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Characteristics, treatment and in-hospital outcomes of patients with STEMI in a metropolitan area of a developing country: an initial report of the extended Jakarta Acute Coronary Syndrome registry

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ABSTRACT

Objective: We studied the characteristics of patients with ST segment elevation myocardial infarction (STEMI) after expansion of a STEMI registry as part of the STEMI network programme in a metropolitan city and the surrounding area covering ~26 million inhabitants.

Design: Retrospective cohort study.

Setting: Emergency department of 56 health centres.

Participants: 3015 patients with acute coronary syndrome, of which 1024 patients had STEMI.

Main outcome measure: Characteristics of reperfusion therapy.

Results: The majority of patients with STEMI (81%; N=826) were admitted to six academic percutaneous coronary intervention (PCI) centres. PCI centres received patients predominantly (56%; N=514) from a transfer process. The proportion of patients receiving acute reperfusion therapy was higher than non-reperfused patients (54% vs 46%, p<0.001), and primary PCI was the most common method of reperfusion (86%). The mean door-to-device (DTD) time was 102±68 min. In-hospital mortality of non-reperfused patients was higher than patients receiving primary PCI or fibrinolytic therapy (9.1% vs 3.2% vs 3.8%, p<0.001). Compared with non-academic PCI centres, patients with STEMI admitted to academic PCI centres who underwent primary PCI had shorter mean DTD time (96±44 min vs 140±151 min, p<0.001), higher use of manual thrombectomy (60.2% vs13.8%, p<0.001) and drug-eluting stent implantation (87% vs

Strengths and limitations of this study

- We were able to include 56 health centres that participated in this study and enrolled 3015 patients with acute coronary syndrome, of which 1024 patients had ST segment elevation myocardial infarction (STEMI).
- This study describes detailed reperfusion characteristics in 56 health centres located in a metropolitan area of a developing country.
- This study is part of the performance measures of the STEMI care (Jakarta Cardiovascular Care Unit Network System) and the results are used to improve the care of patients with STEMI in the metropolitan area.
- This study focuses on the prehospital care of patients with STEMI, by means of door-in to door-out time (DI-DO); Improvement of the time metrics (DI-DO) may improve the reperfusion time for patients with STEMI in the metropolitan city of a developing country.
- An important limitation of the study is data coverage. At the time of analysis, the coverage of the health centres participating in the registry is 26% of all centres in the metropolitan area, but major secondary and tertiary care hospitals with high volume acute coronary syndrome cases have been participating actively; thus, it may reflect the characteristics of the patients with STEMI in the region very well.

69%, p=0.001), but had similar use of radial approach and intra-aortic balloon pump (55.7% vs 67.2%, and 2.2% vs 3.4%, respectively). In patients transferred for primary PCI, TIMI risk score ≥4 on presentation was associated with a prolonged door-in to door-out (DI-DO) time (adjusted OR 2.08; 95% CI 1.09 to 3.95, p=0.02).
Conclusions: In the expanded JAC registry, a higher proportion of patients with STEMI received reperfusion therapy, but 46% still did not. In developing countries, focusing the prehospital care in the network should be a major focus of care to improve the DI-DO time along with improvement of DTD time at PCI centres.
Trial registration number: NCT02319473.

INTRODUCTION

The main goal of a clinical registry of patients with ST segment elevation myocardial infarction (STEMI) is to narrow the gap between evidence and clinical practice, by providing important data to cardiologists and healthcare authorities. The registry data consist of acute management of STEMI, demographic profile, risk prediction tool, timing and type of reperfusion treatment and outcomes.[1 2] The registry records the full spectrum of patients with STEMI, and usually used as a source of data for measuring the performance of an existing STEMI network. The performance measures provide feedback to clinicians and are used to improve the quality of STEMI care and outcomes.[3]

During the previous decade, the results from several established large health database/registries in developed countries such as GRACE,[2] FAST-MI,[4] NCDR,[3 5] NRMI,[6] and Vienna STEMI[7] made important contributions to optimising the care of patients with acute coronary syndrome (ACS). All the established registries may reflect the true characteristics of the patients with ACS in each region because other hospitals in the region are actively involved in data collection. Findings from the registries may optimise the care of patients with ACS in the region where the registry is being conducted, the data may also inform the treatment of patients with ACS worldwide; thus the findings from these registries are often adopted into the European[8] and American guidelines recommendations.[9]

