Research

The efficacy of using Google Maps in accessing nearby public automated external defibrillators in Thailand

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Abstract

Introduction

Early defibrillation remains the highest priority in the chain of survival for out-of-hospital cardiac arrest. Shock delivery should be performed within 5 minutes of collapse to achieve a 50% survival rate. Google Maps has been one of the most popular mobile navigation applications worldwide. Our primary objective was to assess the efficacy of Google Maps in locating nearby public automated external defibrillators (AEDs).

Methods

Local and non-local populations were enrolled. Participants were randomly assigned to locate AEDs with or without the assistance of Google Maps. Participants used Google Maps on the same smartphone and cellular data network, an activity tracker recorded data for distance covered and time required to retrieve the AED. AEDs were located within 150 seconds of the starting point.

Results

Out of 100 recruited participants there was no difference in baseline characteristics. In the local population group, Google Maps assistance did not show statistical significance in successfully locating the AED within 150 seconds. Correspondingly, the travel time also showed no difference (173.52 ± 50.99 seconds for Google Maps vs. 206.20 ± 159.53 seconds for control group). The result in the non-local population group revealed no significant difference in successfully locating AEDs within 150 seconds: Google Maps (18.52%) vs. control group (39.13%); $p=0.126$. The recorded travel time between the Google Maps group and control group were similar (307.59 ± 220.10 seconds vs. 284.0 ± 222.37 seconds; $p=0.709$).

Conclusion

In Thailand, using Google Maps mobile assistance was found to be unhelpful in accessing nearby public AEDs.

Keywords:

automated external defibrillators; Google Maps; mobile application

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Introduction

Ventricular fibrillation and pulseless ventricular tachycardia are common life-threatening cardiac conditions for out-of-hospital cardiac arrest (OHCA); these arrhythmias can be converted to perfusing rhythms with early defibrillation (1-3). The most crucial elements for survival are rapid recognition of a cardiac arrest, effective cardiopulmonary resuscitation and early defibrillation (1,2,4). Emergency medical services may require a substantial amount of time to arrive at the scene, which could delay time to shock delivery. Therefore, defibrillation by members of the public using public automated external defibrillators (AEDs) is key to initial basic life support while waiting for advanced care (2,5).

Time to the first defibrillation is a crucial factor in successful resuscitation. Every delay in defibrillation decreases the survival rate down to 7% and 10% per minute (3); and 90% of ventricular fibrillation patients might survive if shock was delivered within the first minute of cardiac arrest (3). Approximately 50% of OHCA survived to hospital discharge at 5 minutes to defibrillation (3). Survival outcome decreased to 30% at 7 minutes, 10% at 9 to 11 minutes and 2–5% after 12 minutes (6). According to these findings, lay rescuers need to locate an AED within a 2.5 minutes (150 seconds) timeframe to achieve a 50% survival outcome (3).

In Thailand, public-access defibrillators are limited, with the majority provided by private rather than government organisations. The public areas that AEDs are located include airports, government buildings, hospitals, universities, department stores and central public transportation. In our community, only a small number of AEDs are publicly available. There is no national system or application that registers AEDs and demonstrates how to access them, and some AEDs are installed within buildings that are inaccessible to the public.

Several mobile applications are available globally that allow users to locate nearby AEDs (7-12). Google Maps is the most frequently used mapping application; it offers satellite photography, geographically mapped 360-degree street view and transport direction. My Maps is a feature that Google allows users to add new points by searching for locations or drawing directly on the map. Several AEDs that can be found in public or non-residential areas were added to Google Maps by AED owners or volunteers to help locate public-access defibrillators. The objective of this study was to test whether the mobile application Google Maps would assist in AED searching among local and non-local populations.

Methods

This was an experimental scenario-based study between 1 February 2018 and 30 September 2018. The study was conducted at the Faculty of Medicine, Ramathibodi Hospital, Mahidol University (the university's affiliated hospital in Bangkok, Thailand). The inclusion criteria of the participants included being healthy, at least 18 years of age, with normal eyesight and capability of using a mobile application. Those who refused to be enrolled or did not completely participate in the experiment were

excluded. We invited the participants verbally. The randomisation was performed by computer-generated block randomisation. The allocation to each group was arranged by sequential and numbered opaque sealed envelopes and stratified by local (the participants who lived or worked in the area of this study and were familiar with the location) and non-local populations (the participants who did not live or work in the area of this study and were unfamiliar with the location). Participants were divided into the application group and the control group.

