

## **The Impact of MGH STEMI Network and Public Heart Attack Awareness Campaign on outcome of patients with ST elevation myocardial infarction**

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### **Abstract**

**Objective:** To study the effect of MGH STEMI network (Mandalay General Hospital, ST elevation myocardial infarction Network) and Public Heart Attack Awareness Campaign on pre-hospital delay and in-hospital mortality of patients with ST elevation myocardial infarction

**Specific Objectives:** 1). To study the effect of Public Heart Attack Awareness Campaign on patient related pre-hospital delay in patients with ST elevation myocardial infarction. 2). To study the effect of MGH STEMI Network on reperfusion rate of the patients with ST elevation myocardial infarction. 3). To study the effect of MGH STEMI Network on Door to Device time in primary percutaneous coronary intervention (Primary PCI). 4). To study the effect of MGH STEMI Network and Public Heart Attack Awareness Campaign on In-Hospital Mortality of the patients with ST elevation myocardial infarction.

**Design:** Hospital based prospective observational study

**Methods:** Medical records of 2360 consecutive patients presented with acute ST elevation myocardial infarction (STEMI) at Mandalay General Hospital from the start of January, 2013 to the end of December, 2016 were collected and patients arriving in reperfusion eligible time (that is <12 hours from the onset of chest pain to reperfusion capable hospital), patient delay, Door to Device time, reperfusion rate, and in-hospital mortality were reviewed.

**Results:** More patients with acute coronary syndrome came to hospital after the STEMI network. (2,131 in 2 years before STEMI network to 2,411 in 2 years after STEMI network) Number of reperfusion eligible patients was significantly increased from 24.7% to 40% before and after STEMI network respectively ( $p < 0.001$ ). More STEMI patients got reperfusion therapy: 24.25% to 37.61% before and after STEMI network respectively ( $p < 0.001$ ). In patients who got Primary PCI therapy, mean Door to Device time is reduced from  $91.67 \pm 35.89$  mins to  $64.29 \pm 50.35$  mins before and after STEMI network respectively ( $p < 0.001$ ). In-hospital mortality of STEMI patients was reduced from 14.86% in 2013 to 12.81% in 2016. ( $p = 0.334$ ) However, in sub-group analysis, significant decrease in in-hospital mortality was observed in Primary PCI group compared to no reperfusion group (3.7% vs 18.26%) ( $p < 0.001$ ) and thrombolysis group compared to no reperfusion group (12.88% vs 18.26%) ( $p = 0.01$ ) after STEMI network.

**Conclusions:** In conclusion, setting up of STEMI network together with raising the public awareness by well targeted public campaigns can significantly lever up the hospital visits of patients with acute coronary syndrome and even more reperfusion eligible patients with STEMI. Following significant increase in reperfusion rates with thrombolysis or primary percutaneous coronary intervention and reduced mean Door to Device time in Primary PCI, in-hospital mortality rate will be reduced.

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## **Introduction**

Patient with ST elevation myocardial infarction usually have a complete occlusion of an epicardial coronary artery. The primary goal of the initial treatment is early reperfusion therapy through administration of fibrinolysis (pharmacological reperfusion) or Primary Percutaneous Coronary Intervention (mechanical reperfusion).<sup>[1]</sup> Prompt diagnosis and treatment offers the greatest potential benefit for myocardial salvage in the first hours of STEMI.<sup>[2]</sup> Patient based delay in recognition of Acute Coronary Syndrome and activation of the emergency medical service (EMS) system often constitutes the longest period of delay to treatment.<sup>[3]</sup> To reduce the delays and ischaemic times of STEMI patients, Public Heart Attack Awareness Campaign was introduced to decrease patients' delay and MGH STEMI network was set up to decrease mainly the system delay. The study had been carried out to evaluate the impact of the campaign and the network by reviewing patients arriving in reperfusion eligible time (that is <12 hours from the onset of chest pain to reperfusion capable hospital), patient delay, door to Device time, reperfusion rate, and in-hospital mortality.

## **Background**

Cardiovascular diseases (CVDs) cause nearly one-third of all deaths worldwide. Ischaemic heart disease (IHD) is the single most common cause of death causing 7,249,000 deaths accounting for 12.7% of all global death and its frequency is increasing worldwide.<sup>[4]</sup> Myanmar has population of 60 million people. With developing nature of the country, and changing of lifestyles, IHD is more prevalent lately and lead to country burden of 58.2 deaths per thousand.<sup>[4]</sup> Acute coronary syndrome is one of the leading cause of death in the country. Until 2013, thrombolysis with streptokinase was the only available treatment for ST elevation myocardial infarction (STEMI). Primary Percutaneous Coronary Intervention (PPCI) was systematically introduced in early 2013 in Mandalay, Myanmar. STEMI network was officially set up in March, 2015. Our country does not have a proper set up of emergency medical system. General practitioners are usually the first medical contact whom the patients seek for medical advices if they suffer chest pain. Our targets of reducing the patient delay emphasize on 1.) the patients suffering chest pain to seek medical help immediately and 2.) getting diagnosis by the first medical contact and direct transfer to the Primary PCI capable hospital. The STEMI network can provide the STEMI code or direct referral system for STEMI patient to the Primary PCI capable hospital (i.e. Mandalay General Hospital in Upper Myanmar) through phone or through Viber application. STEMI Network Tours are also developed by traveling to the district hospitals in the STEMI Network Area and giving message and knowledge about STEMI network to both public and health care providers. And, the two hotline phone numbers (+959259898661 and +959259898662), which are held by the registrars of the Department, were given to health care providers to contact for the purpose of making exact diagnosis, plan of referral according to distance from Mandalay and to prepare cardiac catheterization laboratory for confirmed and incoming STEMI patients. After arriving the Cath Lab door, soon after the patient's consent, the procedure can start without time consuming and without any delay. Public awareness was implemented through public talks: Heart Attack Awareness week which was held as a remark of PPCI service Anniversary in first week of every March since 2015.

