ORIGINAL ARTICLE

Medical practitioners' Knowledge and Attitude on Prehospital ST Elevation Myocardial Infarction (STEMI) Thrombolysis

WINNIE WONG SIAW TIN*, NIK AZLAN NIK MUHAMAD

Department of Emergency Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, 56000 Cheras, Kuala Lumpur, Malaysia

ABSTRAK

Kajian ini meneroka pengetahuan dan sikap pegawai perubatan yang mempunyai pengalaman dalam penjagaan pra-hospital (PHC) terhadap terapi trombolitik pra-hospital bagi pengurusan 'ST-elevation myocardial infarction' (STEMI) di Malaysia. Walaupun terapi trombolitik pra-hospital dapat memendekkan masa pintu-ke-jarum dan meningkatkan hasil rawatan, pelaksanaannya terhalang oleh kekurangan garis panduan tempatan serta latihan yang terhad kepada penyedia perkhidmatan pra-hospital. Satu tinjauan keratan rentas telah dijalankan di Hospital Canselor Tuanku Muhriz (HCTM) antara November 2023 hingga Mei 2024. Peserta terdiri daripada 65 orang pegawai perubatan dengan pengalaman PHC. Soal selidik yang telah disahkan digunakan untuk menilai pengetahuan dan sikap berkaitan terapi trombolitik pra-hospital, merangkumi pengetahuan teori, interpretasi elektrokardiogram (ECG) dan kenyataan sikap. Ujian chi-square digunakan untuk menganalisis hubungan antara pengetahuan dan sikap. Majoriti peserta (93.8%) mencapai tahap pengetahuan yang boleh diterima, dengan 13.8% diklasifikasikan sebagai mempunyai pengetahuan tinggi. Kecekapan tinggi diperhatikan dalam interpretasi ECG bagi kes STEMI, walaupun cabaran masih wujud dalam mengenal pasti STEMI palsu seperti hipertrofi ventrikel kiri. Kebanyakan peserta (89.2%) menunjukkan sikap positif terhadap trombolisis pra-hospital. Walau bagaimanapun, analisis statistik menunjukkan tiada hubungan signifikan antara pengetahuan dan sikap (p = 0.715). Hasil kajian menunjukkan pegawai perubatan mempunyai pengetahuan yang mencukupi tetapi terdapat jurang dalam pengurusan STEMI palsu dan aliran kerja pra-hospital. Sikap positif mencadangkan kesediaan untuk pelaksanaan, namun faktor seperti kebimbangan medikolegal dan peluang latihan mungkin lebih mempengaruhi sikap daripada pengetahuan. Kajian ini menunjukkan kebolehlaksanaan penglibatan pegawai perubatan dalam melaksanakan trombolisis pra-hospital sebagai amalan piawai di Malaysia, dengan penekanan terhadap keperluan latihan yang disasarkan, kursus interpretasi ECG lanjutan dan protokol piawai. Penyelidikan masa hadapan harus diperluaskan ke pelbagai kawasan dan melibatkan kumpulan penyedia perkhidmatan yang lebih luas.

Kata kunci: Pengetahuan; penjagaan kecemasan pra-hospital, sikap; STEMI; terapi trombolitik

ABSTRACT

This study explores the knowledge and attitudes of medical practitioners with prehospital care (PHC) experience toward prehospital thrombolytic therapy for ST-elevation myocardial infarction (STEMI)

Correspondence: Winnie Wong Siaw Tin. Department of Emergency Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, 56000 Cheras, Kuala Lumpur, Malaysia. Tel: +016 5895125 E-mail: winniewongsiawtin@gmail.com

management in Malaysia. While prehospital thrombolytic therapy shortens the door-to-needle time and improves outcomes, its implementation is hindered by the lack of local guidelines and limited training for prehospital providers. A cross-sectional survey was conducted at Hospital Canselor Tuanku Muhriz (HCTM) between November 2023 and May 2024. The participants included 65 medical practitioners with PHC experience. A validated questionnaire assessed knowledge and attitudes related to prehospital thrombolytic therapy, covering theoretical knowledge, electrocardiogram (ECG) interpretation and attitude statements. Chi-square tests analysed the association between knowledge and attitudes. Majority (93.8%) achieved acceptable knowledge levels, with 13.8% classified as having high knowledge. High proficiency was observed in ECG interpretation for STEMI cases, although challenges persisted with STEMI mimics such as left ventricular hypertrophy. Most participants (89.2%) exhibited positive attitudes toward prehospital thrombolysis. However, statistical analysis revealed no significant association between knowledge and attitudes (p = 0.715). The findings indicated adequate knowledge among medical practitioners but highlight gaps in managing STEMI mimics and prehospital workflows. Positive attitudes suggest readiness for implementation, though factors like medico-legal concerns and training opportunities may influence attitudes more than knowledge. This study demonstrates the feasibility of integrating medical practitioners in performing prehospital thrombolysis as a standard practice in Malaysia, emphasising the need for targeted training, advanced ECG interpretation courses and standardised protocols. Future research should expand to diverse regions and include broader provider cohorts.

