Social media communication shorten door-to-balloon time in patients with ST-elevation myocardial infarction

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Abstract

Primary percutaneous coronary intervention (PPCI) is the preferred treatment method for ST-segment elevation myocardial infarction (STEMI). Many efforts had been made to reduce door-to-balloon (DTB) time in patients with STEMI. The objective of this study is to demonstrate how intrahospital social media communication reduced DTB times in STEMI patients requiring an interhospital transfer.

We retrospectively enrolled patients with STEMI who had been transferred from other hospitals during 2016 and 2017. Patients were divided into 2 groups. The previewed group had an electrocardiogram (ECG) done at the first hospital that was previewed by the cardiologist via social media. The control group was treated using the conventional clinical approach. We compared DTB time and outcome between 2 groups.

The 2 groups shared some similar clinical characteristics. However, the previewed group had significantly shorter DTB times than the control group (n = 51, DTB 52.61 ± 42.20 vs n = 89, DTB time 78.40 ± 50.64, $P = .003$). The time elapsed between ECG and the call to the laboratory decreased most apparently in the previewed group ($-11.24 ± 48.81$ vs $16.96 ± 33.08$, $P < .001$). The previewed group also tended to have less in-hospital major adverse cardiovascular events ($P = .091$).

When the patients with STEMI required transfer to the PCI-capable hospital, using social media to preview ECG reduced DTB time, mainly because the cardiologists activated the catheter laboratories much earlier, sometimes even before the patients arrived at the PCI-capable hospital.

Abbreviations: ACC/AHA = American College of Cardiology Foundation/American Heart Association, AMI = acute myocardial infarction, CPR = cardiopulmonary resuscitation, DTB = door-to-balloon, ECG = electrocardiogram, ED = emergency department, FMC2B = First-medical-contact-to-balloon, LVEF = left ventricular ejection fraction, MACE = major adverse cardiac events, PPCI = primary percutaneous coronary intervention, STEMI = ST-segment elevation myocardial infarction.

Keywords: door-to-balloon time, Social Media Communication, ST-elevation myocardial infarction

1. Introduction

Primary percutaneous coronary intervention (PPCI) is the preferred treatment for patients with ST-segment elevation

myocardial infarction (STEMI). In primary PCI, the door-to-balloon (DTB) time is closely related to mortality and morbidity;[1] therefore, the American College of Cardiology Foundation/American Heart Association (ACC/AHA) guidelines for STEMI recommend a goal of DTB time of <90 minutes for all STEMI patients.[2] However, not all hospitals in Taiwan have PCI facility or round-the-clock care availability. The ACC/AHA guidelines for STEMI recommend transport directly to a PCI-capable facility for primary PCI as Class I (level of evidence B)[2] when the transfer does not delay definitive treatment beyond 120 minutes.[3–7] Hence, when patients with STEMI visit the hospitals without PCI facility, interhospital transfer to PCI-capable centers has become the preferred strategy than fibrinolysis. However, despite several attempts to reduce interhospital transfer, in Taiwan as in the United States, the first-medical-contact-to-balloon (FMC2B) time of within 120 minutes is seldom achieved for the patients transferred. Thus, other strategies to reduce FMC2B time are required to improve the patient outcome.[8–10]

Social media refers to websites and apps that enable users to share content or to participate in social networking. In Taiwan, more than 17 million people (74% of the total population) use LINE[11] If this wide connectivity of social media is utilized for instant communication within the hospital, staff from different departments in the hospital can get immediate information via social network platform, without the constraints of location and time.

Several studies have shown that reduced interhospital transfer time and door-in-door-out time decrease mortality and morbidity in patients with STEMI requiring a transfer.[3,12] However, of the

patients diagnosed with STEMI and needing transfer, the proportion that receive PCI within 120 minutes vary widely and range from 16% to 65%.[13,14]

In this study, a social media platform is used to share information between the emergency department (ED) physicians and the cardiologists. The objective is to investigate whether previewing ECG using LINE in patients with STEMI being transferred from other hospitals could reduce the DTB time.