In contrast to those registries in developed countries, there are still limited numbers of ACS registries in developing countries.[10] The present study was carried out to analyse the characteristics of patients with STEMI in a large metropolitan catchment area of a developing country where a STEMI registry, the Jakarta Acute Coronary Syndrome (JAC) registry, has been applied extensively as part of the regional STEMI network programme in the metropolitan city and the surrounding area that consist of ~26 million inhabitants. The results of the present study are expected to give insights to improve STEMI care in the country.

METHODS

JAC registry

The JAC registry is an on-going, observational registry collecting data on demographic, characteristics, management and outcomes of patients with ACS that began as an initiative only in the emergency department (ED) of a tertiary academic hospital located in a metropolitan city (Jakarta, Indonesia).[11] Since October 2014, the JAC registry has gradually been applied in other hospitals in the metropolitan and the surrounding areas.

At the time of present analysis, 56 centres were actively participating in the JAC registry. All consecutive patients with ACS admitted to each centre are recorded in a standardised registry form. Data quality is maintained through careful evaluation by the cardiologist or physician at the participating centre. After verification, the data are sent electronically to the data analytic centre at the National Cardiovascular Center, Harapan Kita, on regular basis. At the data analytic centre, the data are controlled by monthly data monitoring by the primary investigator of the JAC registry (SD). Using the JAC registry database (recruitment period: October 2014–July 2015), we analysed the characteristics of patients with ACS (N=3015), of which 1024 patients were with STEMI.

The JAC registry is the main data source for measuring the performance of the regional STEMI network, namely Jakarta Cardiovascular Care Unit (CCU) Network System. Several performance measures have been undertaken, and the results were used to improve the system of care for acute myocardial infarction (AMI) in the region.[11–14]

Jakarta CCU Network System

Since 2010, the 'get with the guidelines' project for STEMI in Jakarta was translated by building a STEMI network (Jakarta CCU Network System). The metropolitan city (Jakarta) has ~11 million inhabitants.[13 14] In the surrounding areas of Jakarta, there are many hospitals that by administration do not belong to Jakarta province, but geographically, are located near the metropolitan city. Therefore, in daily practice, many patients with STEMI in the surrounding areas of Jakarta are transferred to the percutaneous coronary intervention (PCI) centres at the metropolitan city for reperfusion therapy. In total, there are ~26 million inhabitants in the five districts of the catchment area (Jakarta, Bogor, Depok, Tangerang and Bekasi).

The network has provided several STEMI algorithms, including the prehospital triage and checklist for fibrinolytic therapy. An ECG transmission scheme is mandatory using several transmission methods.[13 14] This study is part of the regular analysis of the performance measures for the regional STEMI network.

Management protocol

The acute management of patients with STEMI was in accordance with the European Society of Cardiology guidelines[8] and applied at all participating centres. For patients undergoing primary PCI, 600 mg of clopidogrel or 180 mg ticagrelor was given either in the prehospital or in-hospital setting. Before primary PCI, all patients received an intravenous bolus of unfractionated heparin

in the catheterisation laboratory (50 IU/kg if receiving glycoprotein IIb/IIIa inhibitor (GPI) or 100 IU/kg if not receiving GPI).

The choice of vascular access, thrombus aspiration, direct stenting, balloon predilation and the use of intra-aortic balloon pump during primary PCI were at the operator's discretion.

Prehospital care of patients with STEMI

The STEMI algorithm was used as the main protocol for treating patients with STEMI in the region[11 14] including a prehospital triage form.[13] The main metrics to evaluate the prehospital care of patients with STEMI transferred for primary PCI is the door-in to door-out (DI-DO) time.

Study outcome and definition

The primary outcome of the study was the proportion of patients receiving acute reperfusion therapy (primary PCI or fibrinolytic therapy). Other outcomes were in-hospital mortality and DI-DO time. An academic centre was defined as a university teaching hospital for medical students engaged in research, or clinical or related service.[15] DI-DO time (in minutes) was defined as the time spent by a patient with STEMI at the first health-centre before being transferred to a PCI centre for primary PCI, measured by the time difference between admission and the referral time from the referral centre.[16] Killip classification[17] and thrombolysis in myocardial infarction (TIMI) risk score[18] were evaluated at presentation.

