

## Efficiency of Mobile Application of Thai Criteria Based Dispatch: A Randomized Controlled Crossover Trial

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**Abstract**—The main purpose of the emergency medical system is a timely and appropriate response that significantly impacts health outcomes. In Thailand, due to lack of staff, emergency medical personnel at the dispatch center have to multitask to interview and dispatch the EMS responses. According to these problems the novel triage mobile application “Triagist” was developed based on Criteria Based Dispatch (CBD) to optimize prehospital care. This study is a pilot study aiming to test the app by evaluating the reliability and rapidity of code dispatching using “Triagist” compared with the usual method; ITEMS, Criteria Based Dispatch Handbook, or emergency medical personnel’ experiences only. A randomized-controlled crossover (AB/BA) design was conducted which compared mobile application “Triagist” and conventional methods. Eighteen experienced emergency medical personnel each were randomly assigned to AB or BA arm. The primary outcome measure was the accuracy and rapidity of code dispatching to 6 simulated scenarios among experienced emergency medical personnel. Using triage mobile application by experienced emergency medical personnel had gained a chance of correct dispatch 1.5 times, which was significantly more accurate than the conventional method (95%CI 1.03-2.28) and also significantly more rapid dispatch than the conventional method (82 vs 95 sec.,  $p = 0.03$ ).

**Keywords**—triage, emergency medical service, mobile application, dispatch, prehospital care

### 1 Introduction

Nowadays, smart healthcare applications have been applied in a variety of medical settings [1-2], and an increasing number of people are using smart technology to access primary healthcare by smartphone [3-4]. Healthcare applications based on smart technology have become extremely popular in emergency medical settings to support service operations [5-6].

In the emergency department (ED), trying to decrease time and optimize the performance of the pre-hospital process is an ongoing challenging of Thailand medical services nowadays.

The main purpose of an emergency medical system is appropriate response in limited time and resources [7]. In case of the emergency, an admitting patient into the ED, the pre-hospital process is important both in terms of treatment performance and requesting an adequate resource from an emergency unit.

The appropriate time and treatment significantly impact health outcomes [8]. We need adequate support and services to triage and give the most effective treatment on time [9].

The emergency medical service system in Thailand is currently based on CBD (Criteria Based Dispatch) [10] to IDCs (Initial Dispatch Codes) which are the Canadian-standard tool for emergency medical workers at dispatch center (1669) such as Emergency medical call taker: EMCT, Emergency medical dispatcher: EMD, Paramedics and so on to triage and provide the pre-arrival instruction. The IDCs are important tools to identify the condition of patients who request emergency health supports in prehospital setting. These tools are composed of three codes; the main symptom code (IDC-1), a color code (IDC-2), and a triage criterion (IDC-3). The explanation of IDCs is shown in Supplement 1.

The correct IDCs and quick responses are the keys to the services of dispatch center [11]. The National Institute for Emergency Medicine of Thailand (NIEM) has provided them in both computer-based, known as Information Technology for Emergency Medical System (ITEMS), and Criteria Based Dispatch Handbook. Emergency medical staffs in the dispatch center need to ask the important information by phone to dispatch the IDC, respond to the requests with appropriate medical service, and at the same time, provide pre-arrival instruction based on Criteria Based Dispatch Handbook [12]. They also need to report back the information to the included emergency medical services.

Despite the essential role of IDC, there were some barriers to timely use in real practice. Laohakul et al (2020) had explored uses and problems related to ITEMS among emergency medical personnel working in emergency dispatch centers in Health Region 1, Thailand. The result found that not many emergency medical personnel used ITEMS due to shortage of staff and long duration to complete the program. Improvement of the ITEMS program and adequate staffing were recommended to solve the problem [12].

There will be a human error when using standard paper tools. The electronic system may reduce inaccuracy. Savatmongkornkul et al (2017) and Imwatanakul (2019) had studied the triage mobile application in Thailand and found that the application had significantly more effective than the paper-based or standard handbook in both accuracy and inter-rater reliability [13-14]. Accurately and quickly response could increase the survival rate. There is evidence that reducing response time by 5 minutes increases 10% survival rate [15]. Based on such problems, we aimed to use the novel platform of mobile application suitable for android and iOS systems instead.

The new platform of Thailand prehospital triage and dispatch system, mobile application, namely “Triagist”, was developed using data from ITEMS and Criteria Based Dispatch since 2020. The application not only has a Triage function but can also send the information to the emergency care unit, which is beneficial to use in prehospital care. Health care providers can easily use “Triagist” on their smartphones to triage, code dispatch, and provide pre-arrival instruction more effectively [16]. However, there were some problems with the original version, such as the appropriateness of recorded information. The second version of Triagist was developed to fix the weakness [17].

