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## **Reduction of door-to-needle time in the management of patients with acute myocardial infarction admitted to the coronary care unit in District General Hospital Matara Sri Lanka**

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### **ABSTRACT**

**Introduction** Acute myocardial infarction (MI) is the leading cause of death in Sri Lanka. The American College of Chest Physicians (ACCP) guidelines recommend that for patients with acute MI who are candidates for fibrinolytic therapy, the therapy should be administered within 30 min of arrival at the hospital or first contact with the healthcare system (grade 1A).

**Objective** To reduce door-to-needle time to 30 minutes in the management of patients with ST elevated myocardial infarction (STEMI) admitted to the coronary care unit in District General Hospital (DGH) Matara.

**Methodology** A clinical audit was done by analyzing the prevailing process of thrombolysis for acute MI. Based on the identified gaps an integrated care pathway (ICP) was introduced as an intervention. This included the removal of irrelevant steps, avoiding unnecessary delays, and assigning a responsible person to each step in the process. A comparison was done between pre and post-interventional groups.

**Results** Door-to-needle time was significantly shorter after the introduction of ICP (intervention).

**Conclusion** ICP is a good tool for quality assurance. It was helpful in reducing the door-to-needle time in the management of patients with STEMI admitted to the cardiac care unit in DGH Matara, once it was used as the intervention in clinical audit.

### **INTRODUCTION**

#### **Background**

Acute myocardial infarction is the leading cause of death in Sri Lanka<sup>1</sup>. The prevalence of the disease reaches three million people worldwide, with more than one million deaths in the United States annually<sup>2</sup>. Epidemiological studies in the Sri Lankan population are limited, so it is difficult to get an accurate idea about the prevalence of cardiovascular diseases in Sri Lanka. Acute myocardial infarction can be divided into two categories, non-ST-segment elevation MI (NSTEMI) and ST-segment elevation MI (STEMI). Unstable angina is like NSTEMI, but cardiac markers are not elevated<sup>2</sup>.

An MI can lead to irreversible damage to the cardiac muscle by reducing the perfusion to cardiac muscles. It may lead to impairment in diastolic and systolic function and make the patient prone to arrhythmias. In addition, an MI can lead to several serious complications. The main objective of the management of MI is reperfusion of the heart and restoring blood flow. The earlier the treatment (less than 6 hours from the onset of symptom), the better the prognosis<sup>3</sup>. Fibrinolytic therapy (FT) has reduced mortality following Acute Myocardial Infarction (AMI), with the major

effect coming from the early achievement of infarct-related artery patency. The Grampian Region Early Anistreplase Trial (GREAT) showed that delaying thrombolytic treatment by one hour increases the hazard ratio of death by 20%, equivalent to the loss of 43 per 1000 lives within the next 5 years (95% CI 7-88,  $p = 0.012$ )<sup>7</sup> Delaying thrombolytic treatment by 30 minutes reduces the average expectation of life by approximately one year<sup>3</sup>.

### Justification

The American College of Chest Physicians (ACCP) guidelines recommend that for patients with AMI who are candidates for fibrinolytic therapy, the therapy should be administered within 30 minutes of arrival at the hospital or first contact with the

healthcare system (grade 1A). Thus, a short treatment interval must be considered as an adjunctive agent to fibrinolytic therapy. There are three components that determine the time between the onset of MI and the administration of fibrinolytic therapy (grade 1A).

1. Delay in seeking medical attention
2. Transport delays
3. The door-to-needle time (the interval between the patient's arrival at the medical facility and the initiation of fibrinolytic therapy).

