A STUDYOF FACTORS INFLUENCING EMERGENCY MEDICAL SERVICE RESPONSE TIME TO ENHANCE SERVICE EFFECTIVENESS: CASE STUDY, BANGKOK, THAILAND

[1]RAPEE UDOMSUB, [2]NANTHI SUTHIKARNNARUNAI, [3]WITCHAYUT NGAMSAARD

[1,2,3]School of Engineering, University of the Thai Chamber of Commerce, 26/1 Vibhavadee-Rangsit Rd., Dindaeng, Bangkok 10400, Thailand
E-mail: [1]rapee.u@gmail.com, [2]nanthi_sut@utcc.ac.th, [3]witchayut_tim@utcc.ac.th

Abstract - The first study examined the factors influencing the response time of emergency medical services (EMS) in Bangkok, the capital of Thailand, with a total of 50 districts. Secondary data from three government organizations were analyzed. Emergency medicine data from the National Institute of Emergency Medicine, demographic data from Strategy and Evaluation Department and road travel speed data from the Traffic and Transportation. Both agencies are under the Bangkok City Hall. The purpose of this study was to determine the factors influencing emergency medical response times in 50 districts of Bangkok. Multiple regression analysis using the Enter method revealed that distance had the most significant effect on emergency medical response time in 39 districts in 50 districts of Bangkok. With R2 between 0.311 & 0.8531. Try to find more ambulance parking lot increased coverage of the area using the center of gravity method. Use data from District Office locations and population density per area in 9 districts in the northern part of Bangkok. Interested in this area because it is an area where the population has moved to live in the area has grown in recent years. The results obtained bycenter of gravity method will be compared with the results of other test methods to be tested in the next phase. Find increased ambulance coverage forresponse time up to international norms.

Keywords - Ambulance Response Time, Emergency Medical Service (EMS), Emergency Patients, Coverage Area

I. INTRODUCTION

Response time is a key objective for Emergency Medical Services (EMS). Globally, EMS response time is a key indicator of EMS performance. A correlated factor in the death of accident victims by Advanced Life Support Unit (ALS) was the response time of the patient's on-site rescue [1].There was a study to estimate the loss in terms of baht for EMS with an average response time of 12 minutes and an average operating time of 26 minutes,loss value is approx 115.089-227.130 million baht [2].The mortality rate for emergency patients who use EMSin Thailand has increased from 7,776 people in 2012 to 13,580 people in 2017.Mortality has increased from 12.06 per 100,000 inhabitants to 20.52 per 100,000 inhabitants.The demographic data from Thailand shows that the proportion of the elderly population is growing rapidly, increasing from 16.5% in 2016 to 20% in 2021 and is likely to increase to 32.2% in 2032 [3].The elderly are more likely to live alone and most of them areat risk from emergency illnesses with chronic diseases.Based on the response time criteria, the percentage of ambulances that can go to emergency patients at the scene of the incident within 8-10 minutes should be more than 40%.Bangkok is the largest population in Thailand and is divided into fifty administrative districts, also has an EMS response time that is not up to international norms [4].This study will use the independent variables derived from this study to determine the conditions used to create a mathematical model.This will guide decision-making to help reduce the response time to EMS in another method in the future.