## The MGH STEMI network and Heart Attack Awareness campaign

### The public

The Heart Attack Awareness Campaign was started as a remark of Anniversary of starting primary percutaneous coronary intervention in the first week of every March since 2015. During the Campaign week, public talk was delivered at Mandalay City Hall. During the talk, the information about signs and symptoms of heart attack, about how the time is important for the patient with chest pain, with the slogan “Time is Muscles (Saving Time, Saving Life)”, and treatment options, were delivered to the attending public. Also, the patients who has undergone Primary PCI (“Survivors from Heart Attack”), shared their experiences during the chest pain: about how they seek medical advice as soon as they got chest pain and about the treatment procedures they had experienced. Cardiovascular risk assessment and advices were given to the attending patients. Besides, in this week, pamphlets educating about heart attack were distributed in every main corner of the streets of Mandalay. On the FM radio, signs and symptoms of heart attack, and how to work out if one suffers heart attack were aired whole week.

### The health care providers

After the patient recognizing the chest pain and seeking medical advice, it will be important that the health care provider need to recognize the electrocardiogram (ECG) about ST elevation myocardial infarct, and refer to the nearest reperfusion capable hospital as early as possible. STEMI network fills up this gap by giving ECG course for STEMI recognition to general practitioners, medical officers and emergency medical officers. Cardiopulmonary resuscitation courses were given monthly for health care providers and also for enthusiastic volunteer social workers to revive the patient in case of cardiac arrest during the patient transfer.



Fig 1 (a) Public Talk. (b) survivors from Heart attack. (c) MGH STEMI Network. (d)CME to Primary Care Providers

## Analysis

The impact of the MGH STEMI network and Public Heart Attack Awareness Campaign was evaluated by means of a prospective observational study within two phases: 2 years before the STEMI network set up (January 2013 to December 2014) and 2 years after the set up (January 2015 to December 2016).

### Patient population and data collection

Medical records of 2360 consecutive patients with ST elevation myocardial infarction who had presented to Department of Cardiovascular Medicine, MGH during the 24 months before the STEMI network and 24 months after the STEMI network were retrospectively reviewed. These patients had come with STEMI and chest pain with electrocardiographic evidence in >2 contiguous leads with ST-segment elevation  $\geq 2.5$  mm in men < 40 years,  $\geq 2$  mm in men  $\geq 40$  years, or  $\geq 1.5$  mm in women in leads V2-V3 and/or  $\geq 1$  mm in the other leads [in the absence of left ventricular (LV) hypertrophy or left bundle branch block] or new left bundle branch block.

### Statistical Analysis

All the variables were entered into the Stata SE, version 14.1 and the Statistical Package for Social Sciences software, version 23 (SPSS Inc) for data analysis. Descriptive statistics were computed and presented as means and standard deviations were calculated for continuous variable like Door-to-Balloon time. Categorical variables reported in percentages for the reperfusion eligible patients, reperfusion rate for thrombolysis, Pharmacoinvasive, Primary PCI and total reperfused patients and in-hospital mortality. A chi-squared test was used to compare categorical variables and Student's t test for continuous variables. All tests were regarded significant if  $p < 0.05$ .

## Results

### Admission

Overall STEMI admission were 491, 614, 693, and 562 from 2013 to 2016 respectively. [Fig. 2.1] In 2013, of all 491 STEMI patients, 119 patients were eligible for reperfusion. (i.e. patients arriving to Department of Cardiovascular Medicine, Mandalay General Hospital within 12 hours from the onset of chest pain). In 2014, of all 614 STEMI patients, 154 patients were eligible for reperfusion. In 2015, of all 693 STEMI patients, 268 patients were eligible for reperfusion. In 2016, of all 562 STEMI patients, 234 patients were eligible for reperfusion. [Fig. 2.2] There were 1105 STEMI patients admitted to the Department of Cardiovascular Medicine, Mandalay General Hospital in 2 years before STEMI network and 1255 STEMI patients in 2 years after STEMI network. Reperfusion eligible patients were 273 before STEMI network and 502 after STEMI network. [Table 1]

More patients with acute coronary syndrome come to hospital after the STEMI network. (2,131 to 2,411 before and after STEMI network respectively) Significantly, more reperfusion eligible patients come to hospital from 24.7% to 40% before and after STEMI network respectively ( $p < 0.001$ ).