Statistical methods

Categorical data are expressed as percentage and continuous data are expressed as mean±SD. For continuous data that are not distributed normally, the data are expressed as median (range). We compared the demographic and clinical characteristics of patients with STEMI between PCI and non-PCI centres. The primary PCI procedural data were compared between academic and non-academic PCI centres. The characteristics of non-reperfused patients were also described. Continuous variables were compared with Student's t-test or Mann-Whitney U test and χ^2 test or Fisher's exact test were used to compare categorical variables as appropriate. Multivariate predictor of prolonged DI-DO time was analysed using logistic regression analyses in patients with STEMI transferred for primary PCI. The cut-off for a prolonged DI-DO time in this study was >180 min.

All statistical tests were two-tailed and a p value <0.05 was considered significant. Statistical analyses were performed with SPSS for Windows V.17.0 (SPSS, Chicago, Illinois, USA).

RESULTS

Study sample

Between October 2014 and July 2015, a total of 1024 patients with STEMI were admitted to the emergency departments of the participating health centres, 917 (89%) were admitted to the PCI centres and the remaining (11%) were admitted to non-PCI centres. Of these, the majority of patients with STEMI (81%; N=826) were admitted to six academic PCI centres.

Clinical characteristics

Patients with STEMI at both PCI centres (86%) and non-PCI centres (85%) were predominantly male. PCI centres received patients predominantly (56%; N=514) from a transfer process, while patients at non-PCI centres were predominantly patients who presented directly/self-presentation (80%; N=86). Smoking was a common risk factor in the overall STEMI population (61%; N=628). Patients at non-PCI centres had more Killip class 1 but lesser TIMI score ≥4 as compared with patients admitted to the PCI centres (table 1).

Characteristics of reperfusion therapy

The proportion of patients receiving acute reperfusion therapy (fibrinolytic therapy or primary PCI) was higher than non-reperfused patients (54%; (N=551) vs 46%; (N=473), p<0.001), and primary PCI was the most common method of reperfusion (86%). As expected, the utilisation of thrombolysis therapy was significantly higher at non-PCI centres than in PCI centres (17.7% vs 6.4%, p<0.001) (table 1).

Characteristics of non-reperfused patients

Non-reperfused patients with STEMI admitted to PCI centres were commonly coming through a transfer process (52%), while most patients at non-PCI centres (79%) were self-presenters. The majority of non-reperfused patients arrived at the ED more than 12 hours after symptom onset (N=291; 61%) (table 2).

Angiographic and procedural characteristics

Compared with non-academic PCI centres, patients with STEMI admitted to academic PCI centres and underwent primary PCI had higher use of manual thrombectomy and drug-eluting stent implantation (60% vs 14%, p<0.001 and 87% vs 69%, p=0.001, respectively), but had similar use of transradial approach and intra-aortic balloon pump (56% vs 67%, and 2.2% vs 3.4%, respectively). The mean DTD time was 102±68 min. At academic centres, the mean DTD time was shorter than at non-academic centres (96±44.3 vs 140±151 min). The left anterior descending artery was the most common infarct-related artery (53%; table 3).

In-hospital mortality

In-hospital mortality of non-reperfused patients with STEMI was significantly higher than patients with STEMI receiving primary PCI or fibrinolytic therapy (9.1% vs 3.2% vs 3.8%, p<0.001) (table 4). The in-hospital mortality between academic and non-academic centres was similar (3.1% vs 3.4%) (table 3).

