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# IMPACT OF DATA FEEDBACK IMPLEMENTATION FOR IMPROVING DOOR-IN-DOOR-OUT TIME IN PATIENTS PRESENTING WITH ST-ELEVATION MYOCARDIAL INFARCTION TO EMERGENCY DEPARTMENT.

**Mohammad Noh LATIP[1], Linawati JUMAT[1], Li Ling CHAW[2].**

**[1]Emergency Department, Raja Isteri Pengiran Anak Saleha Hospital, Bandar Seri Begawan, Brunei.**
**[2] PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Gadong, Brunei.**

## ABSTRACT

**Background:** In a non-PCI capable hospital, it is important to transfer patients within 30 minutes of recommended door-in-door-out (DIDO) time to reduce STEMI patient mortality. Introducing data feedback of STEMI transfers to emergency doctors is one key strategy to improve efficiency and timely transfer. This study aims to evaluate the effect of implementing monthly departmental data-feedback on reducing DIDO transfer time. **Methods:** A 2-phase quantitative interventional study was performed at the emergency department, RIPAS Hospital for 12 months, where DIDO time was used as the primary end point. Data was first extracted from the electronic health care records for the first 6 months, and then monthly data feedback regarding DIDO time was introduced for the next 6 months. DIDO time difference analysis was conducted between these 2 phases. **Results:** A total of 59 patients were enrolled, where 25 (42.4%) and 34 (57.6%) were in the pre- and post- intervention groups, respectively. Their mean age was 49.7 years and 89.9% were male. The median DIDO time in the pre-intervention group was 40 minutes. We found a modest DIDO time improvement to 39 minutes in the post-intervention group (p = 0.784). There was a 2% increase of STEMI patients being transferred within the recommended DIDO time. **Conclusion:** Data feedback of STEMI transfer is a simple intervention that can be utilised to improve awareness among emergency doctors in reducing transfer delays. Identifying the cause of delays, organising system improvement and providing continuous data feedback are all important to improve timely patient transfer.

**Keywords: Emergency department, Efficiency, Percutaneous coronary intervention, Quality improvement, ST Elevation myocardial infarct.**

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**Mohammad Noh LATIP[1], Linawati JUMAT[1], Li Ling CHAW[2].**

**[1]Emergency Department, Raja Isteri Pengiran Anak Saleha Hospital, Bandar Seri Begawan, Brunei.**
**[2] PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Gadong, Brunei.**

## ABSTRACT

**Background:** In a non-PCI capable hospital, it is important to transfer patients within 30 minutes of recommended door-in-door-out (DIDO) time to reduce STEMI patient mortality. Introducing data feedback of STEMI transfers to emergency doctors is one key strategy to improve efficiency and timely transfer. This study aims to evaluate the effect of implementing monthly departmental data-feedback on reducing DIDO transfer time. **Methods:** A 2-phase quantitative interventional study was performed at the emergency department, RIPAS Hospital for 12 months, where DIDO time was used as the primary end point. Data was first extracted from the electronic health care records for the first 6 months, and then monthly data feedback regarding DIDO time was introduced for the next 6 months. DIDO time difference analysis was conducted between these 2 phases. **Results:** A total of 59 patients were enrolled, where 25 (42.4%) and 34 (57.6%) were in the pre- and post- intervention groups, respectively. Their mean age was 49.7 years and 89.9% were male. The median DIDO time in the pre-intervention group was 40 minutes. We found a modest DIDO time improvement to 39 minutes in the post-intervention group ($p = 0.784$). There was a 2% increase of STEMI patients being transferred within the recommended DIDO time. **Conclusion:** Data feedback of STEMI transfer is a simple intervention that can be utilised to improve awareness among emergency doctors in reducing transfer delays. Identifying the cause of delays, organising system improvement and providing continuous data feedback are all important to improve timely patient transfer.

