Strengthening acute coronary syndrome referral network: Insights from initiatives of Penang General Hospital cardiology centre

Muhamad Ali SK Abdul Kader, MRCP, FNHAM

Department of Cardiology, Penang General Hospital, Pulau Pinang, Malaysia

SUMMARY
The importance of networking for the management of acute coronary syndrome (ACS) has been emphasised in the 2012 guidelines by the European Society of Cardiology (ESC) on ST-segment elevation myocardial infarction (STEMI). In Penang, the ACS referral network has the Penang General Hospital (PGH), a percutaneous coronary intervention (PCI)-capable hospital, with 14 other hospitals referring their patients for PCI to PGH on a daily basis. In one of its review regarding the referral methodology in the network, PGH's Cardiology centre observed gaps in the referral systems, which was leading to poor quality of referrals. To address these issues, the PGH Cardiology centre developed a standardised protocol and conducted a one-day workshop to educate medical officers about the standardised protocol. This commentary piece is a proof of this concept, and aims to share the experience and provide an overview on the initiatives by the PGH, which has resulted in improved quality of PCI referrals.

INTRODUCTION

The 2012 guidelines by the European Society of Cardiology (ESC) on ST-segment elevation myocardial infarction (STEMI) emphasised on the importance of networking for the management of acute coronary syndrome (ACS).[1] The networking is aimed at providing optimal care by minimising delays and, thereby, improving clinical outcomes. In the management of patients with STEMI, primary percutaneous coronary intervention (PPCI) is a preferred reperfusion strategy and a better choice than pre-hospital fibrinolysis or in-hospital fibrinolysis.[2] Patients, who present to the hospital without cardiac catheterisation facilities within 2–3 hours after symptom onset, undergo a pharmaco-invasive strategy-based treatment that involves the administration of a fibrinolytic agent in an attempt to restore partial blood flow to the infarct-related artery, followed by immediate transfer to a tertiary care centre for angiography and PCI, if required.[2]

There are two transfer models for STEMI patients. The first model is termed 'hub-and–spoke' model, while the second model is termed 'STEMI recruiting centre' model.[2] In the hub-and–spoke model, patients presenting directly to a non-percutaneous coronary intervention (PCI) centre are immediately transferred to a PCI centre, with or without fibrinolytic treatment, according to the expected time delay. The model connects several smaller hospitals ('spoke') with a central, large PCI-enabled hospital ('hub') that improves access to PPCI.[3–5]

The decision on the reperfusion strategy, including the presentation of patients to centres by a private vehicle when there is no opportunity for emergency medical services bypass, is made in the referring hospitals. In the STEMI recruiting centre model, diversion protocols enable the bypass of non-PCI centre, with patients being directly transported to a 24-hour/seven-day-a-week PCI centre. The advantages of this model are that it reduces system delay and door-to–balloon time, thereby, increasing timely reperfusion, myocardial salvage, and survival.[2]

Penang, a northern state in Malaysia, has a PCI-referral network with the Penang General Hospital (PGH) as the PCI-capable hospital. The PGH is the largest tertiary hospital in the state of Penang. The hospital has 15 specialisations and 34 sub-specialisations. In 1994, the Ministry of Health Cardiology Centre was established in PGH and a Cath Lab was set-up a year later. Since then, the department has evolved into an established centre for PCI. The PGH follows the hub-and–spoke model and, thereby, receives referrals for PCI from five different local healthcare centres within the public sector on a daily basis. All the feeder hospitals are within a 1-hour ground-transfer range, with an optimal traffic condition, from the PGH. The patients are referred to the PGH, as the feeder hospitals do not provide PCI. Over the years, there has been a steady increase in the number of referrals for PCIs. This increase can be evidenced from the National Cardiovascular Disease Database (NCVD-PCI; 2010–2012), which reported a steady increase in the number of PCI procedures being performed in the centre (Figure 1).[6] The PGH Cardiology centre carries out regular auditing of its quality of service. In 2012, on reviewing its referral systems in the ACS network, the Cardiology centre observed certain factors that were anticipated to have an impact the quality of PCI. These factors included:

- Poor quality of the referral from feeder hospitals: The time-based metrics, such as electrocardiogram (ECG) within 10 minutes, door-to–needle time within 30 minutes, and

door-to–balloon time within 120 minutes, were never achieved. Patients were always referred very late to the hub, leading to higher rates of complications, e.g. non-reperfusion of the infarct artery, which ultimately resulted in cardiogenic shock, heart failure, arrhythmias, and death.
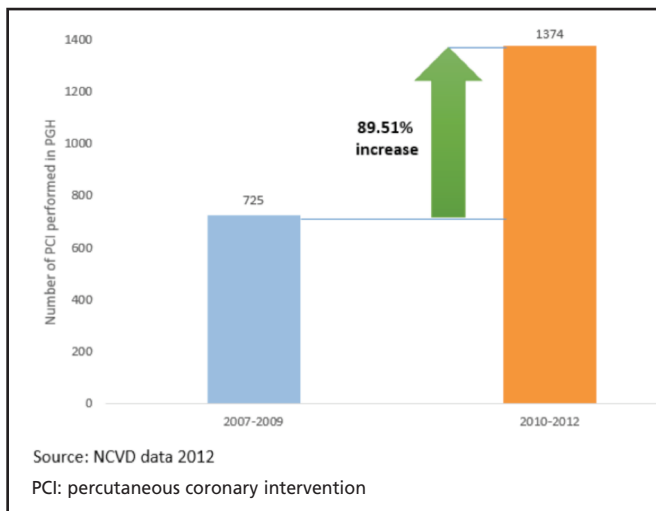

Source: NCVD data 2012

PCI: percutaneous coronary intervention

Fig. 1: The number of PCIs performed in PGH between 2007–2009 and 2010–2012.

• The absence of a standardised protocol-based management for ACS management among feeder hospitals: Poor coordination was observed between clinicians, and the supporting and ambulance staff.
• Lack of adequate cardiology updates among medical officers in these hospitals

To address these factors and further strengthen the networking, the PGH Cardiology Department suggested the following initiatives:
1. Development and implementation of a standardised protocol in all referral hospitals
2. AACS referral network workshop: A one-day workshop to provide cardiology updates to the medical officers of these hospitals

Development of Standardised Protocol
The PGH Cardiology centre has developed a standardised protocol for STEMI patients and non-ST elevated myocardial infarction (NSTEMI)/unstable angina (UA) patients (Figure 2A and B) based on the latest guidelines by the European Society of Cardiology and American College of Cardiology.[1,7] These protocols are implemented in all referral hospitals. The summary of protocols for STEMI and NSTEMI/UA patients is as follows:
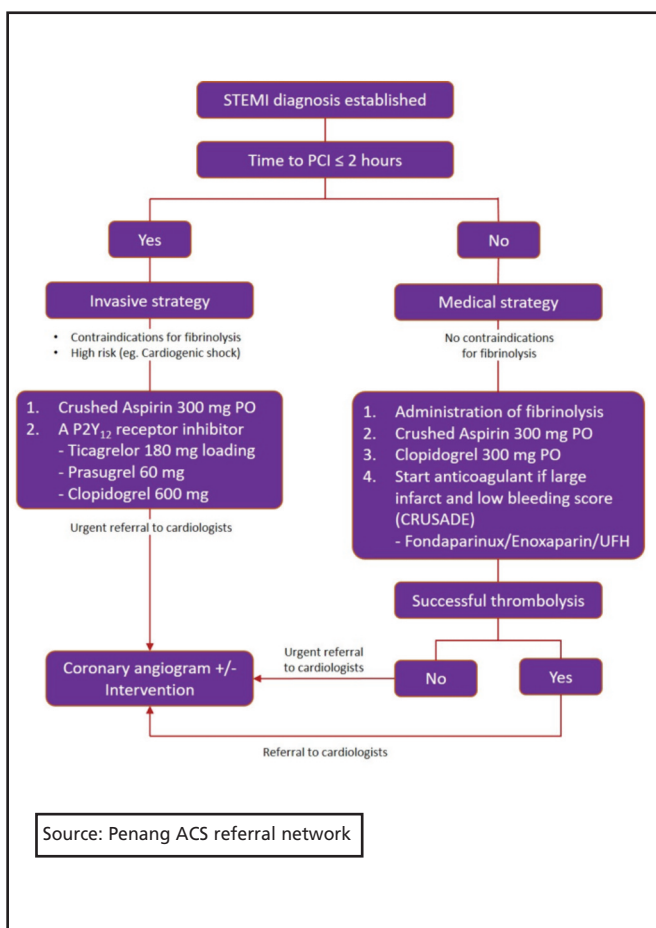

Source: Penang ACS referral network

Fig. 2A: Standardised protocol for the management of STEMI patients.