2. Materials and methods

2.1. Study design and population

This retrospective study collected data about patients with STEMI diagnosed at other hospitals and transferred to the China Medical University Hospital from January 2016 to December 2017. China Medical University Hospital is known for its dependability regarding the provision of first-rate first aid as well as for experienced cardiologists available to perform round-the-clock PCI. We designed a closed communication group in LINE. LINE is a social media platform that is widely used in 74% Taiwan population. LINE app is available for a variety of Smartphone devices, including iPhone, Android, Windows Phone, BlackBerry, and Nokia and even personal computers. Through this application, we can communicate in real time through text and voice messages. The application also provides free voice and video calls. We can also share images and videos instantly via the Internet. We included all emergency physicians and cardiologists in the hospital into this closed group. Only invited members can read the content inside this closed group. When we posted the ECG to the social media, only the patient's age, sex, and the title of original hospital were informed. Other patient identities, such as names and medical record numbers, are prohibited in this group. All messages in the group are forbidden to be reprinted or any other use.

The patients were divided into 2 groups. One group included patients who had ECG done first at the original hospital, which was then faxed to the PCI-capable hospital. The ED physician then examined the ECG and posted it to the closed group of emergency physicians and cardiologists on the LINE communication platform after STEMI was confirmed. The on-duty cardiologist then read the ECG instantly and decided whether to activate the laboratory to perform PCI—sometimes even before the patient arrived at the PCI center.

The other group comprised patients whose initial ECG was not faxed to the PCI-capable center. Thus, the ED physicians and cardiologists could only examine the initial ECG when the patients arrived with it (Fig. 1).

This study was approved by the Institutional Review Board of China Medical University. A written informed consent was not obtained from the patients because of the retrospective nature of the study. Some patients were excluded for the reasons listed in Figure 1.

2.2. Data definitions

The diagnosis of STEMI is based on the following criteria:

1) ST-segment changes on ECG consistent with an elevation of ≥2 mm in the contiguous chest leads, ST-segment elevation of ≥1 mm in 2 or more standard leads, or new left bundle branch block.
2) Positive cardiac necrosis markers.
3) Acute myocardial infarction (AMI) symptoms.[1]

The DTB time is the time taken between the arrival of the patient at the PCI-capable hospital and the balloon dilation or thrombus aspiration. The door-to-ECG time is the time taken between the arrival of the patient at the PCI-capable hospital and obtaining the ECG. ECG-to-call laboratory time is the time taken between viewing of ECG by doctors and activation of the catheterization laboratory. Catheterization room prepare time is the time taken for preparation of the catheterization laboratory. Needle-to-balloon time is the time taken between the start of PCI and balloon dilatation or thrombus aspiration. ED transfer time is defined as the time taken between the ED informing the catheterization laboratory coordinator about the patient and arrival of the patient at the catheterization laboratory. In-hospital major adverse cardiac events (MACE) includes in-hospital death, in-hospital or periprocedural myocardial infarction (non-Q wave), and urgent revascularization during the same admission.[15]

2.3. Study endpoints

The primary endpoint was median DTB time. Door time in this study represented the arrival time at the PCI-capable hospital. Secondary endpoints included the individual components of DTB time and the patient outcome, including postcatheterization left ventricular ejection fraction (LVEF), postprocedure cardiopulmonary resuscitation (CPR) and cardiogenic shock, intrahospital MACE, and patient readmission rate at intervals of 72 hours, 14 days, and 30 days.

2.4. Statistical analysis

The patients were divided into 2 groups depending on whether or not their ECG was previewed using LINE. Patient characteristics and pre-existing comorbidities were compared. The primary endpoint—the DTB time—and each of its components were then investigated. The cardiovascular prognosis and incidence of MACE in the 2 groups were also compared. The categorical variables were presented as percentages and examined using chi-square tests. The continuous variables were presented as the mean ± standard deviation and analyzed using independent-samples t-tests.

All statistical analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC). Two-tailed P-value <.05 was considered significant.

3. Results

A total of 144 STEMI patients were referred to the China Medical University Hospital for advanced PCI from January 2016 to December 2017. Of these patients, 52 patients with STEMI were transferred for PCI and had ECG done at the original hospital. During interhospital transfer, the ECG was faxed to our hospital and posted to the LINE intrahospital group, which included most ED physicians and cardiologists. Of these 52 patients, data loss led to the exclusion of one patient. The other 92 patients with STEMI were transferred to our hospital without their ECG faxed first, and the cardiologist was consulted to examine the ECG only after the patient arrived at the ED. Amongst these 92 patients, data loss led to the exclusion of 3 patients. Thus, the total study population was 140 STEMI patients (Fig. 1).