**Keywords: Emergency department, Efficiency, Percutaneous coronary intervention, Quality improvement, ST Elevation myocardial infarct.**

## INTRODUCTION

For patients diagnosed with ST-Elevation Myocardial Infarction (STEMI), timing of reperfusion therapy is very important to improve patient survival.[1,2] Any time delays during patient transfer can occur at the referring hospital, leading to poor patient outcomes.[3] The American Heart Association strongly recommends a Door-In-Door-Out (DIDO) time for STEMI patients to be less than 30 minutes for

**Corresponding author:** Chaw Li Ling, PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Jalan Tungku Link, Gadong, Brunei Darussalam.
Email: liling.chaw@ubd.edu.bn

every non-PCI (percutaneous intervention) capable hospital.[4] Meeting such recommended DIDO time for STEMI patients is a well-known and common challenge faced by non-PCI capable hospitals.[5] A national performance study in the United States showed that DIDO time of > 30 minutes was only attained in 9.7% of STEMI patients.[5] Also, a large cohort study showed that only 11% of STEMI patients achieved transfer within the recommended DIDO time.[6]

Recognising the causes of reperfusion delay and implementing recommended changes to improve DIDO time for STEMI transfers are two of the main priorities in improving STEMI care.[4] One simple approach for the latter is to implement departmental data feedback [7], an intervention recognised as one of the six significant key strategies in improving STEMI transfer time.[8] In 2013, Wilson et al., found a reduction in median DIDO time for STEMI patients by providing data feedback in their emergency department protocol.[9] In another study, Sholz et al., found that STEMI patients median time spent in a referral hospital was reduced significantly after their initiation of formalised data feedback.[10] These observations could be explained by two main reasons. Firstly, formalised data feedback improves the understanding of each individual's own role in the STEMI transfer process and secondly, it also promotes a sense of team responsibility in achieving one common goal.[10] Audit and feedback amongst professional health providers are also proven to improve clinical performance.[11,12] Doctors are usually the leaders of the emergency team, particularly in resuscitation care, and the effectiveness of quality improvement can be enhanced by using achievable physician performance feedback.[13]

Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital is Brunei Darussalam's main tertiary hospital, with their emergency department being the major referral centre for transferring STEMI patients to a facility with PCI for urgent reperfusion care. Like in other non-PCI capable hospitals, this department also faces several challenges in achieving optimum patient management and timely transfer. Hence, the primary aim of this study was to investigate the impact of monthly departmental data-feedback implementation amongst emergency doctors on STEMI DIDO and transfer time at RIPAS Hospital. A secondary aim was to investigate the common patient-related causes that can contribute to transfer delay.

## MATERIALS AND METHODS

### Study design

In this two-phase quantitative interventional study, all STEMI patients who presented at the Emergency department, RIPAS Hospital and requiring transfer to a PCI facility from January to December 2018 (one year) were included in the study. Patients presenting with STEMI who are unable to self fund their PCI treatment or those whose DIDO time was not recorded were excluded from the study. The former were given fibrinolytic therapy and managed in Corornay Care Unit at RIPAS Hospital.

Upon receiving a patient at the Emergency department, the doctor first takes a focused history and examination followed by STEMI diagnosis from electrocardiogram (ECG) readings. Once STEMI was clinically diagnosed, the doctor would activate the existing STEMI activation protocol and transfer the patient to a designated resuscitation area. STEMI management would then be initiated by prescribing initial medical management depending on patient risk factors, as per STEMI management guidelines. The doctor would then refer to the PCI-capable hospital. STEMI patients' arrival time and DIDO time were recorded in Bru-HIMs electronic health care (EHC) record for data collection.

In the first phase of the study (January to June 2018), we retrospectively collected data of all STEMI patients requiring transfer from the Bru-HIMs EHC records of patient notes and ambulance transfer records. The collected information included patient background details, risk factors, clinical management, time of arrival and time of departure. This data reflected the existing STEMI management guidelines before the implementation of data feedback intervention. No data feedback intervention was introduced during this 6-month period.

In the second phase (July to December 2018), the same data collection continued and monthly data-feedback intervention was implemented. During this period, a brief monthly STEMI transfer report was presented to the emergency department doctors, in a form of a 10 to 15 minute powerpoint presentation. During each monthly meeting, the emergency doctors were updated on the performance of the STEMI DIDO timings from the previous month. They were also reminded about the importance of adhering to the existing STEMI protocol.