Efforts to reduce each of these components will lead to additive benefits in improving the survival of patients with acute MI. The door-to-needle time (DNT) is the easiest to modify. The rationale of the study is that, in health staff, concern about DNT is lacking

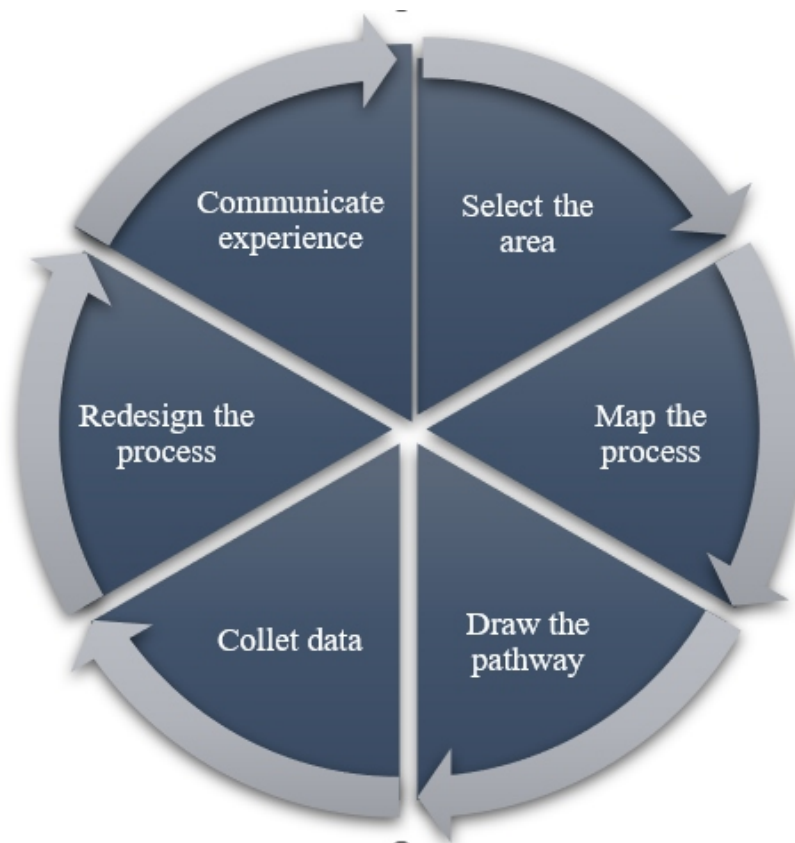


Figure 1. Implementing an integrated care pathway

and very few of them actually think of the importance of giving early thrombolysis to their patients after MI

Therefore, this study was carried out to determine the door-to-needle time (DNT) and identify the factors causing a delay in DNT, so that prompt measures can be taken to reduce this time to save many lives after myocardial infarction.

In Sri Lanka Median DNT is 64 minutes while the mean is 98 minutes<sup>3</sup>. There is no study carried out to assess the DNT for STEMI in District General Hospital (DGH) Matara. However, there is a possibility for it to be similar to the national level. Current guidelines for the management of STEMI recommend reducing the DNT by at least 30 minutes for fibrinolytic therapy and 90 minutes for primary percutaneous coronary intervention (PCI) as treatment goals<sup>4</sup>.

Most of the possible factors causing delays in DNT can be overcome by the introduction of integrated care pathway (ICP). An ICP is a multidisciplinary outline of anticipated care, placed in an appropriate timeframe, to help a patient with a specific condition or set of symptoms move progressively through a clinical experience to positive outcomes. Variations from the pathway may occur as clinical freedom is exercised to meet the needs of the individual patient. The introduction of ICP in the management process of acute myocardial infarction is important because they help to reduce unnecessary delays. ICPs can also be used as

a tool to incorporate local and national guidelines into everyday practice, manage clinical risk, and meet the requirements of clinical governance<sup>4</sup>.

### **Research problem**

Extended door-to-needle time in the management of patients with acute myocardial infarction admitted to Coronary Care Unit (CCU) in DGH Matara

### **General Objective**

To reduce the door-to-needle time to 30 minutes in the management of patients with STEMI admitted to CCU in DGH Matara.

### **Specific objectives**

1. To identify the factors associated with increased door-to-needle time in the management of patients with STEMI admitted to CCU in DGH Matara.
2. To introduce corrective measures to reduce door-to-needle time in the management of patients with STEMI admitted to CCU in DGH Matara.