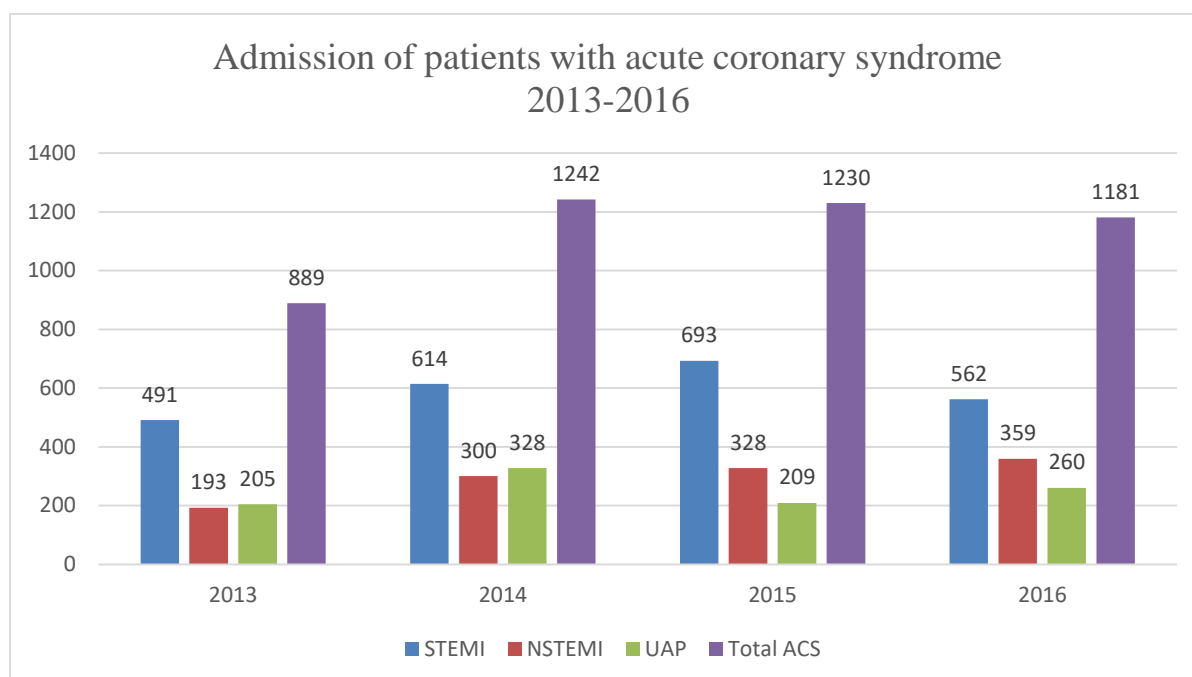


Fig 2.1: ACS patients' admission: ST elevation myocardial infarction, non-ST elevation myocardial infarction, unstable angina pectoris at Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016

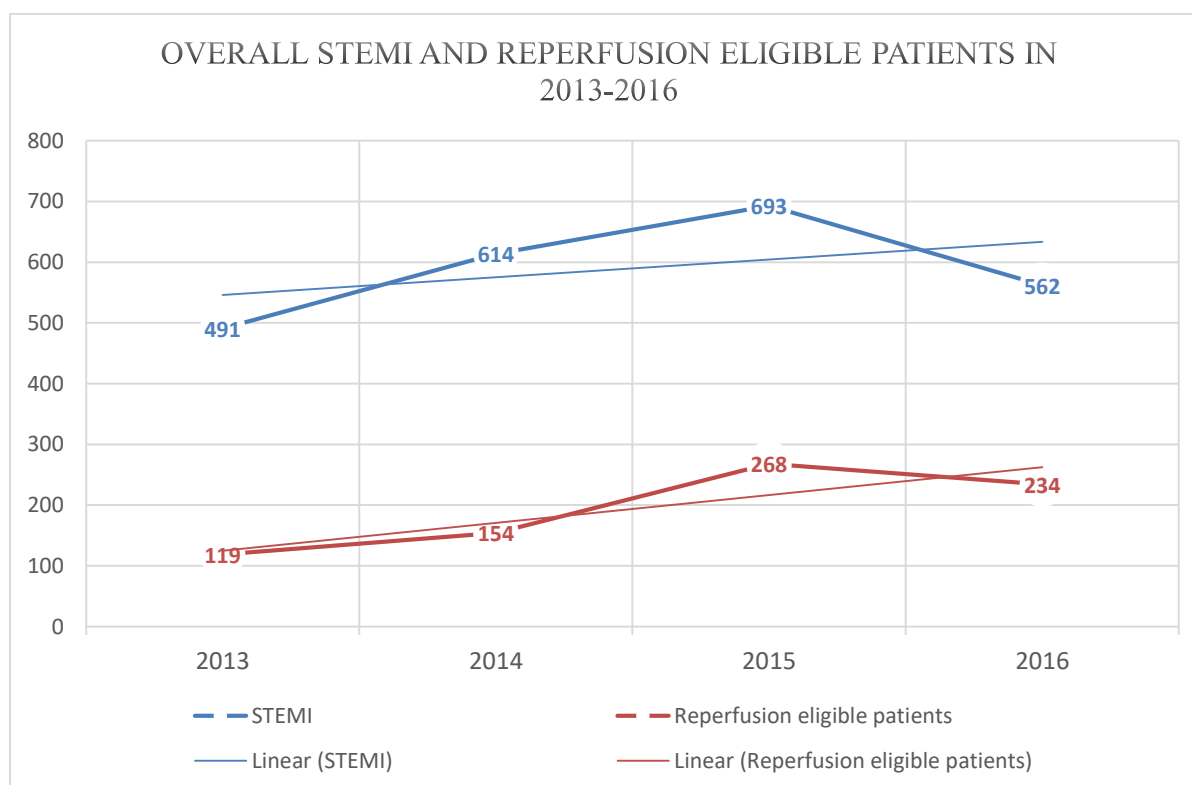


Fig 2.2: STEMI patients' admission and reperfusion eligible patients (that is, patient arriving to Primary PCI capable hospital within 12 hours) at Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016

### ***Reperfusion rates***

In 2013, out of 491 STEMI patients, 117 patients (23.83%) got reperfusion therapy (68 and 49 patients got thrombolysis and PPCI respectively) and 374 patients (76.17%) did not get the reperfusion therapy (among these, although 2 patients arrived the hospital within 12 hours after the onset of chest pain, one denied and one had contraindications for

reperfusion therapies). In 2014, out of 614 STEMI patients, 151 patients (24.59%) got reperfusion therapy (92 and 59 patients got thrombolysis and PPCI respectively) and 463 patients (75.41%) did not get the reperfusion therapy (among these, although 3 patients arrived the hospital within 12 hours after the onset of chest pain, all had contraindications for reperfusion therapies). In 2015, out of 693 STEMI patients, 262 patients (37.81%) got reperfusion therapy (129 and 133 patients got thrombolysis and PPCI respectively) and 431 patients (62.19%) did not get the reperfusion therapy (among these, although 6 patients arrived the hospital within 12 hours after the onset of chest pain two patients got spontaneous reperfusion and four patients denied both reperfusion therapies). In 2016, out of 562 STEMI patients, 210 patients (37.37%) got reperfusion therapy (34, 12 and 164 patients got thrombolysis, Pharmacoinvasive and PPCI respectively) and 352 patients (62.63%) did not get the reperfusion therapy (among these, although 24 patients arrived the hospital within 12 hours after the onset of chest pain, four patients got spontaneous reperfusion, six patients refused reperfusion therapies and 14 patients had contraindications for reperfusion therapies)

