individual hospitals, progressing to hospital networks with transfers, and culminating in fully integrated EMS and hospital systems.[12] These stages have unfolded over the past 15 years in North America and Europe, and now low- and middle-income countries are going through the same progression. A staged process, as outlined in Figure 2, is needed to improve STEMI care. The first stage is in areas with no existing regional organized EMS and that may or may not have full-service PCI centers. This stage should involve use of fibrinolytic therapy (including streptokinase in cost-constrained environments) at non-PCI-hospitals and rapid primary PCI for patients who present to Emergency Departments at PCI-capable centers. The second stage involves linkage of non-PCI and PCI capable centers into a network for transfer for primary PCI for fibrinolytic ineligible and for patients who can obtain first door to device within 120 minutes. Otherwise, fibrinolytic therapy should be used with

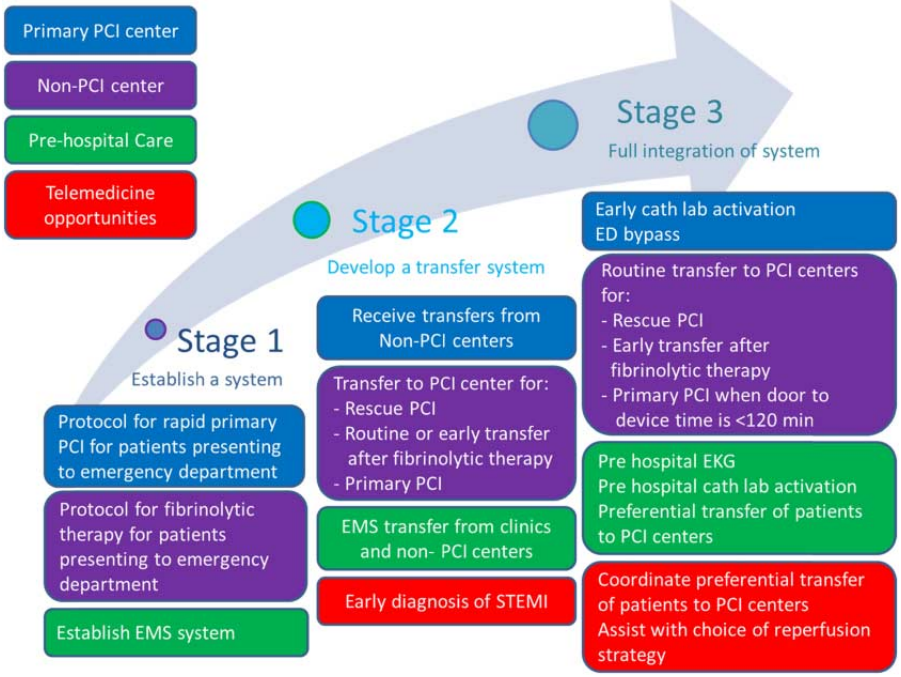

Figure 2. Stages of implementing STEMI care incorporating telemedicine opportunities.

alteplase or tenecteplase in preference to streptokinase. Patients with failure to resolve ST elevation within 60–90 minutes of fibrinolytics should be transferred for rescue PCI, and routine transfer of fibrinolytic-treated patients should be considered. The third and final stage is dependent on a sophisticated EMS system that responds promptly to chest pain calls, obtains ECGs in the field, and takes patients preferentially to nearest PCI centers whose catheterization laboratories are preactivated.

Mehta and colleagues describe how a telemedicine strategy can promote and enhance this staged implementation of STEMI systems in low- and middle-income countries (Fig. 2). A "hub-and-spoke" model, as previously described in the TN-STEMI program in India, creates a regionalized network by linking sites employing fibrinolytic and pharmacoinvasive strategies to sites using primary PCI for STEMI care.[13–14] The sites are encouraged to create an STEMI protocol according to the therapies available. In general, the strategy recommends thrombolytic therapy for patients who do not have contraindications and are less than 3 hours from symptom onset will take greater than 90 minutes to reach a PCI facility and when primary PCI is not available. Failed reperfusion after thrombolytic therapy is an indication for immediate transfer for rescue PCI while successful thrombolysis will result in early transfer to a primary PCI center within 4–24 hours. Primary PCI is recommended within 12 hours of symptom onset or in patients with cardiogenic shock. In each network, telemedicine devices are placed in ambulances and other locations where patients commonly present with chest pain. The telemedicine devices deliver EKGs to cardiologists who provide immediate, around-the-clock EKG diagnosis in order to improve accuracy and time to diagnosis. These cardiologists also serve to provide consultation to guide triage and therapy. Once the diagnosis of STEMI is made based on the EKG, the expert cardiologist provides advice as to the most appropriate strategy for the patient given the clinical context. While the ultimate clinical decisions are left to the discretion of the treating providers, the expert consultation can help with clinical decisions and improve communication between "spoke" sites and "hub" sites. The addition of telemedicine to the network created by the "hub-and-spoke" model promotes the integrated application of regional EMS methods starting in the community where patients present, extending through "spoke" non-PCI hospitals and ultimately ending at "hub" PCI centers. Additionally, this model facilitates the creation of regional STEMI protocols for PCI and non-PCI hospitals. There are some important considerations when incorporating telemedicine into the network strategy. The addition of the consulting telemedicine expert may be extraneous if there is already involvement of a cardiologist; however, it is possible that this will improve care by facilitating further discussion. For an effective conversation, the EKG will need to be provided to the consulting expert as well as a short-clinical form. Providing this form may be difficult during a critical time period when the focus is transporting a patient to a "hub" or "spoke" site. The addition of telemedicine devices will not improve the availability of ambulances and other critical infrastructure but may highlight the need for improvement of these resources. Overall, telemedicine has the potential to aid in early diagnosis of STEMI and improve communication in order to provide more efficient care to patients in low- and middle-income countries during the era of digital revolution.

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