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How to Set Up Regional STEMI Networks: Providing Best Possible STEMI Care

A practical methods paper from the Stent – Save a life! Initiative (www.stentsavealife.com)

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Abstract

Clinical guidelines recommend the development of ST-elevation myocardial infarction (STEMI) networks at community, regional and/or national level to offer ideally primary coronary angioplasty, or, at least the best available STEMI care to all patients. However, there is a discrepancy between this clinical recommendation and daily practice, with no coordinated care for STEMI patients in many regions of the world. While this can be a consequence of lacking resources, in reality, it is more frequently a lack of organizational power.

In this paper, the Stent-Save a life! Initiative proposes a practical methodology to effectively set up a STEMI network in any region of the world, with existing resources, and to continuously develop the STEMI network once established.

Classifications

STEMI, Adjunctive Pharmacotherapy, Miscellaneous

Abbreviations

ACC/AHA	American College of Cardiology/American Heart Association
Cath Lab	cardiac catheterization laboratory
EMS	emergency medical service
ESC	European Society of Cardiology
FMC	first medical contact
GP/GC	general practitioner/general cardiologist
LMIC	low and middle-income countries
PI	pharmacoinvasive
PCI	percutaneous coronary intervention
pPCI	primary percutaneous coronary intervention
SSL	Stent-Save a Life!
STEMI	ST-elevation myocardial infarction
TIT	total ischemic time

1. Introduction

Primary percutaneous coronary intervention (pPCI) is the preferred reperfusion therapy for patients presenting with ST-elevation myocardial infarction (STEMI) as recommended by clinical guidelines (1). pPCI is clearly superior to all other treatments investigated to date regarding mortality and morbidity and is in addition cost saving for national economies (2). All health care systems should aim to provide pPCI to all STEMI patients, independent of location, nationality, race, sex or personal wealth. As a first step, available resources should be organized to provide the best available care to all patients and to optimize STEMI management nationwide. To reach this goal, systems of care for STEMI management need to be developed at community, regional and/or national level (3-5). This document proposes a universal methodology to provide the best available, guideline-adherent care for STEMI patients based on five general assumptions (Table 1).

2. Review of clinical guidelines

2.1 Therapeutic options

Reperfusion of the myocardium by pPCI within 12 h of symptom onset is the cornerstone of STEMI treatment, followed by a pharmacoinvasive strategy (PI) if pPCI cannot be performed within 120 minutes of diagnosis, or, if the latter is also not available, standalone fibrinolysis. In any PI or lysis strategy, patients should be urgently transferred to a PCI center after lysis (1, 6-8).

2.2 Choice and timing of the optimal therapy

As a first step, all healthcare systems should develop regional networks of care for STEMI patients to encounter regional disparities as good as possible (9). Until timely pPCI can be provided to all patients, the preferred reperfusion strategy for each patient will depend on local

resources, timing, and the entry point into the network *(Figure 1; Table 3 and Supplementary Table 1).*

3. Characteristics, elements and roles in a STEMI Network

Only an effectively organized STEMI network will ensure that all STEMI patients will be optimally treated within the window of opportunity. All resources and processes in a region should be organized to serve this single purpose.

3.1 Main characteristics of a STEMI network:

- 24/7 treatment service for all STEMI patients
- structured cooperation between all parties involved following standardized protocols
- regular structured meetings and continuous education of all parties involved
- continuous self-assessment and improvement of the network

3.2 Main players in a STEMI network

Patients

Ideally patients should be able to recognize symptoms of myocardial infarction and understand the importance of receiving urgent treatment. They should understand how to activate the emergency medical service (EMS) or otherwise seek immediate medical attention. (Supplementary Table 2).

General Practitioner/General Cardiologist (GP/GC)

GPs/GCs play an important role as first responders to patient consultations. GPs/GCs should be integrated into a STEMI network and should be able to recognize and manage patients with STEMI according to standardized protocols (Supplementary Table 2).

Emergency Medical Services

EMS are important coordinators of the referral pathway (3, 10). Their main actions entail pre-hospital patient management and between hospital transfer. An EMS should always coordinate its actions with the network and notify the receiving hospital prior to arrival to check capacities and allow for preparation. Ideally all EMS should be centralized and activated through a single and well-publicized dispatch telephone number (1) (Supplementary Figure 1, Supplementary Table 2).

Non-pPCI centers and hospitals without PCI facilities

These centers receive STEMI patients through two different pathways: directly from home or community, or, via transfer by EMS. Non-pPCI centers should diagnose a STEMI within 10 min after the patient´s arrival and perform pPCI or transfer to a pPCI center, or handle a PI strategy. (Supplementary Figure 2; Supplementary Table 2).