## **METHODOLOGY**

### **Study setting**

This was an interventional study carried out in DGH Matara. It is the largest hospital in Matara district, and an average of 1338 people receive treatment daily from the hospital (OPD:391, Admissions:297, Clinics:650). It has emergency management facilities including emergency cardiac care. Patients with Acute Coronary Syndrome

(ACS) are managed basically in CCU and Emergency Treatment Unit (ETU) where the initial management is done. In addition, a significant number of patients with ACS are managed also in medical wards. Management of patients with STEMI is carried out in two places. The initial management to stabilize the patient is done at the ETU and the rest is done in the CCU. Patients included in the study were those with STEMI and were managed at the ETU or CCU or in both, provided that the patient was registered at the CCU with a bedhead ticket. A Google form was used for the collection of data and the collected data was sent to Principal Investigator (PI). Secondary data was collected through a desk review. A data collector was trained to collect the data to measure DNT in the management of patients with STEMI admitted to the cardiac care unit.

The DNT was measured and recorded. Integrated care pathway (ICP) was introduced after discussing with relevant stakeholders such as the consultant cardiologist and emergency care physician. Staff training was done, and awareness programs were conducted for the proper functioning of ICP. After the introduction of ICP, DNT was measured for the second time and compared with the earlier measurement to see if there was any statistically significant difference between the pre and post-interventional figures.

- Null hypothesis ( $H_0$ ) – The introduction of an integrated care pathway does not significantly lower the DNT.
- Alternative hypothesis ( $H_1$ ) – The introduction of an integrated care pathway significantly lowers the DNT.