Table 1 JAC registry database consists of 1024 patients with STEMI

	PCI centre (N=917)	Non-PCI centre (N=107)	p Value
Age, years	55.93±10.07	55.29±10.31	0.535
Male gender, N (%)	788 (86)	91 (85)	0.80
Onset of STEMI, hours	7 (0.25–240)	3 (0.50–120)	0.004
Systolic blood pressure, mm Hg	129 (53–254)	130 (60–200)	0.456
Diastolic blood pressure, mm Hg	78 (30–182)	80 (0–120)	0.255
Heart rate, bpm	81 (20–210)	86 (41–189)	0.483
Source of referral, N (%)			
Public health centre	6 (0.6)	6 (5.6)	<0.001
Interhospital	514 (56)	10 (9.3)	<0.001
Intrahospital	17 (1.85)	2 (1.9)	1.0
Self-walk-in	367 (40)	86 (80)	<0.001
Private clinic	13 (1.41)	3 (2.8)	0.23
CAD risk factors, N (%)			
Hypertension	496 (54)	57 (53)	0.951
Diabetes mellitus	260 (28)	28 (26)	0.674
Family history	138 (15)	18 (17)	0.600
Dyslipidaemia	278 (30)	25 (23)	0.151
Smoker	575 (63)	53 (49)	0.037
Location of MI, N (%)			
Anterior	238 (26)	37 (34.6)	0.01
Killip class 1 at presentation, N (%)	646 (70.4)	89 (83.2)	0.006
TIMI score ≥4, N (%)	549 (59.8)	25 (23.3)	<0.001
Acute reperfusion therapy, N (%)			
Fibrinolytic therapy	59 (6.4)	19 (17.7)	<0.001
Primary PCI	473 (51.6)	NA	NA
Non-reperfused	385 (42)	88 (82.2)	<0.001

CAD, coronary artery disease; MI, myocardial infarction; NA, not applicable; PCI, percutaneous coronary intervention; STEMI, ST segment elevation myocardial infarction; TIMI, thrombolysis in myocardial infarction.

Table 2 Characteristics of non-reperfused patients with STEMI

	PCI centre (N=387)	Non-PCI centre (N=86)	p Value
Source of referral			
Public health centre	1 (0.2)	6 (6.9)	<0.001
Interhospital	203 (52)	8 (9.3)	<0.001
Intrahospital	12 (3.1)	2 (2.3)	0.7
Self-walk-in	163 (42)	68 (79)	<0.001
Private clinic	8 (2.1)	2 (2.3)	0.88
TIMI risk score ≥4	266 (69)	41 (48)	<0.001
Anterior wall MI	129 (33)	42 (49)	0.009
Onset >12 hours	264 (68)	27 (31)	<0.001

Data are presented as numbers percentages.
MI, myocardial infarction; STEMI, ST segment elevation myocardial infarction; TIMI, thrombolysis in myocardial infarction.

Predictor of a prolonged DI-DO time in patients with STEMI transferred for primary PCI

The mean DI-DO time in this study was 186±111 min. After adjustment with several clinical variables (women, older age, diabetes mellitus, hypertension, Killip classification and TIMI risk score), TIMI risk score ≥4 on presentation was associated with a prolonged DI-DO time (>180 min) (adjusted OR 2.08; 95% CI 1.09 to 3.95, p=0.02) (figure 1).

DISCUSSION

The JAC registry was created to improve the quality of care for patients with ACS (particularly STEMI) by providing information on acute management of STEMI, risk prediction tool, timing and type of reperfusion treatment. The results from the registry analysis will be translated into clinical practice by giving knowledge on how to improve patient care and outcomes. Since its inception in 2007, the JAC registry has contributed to the improvement of STEMI care in the region.[12–14] Recently, the JAC registry has been expanded to 56 health centres and like other registries,[4–7] this report is used as a performance measure for the STEMI care that included several insights to improve the STEMI care in the region which are described below. The challenges found in implementing the regional registry and the concept for future network in the region are also discussed.

Changes in acute reperfusion therapy

The number of patients with STEMI who received reperfusion therapy was higher than non-reperfused patients (54% vs 46%) and primary PCI was commonly used

Table 3 Primary PCI characteristics at PCI centres (N=473)