**Definitions and statistical analysis**

The arrival time (Door-in-time) of the patient at the emergency department was recorded based on the time they were registered or the time of first medical contact (FMC), whichever is earlier. The time of departure of patients from the emergency department was recorded as Door-out-time. The difference between "Door-in" and "Door-out" time was the patient's "DIDO time".

Documented "patient-related factors" that can contribute to transfer delay were defined as follows: (i) *Atypical chest pain,* where patients presented with chest pain that are not characteristic of typical acute STEMI presentation; (ii) *Difficult ECG interpretation,* where patient's first ECG needs to be discussed with one or more colleagues for interpretation, or ECG diagnosis needs to have supporting cardiac enzymes; (iii) *No chest pain,* where the patient's main presenting complaint was not chest pain; (iv) *No STEMI initial ECG* where patients whose initial ECG did not show STEMI, and that STEMI changes were only found on subsequent ECGs and lastly, (v) *Unstable patient* where STEMI patients were clinically unstable requiring intubation or inotropic support.

DIDO time was the primary end-point in this study. Median time for respective pre- and post- intervention DIDO time were compared and evaluated. Group comparisons were conducted via Chi-square or Fisher's exact test for categorical data and independent t-test or Mann-Whitney test for numerical data, whichever appropriate. A p-value of $< 0.05$ was considered statistically significant. Microsoft Excel and SPSS (IBM SPSS Statistics 20 version) were used for statistical analysis.

## RESULTS

A total of 59 patients were included from January to December 2018, where 42.4% (n=25) patients were in the pre-intervention group and 57.6% (n=34) patients were in the post-intervention group (Table I). Their mean age was 49.7 years (SD ±11.96) and most (89.9%) were male. The most common documented cardiovascular risk factors were smoking (44.1%) and hypertension (44.1%). Forty patients (67.8%) arrived at the emergency department using self-transportation. The highest attendance of STEMI patients occurred during the morning shift (40.7%, n = 24).

Amongst the emergency doctors who managed STEMI cases, there was a significant increase in the proportion of Senior Medical Officers involved in management care (Table II: from 25% to 75%, p = 0.01).

**Table I: Demographic and clinical characteristics of STEMI patients on arrival at Emergency Department, RIPAS Hospital.**

| Characteristic | Overall, n (%) | Pre-intervention, n (%) | Post-intervention, n (%) | p Value |
|---|---|---|---|---|
| **Gender** | | | | |
| Male | 53 (89.8) | 22 (41.5) | 31 (58.5) | 0.690 |
| Female | 6 (10.2) | 3 (50.0) | 3 (50.0) | |
| **Mean age in years (SD)** | 49.7 (±11.96) | 50.2 (±8.70) | 49.3 (±13.90) | 0.786 |
| **Presence of Comorbidities** | | | | |
| Hypertension | 26 (44.1) | 9 (34.6) | 16 (65.4) | 0.284 |
| Hyperlipidimia | 19 (32.2) | 6 (31.6) | 13 (68.4) | 0.248 |
| Diabetes | 22 (37.3) | 9 (40.9) | 13 (59.1) | 0.861 |
| Smoking | 26 (44.1) | 11 (42.0) | 57 (57.7) | 0.993 |
| Family History of Cardiac Disease | 10 (16.9) | 3 (30.0) | 7 (70.0) | 0.385 |
| **Mode of transport to hospital** | | | | |
| Self-transport | 40 (67.8) | 18 (45.0) | 22 (55.0) | 0.554 |
| Ambulance | 19 (32.2) | 7 (36.8) | 12 (63.2) | |
| **Vital Signs on arrival** | | | | |
| Mean Systolic BP in mmHg (SD) | 133.4 (±30.47) | 131.0 (±26.48) | 135.0 (±33.55) | 0.639 |
| Mean Diastolic BP in mmHg (SD) | 83.5 (±21.19) | 84.1 (20.50) | 83.0 (±22.08) | 0.850 |
| Mean Pulse in BPM (SD) | 81.3 (±18.47) | 78.9 (±12.85) | 83.2 (±22.19) | 0.383 |
| Mean Temperature in Celsius (SD) | 36.7 (±1.13) | 36.7 (±0.55) | 36.7 (±0.59) | 0.913 |
| Mean Oxygen saturation (SD) | 97.5 (±2.49) | 98.0 (±2.80) | 97.0 (±2.26) | 0.798 |
| **Clinical patient stability** | | | | |
| Stable | 47 (79.7) | 21 (44.7) | 26 (55.3) | 0.478 |
| Unstable | 12 (20.3) | 4 (33.3) | 8 (66.7) | |