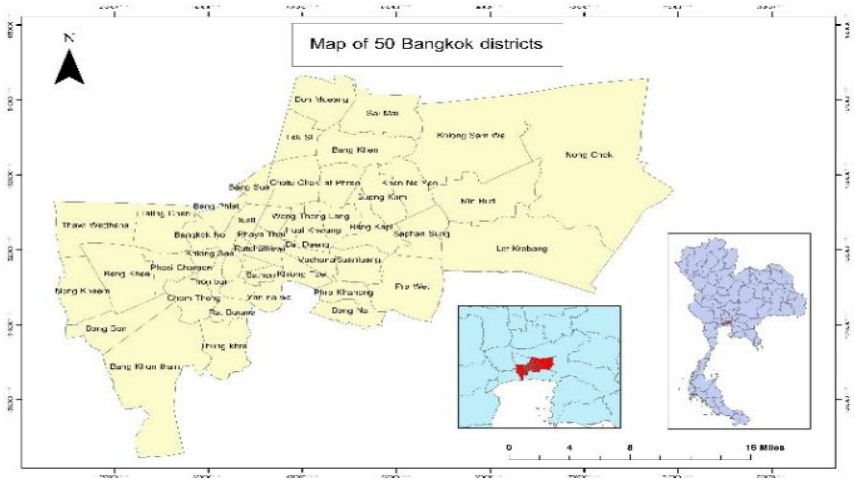

Figure 1: Bangkok's 50 Districts

II. EMS PROCEDURES

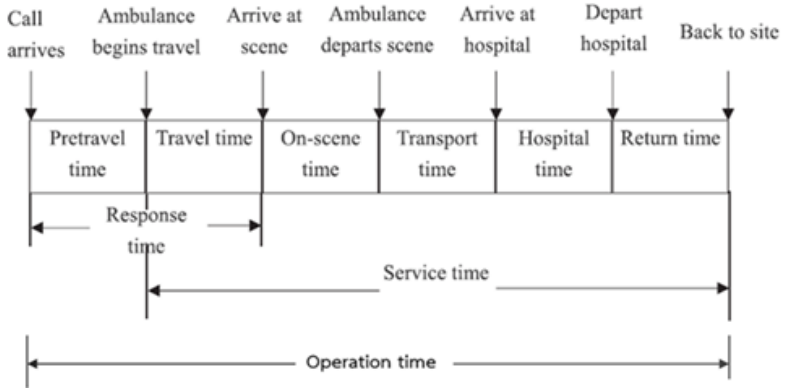

Figure 2: EMS procedures

Procedures for providing emergency medical services, as shown in Figure 1, since patient calls to report the incident to the Emergency Centre 1669 in Thailand. A dispatcher will ask for the patient's emergency symptoms and placement. To be used as information to make the decision to send a suitable ambulance for emergency patient symptoms. When a dispatcher receives a notification, the ambulance moves from its original to the scene of the incident. The crew locates the patient, provides emergency medical attention and, if required, transports the patient to the hospital. At the hospital, the crew transfers the patient to the emergency room. When a call is complete, either at a hospital or at the scene of the incident, the ambulance travels to its site to wait for the next call.Ambulance response time is the time ambulance begins travel to the scene of the incident. Response time is the time from dispatcher receivesa notification until the ambulance travels to the scene of the incident.

III. FACTORS INFLUENCING EMS RESPONSE TIME

A study to identify factors related to delay in assisting patients in case of an emergency accident in Buriram province. The location of the accident site or the distance from the ambulance parking was found to be statistically significantly related to the delay, p-value < 0.001. [5]. The following is as a monitoring of treatment outcomes after emergency patients come to the hospital for treatment. It was found that factors related to death after admission to the hospital were the degree of injury severity, elderly patients, and being Improper hospital's transportation of severely ill patients to. The group that died before arriving at the hospital was caused use a response time exceeding 10 minutes. It took over 60 minutes to arrive at the hospital [6]. Factors affecting the survival rate of cardiovascular emergency patients in the three major emergencies in Guangzhou, Guangdong, China were distant, hospital capacity level, and scene [7].Singapore carried out a study and found that road traffic conditions have the greatest impact on the response time of emergency medical operations, followed by weather and scene [8].The effectiveness of the EMS evaluation system was evaluated in Nakhon Ratchasima province.Evaluate operational potential in 5 aspects: 1) Emergency coverage 2) Speed of access 3) Availability of service points 4) Security of staff access 5) Ability to manage risks within the system.It was found that the location of the emergency medical operation car park affected the quality of service.One of the performance measures of the EMS is response time.But the response time effect is also driven by many other factors.For example, coverage of new areas, availability of the service point, and risk control in the process of assisting patients [9].

Scope and limitations of information, response time, number of emergency vehicles, Number of emergency operations with more than 10 kilometers and emergency operating parking lot from the National institute for emergency medicine. Demographic data from Strategy and Evaluation Department and road travel speed data from the Traffic and Transportation. Both agencies are under the Bangkok City Hall.

IV. MATCH

Pearson's Product Moment Correlation

$$r = \frac{\sum(x-\bar{x})\,(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}} \qquad (1)$$

where:

r is the Pearson correlation coefficient

$\bar{x}$, $\bar{y}$is the mean of the variablesxและy

Multiple Linear Regression Analysis

$$y = ß_0 + ß_1x_1 + ß_2x_2 + \ldots + ß_kx_k + \varepsilon \qquad (2)$$

where:

y is the dependent variable

x_i is the independent variable

k is the number of independent variables

$ß_0$ is a constant

$ß_i$ is the regression coefficient of the variable x_i

ε is an error term

Center of Gravity method

$$\overline{X} = \frac{\sum Q_i X_i}{\sum Q_i}; \overline{Y} = \frac{\sum Q_i Y_i}{\sum Q_i} \quad (3)$$

where:

Q_i is the Quantity at destination i
X_i is the position X destination i
Y_i is the position Y destination i
$\overline{X}$ is the center point of position X
$\overline{Y}$ is the center point of position Y

V. EXPERIMENTAL RESULTS

The data were analyzed for n = 20 using descriptive statistics with minimum, maximum, mean, and standard deviation values. Pearson's Product Moment Correlation method was used to test five independent variables. The dependent variable was time. The independent variables were found to have a high correlation. Multicollinearity uses the Best's criterion, the correlation coefficient of which is higher than 0.80. Three independent variables are used for the analysis: 1) Road velocity 2) Density of population3) Distance. Analyze the factors affecting the response time of the EMS using the multiple linear regression analysis method. Choose to use the Stepwise method for the selection of independent variables in the equation.Out of 50 districts, 39 had independent variables that affected EMS response time and were statistically significant. In 39 districts, it was found that the independent variables that most affected EMS response time were distance, followed by population density and speed.The R-square value ranges from 0.311 to 0.853.Statistically significant three variables, only in Sai Mai district.Statistically significant two variables, namely distance variable and density variable, had three districts: Nong-Khaem District, Bangkok-Yai District, and Khlong-Sam-Wa District.Statistically significant, two variables were the distance variable and the speed variable was Bangna District.Statistically significant onevariable is the speed variable, Yannawa District.For the rest of the district Statistically significant singlevariable is the distance variable.