The average ages of the social media and non-social-media groups were 60.65 ± 13.37 and 61.55 ± 12.70, respectively. Baseline patient characteristics were mostly similar between
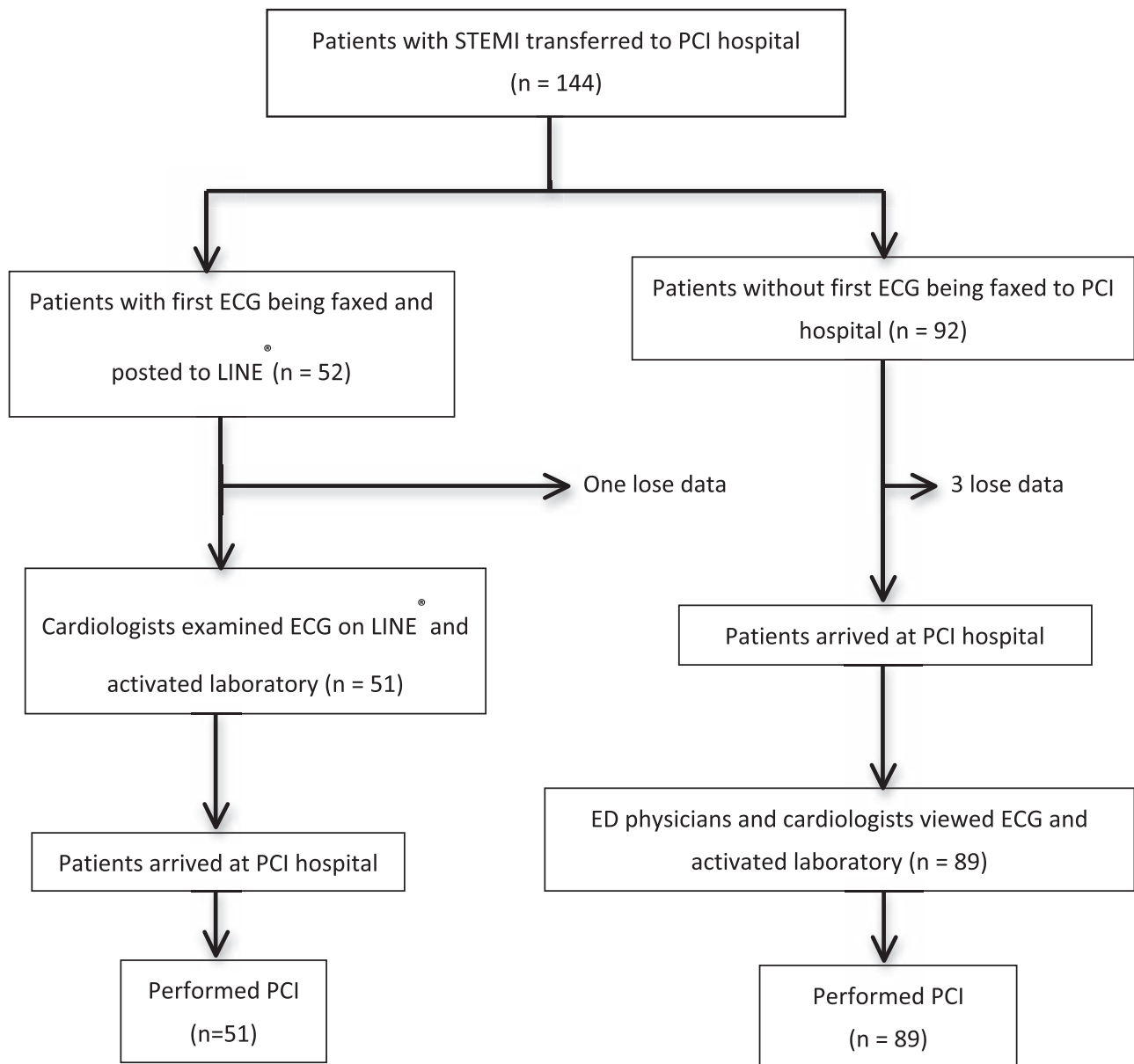
Figure 1. Study population. ECG = electrocardiogram; ED = emergency department; PCI = percutaneous intervention; STEMI = ST-segment elevation myocardial infarction.

the 2 groups. Table 1 presents a comparison of patient characteristics of the 2 groups.