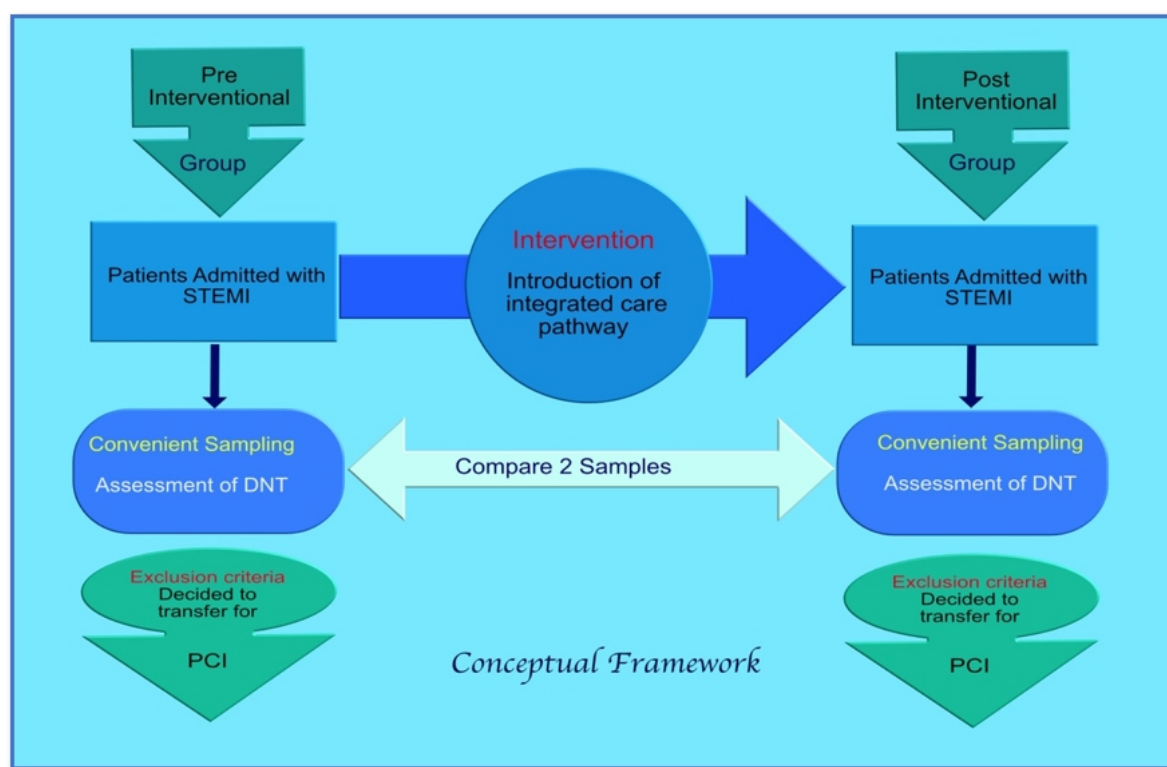


Figure 2. Conceptual framework of the project

## Intervention

In the reduction of DNT, the development and redesigning of the process of thrombolysis were extremely important. ICP was introduced to the thrombolysis process as a major part of this development. In the process of mapping, PI carefully observed what really happened once a patient with

1. After the initial management MO ETU should directly contact the relevant consultant and get an opinion on thrombolysis rather than contacting MO CCU and waiting until he comes. They can contact either the consultant cardiologist or the emergency physician assigned to ETU.

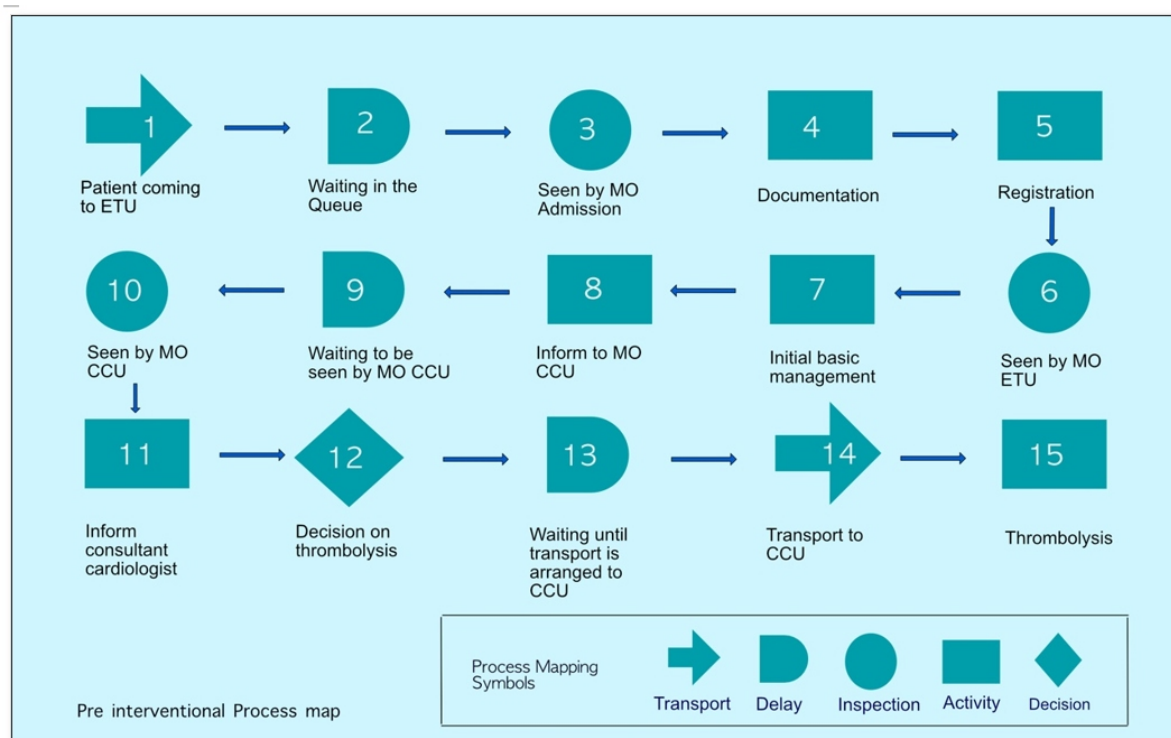


Figure 3. Process map of thrombolysis for a patient with STEMI before the intervention

STEMI comes to the hospital. Each step of the process was noted down and mapping was done before the intervention. (Figure 3)

With the careful mapping of the process of thrombolysis, unwanted steps and delays were identified. The process was redesigned as shown in Figure 4.