Primary PCI Centers

pPCI centers receive STEMI patients through one of three pathways: directly from home or community, via transfer by EMS, or by secondary transportation from a non-pPCI center. They should have a mandatory 24/7 Cath Lab available within 30 min of activation. They are obliged to a "non-refusal" admission policy (Supplementary Figure 3, Supplementary Table 2).

4. Setting up a STEMI network

Despite national or regional challenges, the implementation of a STEMI network is always similar.

Stage 1: Preparation phase

The first step is to set up a local task force and an action plan for developing the network. This task force is also responsible for assigning roles, developing standard protocols for diagnosis and treatment in cooperation with the regional stakeholders, and, later, coordinating the network.

Stage 2: Mapping phase

In this phase, the task force identifies all potential pPCI and non-pPCI centers, estimates the distances and the time needed for transportation, checks the availability of EMS services and contacts the centers and the EMS to confirm their willingness to participate and ability to cope with the demands. All these resources should be mapped to understand the regional situation and to determine the best possible layout of regional network(s).

Stage 3: Building phase

Following the assumption, that the role of each player in any network is always defined by the presence or absence of other players, any network can be categorized following the specifications in Table 2 (Central Illustration). The task force assigns the individual roles to each player, nominates the coordinators of the centers, the EMS, and the GP/GC groups.

Stage 4: Quality assessment and continuous education phase

Quality assessment

At least one basic set (Supplementary Tables 3.1 and 3.2) of quality variables should be established (7). This refers to performance parameters of all network components and includes e.g. presentation timing, rate of patients treated, procedural success and in-hospital mortality.

The task force should meet periodically to analyze the performance and discuss necessary adaptations. The connection of reimbursement and compliance with standards can be a relevant steering instrument (11). One question that remains unanswered is, if having too many pPCI centers in a region may be disadvantageous, since each single center could end up having not enough experience and routine.

Continuous education for professionals

Not all professionals involved have a basic training in cardiology. It may be important to offer specific educational and training programs for paramedics, nurses, technicians and non-cardiology physicians on a recurrent basis due to staff rotation.

Population awareness campaigns

Patient awareness of indicative symptoms and knowledge of how to effectively seek medical attention is key for the success of a STEMI network program, since the longest delays are usually caused by the patients (12). Awareness programs involving social media, entertainment industry, community organizations and scientific associations may be helpful; however, their effects quickly fade, once they are discontinued (13).

Conclusions

The implementation of regional STEMI care systems overcomes local barriers and guarantees the best available reperfusion treatment for STEMI patients. A coordinated network of all stakeholders, guided by evidence-based, standardized protocols with a clear definition of roles and responsibilities are key, and, should be accompanied by a process of continuous improvement through evaluation of quality measures.

Figure Legends

Figure 1: Recommended reperfusion strategies according to timing and point of entry to the network. EMS= emergency medical service; FL= fibrinolysis; GP/GC=general practitioner/general cardiologist; PCI=percutaneous coronary intervention; pPCI= primary percutaneous coronary intervention; min=minutes.

Central Illustration: Typical combination of a hub-and-spoke network with an inner zone (green circle) organized as pPCI network and an outer zone following a PI strategy (blue circle). The external purple zone resembles a fibrinolysis network with no PCI center in reach. GP/GC=general practitioner/general cardiologist; PI=pharmacoinvasive; pPCI= primary percutaneous coronary intervention

Table 1. Key factors for any STEMI network

Factor	Assumption
Players	The relevant stakeholders in any STEMI network are: patient and family, GP/GC, EMS, non-pPCI hospital, and pPCI-hospital.
Roles	The roles of the players are defined by i) evidence based clinical guidance and ii) the presence or absence of other players.
Scenarios	The existing players and their roles determine the number of possible scenarios for any network
Treatment options	A given scenario always defines the best available therapeutic option in a region for STEMI patients.
Quality metrics	Continuous monitoring and feedback is key to improve the network
EMS=emergency medical service; GP/GC=general practitioner/general cardiologist; pPCI=primary percutaneous coronary intervention; STEMI=ST-segment elevation myocardial infarction	

Table 2. Network types according to existing resources.