Before STEMI network, out of 1,105 STEMI patients, 160 patients got thrombolysis therapy, 108 patients got Primary PCI and total of 268 patients (24.25%) got reperfusion therapy. After STEMI network, out of 1,255 STEMI patients, 163 patients got thrombolysis therapy, 12 patients got Pharmaco-invasive therapy, 297 patients got Primary PCI and total of 472 patients (37.61%) got reperfusion therapy. [Fig. 3.2]

More STEMI patients got reperfusion therapy: As more number of STEMI patients were admitted to hospital within 12 hours after the onset of chest pain, the reperfusion rate is significantly increased from 24.25% to 37.61% before and after STEMI network respectively. ( $p < 0.001$ )

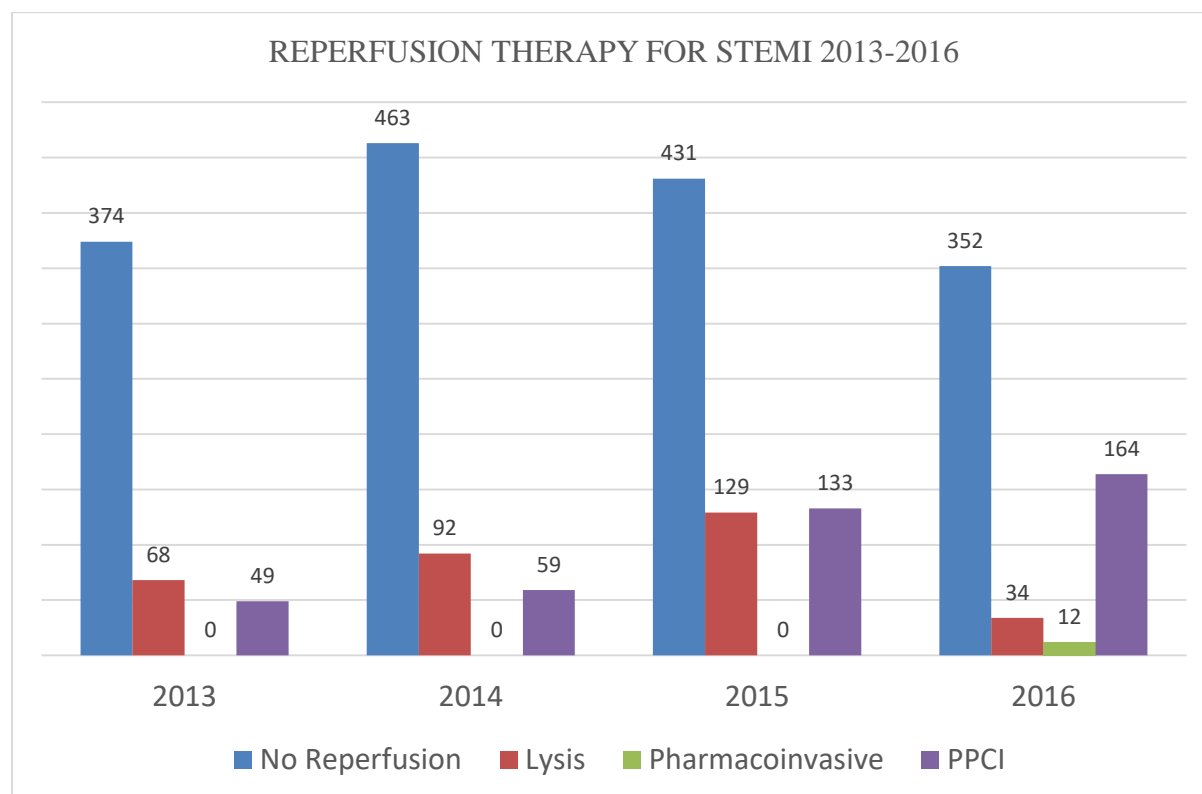


Fig 3.1: Reperfusion rates (patients received reperfusion therapy) in Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016

