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The Effect of Code Stemi Program on Door to Balloon Time in Patients with St Elevation Myocardial Infarction in Manado City

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ABSTRACT

ST-Elevation Myocardial Infarction (STEMI) is a life-threatening cardiovascular emergency that requires rapid and appropriate intervention. One key indicator of successful management is Door-to-Balloon Time (D2BT), which reflects the interval between a patient's arrival at the emergency department and the initiation of primary percutaneous coronary intervention. The CODE STEMI program was developed to streamline the clinical pathway and accelerate reperfusion therapy. To evaluate the impact of the CODE STEMI program on achieving optimal D2BT in STEMI patients. This quantitative comparative study employed an analytical design using the Chi-Square test. Data were collected from two hospitals in Manado City Siloam Hospitals Manado and RSUP Prof. Dr. R. D. Kandou covering the period 2022–2024. A total of 100 STEMI patients were included, consisting of 34 patients managed under the CODE STEMI protocol and 66 patients managed without the protocol. Results Implementation of the CODE STEMI program was associated with a significantly higher proportion of patients achieving D2BT < 90 minutes compared with the non-CODE STEMI group. Patients in the CODE STEMI pathway reached timely D2BT more frequently than those managed through standard procedures. The CODE STEMI program effectively accelerates clinical management in STEMI cases, resulting in improved achievement of D2BT targets. These findings highlight the importance of structured, protocol-based emergency cardiac care to enhance early clinical outcomes in STEMI patients.

Keywords: code STEMI, door to balloon time, primary PCI, STEMI

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BACKGROUND

ST-Elevation Myocardial Infarction (STEMI) is an acute and life-threatening cardiac emergency caused by complete occlusion of a coronary artery, requiring prompt reperfusion therapy to prevent extensive myocardial damage. Reperfusion can be achieved through fibrinolytic therapy or primary percutaneous coronary intervention (PCI), with PCI being the preferred approach when it can be performed in a timely manner.

Globally, the burden of STEMI remains substantial, with incidence varying widely across regions. In the United States, several hundred thousand STEMI cases are reported annually. In European countries, the incidence ranges from 80 to 370 cases per 100,000 person-years, while in Asia it ranges from 33 to 138 cases per 100,000 person-years. These variations highlight differences in population risk profiles and healthcare system responsiveness in managing acute cardiac emergencies. (Omeludike et al. 2023). In Indonesia, cardiovascular disease remains one of the leading causes of mortality. According to the 2018 Basic Health Research (Riskesdas), the prevalence of physician-diagnosed heart disease is 1.5% of the population. Hospital-level data also show a rising trend of STEMI cases. At Prof. Dr. R. D. Kandou Hospital in Manado, the number of STEMI cases increased from 1,221 cases in 2022 to 1,958 cases in 2023, and 2,192 cases in 2024. This escalation underscores the need to strengthen emergency cardiac care pathways, particularly in referral hospitals. (Ministry of Health RI, 2019).

To improve timely management, many hospitals have adopted rapid activation protocols such as the “CODE STEMI” system. This single-call mechanism enables immediate coordination among emergency physicians, cardiologists, interventional cardiologists, catheterization laboratory teams, and supporting personnel. The program is designed to accelerate clinical workflow—from STEMI recognition to PCI—thereby increasing the likelihood of achieving the recommended Door-to-Balloon Time (D2BT) of less than 90 minutes. (Funay et al., 2020).

Given the critical importance of rapid reperfusion in determining patient outcomes, this study aims to analyze the effect of the CODE STEMI program implementation on achieving optimal Door-to-Balloon Time among STEMI patients in Manado City.

METHODS

This study employed a quantitative analytical design using a retrospective cohort approach. A retrospective cohort study is an observational design in which researchers compare outcomes between predefined groups using previously recorded data. In this study, two cohorts were compared: patients managed with the CODE STEMI protocol and patients managed without the CODE STEMI protocol. All data were obtained from the medical records of STEMI patients treated at Siloam Hospitals Manado and Prof. Dr. R. D. Kandou Hospital between January 1, 2022 and December 31, 2024.