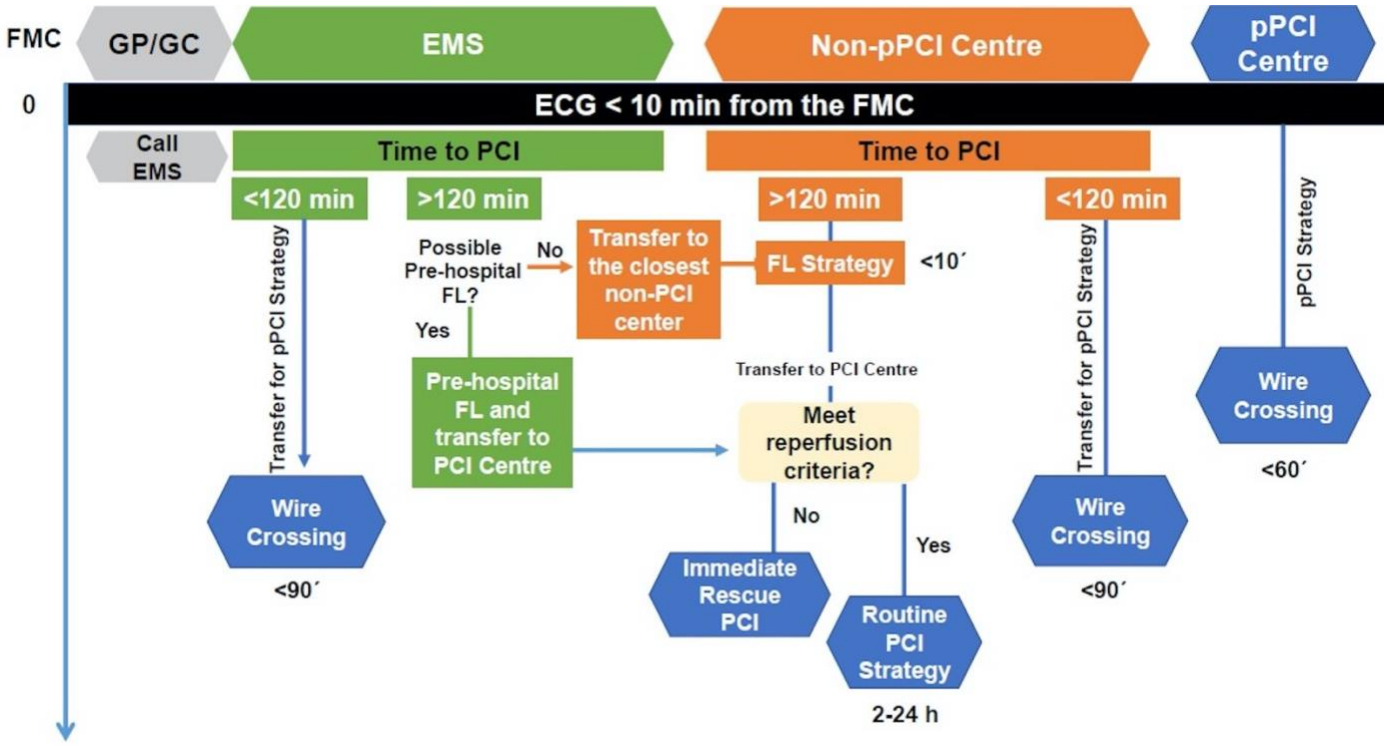
Primary PCI networks	
Ranking	Optimal long-term solution for STEMI care
Mandatory Resources	pPCI centres which can be reached within 90 min after symptoms onset or diagnosis of STEMI; EMS coordinated with the network
Primary therapies offered	pPCI 24/7 If the pPCI centre is occupied or has a technical failure, a PI strategy is offered if pPCI cannot be offered within guideline coherent timelines
Processes	The EMS should bypass all other centres and transfer STEMI patients directly to the closest pPCI centre
Hub-and-spoke PCI networks	
Ranking	Acceptable long-term solution for STEMI care
Mandatory Resources	pPCI centres; non-pPCI centres; EMS coordinated with the network
Primary therapies offered	pPCI, PI strategy
Processes	This model comprises two zones: i) the inner zone resembles a primary PCI network, the outer zone consists of non-pPCI centres or non-PCI hospitals which are connected to the inner zone via an EMS. They offer a PI strategy and either transfer the patient for PCI or perform PCI in the same place during office hours following the recommended timelines.
Important steps to upgrade	Turn non-pPCI centres into pPCI centres
Pharmaco-invasive networks	
Ranking	Transient solution for STEMI care, should be upgraded in the midterm.
Mandatory Resources	non-pPCI centres; an EMS, coordinated with the network, is highly desirable