With this process development following decisions were made after discussing with the relevant authorities.

2. All other unnecessary steps in the existing long process were removed and delays were

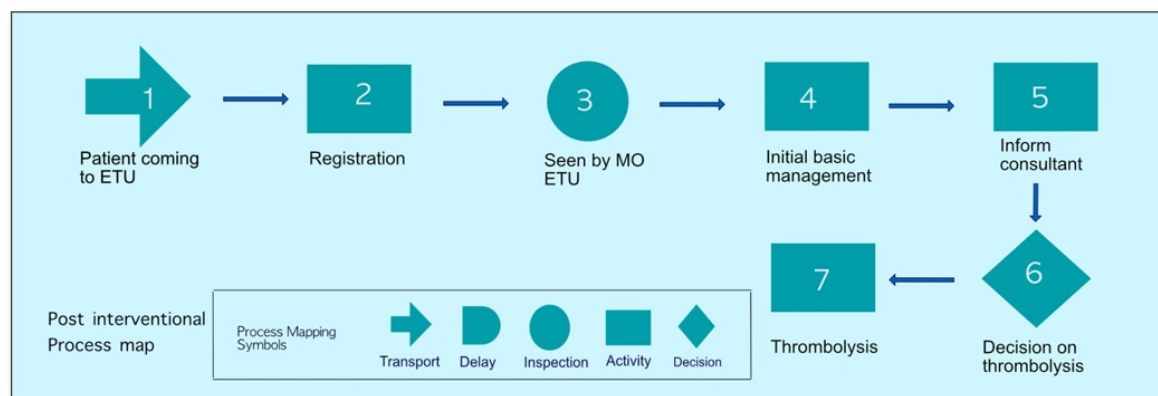


Figure 4. Process map of thrombolysis for a patient with STEMI before the intervention

with the patient (with consent) can be sent to the consultant through the above media to help him to arrive at a decision.

4. Each step in the process should have a responsible person and a minimum time period to avoid unnecessary delays.

5. Door-to-needle time for thrombolysis in MI to be monitored continuously. After the introduction of ICP with process development, DNT was remeasured as shown in Figure 6.

## Variables

The following variables were considered in the analysis.

1. Door-to-needle time in the management of patients with ST elevated myocardial infarction (STEMI) admitting to CCU in DGH Matara before the intervention.

2. Door-to-needle time in the management of patients with STEMI admitted to CCU DGH Matara after the intervention.

## Sampling method

All the patients with STEMI admitted and underwent thrombolysis within a period of three months starting from the 1st of October 2021 were included in the study. The

participants were selected for two samples

1. Pre interventional sample
2. Post interventional sample

### Pre interventional sample

BHTs of all those patients admitted with STEMI and underwent thrombolysis from the 1<sup>st</sup> of October to the 13<sup>th</sup> of November 2021, it was taken as the pre-interventional sample. This sample had a total of 42 participants.

### post interventional sample

The intervention was done during the period starting from the 14<sup>th</sup> of November 2021 to the 17<sup>th</sup> of November 2021. All patients admitted with STEMI and who underwent thrombolysis from the 18<sup>th</sup> of November to the 31<sup>st</sup> of December were taken as the post-interventional sample. It was also a convenient sample and had a total of 51 participants.

### Exclusion criteria

Patients admitted during the period of 14<sup>th</sup> of November 2021 to 17<sup>th</sup> of November 2021 were excluded as it was the period when the intervention was carried out. In addition, those patients who were admitted to CCU but transferred to other healthcare institutions for thrombolysis and those who were admitted to other wards in the same hospital and transferred to CCU for thrombolysis also were excluded. There were very few patients who were seen by the consultant cardiologist in the private sector and admitted with written advice to MO CCU for thrombolysis. They were excluded too.