The application group were asked to use Google Maps to locate the nearest AED demonstrated on the application. The same smartphone with a cellular data network and installed application was used by all participants, an activity tracker recorded data for distance covered and time required to retrieve the AED. Instructions on how to use the application were given before starting the experiment. The control group had to locate an AED without any assistance from investigators or locals. The control group was only given information about the numbers of nearby AEDs. They were asked to locate the nearest AED by using their prior knowledge. If the control group tried to locate the nearest AED with assistance, the experiment was terminated and the study data excluded.

The starting point was a convenience store surrounded by 14 AEDs that were possible to reach within 2.5 minutes. Participants were given a scenario that someone had collapsed and was in cardiac arrest. While chest compression was being performed by one of the research assistants, participants were instructed to locate the nearest AED as quickly as possible. Once they found an AED, the experiment was completed.

Sample size estimation

In accordance with a study by Sakai et al (7) on the effectiveness of Mobile AED Map to retrieve an AED, it was found that the time from starting point to reach an AED was 333.6 ± 213.4 seconds in the Mobile AED Map group compared to 286.5 ± 162.8 seconds in the control group. Stata version 12 analysis software was used to calculate the sample size by employing two-sample comparison of mean (time from starting point to reach an AED). The assumptions were as follows: $\alpha = 0.05$ (two-sided test), power of sample size = 0.8 and ratio of sample size = 1:1. The sample size of 39 was obtained in each population group.

Statistical analysis

Data were analysed using Stata version 14.0. Baseline demographic and results between groups were compared using unpaired t-test for numerical variables and chi-square test for categorical variables. An independent t-test or Wilcoxon rank-sum test was used in continuous variables. Data would be presented in mean and standard deviations. The p-value of less than 0.05 was considered statistically significant.

Ethics

This study was approved by the Committee on Human Rights related to research involving human subjects of the Faculty of Medicine at Mahidol University in Bangkok, Thailand (ID 08-

60-46). All participants gave written informed consent before participation and protocols were based on the Declaration of Helsinki.

Results

A total of 108 participants were recruited. In the local population group, 25 used Google Maps, while 25 did not. We excluded eight participants from this group due to a technical problem. In the 50 participants of the non-local population group, Google Maps was used by 27 participants while the rest used none. All the participants were healthy young adults 20–29 years of age. Most of the local population group were paramedic students, medical students and doctors who all had basic knowledge of AED and basic life support. Similarly, the non-local population were mainly medical students and doctors from other faculties or universities, and hospital visitors; 88% had knowledge about AED, however, only 63% knew how to perform basic life support (Table 1).

Table 2 demonstrates the distance and time to reach a nearby AED in the local population group. The success in locating an AED within 150 seconds showed no difference with Google Maps (11/25, 44%) and without (14/25, 56%); $p=0.572$. The total distance to an AED using Google Maps was shorter than the control group (336.40 ± 89.06 vs. 418.80 ± 223.03 ; $p=0.093$). The overall time to an AED using Google Maps was shorter than the control group (173.52 ± 50.99 vs. 206.20 ± 59.53 ; $p=0.334$).

In the non-local population group, the success in locating an AED within 150 seconds was better in the control group than Google

Maps assistance: 9/23 (39.13%) vs. 5/27 (18.52%); $p=0.126$, respectively. The total distance to an AED using the application was shorter than the control group (454.81 ± 275.27 vs. $590.30 \pm 411.14.03$; $p=0.172$). The overall time to an AED using the application was longer than the control group (307.59 ± 220.10 vs. 284.0 ± 222.37 ; $p=0.709$).

Discussion

In the local population group, the average travel time to the AED was 2.53 minutes for Google Maps and 3.26 minutes for the control group. If twice the time was required for the return journey then the Google Maps group would have a 50% survival rate at 5 minutes to defibrillation, while the control group would have a 30% survival chance at 6.52 minutes (3,6). In the non-local population it took 5.07 minutes for Google Maps and 4.44 minutes for the control group. Accordingly, it was assumed that it would have taken 10.14 minutes and 9.28 minutes from collapse to shock delivery. Survival to hospital discharge at 9 to 11 minutes of defibrillation was 10% (3,6). The following amount of time was only an estimation of AED retrieval. We have not evaluated the time from turning on the equipment to shock delivery. Moreover, this is only a speculation as survival in cardiac arrest depends on multiple factors such as early recognition of cardiac arrest, early chest compression, early activation of emergency medical services and effective AED usage.