Population and Sampling

The population consisted of all patients diagnosed with STEMI during the study period. Since the research used existing medical records and aimed to include all eligible cases, the sampling method was total sampling, not random sampling. All medical records that met the inclusion criteria were included in the analysis. A total of 100 medical records were eligible: 34 CODE STEMI cases and 66 non-CODE STEMI cases.

Inclusion Criteria

Inclusion criteria were simplified to avoid overly broad or redundant categories. Medical records were included if the patient:

Had a confirmed diagnosis of ST-Elevation Myocardial Infarction (STEMI) based on ECG.
Was treated with primary PCI.
Had complete documentation of Door-to-Balloon Time (D2BT).

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Was treated within the study period (January 1, 2022 – December 31, 2024).

Exclusion Criteria

Medical records were excluded if:

The diagnosis of STEMI was unclear or incomplete.

Key variables required for analysis (e.g., time of arrival, PCI start time) were missing.

The patient received fibrinolysis instead of primary PCI.

Data Collection

Data were collected from the medical record systems of both hospitals. Extracted variables included demographic data, risk factors, time of emergency department arrival, CODE STEMI activation status, and Door-to-Balloon Time.

Data Analysis

Data were analyzed using the Chi-Square test to compare the proportion of patients achieving the recommended D2BT (<90 minutes) between the CODE STEMI and non-CODE STEMI groups. The significance level was set at $p < 0.05$.

RESULTS

Table 1 Characteristics of Respondents based on Code STEMI Program and Non-Code STEMI Program in STEMI patients at Siloam Hospitals Manado and Prof. Dr. R. D. Kandou Hospital in January 1, 2022 - December 31, 2024 (n = 100).

Characteristics	CODE STEMI		Non-CODE STEMI	
	n	%	N	%
Age (years), n (%)				
< 35 years	1	2,9	1	1,5
> 35 years	33	97,1	65	98,5
Total	34	100	66	100
Gender, n (%)				
Men	31	91,2	53	80,3
Women	3	8,8	13	19,7
Total	34	100	66	100
Risk Factors (%)				
Has 1 Risk factor	17	50,0	14	21,2
Has 2 Risk factor	15	44,1	28	42,4
Has 3 Risk factor	2	5,9	18	23,7
Has 4 Risk factor	0	0	6	9,1
Total	34	100	66	100

Based on table 1, shows that from the results of research conducted on 34 respondents in the Code Stemi Program group and 66 respondents in the Non Code Stemi group, the distribution of respondents based on age, respondents in the Code Stemi Program group aged <35 years were 1 (2.9%) respondent and >35 years as many as 33 (97.1%) and the Non Code Stemi group aged <35 years were 1 (1.5%) respondent and >35 years as many as 65 (98.5%), based on gender characteristics distribution respondents in the Code Stemi Program group with male gender were 31 (91.2%) respondents and female gender were 3 (8.8%) respondents, in the Non Code Stemi group respondents with male gender were 53 (80.3%) respondents and female gender were 13 (19.7%) respondents. Based on the characteristics of risk factors in the Code Stemi group, there were 17 (50.0%) samples with 1 risk factor, 15 (44.1%) samples or respondents with 2 risk factors, 2 (5.9%) respondents with 3 risk factors, and 0 (0%) respondents with 4 risk factors. Whereas in the Non-Code Stemi group there were 14 (21.2%) respondents who had 1 risk factor, 28 (42.4%) respondents who had 2 risk factors, 18 (23.7%) respondents who had 3 risk factors and 6 (9.1%) respondents who had 4 risk factors. These risk

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factors consist of having a history of hypertension, diabetes mellitus, dyslipidemia, smoking and obesity, in each respondent or sample there is one risk factor and also more than one.