	Academic centre (N=415)	Non-academic centre (N=58)	p Value
Vascular access, N (%)			
Radial artery	228/409 (56)	39/58 (67)	0.09
Thrombectomy, N (%)	248/413 (60)	8/58 (14)	<0.001
Door-to-device time, minutes	96±44	140±151	<0.001
Stent type, N (%)			
Drug-eluting stent	348/400 (87)	38/55 (69)	0.001
Coronary artery by-pass graft, N (%)	1 (0.2)	0 (0)	1.0
Use of intra-aortic balloon pump, N (%)	9 (2.2)	2 (3.4)	0.63
Infarct related artery, N (%)			
LAD	217/409 (53)	30/56 (53.6)	0.94
LCX	24/409 (5.9)	4/56 (7.1)	0.76
RCA	168/409 (41)	22/56 (39.3)	0.79
LM	0	0	NA
Coronary angiography result, N (%)			
1 VD	177 (42.7)	21 (36.8)	0.39
2 VD	134 (32.4)	16 (28)	0.51
3 VD	103 (24.9)	20 (35.1)	1.0
Clinical outcome, N (%)			
Cerebrovascular disease	9 (2.2)	0 (0)	0.61
Mechanical complication	4 (0.9)	0 (0)	1.0
In-hospital mortality	13 (3.1)	2 (3.4)	0.70

Characteristics of patients with STEMI who underwent primary PCI.
LAD, left anterior descending; LCX, left circumflex artery; LM, left main; NA, not applicable; PCI, percutaneous coronary intervention; RCA, right coronary artery; STEMI, ST segment elevation myocardial infarction; VD, vessel disease.

Table 4 Crude in-hospital mortality

	Primary PCI (N=473)	Fibrinolytic therapy (N=78)	Non-reperfused patients (N=473)	p Value
In-hospital mortality, N (%)	15 (3.2)	3 (3.8)	43 (9.1)	<0.001

PCI, percutaneous coronary intervention.

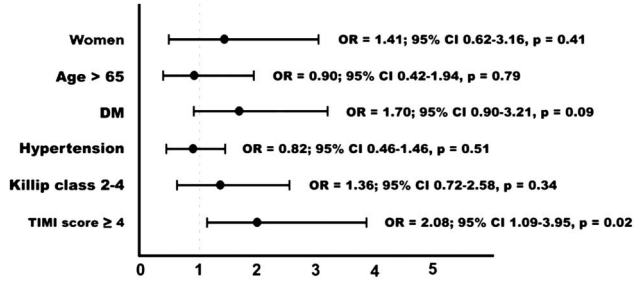

Figure 1 Multivariate predictors of a prolonged DI-DO time in patients with STEMI transferred for primary PCI. DI-DO, door-in to door-out time; DM, diabetes mellitus; PCI, percutaneous coronary intervention; STEMI, ST segment elevation myocardial infarction; TIMI, thrombolysis in myocardial infarction.

(86%). An earlier report showed that the number of non-reperfused patients with STEMI was higher than patients receiving acute reperfusion therapy (59% vs 41%).[11] The current finding suggests that implementation of the regional STEMI network has contributed to improvement of daily management of patients with STEMI in the region, as shown by the higher proportion of patients receiving acute reperfusion therapy.

Our previous report[14] demonstrated the need to apply the registry extensively in the region as part of the STEMI network programme. The wide adoption of the registry may partly explain the changes of reperfusion strategy in the region. Each participating centre may evaluate the characteristics of patients admitted to the centre, that in turn, it may increase the awareness of the emergency medical team to treat patients with STEMI properly based on standard protocols. The increasing awareness of treating STEMI was also found in non-PCI centres as shown by higher utilisation of fibrinolytic therapy than in PCI centres (table 1).

The main reason for patients with STEMI not receiving acute reperfusion therapy in this study was mainly due to high proportion of patients with STEMI (61%) who were admitted to the hospital late after symptom onset (>12 hours). A large proportion of non-reperfused patients (79%) were admitted directly to a non-PCI centre (self-presenters) (table 2). Besides, there are still a number of patients who seek for medical help, but then refuse to receive reperfusion therapy due to

financial problem, afraid of hospitalisation, etc. These findings suggest that the awareness of STEMI care in our community should be raised. Such a programme may include a public campaign to educate the public about the signs and symptoms of MI,[19] emphasis on early recognition and treatment, and national emergency call centre campaign. The Ministry of Health Republic of Indonesia will launch a national call centre (119) to improve the medical emergency services in Indonesia. These efforts are expected to give knowledge to the community to come earlier to the hospital if a heart attack is suspected.