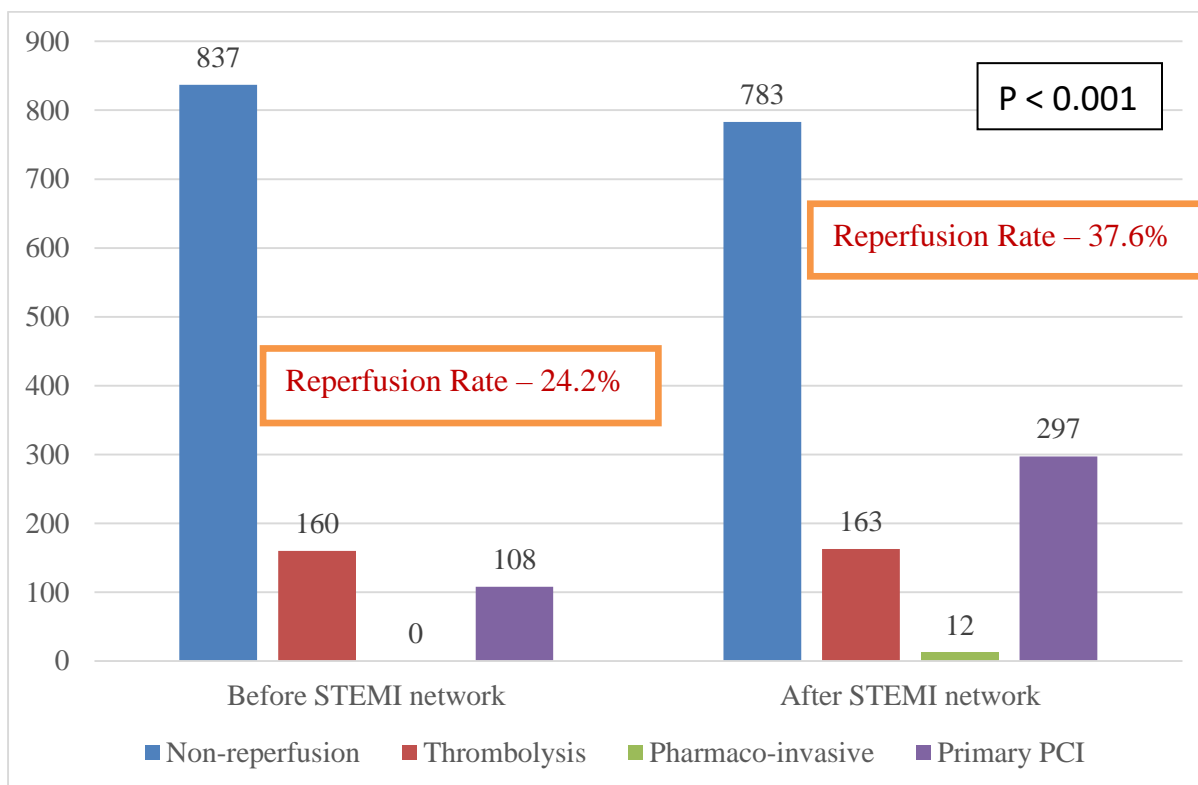


Fig 3.2: Reperfusion rates (patients received reperfusion therapy) compared between pre-STEMI network and post-STEMI network in Department of Cardiovascular Medicine, Mandalay General Hospital

### ***Door to Device Time in Primary PCI***

In patients who received reperfusion with Primary PCI, Mean Door to Device time were  $93.79 \pm 39.69$  mins,  $89.89 \pm 32.63$  mins,  $73.21 \pm 52.02$  mins and  $56.75 \pm 48.02$  mins in 2013, 2014, 2015 and 2016 respectively. [Fig 4.1] Mean Door to Device times were significantly reduced in successive years. Moreover, mean Door to Device time was significantly reduced from  $91.67 \pm 35.89$  mins to  $64.29 \pm 50.35$  mins before and after STEMI network. ( $p < 0.001$ ) [Table 1]

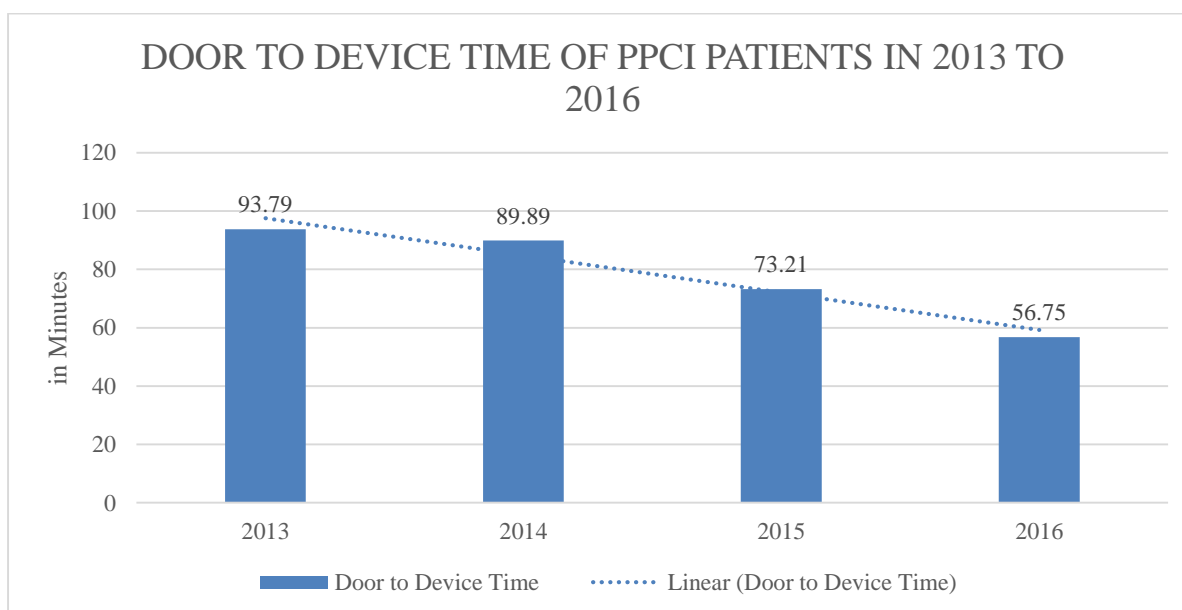


Fig 4.1: Door to device time of the patients who had underwent primary PCI in Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016