Also, the method to determine this app in hands of the frontlines in the previous study was still not well-designed. Thus, these hypotheses remain to be demonstrated [17].

Therefore, in order to further enhance the high reliability of the application, this study aimed to evaluate the accuracy and rapidity of code dispatching among experienced emergency medical personnel using the mobile application “Triagist”. To determine an accuracy of the application, scenario assessment was tested to compare in term of time consuming and an accuracy to receive IDC information.

## **2 Methods**

### **2.1 Study design**

We conducted a randomized-controlled crossover (AB/BA) design to compare mobile application “Triagist” and conventional methods in code dispatching to VI simulated scenarios by experienced emergency medical personnel. The AB/BA scheme is uniform within sequences and periods. All participants were requested their consent to record the scenario and to use the data before starting the study. The study was approved by the Ethics Committee of the Faculty of Medicine, Chiang Mai University (EME-2562-06702/ Research ID: 6702) on December 12, 2019. Note that the flow chart of the study was indicates into Figure 1.

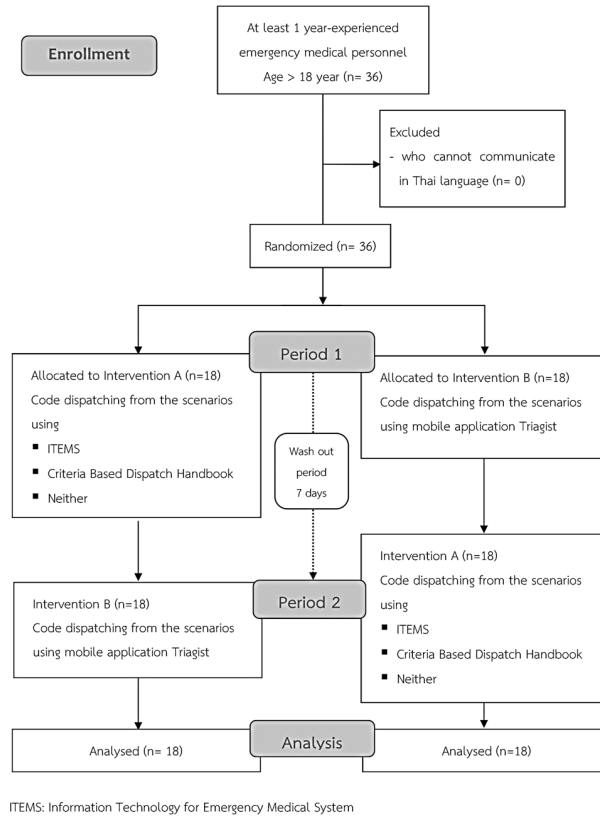


Fig. 1. Flow chart of the study

## 2.2 Participants

At least one-year experienced emergency medical personnel aged over or equal to 18 years were eligible in this study. The exclusion criteria were those who cannot communicate in Thai language, but no eligible one was excluded. The sample was indicated into the Table 1.

Table 1. Demographic and baseline characteristics of samples enrolled in the study

Characteristics	Intervention A before B (Group of Using Conventional method first) (n=18)	Intervention B before A (Group of Using Triageist first) (n=18)
Median Age – year (IQR)	30.5 (29-35)	31.5 (27-35)
Female – n (%)	13 (72.2)	15 (83.3)
Working experiences – median years (IQR)	7.5 (6-12.5)	9 (5-10.5)
<b>Level of hospital service – n (%)</b>		
Primary	2 (11.1)	4 (22.2)
Secondary	7 (38.9)	5 (27.8)

Tertiary	4 (22.2)	4 (22.2)
University	3 (16.7)	2 (11.1)
Others	2 (11.1)	3 (16.7)
<b>Conventional method</b>		
CBD Handbook	18 (100)	17 (94.4)
ITEMS	0 (0)	1 (5.6)
Neither	0(0)	0 (0)

CBD: Criteria-based Dispatch / ITEMS: Information Technology for Emergency Medical System

### 2.3 Setting

The descriptive statistics were used; mean, median, interquartile range, standard deviation and percentages. Primary and secondary outcome were compared Chi-Square and student's t-test, respectively. All tests were two sided and a  $p$ -value  $<0.05$  was considered statistically significant. The statistical analysis was computed by IBM® SPSS® Statistics version 22 (IBM Corp., Armonk, NY, USA).

## 3 Results

Thirty-six emergency medical personnel were enrolled and divided into a group of 18. All participants have completed all dispatching scenarios. Table 1 shows the participants are mostly female, the median age is 31. The median year of working experiences in a group that was randomized to dispatch by using triage mobile application first is 9, which is a year more than another group (31.5 vs 30.5 years in BA vs AB group). However, there was no statistically different ( $p=1.00$ ). Most of the people have been working in a secondary hospital. In the conventional method, most of the participants preferred using the CBD handbook (94.4 to 100%). There was just only one person who used ITEMS, a computer-based program, in real-time dispatching.