Academic versus non-academic PCI centre for STEMI care

The majority of patients with STEMI (81%) admitted to six academic PCI centres. PCI centres had more high-risk patients with STEMI (Killip class 2–4 and TIMI score ≥4) compared with patients at non-PCI centres. The uptake of transradial access for primary PCI is well accepted in the region, as shown by the majority of patients who had transradial PCI at both the academic and non-academic centres. The use of a supporting device like intra-aortic balloon pump was similar. However, in an academic centre, the DTD time was shorter than in non-academic centres. The reason is likely to be associated with the high involvement of clinical trials for patients with STEMI at the academic centres or the presence of mature processes of care for patients with STEMI. This may also explain the higher use of drug eluting stent and manual thrombectomy in academic centres. Importantly, the in-hospital mortality in academic and non-academic centres was similar (table 3); however, longer-term follow-up may be necessary to determine whether there are substantive differences in outcomes between academic and non-academic centres.

A post hoc analysis of data from the FAST-MI registry showed that when managing patients with STEMI, a hospital's capability to perform PCI matters more than its status as an academic or non-academic medical centre.[20] Primary PCI centres should have a comprehensive approach to treat patients with STEMI that encompasses the journey from ED to the catheterisation laboratory, regardless of academic affiliation.

Calling for improvement in prehospital care of patients with STEMI

Non-reperfused patients with STEMI at PCI centres are predominantly transferred from other centres through a transfer process (table 2). We found that in patients with STEMI transferred for primary PCI, TIMI risk score ≥4 was the strongest predictor of a prolonged DI-DO time (>180 min) with adjusted OR=2.08 (figure 1). In other words, high-risk patients with STEMI were likely to stay longer at the referral centre, whereas such patients should be transferred to a PCI centre for a rapid reperfusion therapy. Furthermore, 52% of non-reperfused patients with STEMI at PCI centres were transferred through a transfer process. The results suggest that there are opportunities to improve prehospital care. The delay in transferring the patient suggests that there should be increased consideration of fibrinolytic therapy at the referral hospital, then rapid transfer to a PCI centre similar to the STREAM trial protocol.[21] Routine educational programme for healthcare professionals (general practitioners and nurses) who worked at the ED of referral centres is key to improve the skill and knowledge for treating and transferring patients with STEMI rapidly. The prehospital triage form (data sheet) should be used extensively and collected in a real-time manner.

The DI-DO time is used as the clinical performance of the prehospital care, as part of the quality indicator of the STEMI network at Jakarta and the surrounding areas. In this study, the mean DI-DO time was 186±111 min. We chose 180 min as the cut-off for a prolonged DI-DO times based on our daily observations and it nearly reached the mean value of DI-DO times found in this study. In the real world experience, it is difficult to achieve a targeted DI-DO time of <30 min, as recommended by the guideline, particularly in developing countries. A recent report from a US study showed that the achievement of a DI-DO time <30 min was only possible in 9.7% of patients with STEMI transferred for primary PCI.[22] More studies are needed focusing on the DI-DO time in developing countries in order to evaluate factors associated with and solutions for a prolonged DI-DO time.

Challenges in implementing a regional STEMI registry

Motivating physicians to participate and controlling data completeness were two difficulties faced by the primary investigator when implementing the regional STEMI registry. However, routine discussions with physicians at the other hospitals about the aim of the registry may eliminate such challenges. Another challenge includes convincing non-cardiac hospitals to participate and share their data. There is concern regarding data security and fear of a negative results from the analysis. These barriers should not exist since not all people have access to the database, and data were analysed anonymously on a routine basis. Each hospital may have access to their data for an internal analysis.

The concept of megapolitan STEMI network

Around 26 million inhabitants reside at Jakarta and the four districts surrounding the metropolitan. In total, there are 266 cardiologists and 46 PCI centres. Looking at the size of population, geographical and administration coverage, the STEMI network in the region is in transformation to a megapolitan network (figure 2). The network service will be divided into nine zones. Each zone will develop a heart line (single call activation) located in the ED of the receiving PCI centres. The network will be coordinated by the emergency medical service and it will encompass the public emergency system (prehospital units, primary healthcare-based emergency units, general hospitals and STEMI hospitals).