## RESULTS

A total of 93 patients had been thrombosed either in the ETU or CCU of DGH Matara from the 1st of October 2021 to the 31st of December 2021. Thrombolysis was done only with Tenectaplast injections. A summary of patients who underwent thrombolysis during the period is given in

November 26 December 27 Total 93

### Door-to-needle time before the intervention

The mean of the DNT of pre interventional sample was 47.1905min with a standard

Table 1. Summary of patients who underwent thrombolysis during the study period

| Month    | Number of patients to whom thrombolysis was done |
|----------|--------------------------------------------------|
| October  | 30                                               |
| November | 26                                               |
| December | 37                                               |
| Total    | 93                                               |

Table 1.

Table 1. Summary of patients who underwent thrombolysis during the study period  
Month Number of patients to whom thrombolysis was done  
October 30

deviation of 13.75min. The sample had a total of 42 participants (Table 2).

Table 2. Descriptive statistics of the pre-interventional sample

| Descriptive Statistics |        |       |       |         |                |
|------------------------|--------|-------|-------|---------|----------------|
|                        | Number | Min   | Max   | Mean    | Std. deviation |
| Door to Needle Time    | 42     | 24.00 | 69.00 | 47.1905 | 13.75436       |
| Number (listwise)      | 42     |       |       |         |                |