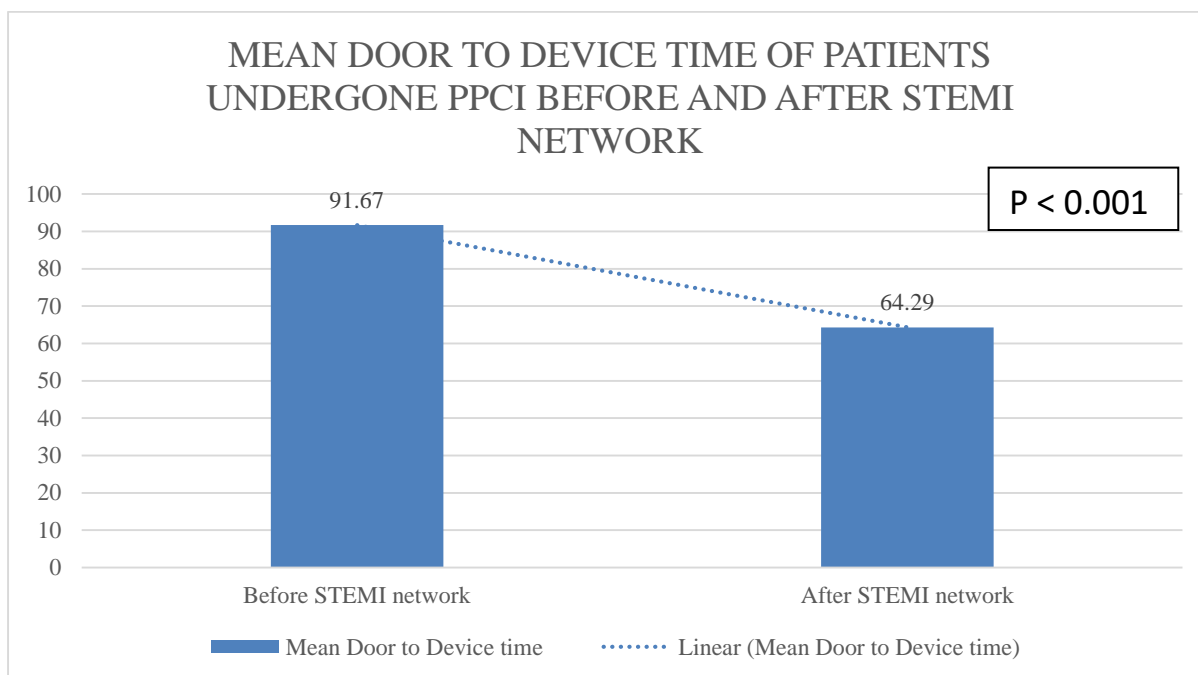


Fig 4.2: Door to device time of the patients who had underwent primary PCI in Department of Cardiovascular Medicine, Mandalay General Hospital before and after STEMI network

### ***In-hospital mortality***

In-hospital mortality of STEMI patients were 73, 93, 103 and 72 in 2013, 2014, 2015, and 2016 respectively [Fig 5.1] and mortality rates were 14.86%, 15.14%, 14.86% and 12.81% respectively. [Fig. 5.2] In-hospital mortality of STEMI patients were 163 in 2 years before STEMI network and 175 in 2 years after STEMI network. [Table 1]

In-hospital mortality reduced from 14.75% to 13.94% before and after the STEMI network respectively. ( $p = 0.577$ ) There is reduction in in-hospital mortality of STEMI patients in 2016 at 12.81% compared to 14.86% in 2013. ( $p = 0.334$ )

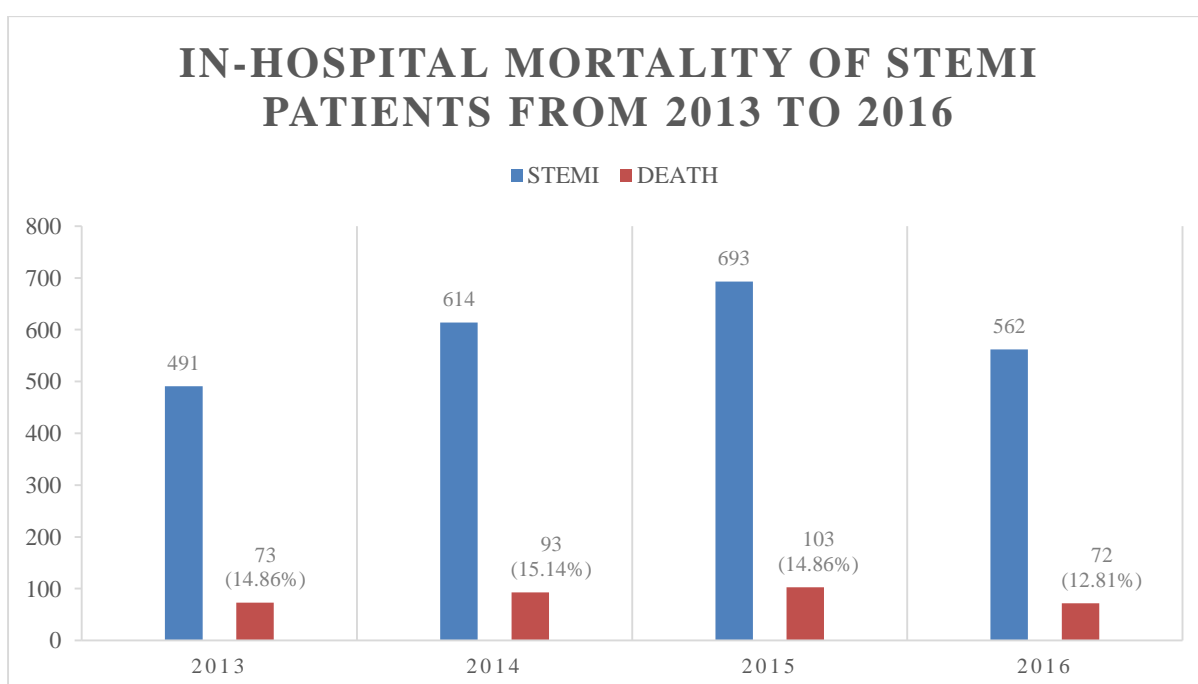


Fig 5.1: In-hospital mortality (Death) among STEMI patients in Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016