From Table 2, the correct dispatch rates, measured by comparison to gold standard Thailand CBD in each scenario, of mobile application group were higher than those of the conventional group (52.8 vs 42.1%). Using Triagist mobile application has a chance of correct dispatch 1.5 times, which significantly more accurate than the conventional method (95%CI 1.03-2.28) especially in scenarios I (chest pain) and V (pregnancy) ( $p<0.01$ ).

**Table 2.** The number of correct all IDCs using Triagist compared with the conventional method

	Triagist	Conventional method	$p$ -value
All scenarios – N (%)	114 (52.8)	91 (42.1)	0.03
Scenario I Chest pain :7 Red 9	16 (44.4)	1 (2.8)	$<0.01$
Scenario II Cardiac arrest: 19 Red 1	26 (72.2)	20 (55.6)	0.08
Scenario III Seizure: 16 Yellow 4	31 (86.1)	32 (88.9)	0.74
Scenario IV Trauma: 25 Yellow 4	3 (8.3)	10 (27.8)	0.05
Scenario V Pregnancy: 15 Green 1	16 (44.4)	2 (5.6)	$<0.01$
Scenario VI Choking: 8 Yellow 2	22 (61.1)	26 (72.2)	0.35

When classifying the dispatch code into 3 parts; the main symptom code (IDC-1), a color code (IDC-2), and a triage criterion (IDC-3), as shown in Figure 2., the correct dispatch rates of each part in the group that using triage mobile application were more precise than the conventional method, especially in IDC-2 which is the most important part to demonstrate how the severity of the symptoms. In scenario II Cardiac Arrest, both methods had brought the same number of correct IDC which was 100% but Triagist is faster. Figure 2 also shows that even IDC-1 was correct but the percentage of correct all IDC decrease respectively (e.g., 50% to 44% by Triagist and 50% to 1% by conventional method in scenario I). In scenario IV shows that conventional group had better outcome than Triagist (28% and 8% respectively), the reason might be the case in scenario was not straightforward which leads to more question to ask before dispatch.

From Table 3, using triage mobile application dispatched significantly faster than the conventional method (82 vs 95 sec.,  $p = 0.03$ ) which resulted in rapid EMS response in all scenarios.

Overall, the mobile application group had a higher proportion of matched triage than the conventional group in most scenarios except scenario VI Choking (as shown in Figure 3). In addition, using Triagist had a lower proportion of undertriage than the conventional group.

**Table 3.** Dispatch time by using Triagist compared with the conventional method

	Mean Dispatch Time (seconds)		<i>p-value</i>
	<i>Triagist</i>	<i>Conventional method</i>	
All scenarios – Sec (SD)	82 (24.6)	95 (24.8)	0.03
Scenario I Chest pain :7 Red 9	78 (28.7)	109 (40.3)	<0.01
Scenario II Cardiac arrest: 19 Red 1	50 (21.8)	57 (25.7)	0.24
Scenario III Seizure: 16 Yellow 4	70(30.9)	81 (31.2)	0.12
Scenario IV Trauma: 25 Yellow 4	110 (22.0)	101 (31.1)	0.16
Scenario V Pregnancy: 15 Green 1	113 (40.7)	129 (48.1)	0.13
Scenario VI Aspiration: 8 Yellow 2	74 (36.5)	91 (40.0)	0.03