Even though Google Maps was not specifically designed for AED searching, it was chosen because it displayed most of the

Table 1. Baseline characteristics of Google Maps and control group stratified by local and non-local populations

Baseline characteristics	Local population			Non-local population		
	Google Maps (N=25)	Control (N=25)	p-value	Google Maps (N=27)	Control (N=23)	p-value
Age (years)	25.36±4.12	24.60±4.03	0.513	23.70±3.12	23.78±3.25	0.931
Weight (kg)	60.08±9.28	66.20±3.15	0.101	58.30±8.48	59.22±12.43	0.758
Height (cm)	167.32±12.19	167.68±16.80	0.863	166.48±76.88	165.57±11.19	0.734
BMI (kg/m ²)	21.41±2.70	23.60±5.76	0.092	20.94±19.0	21.42±28.3	0.486
Knows AED	25 (100%)	25 (100%)	NA	24 (88.9%)	21 (91.3%)	0.578
Knows basic life support	25 (100%)	25 (100%)	NA	17 (63%)	15 (65.2%)	0.552
Knows AED location before experiment	11 (44%)	6 (24%)	0.232	2 (7.41%)	4 (17.39%)	0.395

Table 2. Time and distance to locate AED of Google Maps and control group stratified by local and non-local populations

Baseline characteristics	Local population			Non-local population		
	Google Maps (N=25)	Control (N=25)	p-value	Google Maps (N=27)	Control (N=23)	p-value
Located AED within 150 seconds	11 (44%)	14 (56%)	0.572	5 (18.52%)	9 (39.13%)	0.126
Distance in 150 seconds (metres)	288.20±68.42	316.40±73.42	0.167	273.70±70.23	322.91±89.48	0.034
Total distance (metres)	336.40±89.06	418.80±223.03	0.093			0.172
Total time to AED (seconds)	173.52±50.99	206.20±159.53	0.334		284.0±222.37	0.709

required information, had a user-friendly interface and was one of the most popular navigation applications worldwide. There were four main problems with the application. First, participants found it difficult to navigate the map under emergency conditions resulting in them becoming lost or going in the wrong direction. Second, those who were unfamiliar with the application would require more time to fully understand it, despite an explanation being given. Third, the delay of the mobile GPS caused misdirection of the current location. Fourth, the application usually displayed outdoor building maps. It rarely revealed the floor plans inside the structure, therefore it would be difficult to explore and recognise an AED location.

The occurrence of these challenges resulted in delayed time to retrieve an AED, especially in the non-local population who were not familiar with the study area. Our study showed that the time to retrieve an AED was longer using Google Maps than the control group in non-local population. On the other hand, the local population, who were familiar with the study area, took the shortest time to retrieve an AED even though there were problems with the application. This result was similar to the result of the study by Sakai et al (7) which evaluated the effectiveness of a mobile application in retrieving an AED at Kyoto University. Out of 43 volunteers, the application failed to reduce the time to AED (400 ± 238 vs. 407 ± 256 seconds; $p=0.922$). However, it significantly decreased the travel distance (606 vs. 891 metres; $p=0.019$). It was speculated that a certain amount of time was needed to operate the map system and display the user's location on the phone. Moreover, unfamiliarity with the area and the site's complexity accounted for the difficulty and delay in AED retrieval.

Hatakeyama et al (10) compared the AED delivery time in 52 participants with and without the help of a smartphone application. In the application group the bystander activated a signal notification to two responders who would search for an AED and carry it to the scene. In contrast, the bystander simultaneously looked for an AED. In the non-application group the bystander would search for an AED alone. The outcome revealed that AED delivery time was faster in the smartphone application group.

In a randomised study for AED geo-localisation comparing mobile application, verbal assistance and no assistance by Briard et al (8), 52 volunteers were assigned to deliver an AED and provide defibrillation. The success rate for defibrillation under 10 minutes was 35% in the no assistance group, 56% in the mobile application group, and 76% in the verbal group. Acquaintance with the location was the most specific factor in providing shock within 10 minutes.

Limitations

The limitation of our study was that the participants were mainly young and healthy adults aged 20–30 years, who may not represent general bystanders. Some participants also knew the location of AEDs before the experiment, which could confound

the study. Moreover, this study was conducted in one field area which does not represent actual public places. This study evaluated the travel distance and time from the starting point to nearby AED but it did not assess the return journey and the delivery of defibrillation. Additionally, it was designed as a simulated scenario. Further tests in real emergency settings should be conducted in the future.

Conclusion

In Thailand, using Google Maps mobile assistance was found to be unhelpful in accessing nearby public AEDs.

Competing interests

The authors declare no competing interests. Each author of this paper have completed the ICMJE conflict of interest statement.

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