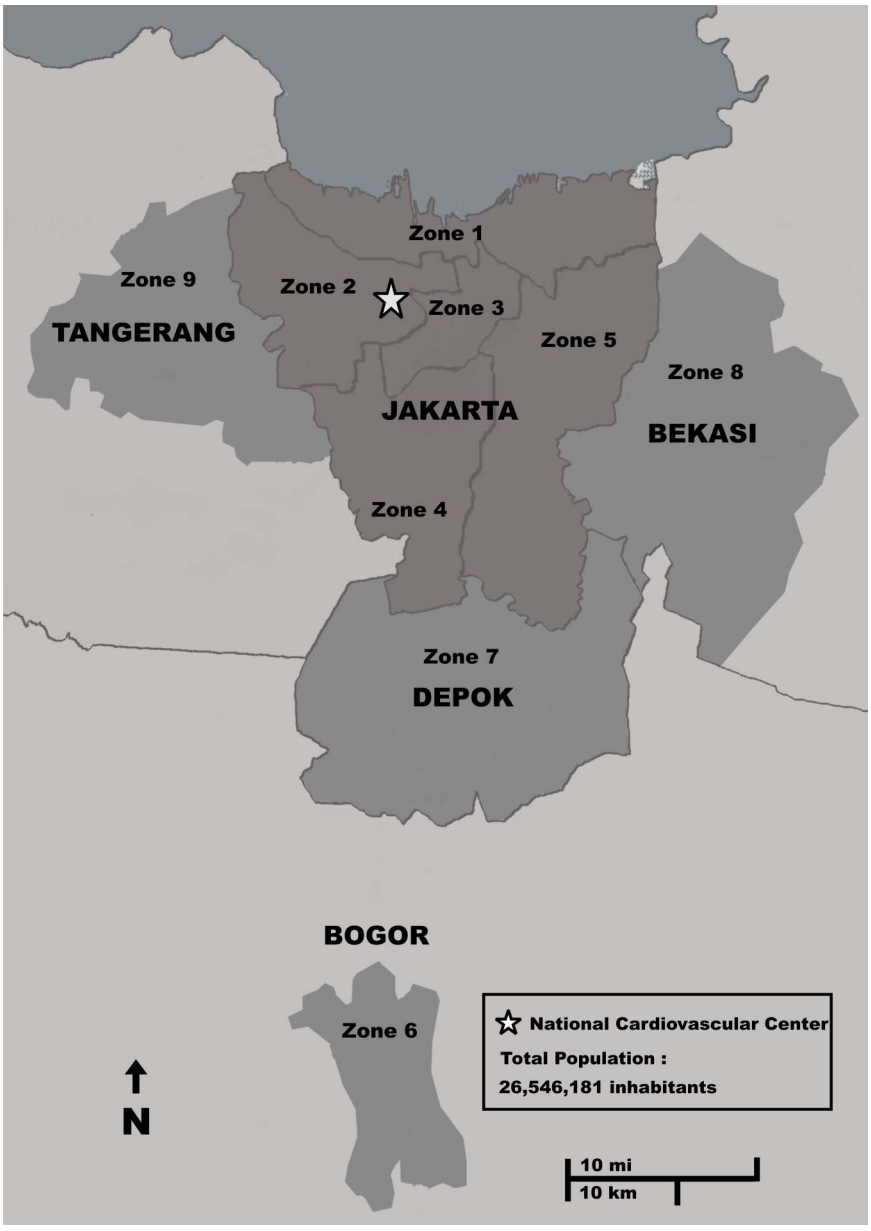

Figure 2 The schematic diagram of the five districts (nine zones) in the Jakarta megapolitan STEMI network. STEMI, ST segment elevation myocardial infarction.

A 12-lead ECG transmission scheme is mandatory in the protocol through several methods.[14] The 24/7 STEMI hospitals at each zone will receive the ECG transmission. If a STEMI is diagnosed, the patients will be transferred to the nearest available PCI centre. A pharmacoinvasive strategy will be adopted in the network. The megapolitan network concept and potential time metrics identified can be seen on figures 2 and 3.

The proliferation of PCI-capable hospitals with efficient regionalised integrated STEMI network, along with accelerating interventional cardiology education to young cardiologists is the main concept for developing the future STEMI network in order to improve outcomes for patients with STEMI in the megapolitan area.