Keywords: Attitude; knowledge; prehospital emergency care; STEMI; thrombolytic therapy

INTRODUCTION

Malaysia is heading toward the implementation of prehospital thrombolysis for ST-elevation myocardial infarction (STEMI) care. Prehospital thrombolytic therapy has achieved faster reperfusion (Bonnefoy et al. 2002). It is an effort to shorten the symptom onset to reperfusion therapy time. However, despite this evidence, prehospital thrombolytic therapy has yet to be implemented as a standard protocol in Malaysia. An isolated case report was recorded in the remote area of Borneo where prehospital thrombolysis was initiated at a healthcare clinic and continued on-route to the hospital by an accompanying medical practitioner under the remote instruction of an emergency physician (Razaman et al. 2021).

Prehospital care (PHC) personnel play a significant role in establishing an effective prehospital thrombolytic therapy system. The knowledge and attitude of healthcare providers are key factors that determine the success of prehospital thrombolysis. A survey at the Hospital Caselor Tuanku Muhriz (HCTM) revealed unsatisfactory knowledge regarding prehospital

thrombolysis among paramedics (Nik Muhamad & Muhamad Syis 2019). This knowledge gap became a significant barrier in starting prehospital thrombolysis at HCTM. We can overcome this by including a medical practitioner as one of the ambulance team members. An ambulance team staffed with a medical practitioner can provide more advanced care, administer medications and perform interventions that the usual ambulance service cannot do (Strandqvist et al. 2023).

Knowledge and attitude of the medical practitioner toward prehospital thrombolysis should be assessed. However, there is a lack of research on this topic. Our study evaluated the knowledge and attitudes of these medical practitioners regarding prehospital thrombolysis. The findings could pave the way for the integration of prehospital thrombolysis into standard practice, even in ambulances without electrogram transmission capabilities.

Our study objective was to assess knowledge and attitude, specifically the level of knowledge and attitude among medical practitioners with PHC experience regarding thrombolysis of

STEMI patients in the prehospital setting. We also investigated the association between the knowledge level and the attitude of medical practitioners with PHC experience towards initiating thrombolysis for STEMI in a prehospital setting.

Our hypothesis was medical practitioners with PHC experience have adequate knowledge of performing thrombolysis for STEMI patients in a prehospital setting. They would have a positive attitude towards implementing thrombolytic therapy on STEMI patients in a prehospital setting. Medical practitioners with excellent knowledge had a good attitude toward implementing prehospital thrombolysis for STEMI.

MATERIALS AND METHODS

This was a cross-sectional survey design. The study was conducted at the Department of Emergency Medicine, HCTM from November 2023 to May 2024. The study population included medical practitioners within the Masters of Emergency Medicine Programme at HCTM. This cohort was selected due to their advanced training and exposure to emergency and PHC, making them suitable participants for assessing knowledge and attitudes towards prehospital thrombolysis. Medical practitioners lacking experience in PHC were excluded from the study to maintain a focus on individuals with direct PHC exposure.

Data for this study were collected using a questionnaire, which was adapted from a previously validated tool used in the research study by Nik Muhamad an Muhamad Syis (2019). The revised questionnaire was content validated by one cardiologist and three emergency physicians. Based on the calculated I-CVI, S-CVI/Ave and S-CVI/UA, the scale of questionnaire had achieved satisfactory level of content validity. The adapted questionnaire face validation by 10 subjects which were not included in the study population. Based on the percentage agreement approach, the overall agreement reached a satisfactory level, indicating that the questionnaire had achieved an acceptable level of face validity. The 5-point Likert scale for attitude statement achieved Cronbach's alpha of 0.724 which indicate acceptable internal consistency or reliability.