Source: Penang ACS referral network

STEMI: ST-segment elevation myocardial infarction, LVEF: left ventricular ejection fraction, UFH: ultra-fractionated heparin.
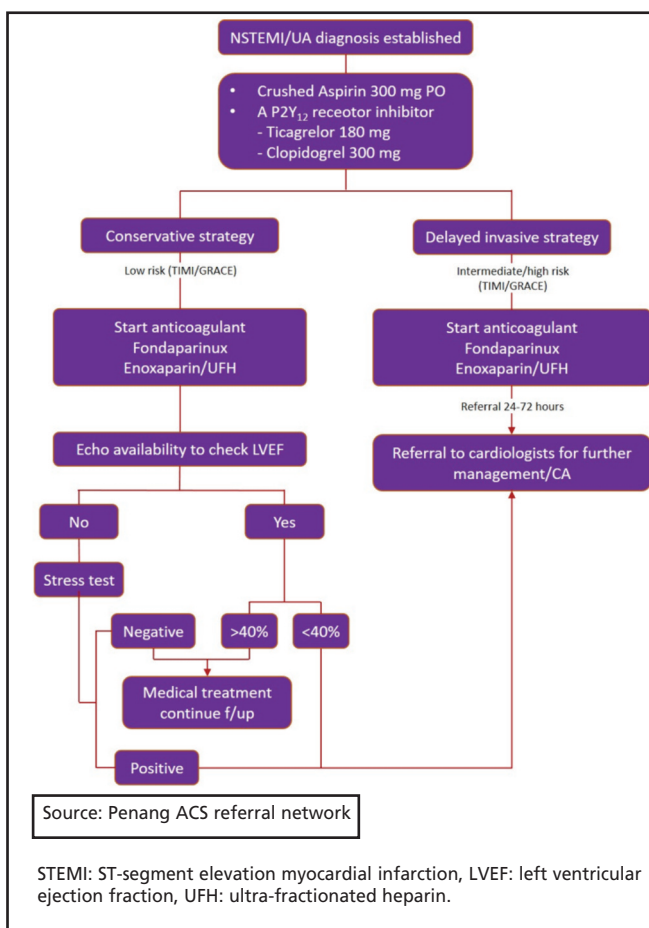
Fig. 2B: Standardised protocol for the management of NSTEMI/UA.

Protocol for Management of STEMI Patients
- Once the diagnosis of STEMI is established, based on the contraindications of fibrinolysis and time to PCI ≤2 hours, a medical strategy (no contraindications) or invasive strategy (contraindications/high risk such as a cardiogenic shock) is selected for the patient.
- **Patients selected for invasive strategy are immediately referred to a cardiologist** for coronary angiogram, with or without intervention, after an antiplatelet therapy (crushed aspirin 300 mg PO or a P2Y12 receptor inhibitor [ticagrelor 180 mg loading, prasugrel 60 mg, or clopidogrel 600 mg] is given).
- In patients selected for the medical strategy, thrombolysis is conducted by the administration of, crushed aspirin 300 mg PO, or clopidogrel 300 mg PO, and if the patient has a large infarct and low bleeding score (CRUSADE),[8] an anticoagulant therapy (fondaparinux/enoxaparin/unfractionated Heparin [UFH]) is initiated.
- If thrombolysis is not successful, patients are immediately referred to cardiologists for coronary angiogram, with or without intervention.