Future healthcare research/registries in developing country

In a developing country, it is more necessary to have a large electronic health database that can be used to evaluate the current therapeutic modalities than performing experimental studies. A large health database provides opportunities for research and large data studies may greatly reduce costs without sacrificing quality. For example, in STEMI research, large database is usually used as source of data for measuring the performance of the STEMI network by analysing the reperfusion therapy status; thus the results of the studies are used to improve the quality of care for patients with STEMI.

In the future, large data set/registries will be used extensively as part of the modern healthcare system in developing countries and become the main data source for research that may facilitate the development and improvement of the national healthcare strategy. The current JAC registry has been expanded to other centres in the four districts, and will be used as the main concept for making a national ACS registry that is currently not available in Indonesia. The data

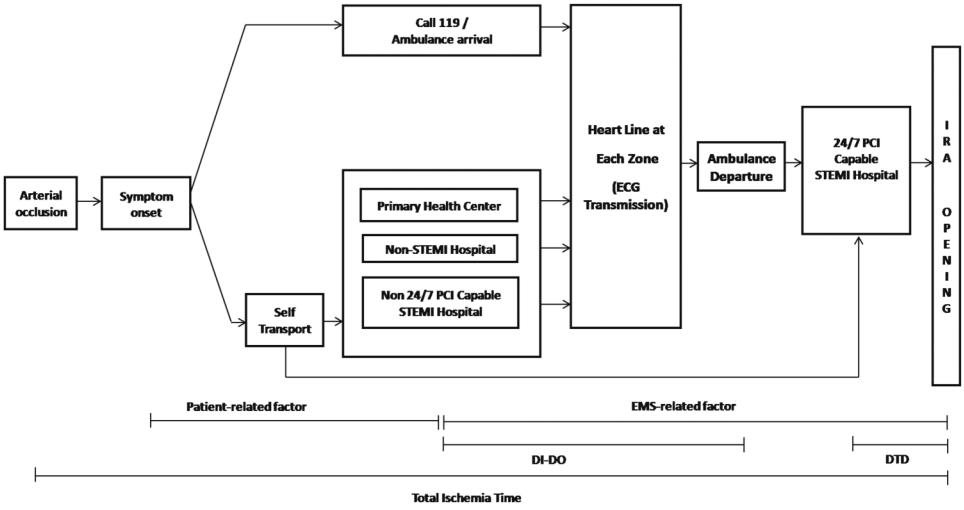

Figure 3 Time metrics variables identified in the Jakarta megapolitan STEMI network. STEMI, ST segment elevation myocardial infarction; PCI, percutaneous coronary intervention; IRA, infarct-related artery; DTD, door-to-device; DI-DO, door-in to door-out; EMS, emergency medical service.

will become the main source of data for measuring the performance of the STEMI care in the country.

Study limitation

The major limitation found in this study is the data coverage. At the time of the present analysis, only 26% of all centres in the metropolitan area were participating in the registry. However, major secondary and tertiary care hospitals with high volume ACS cases have been participating actively; thus, it may reflect the characteristics of the patients with STEMI in the region very well. In the future, other centres in the region are expected to be involved actively in the registry. Finally, the retrospective nature of the study may introduce some bias and missing values.

CONCLUSION

In the expanded JAC registry, a higher proportion of patients with STEMI received reperfusion therapy, but 46% still did not. Focusing on the prehospital care in the network is still mandatory to improve the DI-DO time along with improvement of DTD time at PCI centres. The expansion of the registry affords the opportunity to improve the care of patients with STEMI in the country.

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Correction: *Characteristics, treatment and in-hospital outcomes of patients with STEMI in a metropolitan area of a developing country: an initial report of the extended Jakarta Acute Coronary Syndrome registry*

Dharma S, Andriantoro H, Purnawan I, *et al*. Characteristics, treatment and in-hospital outcomes of patients with STEMI in a metropolitan area of a developing country: an initial report of the extended Jakarta Acute Coronary Syndrome registry. *BMJ Open* 2016;6:e012193. The name of the 12th co-author of this paper is incorrect. The correct name is: Tjatur Bagus Gunarto.

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