The questionnaire had three sections to evaluate knowledge and attitudes about prehospital thrombolysis in STEMI i.e (i) Section 1 consisted of 20 multiple-choice questions (MCQs) covering knowledge, contraindications, and management strategies for prehospital thrombolysis in STEMI patients; (ii) Section 2 focused on participants' ability to interpret electrocardiograms (ECGs) and decide on thrombolytic therapy; and (iii) Scoring for both sections was based on the percentage of correct answers. Participants' performance was classified into three categories using Bloom's taxonomy cut-offs. Section 3 consisted of 20 statements designed to assess attitudes toward prehospital thrombolysis. Responses were collected using a 5-point Likert scale, allowing participants to indicate their level of agreement with each statement. The Likert scale was designed to provide a comprehensive view of participants' attitudes, with the overall attitude for each participant calculated as a mean score.

Statistical Analysis

Knowledge was assessed through multiple-choice questions and ECG interpretation. Each participant's score was converted into a percentage, and knowledge levels were classified into three categories based on Bloom's cut-off: high (80-100%), moderate (60-79%), and low (<60%). Attitude was assessed using 20 statements on a 5-point Likert scale, with responses ranging from strongly agree (1) to strongly disagree (5). The mean attitude score for each participant was calculated and categorised into five levels: high positive (1.00-1.79), positive (1.80-2.59), neutral (2.60-3.39), negative (3.40-4.19) and very negative (4.20-5.00).

To evaluate associations between knowledge and attitude, a Chi-square test was conducted using a 2x2 table, grouping participants into acceptable and not acceptable knowleged level and good versus pooer attitude categories.

A p-value of less than 0.05 was considered statistically significant.

Sample Size Calculation

The sample size for our study was calculated using the formula for a single proportion in a population. As of May 2023, there were 43 post-grade Master's medical practitioners with PHC experience working in the Emergency Department of HCTM. Based on the pre-calculated sample size table by Krejcie and Morgan (1970), a minimum of 36 participants was needed to achieve a statistical power of 80% at a 95% confidence level. To account for potential missing data and dropouts, a 10% increase was added, resulting in a target sample size of 39 participants. Due to an unexpectedly large batch of intake for post-grade master medical practitioners, 91 candidates were identified. However, 21 candidates did not respond to the questionnaire, and 70 practitioners agreed to participate in the research. Sixty-five out of 70 candidates fulfilled the inclusion criteria. Ethical approval from the University Kebangsaan Malaysia Research and Ethics Committee was obtained with the code of UKM PPI/111/8/JEP-2023-526.

RESULTS

In section 1, 64 candidates (98.5%) had achieved an acceptable knowledge level. Among them, 24 candidates (36.9%) obtained above 80% marks (Table 1). Question number 6 and 12 showed the highest right answer with a percentage of 100%. Question number 14 showed the lowest right answer with a percentage of 32.3%.

For Section 2, 50 (76.9%) candidates achieved an acceptable knowledge level and 19 participants (29.2%) attained a high knowledge level. Correct answers and thrombolysis decisions were highest in ECG 1(96.9%). The second highest percentage was for ECG 10, with 93.8%. Conversely, ECG 8 showed the lowest of correct answers at 35.8%. ECG 8 and 9 had a low percentage for ECG identification (35.3% and 41.5%, respectively) but a high percentage for thrombolysis decisions (93.8% and 100%, respectively) (Table 2).

A total of 93.8% achieved an acceptable level of knowledge in sections 1 and 2. 13.8% attained a high level of knowledge, whereas the other 80% were categorised as having a moderate level (Table 3).

For section 3, mean values were calculated for each candidate. The distribution of attitude scores revealed that most respondents (89.2%) fell within the category of positive attitude towards the statement provided. This category included strongly positive (53.8%) and positive groups (35.4%). A total of 7.7% of respondents had fallen into the neutral group, signifying their neutral stand toward the statements. Only a small group (3.1%) had a negative attitude. Notably, no subjects had fallen into the very negative groups. This result suggested that none strongly disagreed with the statements provided (Table 4).