Primary therapies offered	PI strategy; primary PCI if patient arrives at PCI centre during office hours
Processes	These networks offer a PI strategy 24/7 with fibrinolysis in all connected hospitals and either transfer the patient for PCI or perform PCI during office hours. pPCI is offered if patients arrive in a PCI hospital during office hours.
Important steps to upgrade	1. Introduce an EMS, coordinated with the network 2. Turn non-pPCI centres into 24/7 pPCI centres
Fibrinolysis networks	
Ranking	Transient organization which provides basic care for STEMI patients. Should be upgraded as early as possible.
Mandatory Resources	Medical centres without PCI option, able to recognize a STEMI and handle fibrinolysis; an EMS, coordinated with the network is highly desirable; a remote ECG interpretation service can be useful.
Primary therapies offered	Standalone fibrinolysis
Processes	These networks offer application of fibrinolysis 24/7
Important steps to upgrade	1. Introduce an EMS, coordinated with the network 2. Install Cath Labs and expand their service to 24/7 pPCI
Cath Lab=cardiac catheterization laboratory; EMS=emergency medical service; FMC=first medical contact; PCI=percutaneous coronary intervention; PI=pharmacoinvasive; pPCI=primary percutaneous coronary intervention; PI=pharmacoinvasive; STEMI=ST-elevation myocardial infarction	

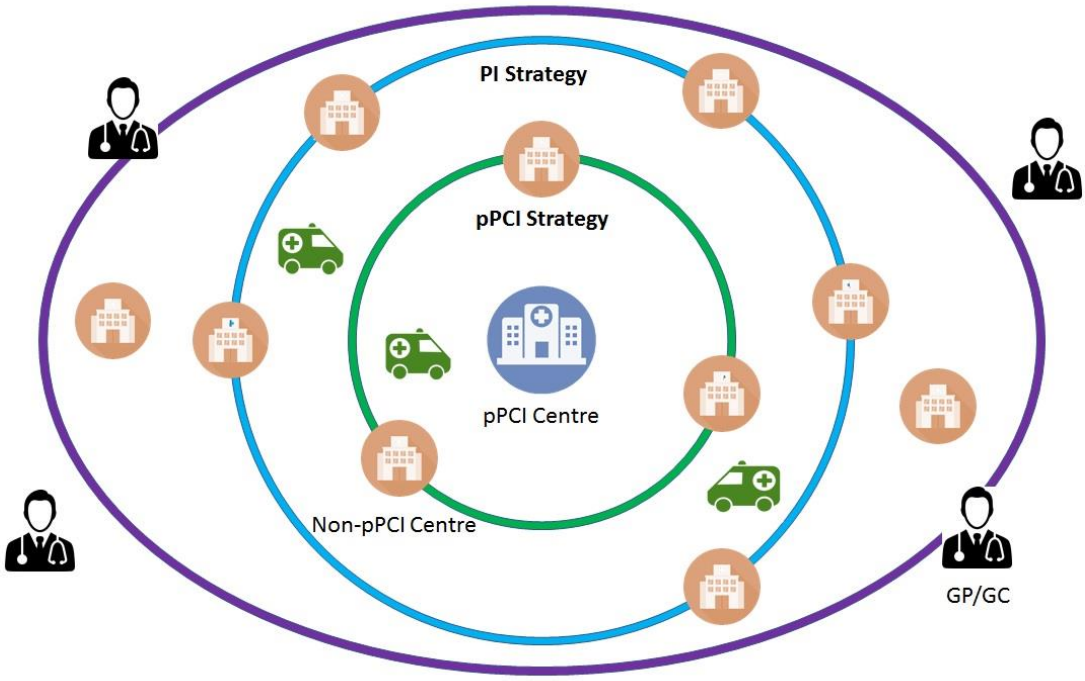
Table 3. Definition of important time points and intervals in STEMI networks

Time period	Abbreviation	Definition
First medical contact	FMC	Time point when the patient is initially assessed by a physician, paramedic, nurse or trained EMS personnel who can obtain and interpret the ECG and deliver initial interventions. FMC can be in the pre-hospital setting or upon arrival at the hospital. In all scenarios, STEMI diagnosis via ECG should be obtained within 10 minutes.
Time of reperfusion	TOR	The time point of either a wire crossing the occlusion or the start of administration of lytic therapy
Total ischemic time	TIT	The time from symptom onset until reperfusion and is a strong predictor of patient outcomes. TIT comprises patient delay and system delay.
Patient delay	PD	Time interval between symptoms onset and FMC
System delay	SD	Time interval between FMC and time of reperfusion
Door-in-door-out time	DIDO	Time between patient arrival in a non-pPCI centre and the transfer to a pPCI centre
ECG=electrocardiogram; EMS=emergency medical service; pPCI=primary percutaneous coronary intervention; STEMI=ST-segment elevation infarction		

Figure 1



Central Illustration



SUPPLEMENTARY MATERIAL

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