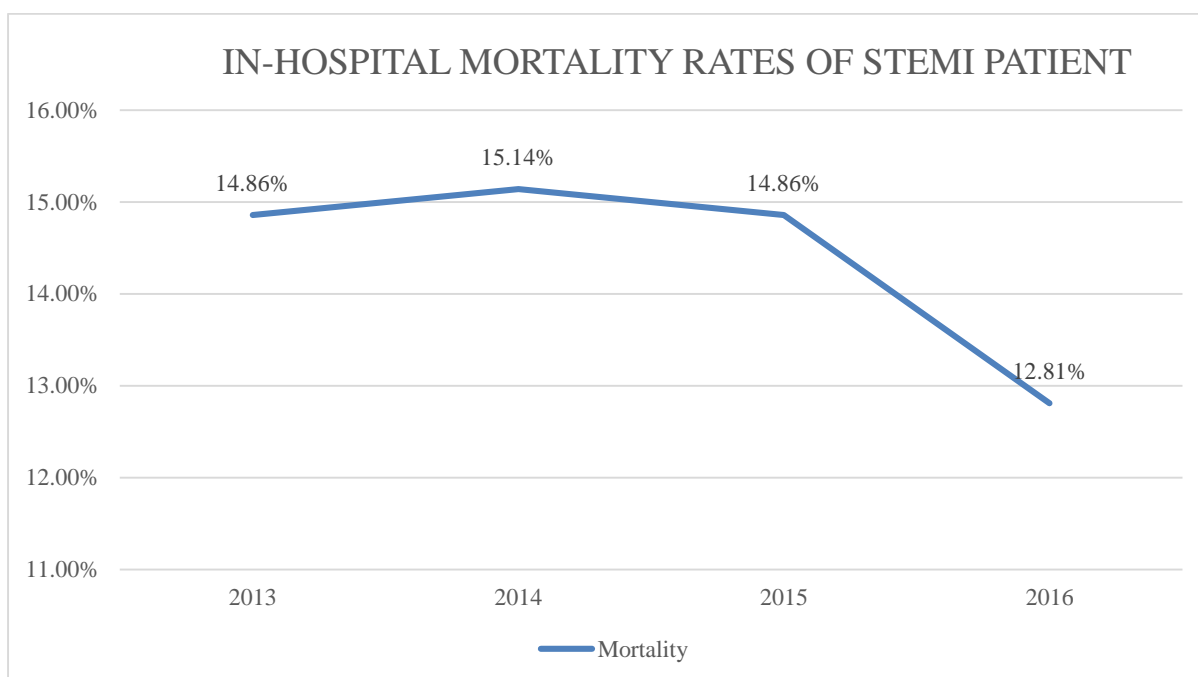


Fig 5.2: In-hospital mortality rates of STEMI patients in Department of Cardiovascular Medicine, Mandalay General Hospital from 2013 to 2016

### ***Sub-group analysis of In-hospital mortality after STEMI network***

In sub-group analysis of in-hospital mortality after STEMI network, eleven out of 297 patients who underwent Primary PCI (3.7%), 21 out of 163 patients who underwent thrombolysis (12.88%), 143 out of 783 patients who did not get reperfusion (18.26%) died. There is no in-hospital mortality case in 12 patients who underwent pharmacoinvasive therapy. [Fig 5.3] Significant decrease in in-hospital mortality was observed in Primary PCI group compared to no reperfusion group (3.7% vs 18.26%) ( $p < 0.001$ ) and thrombolysis group compared to no reperfusion group (12.88% vs 18.26%) ( $p = 0.01$ ) after STEMI network.

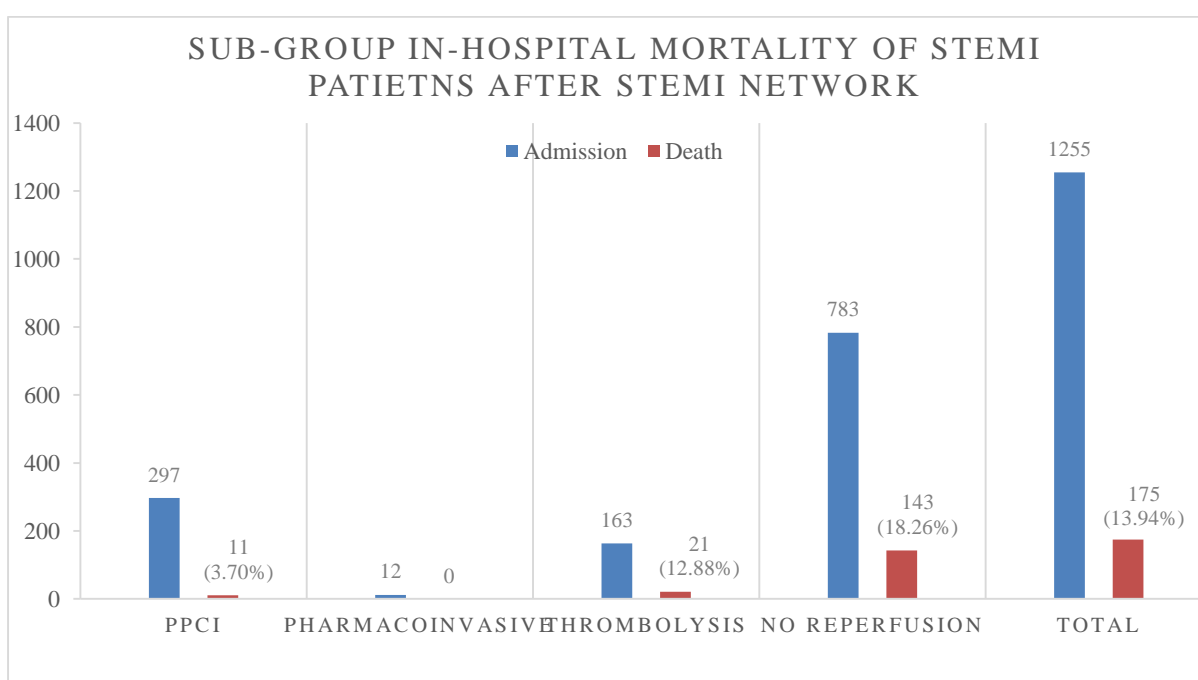


Fig 5.3: Sub-group in-hospital mortality according to reperfusion methods after STEMI network at Department of cardiovascular Medicine, Mandalay General Hospital