The association between knowledge level and attitude among medical practitioners with PHC experience was tested using a Chi-square test. To create a 2x2 table for Chi-square tests, candidates with 60% or above were grouped as having an acceptable knowledge level, while those with less than 60% were grouped as not having an acceptable knowledge level. For the attitude category, high positive, positive and neutral

TABLE 1: Percentage of respondents for each category of knowledge level

		Number (N)	Percentage (%)
Knowledge level	High	24	36.9
	Moderate	40	61.5
	Low	1	1.5
Total		65	100

TABLE 2: Percentage of correct answer for each electrocardiograms

ECG	Diagnosis		Prehospital thrombolysis		Diagnosis and prehospital thrombolysis	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)	Number (n)	Percentage (%)
1	64	98.5	64	98.5	63	96.9
2	48	73.8	40	61.5	33	50.8
3	59	90.8	58	89.2	57	87.7
4	52	80.0	53	81.5	51	78.5
5	27	41.5	31	47.7	28	43.1
6	54	83.1	56	86.2	54	83.1
7	51	78.5	41	63.1	31	47.7
8	23	35.4	61	93.8	23	35.4
9	27	41.5	65	100	27	41.5
10	62	95.4	64	98.5	61	93.8

TABLE 3: Percentage of respondents in each category of overall sections 1 and 2

		Number (N)	Percentage (%)
Category for overall mark for Sections 1 and 2	High	9	13.8
	Moderate	52	80.0
	Low	4	6.2
Total		65	100

TABLE 4: Percentage of respondents in each category of attitude

Range of Mean	Attitude	Number (N)	Percent (%)
1.00 – 1.79	High Positive	35	53.8
1.80 – 2.59	Positive	23	35.4
2.60 – 3.39	Neutral	5	7.7
3.40 – 4.19	Negative	2	3.1
4.20 – 5.00	Very negative	0	0
	Total	65	100.0

responses were grouped as good attitudes, while negative and very negative responses were grouped as poor attitudes.

The null hypothesis (H_0) stated no association between knowledge level and attitude. The chi-square statistic was 0.133 with 1 degree of freedom, resulting in a p-value of 0.715. Since the p-value was greater than the conventional significant level of 0.05, we failed to reject the null hypothesis. This indicated there was no statistically significant association between knowledge level and attitude among medical practitioners with PHC experience.

The results suggested that knowledge level did not significantly influence the attitude among the participants. This finding implied that factors

other than knowledge might be contributing to the variations in attitudes.

DISCUSSION

Our study found that most medical practitioners with PHC experience possess adequate knowledge regarding the delivery, contraindications and management of adverse effects of thrombolysis for STEMI patients in prehospital settings. This finding aligns with a Sri Lankan study in 2018 demonstrating better performance among doctors compared to nurses and emergency medical technicians (EMTs) (Nandasena & Abeysena 2018). Conversely, a study in 2019 reported poor performance and knowledge among paramedics rather than medical practitioners (Nik Muhamad & Muhamad Syis 2019). Medical practitioners' better performance may be attributed to their extensive exposure to STEMI thrombolysis in emergency departments, particularly in ECG recognition and drug handling. While these factors were not analysed in our study, they likely contribute to the observed differences.

Survey results indicate that questions with the highest scores (e.g. Q6, Q12) generally involved theoretical knowledge about standard protocols and well-established clinical outcomes, areas thoroughly covered in medical training. These findings suggest familiarity with established guidelines for post-thrombolysis care and the critical importance of minimising delays in STEMI treatment. Theoretical knowledge among medical practitioners is a proven advantage compared to prehospital paramedics where overall knowledge and STEMI detection are generally poor (Khaleed et al. 2024; Nik Muhamad & Muhamad Syis 2019).

However, the lowest-scoring questions (e.g. Q14, Q15) addressed complex clinical decision-making in emergency scenarios. Knowledge deficiencies in STEMI management were displayed in a study among intern doctors in a Moroccan Emergency Department. The study employed a descriptive-analytical design to assess the knowledge gaps in STEMI management among 141 intern doctors working in emergency departments. The findings highlighted the need for improved training and education to enhance patient care (Bourkhissi et al. 2023). Managing complications arising from thrombolytic therapy requires specific expertise. These deficiencies emphasise a need for further training in managing complications such as cardiogenic shock or pulmonary edema. Practical simulations and additional exposure to PHC scenarios could enhance medical practitioners' confidence and decision-making capabilities in these critical situations.