Table 2 shows the differences in the various time-related parameters in the 2 groups. In the patient group using social media, DTB time was shorter than the group not using social media (52.61 ± 42.20 vs 78.40 ± 50.64, $P=.003$). In each patient, the components of DTB time, namely door-to-EKG time, catheterization laboratory prepare time, needle-to-balloon time, and ED transfer time, showed no significant difference. However, EKG-to-call laboratory times decreased significantly in those with previewed ECG (-11.24 ± 48.81 vs 16.96 ± 33.08, $P<.001$). The average time in the group using social media were -11 minutes, which indicated that the cardiologist had called the laboratory before the patient arrived at the PCI center.

Table 3 compares the patient outcomes between the 2 groups. The 2 groups did not differ significantly in their post-PCI LVEF, postprocedure cardiopulmonary resuscitation (CPR) and cardiogenic shock, in-hospital MACE, and patient readmission rate intervals at 72 hours, 14 days, and 30 days. However, in-hospital MACE tended to be lower in the patient group using social media (5.77% vs 15.22%, $P=.091$).

4. Discussion

Our study demonstrates that in patients with STEMI requiring transfer to a PCI-capable hospital, use of social media to share ECG before the patients arrived could reduce their DTB time. This time reduction was possible mainly because the cardiologists could read the ECG via a social media platform before the

Table 1

Baseline patient characteristics.

STEMI from transfer	Line (N=51)	Nonline (N=89)	P-value
Age	60.65 ± 13.37	61.55 ± 12.70	.689[*]
Sex (%)			.837[†]
Male	84.62	85.87	
BMI	25.00 ± 4.62	25.89 ± 5.08	.302[*]
Clinical history (%)			
Smoking	46.15	44.57	.854[†]
Hypertension	57.69	50.00	.374[†]
Diabetes mellitus	28.85	33.70	.548[†]
Prior CAD	15.38	7.61	.142[†]
Prior CVA	5.77	3.26	.667[†]
Dyslipidemia	1.92	5.43	.418[†]
ESRD	3.85	5.43	1.000[†]
VT/VF (%)[‡]	11.54	8.70	.580[†]
OHCA (%)[‡]	7.69	9.78	.770[†]

BMI = body mass index; CAD = coronary artery disease; CVA = cerebrovascular disease; ESRD = end-stage renal disease; OHCA = out-of-hospital cardiac arrest VT/VF = ventricular tachycardia/ventricular fibrillation.
[*] t-test.
[†] Chi-square test.
[‡] Events before PCI.

Table 3

Patient outcome.

STEMI from transfer	Line (N=51)	Nonline (N=89)	P-value
LVEF (%)	50.71 ± 10.16	49.39 ± 13.48	.539[*]
CPR			.190[†]
Yes	4 (7.84)	2 (2.25)	
No	47 (92.16)	87 (97.75)	
Cardiogenic shock			.722[†]
Yes	4 (7.84)	5 (5.62)	
No	47 (92.16)	84 (94.38)	
In-hospital MACE			.091[†]
Yes	3 (5.88)	14 (15.73)	
No	48 (94.12)	75 (84.27)	
72 hours return to ED rate			1.000[†]
Yes	1 (1.96)	1 (1.12)	
No	50 (98.04)	88 (98.88)	
14 days readmission rate			.536[†]
Yes	0 (0.00)	2 (2.25)	
No	51 (100.00)	87 (97.75)	
30 days readmission rate			.374[†]
Yes	3 (5.88)	11 (12.36)	
No	48 (94.12)	78 (87.64)	

CPR = cardiopulmonary resuscitation; LVEF = left ventricle ejection fraction; MACE = major adverse cardiovascular events.
[*] t-test.
[†] Chi-square test.

patients arrived and thus could activate the catheterization laboratories much earlier, sometimes even before the patients arrived at the PCI-capable hospital [ECG-to-call laboratory time: −11.24 ± 48.81 minutes (Table 2)]. Previous studies have shown that when DTB time decreased, the patients had better outcomes and less mortality.[1,16–19] To our knowledge, this is the first study demonstrating that the intrahospital use of a social media platform for communication between the ED physicians and the cardiologists can efficiently decrease DTB time.