## Discussion

In a prospective, single-centre observational study of Australian Hospital evaluating the Australian Heart Foundation's Warning Signs Campaign, the result shows reasonably high awareness of the warning signs campaign, which was significantly associated with shorter pre-hospital decision making by increasing the patients' understanding of what is heart attack (63%), by increasing the patients' awareness of the signs and symptoms of heart attack (68%), by influencing their actions in response to symptoms (43%) and faster presentation to hospital associated with patient delay time of  $\leq 1$  hour (AOR = 2.21, 95% CI: 1.03 to 4.91,  $P=0.04$ ) and prehospital delay time  $\leq 2$  hours (AOR = 3.11, 95% CI: 1.36 to 7.08,  $P=0.007$ ).<sup>[5]</sup> In population based prospective observational study in Switzerland shows that 92/314 (29.3%) AMI patients underwent thrombolysis or Primary PTCA during the 12 months before the campaign, whereas 120/346 (34.7%) underwent these procedures during the 12 months of the campaign. Mortality from AMI went down from 15% before the campaign to 12% during it.<sup>[6]</sup> In the study of PPCI network in Bulgaria, the result shows that there is increase of the percentage of STEMI patients treated by primary PCI (14% in 2008 to 25% in 2011) and the decrease of overall STEMI mortality rates (16.3% to 12.7%) by implementing the important factors such as spreading of PCI centres, networks and infrastructure, training and certification, emergency medical service, public awareness campaigns, 24/7 work, reimbursement, etc.<sup>[7]</sup>

This Study is comparable to above studies with the increase in reperfused patients from 24.25% before STEMI network to 37.61% ( $p < 0.001$ ) after STEMI network, and reduction in mortality from about 14.75% before the STEMI network to about 13.94% after the STEMI network ( $p = 0.577$ ). The insignificant reduction in overall in-hospital mortality of STEMI patients is driven by the unchanged and high in-hospital mortality of STEMI patients who did not have reperfusion therapy. To reduce the in-hospital mortality of patients who do not have reperfusion therapy, 1). public awareness should be promoted and reduce the patients' delay and 2). improvement of guidelines and study for the treatment of patients who did not have reperfusion therapy. The public awareness should be more targeted and consecutive to reduce the patients' delay and enable them to get reperfusion therapy. Although there is founding of Volunteer Rescue and Ambulance Service teams by enthusiastic social volunteer for the transfer and transport of the sick people, the ambulances are not well equipped and the volunteers are not well trained. We alleviated the people factor by training and giving the cardiopulmonary resuscitation courses to the volunteers in case of cardiac arrest during transfer. But, the equipment of emergency kits, drugs, defibrillator and monitor, along with the attendance of paramedics or preferably medical officer, should be considered and worked out by the state authorities, ministry and government.

In Multistage action research project of single centre study in Sweden (Strategies to reduce time delays in patients with acute coronary heart disease treated with primary PCI – the STOP WATCH study) concluded that identification of time delays in an STEMI network with awareness of delay factors, reorganization of logistics and continuous feedback can reduce system delay times significantly. (Time from first medical contact (FMC) to a patent artery and time from FMC-to-catheter laboratory (Cath-lab) arrival decreased by 6 and 12 mins respectively. Total time from diagnosis to a patent artery decreased by 11 mins)<sup>[8]</sup>

In this study, there was development of activation of the STEMI network through phone call and Viber and preparation of the catheterization lab as soon as the STEMI activation. So that, more STEMI patients received reperfusion therapy after STEMI network and mean Door to Device time reduced from  $91.67 \pm 35.89$  mins to  $64.29 \pm 50.35$  mins (standard deviation) before and after STEMI network respectively.

In sub-group analysis, significant decrease in in-hospital mortality was observed in Primary PCI group compared to no reperfusion group (3.7% vs 18.26%) ( $p < 0.001$ ) and thrombolysis group compared to no reperfusion group (12.88% vs 18.26%) ( $p = 0.01$ ) after STEMI network. With more reperfusion eligible patients coming to hospital in time, reduced Door to Device time in Primary PCI, and reduced in-hospital mortality of patients who underwent Primary PCI than who underwent thrombolysis and who did not get reperfusion therapy, Primary PCI should be the only and best treatment for STEMI patients who come to hospital in reperfusion eligible time to reduce the overall in-hospital mortality of STEMI patients.

### **Conclusion**

In conclusion, setting up of STEMI network together with raising the public awareness by well targeted public campaigns can significantly lever up the hospital visits of patients with acute coronary syndrome and even more reperfusion eligible patients with STEMI. Following significant increase in reperfusion rates with thrombolysis or primary percutaneous coronary intervention and reduced mean Door to Device time, in-hospital mortality rate will be reduced.

**Table 1: ACS admissions, reperfusion rates, ischaemic times and mortalities compared between pre-STEMI network and post-STEMI network**

	Pre STEMI network (2013-2014) (N – 1,105)	Post STEMI network (2015-2016) (N – 1,255)	p value
<u>ACS</u>			
- STEMI	1,105	1,255	
- NSTEMI	493	687	
- UAP	533	469	
- Total ACS	2,131	2,411	
<u>Reperfusion eligibility</u>			
- Reperfusion eligible patients	273 (24.70%)	502 (40%)	p <0.001
<u>Reperfusion rate</u>			
- Thrombolysis	160 (14.47%)	163 (12.99%)	p = 0.293
- Pharmacoinvasive	0	12 (0.95%)	p <0.001
- Primary PCI	108 (9.77%)	297 (23.66%)	p <0.001
- Total reperfused patients	268 (24.25%)	472 (37.61%)	p <0.001
<u>Ischaemic Times</u>			
- Door to balloon time	91.67 ± 35.89 mins	64.29 ± 50.35 mins	p <0.001
- Minimum	20 mins	9 mins	
- Maximum	234 mins	473 mins	
<u>Mortality</u>			
- In-hospital mortality of all STEMI patients	163 (14.75%)	175 (13.94%)	p = 0.577

(ACS = acute coronary syndrome, STEMI = ST elevation myocardial infarction, NSTEMI = non-ST elevation myocardial infarction, UAP = unstable angina pectoris)

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