The median DIDO time-in pre- and post-intervention groups were 40 and 39 minutes, respectively (Table III). Although not statistically significant, the percentage of patients who achieved DIDO time < 30 minutes improved from 36% in pre-intervention group to 38.2% in the post-intervention group (p = 0.861). Amongst STEMI patients with transfer delay, the most common reason was haemodynamic instability (20.3%, n=12). No statistically significant differences were found when investigating the possible patient-related factors in causing this delay (Table III: p = 0.797).

## DISCUSSION

We have conducted a 6-month interventional study where monthly data feedback on DIDO time were given to the emergency doctors in an effort to improve DIDO time for all STEMI transfers. We found only a slight reduction of median DIDO time from 40 to 39 minutes. We demonstrated that a simple intervention for only a 6-month period can lead to a 2% increase in the number of patients transferred within the recommended DIDO time. Although our findings did not show any statistically significant improvement for our STEMI transfers, it is notable that these small changes can be attributed by simply improving the doctor's awareness to achieve the recommended optimum DIDO time.

In the comprehensive STOP WATCH study in which consecutive feedback on time delays were implemented, an improvement of diagnosis to PCI time by 11 minutes was achieved.[14] Furthermore, Wilson et al., has also managed to achieve an improved median

**Table II: Rank and type of shift work of clinicians attending to STEMI patients at RIPAS Hospital during the study period.**

| Variables | Overall, n (%) | Pre-intervention, n (%) | Post-intervention, n (%) | p Value |
|---|---|---|---|---|
| **Rank of Doctor** | | | | |
| Senior Medical Officer | 28 (47.5) | 7 (25.0) | 21 (75.0) | *0.010** |
| Medical Officer | 31 (52.5) | 18 (58.1) | 13 (41.9) | |
| **Type of Work Shift** | | | | |
| Morning | 24(40.7) | 9 (37.5) | 15 (62.5) | |
| Afternoon | 16 (27.1) | 9 (56.2) | 7 (43.8) | 0.420 |
| Night | 19 (32.2) | 7 (36.8) | 12 (63.2) | |

*****indicates statistical significance, p<0.05

DIDO time from 44 to 35 minutes in their study. However, the data feedback process for the latter study was far more extensive and also included an intensive intervention on patient transfer.[9] Our study results, although small, suggests that there is an opportunity for our Emergency department to further improve the overall transfer time. This can be done through upgrading the departmental logistics involved in the transfer processes (such as human resources, transportation, medical devices and inter-hospital communications) as suggested by Bradley et al.[8]

Notably, our total overall median DIDO time of 40 minutes is relatively shorter than other studies.[15] In a Canadian population-based study, the median DIDO time achieved was 55 minutes, while two similar studies in the United States achieved median DIDO times of 68 and 64 minutes respectively.[6,16] Our overall percentage of patient DIDO time within the recommended 30 minutes was also higher than that reported in other studies.[5,6,17] This suggests that our Emergency department has good adherence to our local STEMI protocol, however, this needs to be consistently audited with data feedback continuation.