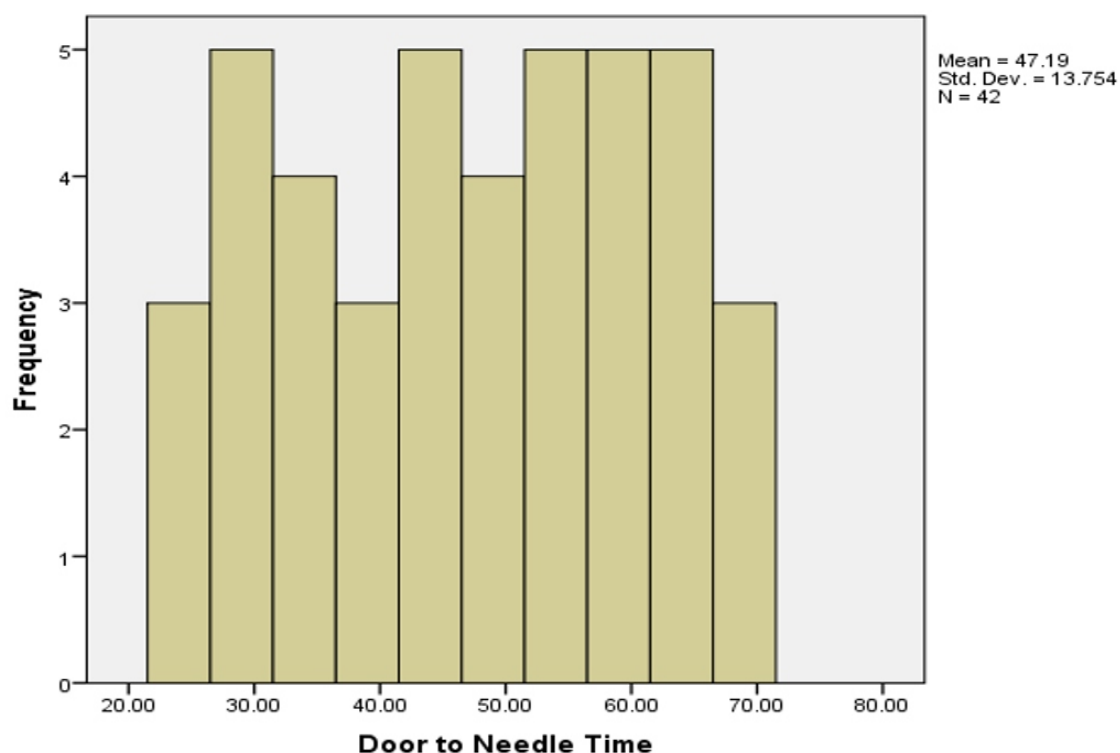


Figure 5. Histogram of the DNT of the pre-interventional sample

Table 3. DNT according to the class interval in the pre interventional sample

| The class interval of Door -to-Needle time |           |         |               |                    |
|--------------------------------------------|-----------|---------|---------------|--------------------|
| DNT class interval                         | Frequency | Percent | Valid Percent | Cumulative Percent |
| 20-30min                                   | 7         | 16.7    | 16.7          | 16.7               |
| 30-40min                                   | 7         | 16.7    | 16.7          | 33.3               |
| 40-50min                                   | 8         | 19.0    | 19.0          | 52.4               |
| 50-60min                                   | 11        | 26.2    | 26.2          | 78.6               |
| 60-70min                                   | 9         | 21.4    | 21.4          | 100.0              |
| Total                                      | 42        | 100.0   | 100.0         |                    |

Table 4. Descriptive statistics of the post-interventional sample

| Descriptive Statistics |        |       |       |         |                    |
|------------------------|--------|-------|-------|---------|--------------------|
|                        | Number | Min   | Max   | Mean    | Standard deviation |
| Door to Needle Time    | 51     | 15.00 | 55.00 | 27.9608 | 6.86720            |
| Number (listwise)      | 51     |       |       |         |                    |

redesigning of the integrated care pathway, DNT was measured in post interventional sample (Figure 6 and Table 4, 5).

According to Table 5, the majority of patients

who underwent thrombolysis had a DNT between 20-30 min. The number of cases with DNT of more than 40 min has been reduced. Statistical comparison between the DNT of pre and post-interventional groups

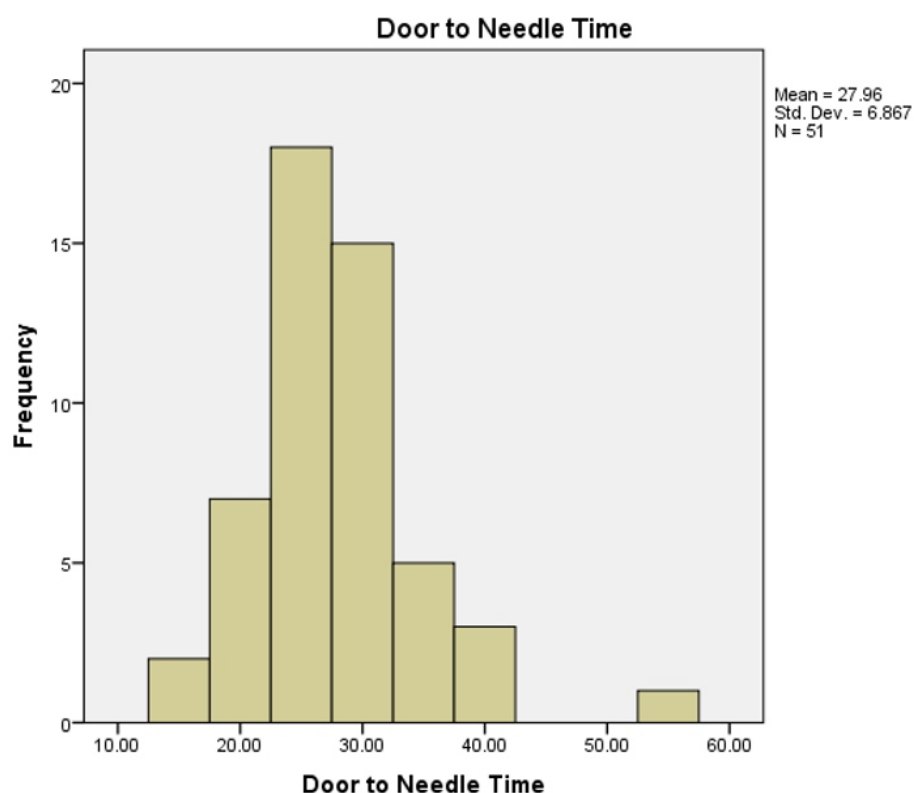


Figure 6. Histogram of the DNT of the post-interventional sample (DNT in minutes)

Table 5. DNT according to the class interval in the post-interventional sample

| DNT class interval | Frequency | Percent | Valid Percent | Cumulative Percent |
|--------------------|-----------|---------|---------------|--------------------|
| 10-20min           | 6         | 11.8    | 11.8          | 11.8               |
| 20-30min           | 33        | 64.7    | 64.7          | 76.5               |
| 30-40min           | 10        | 19.6    | 19.6          | 96.1               |
| 40-50min           | 1         | 2.0     | 2.0           | 98.0               |
| 50-60min           | 1         | 2.0     | 2.0           | 100.0              |
| Total              | 51        | 100.0   | 100.0         |                    |

was done using independent-sample Mann-Whitney U test as the samples were not normally distributed (Figure 6).