When patients with STEMI visit a non-PCI-capable hospital, when the transfer does not delay definitive treatment beyond 120 minutes, the preferred strategy is interhospital transfer to a PCI-capable center (rather than performing fibrinolysis).[2,20] Several attempts have been made to limit the time to less than 120 minutes. The time intervals that contribute to FMC2B time can be divided into 3 parts: door-in–door-out, interhospital transfer, and DTB time. Many studies have demonstrated several ways to shorten interhospital transfer time and have proven that reduced interhospital transfer time improves patient outcome.[8–10,13,21–23]

In patients with STEMI requiring transfer, implementing our design can reduce the DTB time. In Taiwan, the government implemented an ED referral system in 2012; this system allows all hospitals to transfer patients and share patients' information on the internet instantaneously. When the ED physicians receive the ECG through ED referral system via the internet or fax, they

cannot share the ECG with the cardiologist in most scenarios due to the unavailability of the cardiologist at the scene or the lack of an intrahospital communication platform suitable for sharing images and information. When we utilized the social media LINE to set up a group that included ED physicians and cardiologists, we could share the information and images of the patients such as ECG obtained via fax or ED referral system immediately even before the patients arrived. The cardiologists can then decide whether to activate the catheterization laboratory before the patients reach or do so shortly after their arrival, thus reducing the DTB time. This study demonstrated that the use of a social media platform reduces DTB time in patients with STEMI requiring transfer [52.61 ± 42.20 vs 78.40 ± 50.64, P = .003 (Table 2)]. This social media tool is still used in our daily medical practice and further prospective validation studies are needed to assess the benefits of STEMI patients.

4.1. Limitations

The present study has the following limitations: First, being a single-center retrospective observational study, a risk of selection bias is present. Since the study population was relatively small, the statistical analysis has an inherent risk of beta error. We could not gather information about the first medical contact time and interhospital transfer time in most patients. Therefore, we could not show FMC2B time, and given the time limitation, we could not calculate one-year mortality rate for outcome evaluation in each group. Additional prospective studies are warranted to provide information about the potential improvement of the AMI network.

Table 2

Time difference of STEMI (minutes).

STEMI from transfer	Line (N=51)	Nonline (N=89)	P-value
D2B time	52.61 ± 42.20	78.40 ± 50.64	.003[*]
Door to EKG	6.10 ± 11.51	4.92 ± 11.63	.560
EKG to Call Lab	−11.24 ± 48.81	16.96 ± 33.08	<.001[*]
Cath room prepare time	27.49 ± 35.96	22.30 ± 25.89	.368
Needle to balloon	13.35 ± 8.49	15.79 ± 10.86	.179
ED transfer time	11.76 ± 10.24	14.48 ± 14.46	.197

[*] P < .01.

5. Conclusion

Using social media to preview ECG before patients with STEMI transferred to PCI hospital allowed cardiologist to early activate the catheterization laboratory and reduce the DTB time.

References

[1] Tsukui T, Sakakura K, Taniguchi Y, et al. Determinants of short and long door-to-balloon time in current primary percutaneous coronary interventions. Heart Vessels 2017;33:498–506. doi: 10.1007/s00380-017-1089-x.

[2] Association AH, AHA . ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction: Executive Summary. Circulation 2013;127:529–55.

[3] Miedema MD, Newell MC, Duval S, et al. Causes of delay and associated mortality in patients transferred with ST-segment–elevation myocardial infarction. Circulation 2011;124:1636–44.

[4] Andersen HR, Nielsen TT, Rasmussen K, et al. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. N Engl J Med 2003;349:733–42.

[5] Henry TD, Sharkey SW, Burke MN, et al. A regional system to provide timely access to percutaneous coronary intervention for ST-elevation myocardial infarction. Circulation 2007;116:721–8.