Table 2. Effect of CODE and Non-CODE STEMI Program on Door to Balloon Time at Siloam Hospitals Manado and Prof. Dr. R. D. Kandou Hospital in January 1, 2022 - December 31, 2024 (n = 100).

Variabel	CODE STEMI		Non-CODE STEMI		Sig
	n	%	n	%	
Achieved	8	8.0	1	1,0	.001
Not Achieved	26	26,0	65	65,0	

Based on the results of the analysis, it shows that in the Stemi code program, there were 8 (8.0%) samples that achieved Door to Balloon or ≤ 90 minutes and did not achieve 26 (26.0%) samples. While in the non-code Stemi program group, it was found that ≤ 90 minutes was achieved by 1 (1.0%) sample and not achieved by 65 (65.0%).

Table 3 Relationship between CODE and Non-CODE STEMI Program and Door to Balloon Time at Siloam Hospitals Manado and Prof. Dr. R. D. Kandou Hospital in January 1, 2022 - December 31, 2024 (n = 100).

Variable	CODE STEMI	Non-CODE STEMI	Sig
D2BT (minutes)	134,5	226	.001
D2BT Components (minutes)			
Door – Diagnosis	4		
Diagnosis – Decision	42,5		
Decision - Delivery	45		
Delivery – Definitive	20		

Based on table 3, it was found that there was a relationship between the "CODE STEMI" Program and Door to Balloon (D2BT) with a significance of 0.001. It was found that the "CODE STEMI" Program group could reduce the D2BT time by 134.5 minutes and the Non-Code STEMI Program group had a longer time of 226 minutes.

Based on the Chi-Square test results, the Pearson Chi-Square value is 13.278 with a degree of freedom (df) of 1 and an asymptotic significance value (Asymptotic Significance 2-sided) of 0.000. This indicates that there is a statistically significant relationship between the two variables tested, as the significance value is below the critical limit of 0.05. Furthermore, Continuity Correction, which was used to correct the test values in the 2x2 table, yielded a value of 10.727 with a significance value of 0.001. This further strengthens the finding that there is a significant association. The Likelihood Ratio test yielded a value of 13.043 with a significance value of 0.000, which supports the Pearson Chi-Square results that the association between the variables is significant. In addition, Fisher's Exact Test, which is suitable for use when there are cells with a small expected number, showed a significance value of 0.001 for both two-sided and one-sided tests. This shows a consistent result that the relationship between the variables is significant. So the results state that there is an effect of the CODE STEMI program on Door to Balloon Time.

DISCUSSION

Based on the results of data collection conducted in two major referral hospitals in Manado City, namely Prof. Dr. R. D. Kandou Hospital and Siloam Hospitals Manado, it was found that there was a significant difference in the number of patients who received treatment using the CODE STEMI program compared to conventional treatment or Non-CODE STEMI. There were 34 patients treated with CODE STEMI program activation, while 66 patients were treated without activation of the program (Non-CODE STEMI). This shows that although the CODE STEMI program is available, its use is still uneven and has not become a standard protocol in every STEMI case management.

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The CODE STEMI program is a multidisciplinary team-based emergency treatment system that aims to speed up the time from diagnosis to reperfusion measures such as primary percutaneous coronary intervention (PPCI). Based on the Time is Muscle theory introduced by DeWood et al., any delay in the management of patients with STEMI will significantly increase the risk of heart muscle tissue loss (DeWood et al., 1980). Therefore, speed of treatment is a key factor in reducing morbidity and mortality from STEMI.

Research conducted by Morrison et al. (2020) showed that the implementation of the CODE STEMI program can consistently reduce the door-to-balloon (D2B) time to below 90 minutes, which significantly improves patient survival rates. Meanwhile, in a study by Arora et al. (2018), it was found that hospitals with CODE STEMI activation protocols had higher reperfusion success rates and shorter hospitalization durations than hospitals without such systems.