Protocol for Management of NSTEMI/UA Patient
- Once the diagnosis of NSTEMI/UA is established, patients are administered an antiplatelet therapy (crushed aspirin 300 mg PO or a P2Y12 receptor inhibitor [ticagrelor 180 mg or clopidogrel 300 mg]).
- In these patients, a conservative strategy (for low-risk patients) or delayed invasive strategy (for intermediate/high-risk patients), based on the risk assessment by Thrombolysis In Myocardial Infarction/Global Registry of Acute Coronary Events (TIMI/GRACE) scores, is carried out.
- In patients selected for delayed invasive strategy, anticoagulant therapy (Fondaparinux and Enoxaparin/UFH) is initiated and the patients are **referred to cardiologists for further management within 24–72 hours.**
- In a conservative strategy, treatment is initiated with an anticoagulant (Fondaparinux or Enoxaparin/UFH). If echocardiogram is not available to check the left ventricular ejection fraction (LVEF), stress test is performed.
  - o If the stress test is negative, medical treatment is continued with follow-up.
  - o When an echocardiography is performed and the LVEF is more than 40%, the medical treatment is continued and followed.

The guidelines by the European Society of Cardiology and the American College of Cardiology/American Heart Association recommend the initiation of P2Y12 inhibitors soon after the diagnosis of non-ST elevation-acute coronary syndrome (NSTE-ACS), irrespective of the management strategy.[7] This implies that P2Y12 inhibitor is administered prior to coronary angiography in patients scheduled for an invasive approach. Inhibition of P2Y12 (preferably ticagrelor) is recommended in NSTE-ACS patients planned for conservative management in the absence of contraindications.[7]

Referral Network Workshop of ACS
Permanent education of paramedics or physicians on ambulance systems, with respect to ECG interpretation (when automatic ECG diagnosis or ECG telemetry is not available) and pre-hospital treatment strategies, has been identified as an unmet need in the STEMI networks.[9] In its efforts to provide cardiology updates to the medical staff of referring hospitals, the PGH Cardiology centre conducts one-day workshops. The programme schedule in this workshop includes case presentations, refresher courses, and presentations by experts to help the medical officers expand their knowledge in ACS management. The first workshop was launched in 2013.

The second workshop was held on 23 August, 2015, which included a refresher course on ECG, and lectures on acute myocardial infarction (AMI): Optimising available resources when referral is necessary and UA/NSTEMI guidelines-based management. The highlight of the workshop was a session on case presentations on the management of UA, NSTEMI, stable STEMI, and unstable STEMI. These case presentations were intended to provide clinical insights as well as practical approaches in managing ACS patients. The workshop was attended by 112 medical officers.

At the end of the workshop, the participants provided their feedback. More than 80% of these participants found the programme topics to be 'beneficial' in updating their knowledge on cardiology. These result was consistent with evidence generated from various other types of public health programmes evaluation model, involving several aspects of public healthcare systems. In an European study, using hub-and–spoke organisational model showed them a model effective in facilitating primary PCI on STEMI and also helped in reducing in-hospital mortality.[10,11] Evidence also highlights the engagement from multiple stakeholders and online performance analyses for creating compelling solutions in the ACS network.[12,13]

Impact of Initiatives
The PGH Cardiology Department started implementing its initiatives in 2013. Since then, there has been an improvement in the referrals for PCI due to the implementation of a standardised protocol.

The increased number of PCIs in the region is due to an increased number of newly diagnosed patients with ACS, as a result of higher incidence of diabetes and hypertension in the Malaysian population.[14,15] Furthermore, the private healthcare cost in Malaysia has been mounting over the years, which has caused a significant number of patients, with no personal insurance, opting for treatment at public hospitals instead of private healthcare establishments.[16]

The improvement has been evidenced by the increase in the number of PCIs performed in 2014 (active/primary PCI: 527 and elective PCI: 89) compared to the number of PCIs conducted in the previous years. Similarly, the number of emergency PCIs performed in 2015 were considerable (198) compared to the previous years.

In a nutshell, the referral system was found to be more coordinated and timelier after the ACS referral initiatives were applied. The awareness of clinicians and supporting staff on the care of STEMI patients improved tremendously.

Inter-hospital coordination (between the hub and spoke) was enhanced, and improvement was observed in the use of a single referral system via a single network platform.

CONCLUSION
Referral networks for PCI have gained popularity and significance in the management of ACS patients. Worldwide, constant efforts have been made to strengthen the respective network systems by identifying and addressing unmet needs during review processes. In Penang, the PGH identified a few gaps in its ACS referral network. As a corrective measure, the PGH standardised its protocol for referral hospitals and conducted one-day workshops periodically to provide cardiology updates to the medical staff in referral hospitals, which helped implement the protocol. The success of conducting the workshop in 2013 led to an increase in the number of PCIs performed by the PGH in 2014 and it also conducted another workshop in August 2015. Thus, the PGH is continuing its initiative in strengthening its ACS management and referral network.