[6] Muñoz D, Roettig ML, Monk L, et al. Transport time and care processes for patients transferred with ST-segment—elevation myocardial infarction: the reperfusion in acute myocardial infarction in carolina emergency rooms experience. Circ Cardiovasc Interv 2012;5:555–62.

[7] Levine GN, Bates ER, Blankenship JC, et al. ACCF/AHA/SCAI guideline for percutaneous coronary intervention: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. J Am Coll Cardiol 2011;58:2550–83.

[8] Bosson N, Baruch T, French WJ, et al. Regional "Call 911" emergency department protocol to reduce interfacility transfer delay for patients with ST-segment-elevation myocardial infarction. J Am Heart Assoc 2017;6: doi: 10.1161/JAHA.117.006898.

[9] Wang TY, Peterson ED, Ou FS, et al. Door-to-balloon times for patients with ST-segment elevation myocardial infarction requiring interhospital transfer for primary percutaneous coronary intervention: a report from the national cardiovascular data registry. Am Heart J 2011;161:76–83e1.

[10] Kawecki D, Gierlotka M, Morawiec B, et al. Direct admission versus interhospital transfer for primary percutaneous coronary intervention in ST-segment elevation myocardial infarction. JACC Cardiovasc Interv 2017;10:438–47.

[11] Available at: www.metaps.com/press/en/blog/194-0113 taiwan 2015. Accessed on 15 April, 2018].

[12] Wang TY, Nallamothu BK, Krumholz HM, et al. Association of door-in to door-out time with reperfusion delays and outcomes among patients transferred for primary percutaneous coronary intervention. JAMA 2011;305:2540–7.

[13] Chakrabarti A, Krumholz HM, Wang Y, et al. Time-to-reperfusion in patients undergoing interhospital transfer for primary percutaneous coronary intervention in the U.S: an analysis of 2005 and 2006 data from the National Cardiovascular Data Registry. J Am Coll Cardiol 2008;51:2442–3.

[14] Nallamothu BK, Bates ER, Herrin J, et al. Times to treatment in transfer patients undergoing primary percutaneous coronary intervention in the United States: National Registry of Myocardial Infarction (NRMI)-3/4 analysis. Circulation 2005;111:761–7.

[15] Fang H-Y, Lee W-C, Hussein H, et al. In-hospital and 3-year clinical outcomes following ad hoc versus staged percutaneous coronary interventions in chronic total occlusion—a real world practice. IJC Heart Vessels 2014;4:73–80.

[16] Lambert L, Brown K, Segal E, et al. Association between timeliness of reperfusion therapy and clinical outcomes in ST-elevation myocardial infarction. JAMA 2010;303:2148–55.

[17] McNamara RL, Wang Y, Herrin J, et al. Effect of door-to-balloon time on mortality in patients with ST-segment elevation myocardial infarction. J Am Coll Cardiol 2006;47:2180–6.

[18] Nallamothu BK, Normand S-LT, Wang Y, et al. Relation between door-to-balloon times and mortality after primary percutaneous coronary intervention over time: a retrospective study. Lancet 2015;385:1114–22.

[19] Mentias A, Raza MQ, Barakat AF, et al. Effect of shorter door-to-balloon times over 20 years on outcomes of patients with anterior ST-elevation myocardial infarction undergoing primary percutaneous coronary intervention. Am J Cardiol 2017;120:1254–9.

[20] Members ATF, McMurray JJ, Adamopoulos S, et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012: The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2012 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association (HFA) of the ESC. Eur Heart J 2012;33:1787–847.

[21] Eckstein M, Schlesinger SA, Sanko S. Interfacility transports utilizing the 9-1-1 emergency medical services system. Prehosp Emerg Care 2015;19:490–5.

[22] Nakatsuma K, Shiomi H, Morimoto T, et al. Inter-facility transfer vs. direct admission of patients with ST-segment elevation acute myocardial infarction undergoing primary percutaneous coronary intervention. Circ J 2016;80:1764–72.

[23] Fordyce C, Ramanathan K, Perry M, et al. A protocol to reduce door-to-balloon times for inter-facility transfer in patients receiving primary Pci for Stemi. J Am Coll Cardiol 2013;61:E1512.