In this study, we also identified that the common cause of transfer delays was due to patient-related factors. The most common contributor to transfer delays were in "transferring unstable patients" where 20.3% of the patients required more time for proper resuscitation prior to safe transfer (Table III). Another common cause for delay was that 8.5% of STEMI patients had no chest pain upon presentation, and that 8.5% of patients

**Table III: Patients' DIDO duration and possible patient-related factors for transfer delay.**

| Variables | Overall | Pre-intervention | Post-intervention | p Value |
|---|---|---|---|---|
| **Median DIDO time in minutes (IQR)** | 40 (44) | 40 (23) | 39 (46) | 0.784 |
| **DIDO time (<30mins vs >30mins)** | | | | |
| DIDO < 30min | 22 (37.3) | 9 (36.0) | 13 (38.2) | 0.861 |
| DIDO > 30min | 37 (62.7) | 16 (64.0) | 21 (61.8) | |
| **Possible patient factor for transfer delay** | | | | |
| No delay | 22 (37.3) | 9 (36.0) | 13 (38.2) | 0.797 |
| Atypical chest pain | 3 (5.1) | 2 (8.0) | 1 (2.9) | |
| Difficult ECG | 4 (6.8) | 2 (8.0) | 2 (5.9) | |
| No Chest Pain | 5 (8.5) | 3 (12.0) | 2 (5.9) | |
| No STEMI on initial ECG | 5 (8.5) | 1 (4.0) | 4 (11.8) | |
| Unstable patient | 12 (20.3) | 4 (16.0) | 8 (23.5) | |
| Unknown | 8 (13.6) | 4 (16.0) | 4 (11.8) | |

did not display conclusive STEMI changes in the first initial ECG. These factors made it challenging for emergency doctors to activate the STEMI activation protocol promptly, hence resulting in delayed DIDO time. This result is similar with a study conducted by Dogan et al. whereby 14% of patients demonstrated a combination of delayed diagnosis and late ECG timing.[15] However, these findings are not necessarily a direct reflection of the sole cause for transfer delays, as there could be other contributing factors. Nevertheless, these results do demonstrate that the challenges of recognising and diagnosing STEMI patients is one of the key factors in transfer delay, which can potentially be improved by continued health care training for early detection of unusual STEMI presentation.

This study has several limitations. First, our study population is relatively small, mainly due to our small national population. Our study population (n=59) is more or less the number of STEMI patients we would expect annually at our department. Second, we have to exclude some patients due to incomplete documentations on their DIDO timings. Third, the data-feedback intervention was introduced for only 6 months, which is a relatively short time period for significant awareness improvements to occur. Fourth, although we were able to explore common patient-related risk factors for transfer delay, we were unable to examine other factors which can possibly contribute to transfer delay (such as transport issues and ECG delay). Lastly, we were unable to investigate the impact of ECG delay from the time of patient arrival; further study needs to be done to investigate if improving ECG time can also improve DIDO time in the local setting. Also, there were no specific timely protocol to repeat ECG, and that the decision to repeat ECG mainly depends on the decision of the treating doctors. Emphasis is thus placed on doctors to improve their individual skills in diagnosing acute coronary syndromes presentations.

## CONCLUSION

Our study shows that by simply providing monthly departmental data feedback for a 6-month period, our STEMI DIDO time was improved slightly by 2%, however, this result is not statistically significant. We also recognized some patient-related factors that could contribute to transfer delays, such as unstable patients and atypical STEMI presentations. Departmental data feedback in STEMI DIDO time is a simple intervention that can also be utilised to improve awareness amongst emergency doctors in reducing transfer delays. Similar studies involving better data collection and longer duration are warranted. With continual implementation of this data feedback protocol in our Emergency department, we expect that the DIDO time can be reduced further down to the recommended <30 mins.

## RECOMMENDATIONS

This is the first study conducted at our Emergency department with the aim of improving overall transfer time. Further research is recommended to investigate other risk factors for transfer delay with ongoing data collection. Continuous improvement with human resources, logistics, protocols and data feedback should be done to further improve the overall quality of STEMI management at RIPAS Hospital.

### CONFLICTS OF INTEREST

There are no conflicts of interest among authors in this study. Approval for this study was obtained from the Medical Superintendent of RIPAS Hospital and carried out as part of the Departmental annual quality improvement (KPIs) projects.

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