Most medical practitioners demonstrated strong proficiency in recognising STEMI and deciding on thrombolysis, especially in clear-cut STEMI ECG changes. High scores were achieved for ECGs illustrating inferolateral STEMI (96.9%) and inferior STEMI (93.8%), reflecting effective training in STEMI diagnostic criteria. As expected, compared to paramedics, medical practitioners would provide better results. The results surpassed that of paramedics who reported poor performance and knowledge (Khaleed et al. 2024; Nik Muhamad & Muhamad Syis 2019). Similarly, Huitema et al. (2014) observed that frequent exposure to ECGs enhances diagnostic accuracy, independent of the overall experience. This underscores the importance of consistent and rigorous ECG interpretation training.

Interpreting STEMI mimics, such as acute pericarditis and left ventricular hypertrophy (LVH), remains a significant challenge. For instance, only 41.5% of participants correctly identified acute pericarditis (ECG 5), with most misinterpreting it as inferior STEMI and potentially risking inappropriate thrombolysis. Similar challenges were noted with LVH (ECG 9), where only 41.5% of participants accurately diagnosed the condition. These findings align with low accuracy rates among paramedics as reported in a Saudi Arabian study (Alrumayh et al. 2022).

Despite these difficulties, participants avoided thrombolysis in cases of LVH, suggesting caution in ambiguous scenarios. Enhanced training in distinguishing STEMI mimics through advanced ECG courses and including telemetry ECG in the

STEMI network could significantly improve safety and diagnostic accuracy. Telemetry systems would enable cardiologists and emergency physicians to review complex ECGs for further consultation.

Most participants expressed confidence in their ability to lead prehospital thrombolysis procedures, reflecting their routine leadership roles in emergency department settings. Their experience directing resuscitation efforts likely contributes to their competence in recognising STEMI on ECGs, selecting appropriate thrombolysis candidates, and managing complications. This is due to the participants being emergency specialist trainees with experience in thrombolysis. Rural general practitioner (GPs) who had previously administered prehospital thrombolysis reported higher confidence compared to GPs who had never given prehospital thrombolysis (7.5 $\pm$ 1.7 vs 6.3 $\pm$ 2.0, p = 0.01) (Bloe et al. 2009). The American Heart Association (AHA) supports prehospital fibrinolytic therapy when conducted by trained emergency medical services (EMS) with physician involvement. This highlights the pivotal role of doctors in the success of prehospital thrombolysis.

Our findings suggest that knowledge level alone does not significantly influence participants' attitudes. Instead, factors such as perceived risks of thrombolytic treatment, medico-legal implications and the availability of training opportunities may play more substantial roles (Humphrey et al. 2005). Addressing these factors through targeted interventions could foster positive attitudes toward prehospital thrombolysis.

Several limitations should be considered when interpreting the findings of this study. Firstly, the study's relatively small sample size may restrict the generalisability of the results to a broader population of medical practitioners or other PHC providers. Secondly, the study was conducted at a single institution, HCTM, which may not accurately represent the knowledge and attitudes of medical practitioners in other settings or regions. Practices, training levels and resource availability vary widely across institutions, potentially limiting the applicability of these findings to other hospitals or emergency services.

Additionally, the study's prolonged data collection period, spanning from November 2023 to July 2024, may introduce variability in participant responses. Changes in participants' experiences or exposure to new information during this time could influence their knowledge and attitudes. Lastly, the study did not assess the impact of specific training programs or interventions on improving knowledge and attitudes, which limits the ability to identify actionable strategies for enhancing PHC.

Recommendation

Involving medical practitioners enhances the feasibility and safety of the prehospital thrombolysis intervention. Further research on the cost-effectiveness of including a medical practitioner in the ambulance for prehospital thrombolysis should be done. Mandatory training focused on prehospital thrombolysis and ECG skills including STEMI mimics should be established to improve practical competency among prehospital providers. Practical training scenarios should be introduced to enhance decision-making in emergencies. Simulation-based training can provide hands-on experience managing thrombolysis complications, improving practitioner confidence and competence. These findings should lead to the initiation of prehospital thrombolysis protocols at Hospital Canselor Tuanku Muhriz. Replicating the study for multi-centered validation across diverse regions in Malaysia may highlight potential regional differences in prehospital thrombolysis readiness.