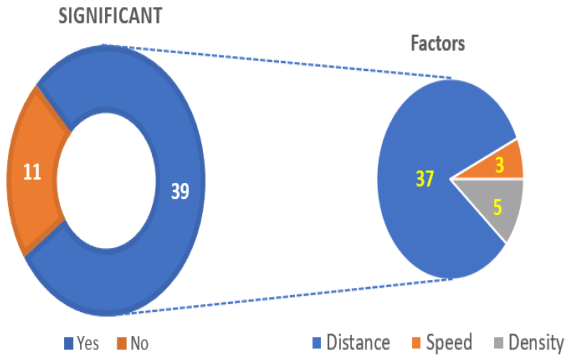

Figure 3: Factors influencing the response time of EMS Bangkok

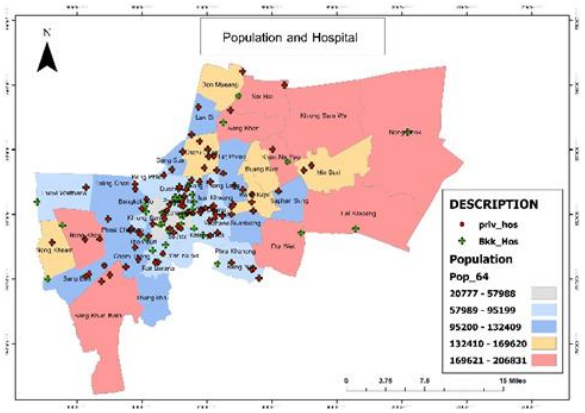

Figure 4: Populationand Hospital

Figure 4 shows a high population in the east of Bangkok. Based on historical population statistics, the number of residents increases annually in the Eastern district. In contrast, there were few hospitals in the area.

District	2017	2018	2019	2020	2021
Bang Khen	107,198	109,112	112,614	114,661	115,522
Sai Mai	97,642	100,196	102,868	106,139	106,948
Lat Krabang	90,000	93,589	96,464	98,260	100,871
Khlong Sam Wa	80,421	82,412	84,728	86,477	88,145
Don Mueang	74,516	75,954	77,220	77,410	78,493
Nong Chok	61,537	63,210	65,048	66,754	68,505
Min Buri	58,200	59,822	61,051	61,665	63,274
Khan Na Yao	42,935	44,234	44,685	45,864	46,218
Saphan Sung	36,855	38,441	40,482	41,308	41,892

Table 1 - Number of households in Bangkok's East District (2017-2021)

From the distance variable that affects the emergency response time. Conduct initial testing for new points of service that help cover more areas initially. Using the center of gravity method where Qi is the district population, Xi is the latitude and Yi is the longitude of the district office. Get a new preliminary position as shown in Figure 5 is the red triangle point.

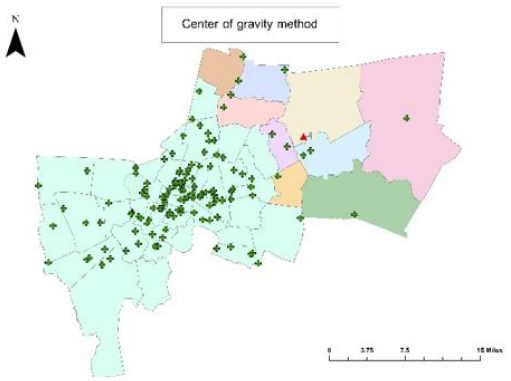

Figure 5: New point of care in earth district of Bangkok

V. CONCLUSION

From the study of factors affecting the EMS response time in Bangkok, it was found that the distance variable had the most significant effect.And preliminary testing by Gravity's center has a new medical service location.Use this as a starting point to create a model to define a new service point with higher accuracy. In nine districts in eastern Bangkok.This is an area close to the high-speed train from Bangkok to the Eastern economic corridor. In eastern Bangkok, there are more and more immigrants[10].An additional analysis was conducted on the value of the new point of care versus the value of life-saving patients. To be information for decision-making for government agencies in the future.And to investigate the value of life, EMS can save patients from death or disability.The value of the study will be a decision support for government agencies to decide to construct new medical service points.

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