According to the test results, the difference between the DNT of pre-interventional and post-interventional samples was statistically significant ( $U=249.5$ ,  $p<0.001$ ). Therefore, the Null hypothesis was rejected, and the alternative hypothesis was accepted. It

concludes that the DNT of post interventional sample was significantly lower than the DNT of pre interventional sample.

## CONCLUSIONS AND RECOMMENDATION

The reduction of DNT in this study was done by redesigning the existing process of

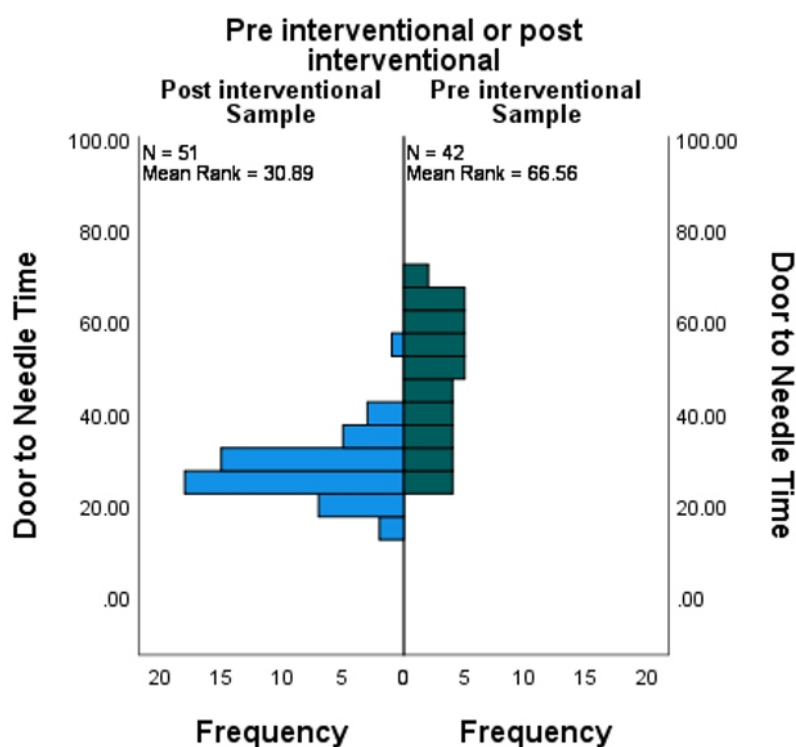


Figure 7. Pre and post-interventional groups compared with the Mann-Whitney U test

Table 6. Test summary of Mann-Whitney U test

| <b>Independent-Samples Mann-Whitney U Test Summary</b> |          |
|--------------------------------------------------------|----------|
| Total number                                           | 93       |
| Mann-Whitney U                                         | 249.500  |
| Wilcoxon W                                             | 1575.500 |
| Test Statistic                                         | 249.500  |
| Standard Error                                         | 129.339  |
| Standardized Test Statistic                            | -6.352   |
| Asymptotic Sig. (2-sided test)                         | .000     |

thrombolysis practiced in both ETU and CCU in DGH Matara. It was successfully done by mapping the process and identifying unnecessary additional steps and delays. It was through a clinical audit. Therefore, it is recommended that clinical audits be used as a continuous measure to achieve the standards of their service and standards of health care institutions. This concept was used to reduce the DNT to less than 30 minutes in the management of patients with STEMI admitted to the cardiac care unit in DGH Matara.

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