CONCLUSION

The survey revealed that medical practitioners with prehospital experience have adequate knowledge of prehospital thrombolysis. The attitudes were generally positive. However, they may be less familiar with the specific workflows in a prehospital setting. Teaching and training

in PHC could increase their confidence in performing these procedures.This survey is an initial step in understanding medical practitioners' perceptions and knowledge of prehospital thrombolysis for STEMI. The findings suggest that implementing prehospital thrombolysis with medical practitioners as part of the team is feasible and enhances safety. By integrating prehospital thrombolysis into standard practice, we can improve the management of STEMI patients and potentially achieve better outcomes. Prehospital thrombolysis will be beneficial in centers where PCI does not operate 24 hours. Even though there is a short distance to the hospital, prehospital thrombolysis will save time in triaging, repeated ECG and repeated assessment by in-hospital practitioners.

REFERENCES

Alrumayh, A.A., Mubarak, A.M., Almazrua, A.A., Alharthi, M.Z., Alatef, D.F., Albacker, T.B., Samarkandy, F.M., Alsofayan, Y.M., Alobaida, M. 2022. Paramedic ability in interpreting electrocardiogram with st-segment elevation myocardial infarction (STEMI) in Saudi Arabia. *J Multidiscip Healthc*,**15**: 1657-65. https://doi. org/10.2147/JMDH.S371877.

Bloe, C., Mair, C., Call, A., Fuller, A., Menzies, S., Leslie., SJ. 2009. Identification of barriers to the implementation of evidence-based practice for pre-hospital thrombolysis. *Rural Remote Health* **9**(1): 1100. https://doi.org/10.22605/RRH1100.

Bonnefoy, E., Lapostolle, F., Leizorovicz, A., Steg, G., McFadden, E.P., Dubien, P.Y., Cattan, S., Boullenger, E., Machecourt, J., Lacroute, J.M., Cassagnes, J., Dissait, F., Touboul, P. 2002. Primary angioplasty versus prehospital fibrinolysis in acute myocardial infarction: A randomised study. *Lancet* **360**(9336): 825-9.

Bourkhissi, I., Ait Brik, A., Amlouk, N., Lahnaoui, F., Najib, A., Hara, L., Echenbouli, A. 2023. Assessment of knowledge gaps in STEMI management among intern doctors in moroccan Emergency Department: A descriptive analytical study. *Eur Heart J* **44**(Suppl 2). https:// doi.org/10.1093/eurheartj/ehad655.1507.

Huitema, A.A., Zhu, T., Alemayehu, M., Lavi, S. 2014. Diagnostic accuracy of ST-segment elevation myocardial infarction by various healthcare providers. *Int J Cardiol* **177**(3): 825-9. https:// doi.org/10.1016/j.ijcard.2014.11.032

Humphrey, J., Walker, A., Hassan, T. B. 2005. What are the beliefs and attitudes of paramedics to prehospital thrombolysis? A questionnaire study. *Emerg Med J* **22**(6): 450-1. ttps://doi. org/10.1136/emj.2004.016998.

Khaleed, F., Abu Bakar, A., Nik Muhamad, N.A. 2024. The impact of pre-hospital 12-lead electrocardiography, rapid ST-elevation myocardial infarction detection, and paramedic-led hospital pre-notification on door-to-needle times. *Mal J Emerg Med* **6**(4): 20-7

Krejcie, R.V., Morgan, D.W. 1970. Determining Sample Size For Research Activities. *Educ Psychol Meas* **30**(3): 607-10. https://doi. org/10.1177/001316447003000308

Nandasena, G., Abeysena, C. 2018. Knowledge, attitudes and skills of doctors, nurses and emergency medical technicians in pre-hospital care and emergency medicine who accompany patients in ambulances which arrive at the National Hospital of Sri Lanka. *Int J Clin Anesth Res* **2**: 38-43. https://doi.org/10.29328/journal. ijcar.1001010.

Nik Muhamad, N.A., Muhamad Syis, Z. 2019. Confidence level and knowledge of pre-hospital thrombolysis therapy of paramedic in prehospital care: A survey. *Med Health* **14**(1): 34-43. https://doi.org/10.17576/MH.2019.1401.03.

Razaman, S.M., Mudin, M.A., Wahab, N., Hanifah, M.H. 2021. Prehospital thrombolysis in ST-segment elevation myocardial infarction: A remote Borneo Island experience. *Malays J Emerg Med* **5**(2): 44.

Strandqvist, E., Olheden, S., Bäckman, A., Jörnvall,

H., Bäckström, D. 2023. Physician-staffed prehospital units: When and how they make a difference. A retrospective follow-up from an urban area in Scandinavia. *Int J Emerg Med* **16**(1): 43. https://doi.org/10.1186/s12245-023-00519-8.