However, this study shows that the implementation of CODE STEMI in Prof. Dr. R. D. Kandou and Siloam Hospitals Manado has not been optimal. Possible causes include the limited number of medical personnel who have been trained to run the CODE STEMI system, the absence of an integrated notification system between units (such as the emergency room, laboratory, and catheterization room), and the lack of comprehensive socialization and implementation of the CODE STEMI SOP at the institutional level.

The results of preliminary interviews with health workers also showed that in some cases, staff ignorance of the code activation mechanism was the main obstacle. In addition, certain conditions such as late arrival of patients or unavailability of cath lab space when needed, also cause treatment to be carried out conventionally even though the patient meets the criteria for STEMI.

Previous research by Wijaya et al. (2021) stated that the successful implementation of CODE STEMI is highly dependent on the readiness of the hospital system as a whole, including human resources, logistics, and management commitment. When all these elements are integrated, treatment time can be significantly reduced and clinical outcomes improved.

Overall, it can be concluded that although the CODE STEMI program has been implemented in two major hospitals in Manado, its utilization is still limited. This reflects the gap between program availability and actual implementation in the field. Therefore, an in-depth evaluation of the barriers to implementation as well as increased training and socialization for all health workers are needed to optimize the program. In the long run, optimizing CODE STEMI could be an important strategy in reducing mortality from acute myocardial infarction in this region.

This study collected data related to Door to Balloon Time (D2BT) in patients with ST-Elevation Myocardial Infarction (STEMI) treated with two different approaches, namely using the CODE STEMI program and without program activation (Non-CODE STEMI). Based on the results of the analysis, the average D2BT time was 150.93 minutes in the group of patients with CODE STEMI activation, while in the Non-CODE STEMI group the D2BT time was recorded higher, reaching 277.72 minutes.

This difference shows that the use of the CODE STEMI program has an impact on accelerating the patient handling process, especially in the crucial phase from the arrival of the patient in the emergency room to the intervention in the catheterization laboratory. In the implementation of handling using CODE STEMI, the rapid notification system and the readiness of the intervention team are the main keys in reducing delays in handling.

This finding is supported by previous research conducted by Funay et al. (2020) conducted at Dr. Cipto Mangunkusumo Hospital Jakarta, which states that the implementation of a coordinated system such as CODE STEMI can accelerate intervention time and have a positive impact on patient clinical outcomes with the results found from the study there were 111 patients in the non-CODE STEMI group and 144 patients in the CODE STEMI group.

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Door to balloon time was significantly reduced from 275 (range 99-2,356) minutes in the non-CODE STEMI group to 165 (range 67-1,165). Another study by Wang et al. (2019) also showed that programs such as CODE STEMI significantly reduced D2BT time compared to standard care, and was associated with reduced cardiovascular complications.

In theory, this approach is in line with the concept of "Time is Muscle", where every minute of delay in reperfusion in STEMI patients can cause more extensive damage to heart tissue. Therefore, speed in providing interventional measures is critical to reduce morbidity and mortality rates.

Thus, it can be concluded that the CODE STEMI program has a positive influence on accelerating D2BT time. Further evaluation and efforts to improve coordination between units and hospital resources are needed so that ideal time standards can be achieved more consistently, so that patient clinical outcomes can be improved as a whole.

CONCLUSION

Based on the results of the research conducted on the effect of implementing the CODE STEMI program on Door to Balloon Time (D2BT) in ST-Elevation Myocardial Infarction (STEMI) patients at Prof. Dr. R. D. Kandou Hospital and Siloam Hospitals Manado, it can be concluded as follows:

1. The use of CODE STEMI program in two referral hospitals in Manado City is still uneven. Most patients are still treated without program activation, even though the program has been proven to speed up the process of handling cardiovascular emergencies.
2. There was a significant difference in Door to Balloon Time between patients treated with CODE STEMI and Non-CODE STEMI. The mean D2BT time was shorter in the CODE STEMI group, indicating that the program helped expedite primary interventions and improve the efficiency of the STEMI patient care pathway.

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