CONTRIBUTORS
Author Muhamad Ali SK Abdul Kader contributed to the conception, writing of the article, revised the article and approved the final manuscript.

REFERENCES
1. Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology (ESC), Steg PG, James SK, Atar D, Badano LP, Blömstrom-Lundqvist C, et al. ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Eur Heart J 2012; 33(20): 2569-619.
2. Wallentin L, Kristensen SD, Anderson JL, Tubaro M, Sendon JL, Granger CB, et al. How can we optimize the processes of care for acute coronary syndromes to improve outcomes? Am Heart J 2014; 168(5): 622-31
3. Alexander T, Victor SM, Mullasari AS, Veerasekar G, Subramaniam K, Nallamothu BK, et al. Protocol for a prospective, controlled study of assertive and timely reperfusion for patients with ST-segment elevation myocardial infarction in Tamil Nadu: the TN-STEMI programme. BMJ Open 2013; 3(12): e003850.
4. Alexander T, Mehta S, Mullasari A, Nallamothu BK. Systems of care for ST-elevation myocardial infarction in India. Heart 2012; 98(1): 15-7.
5. Alexander T, Mullasari AS, Joseph G, Kannan K, Veerasekar G, Victor SM, et al. A System of care for patients with ST-segment elevation myocardial infarction in India: The Tamil Nadu–ST-Segment Elevation Myocardial Infarction Program. JAMA Cardiol 2017; 2(5): 498-505.
6. Ahmad WAW, Sim KH. (Eds). Annual Report of the NCVD-PCI Registry, Year 2010-2012. Kuala Lumpur, Malaysia: National Cardiovascular Disease Database, 2014.
7. Amsterdam EA, Wenger NK, Brindis RG, Casey DE Jr, Ganiats TG, Holmes DR J, et al. 2014 ACC/AHA guideline for the management of patients with non–ST-elevation acute coronary syndromes: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation. 2014; 130: e344-e426.
8. CRUSADE Bleeding Score Available at: http://www.crusadebleedingscore.org/introduction.html. Accessed on 08 January 2019.
9. Huber K, Gersh BJ, Goldstein P, Granger CB, Armstrong PW. The organization, function and outcomes of ST-elevation myocardial infarction networks worldwide: Current state, unmet needs and future directions. Eur Heart J 2014; 35(23): 1526-32.
10. Introduction to Program Evaluation for Public Health Programs: A Self-Study Guide Available at: https://www.cdc.gov/eval/guide/step3/index.html. Accessed on 08 January 2019
11. Saia M, Mantoan D, Fonzo M, Bertoncello C, Soattin M, Sperotto M, et al. Impact of the Regional Network for AMI in the Management of STEMI on Care Processes, Outcomes and Health Inequities in the Veneto Region, Italy. Int J Environ Res Public Health 2018; 15(9): E1980.
12. Birkhead JS, Walker L, Pearson M, Weston C, Cunningham AD, Rickards AF, et al. Improving care for patients with acute coronary syndromes: initial results from the National Audit of Myocardial Infarction Project (MINAP). Heart 2004; 90(9): 1004-9.
13. Radke PW, Halvorsen S, Jukema JW, Kolh P, Annemans L, Postma MJ, et al. Networks for improving care in patients with acute coronary syndrome: A framework. Acute Card Care 2014; 16(2): 41-8.
14. Lu HT, Nordin RB. Ethnic differences in the occurrence of acute coronary syndrome: results of the Malaysian National Cardiovascular Disease (NCVD) Database Registry (March 2006 - February 2010). BMC Cardiovasc Disord 2013; 13: 97.
15. Ang CS, Chan KM. A review of coronary artery disease research in Malaysia. Med J Malaysia 2016; 71(Suppl 1): 42-57.
16. Report HE. Malaysia national health accounts Health Expenditure Report 1997-2016. 2016. Available at: http://www.moh.gov.my/images/gallery/publications/MNHA/MNHA%20Health%20Expenditure%20Report%201997-2016%2007122018.pdf. Accessed on 08 January 2019