SD: Standard deviation

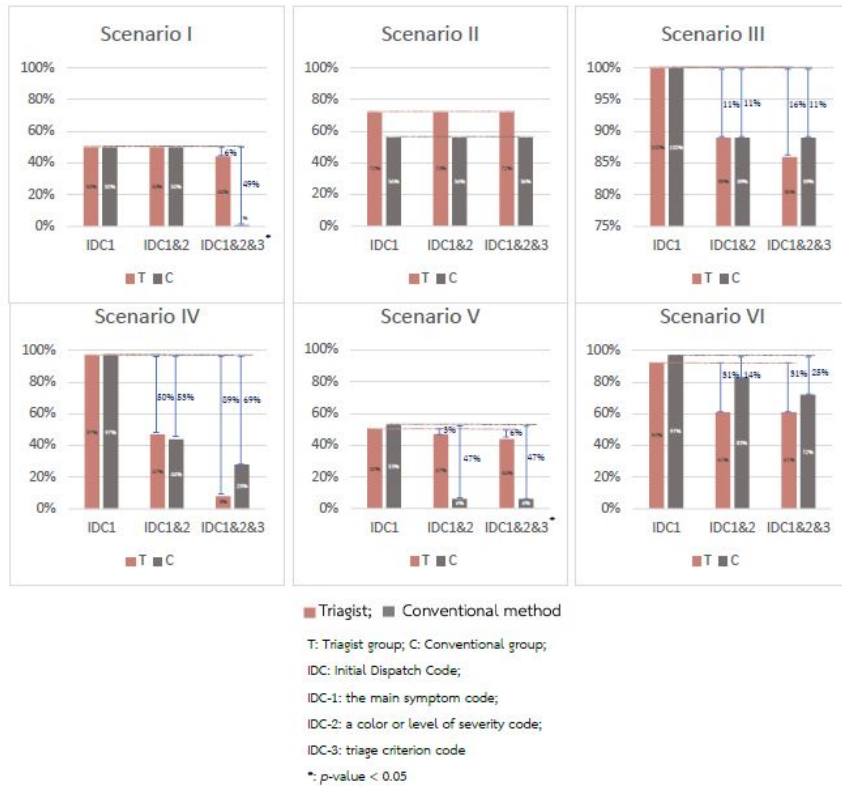


Fig. 2. The percentage of correct IDCs in each part of codes in comparison of using Triagist and the conventional method in scenario I-VI

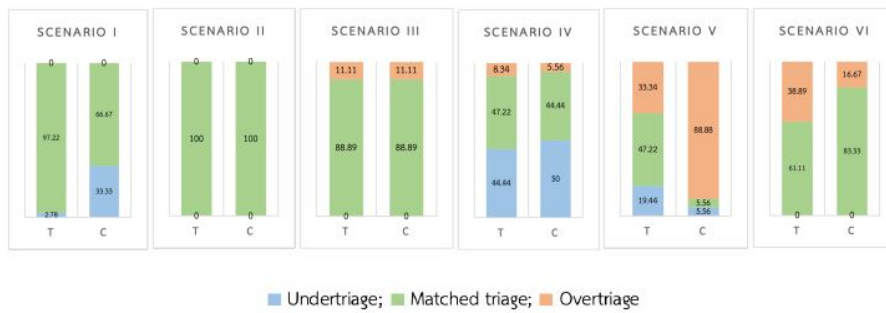


Fig. 3. The proportion of triage matching in comparison of using Triagist and the conventional method in scenario I-VI

## 4 Discussion

This study shows dispatch using Triagist mobile application in simulated scenarios among the experienced emergency personnel is more accurate and faster than the conventional method (Tables 2, 3). Mobile application is user friendly which easy to use and to understand might also be the reason to these outcomes. Handbook is the conventional method that choosing most, which takes time and more difficult to find the information. There were only one person using ITEMS in this study, according to a long duration to complete the program as in the previous stud [12]. If the emergency medical personnel cannot make a decision, they might use their own experiences instead which could be inappropriate.

Dispatch by mobile application was mostly matched (Figure 3). Even though, some scenarios were unmatched, it can reduce the under triage so the patient will have a better chance to receive medical treatment from EMS responses. In contrast, over triage is valuable for patient safety but can lead to over resources and workload.

The population in this study are 5 - 12.5 year experienced emergency medical personnel who were trained on the emergency nurse practitioners' program in Chiang Mai University. Even the participants are all well trained and highly experienced whom familiar with the conventional method, but the study shows that the outcome of triage mobile application is better in overall.

This study might support the efficacy of the triage mobile application. Savatmongkorngul S. had studied in medical students and emergency physicians. According to the complexity of the original triage system, they compared it with the triage application and found that the original system had higher rates of both undertriage and overtriage than the mobile triage [13].

Also, Imwatanakul N. had studied in the population of triage nurses and emergency medical residents shows mobile application had significantly more effective than the original paper [14].

In the present world, technology impacts our daily life. It made our lives easier, faster, and better. Triagist mobile application has been developed to improve the pre-hospital process [16-17]. Emergency services will be able to rapid response and provide appropriate resources if dispatch properly.

## 5 Conclusion

Triage mobile application is more accurate and rapid than the conventional method.

We encourage to use "Triagist" in the dispatch center for better efficacy of EMS responses in Thailand.

### 5.1 Limitations

There are some limitations in our study. Firstly, this is an experimental study. Although we have tried to demonstrate the scenarios closely resemble real, both limited time and simulated patients. The result may be different in real dispatching scenarios



because of the hardly controlled many factors. Secondly, we have chosen only 6 out of 25 main symptoms. We suggest the further investigation should study the accuracy & time in every symptom. Lastly, the study of the performance of triage mobile application in collecting database and provide proper prearrival instruction should also be done to determine the efficacy of this mobile application in the next study.

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