GENERAL ARTICLE

# Response to road traffic injuries: a survey of Royal Thai Traffic Police in a Northeastern Province of Thailand

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## Abstract

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Timely and appropriate response to road traffic accidents can reduce the mortality and severe morbidity associated with it. Traffic police are one of the first responders, and could play a vital role in pre-hospital care of road traffic injuries (RTI).

A cross-sectional survey was conducted to assess knowledge, experience, and practice of Royal Thai traffic police in responding to RTI, and the association between respondent characteristics and their practice of responding to RTI. Self-administered questionnaires were employed among 123 traffic policemen of Nakhon Ratchasima Province. Descriptive statistics and chi square tests were utilized to analyze the data.

A majority of traffic police reported dealing with RTI cases in the previous year (76%), having prior experience of post-crash rescuing (76%) and responding within 10 minutes of being informed about accidents (78%). There were 65 respondents (56%), who had received training on handling RTI cases and they were more likely to respond within 10 minutes to RTI than those who had not received such training (85% versus 69%, p-value 0.04).

This study demonstrates a positive link between training on management of RTI to the traffic police and their responding ability. Providing proper training and encouraging traffic police to respond quickly and effectively to road traffic accidents, in coordination with emergency medical services, may help reduce the burden of RTI in Thailand.

**Keywords:** Pre-hospital care, Response, Road traffic injuries, Royal Thai traffic police, Thailand

## Introduction

Road Traffic Injury (RTI) exerts a global public health burden, with around 1.24 million people dying on the road, and another 20-50 million sustaining non-fatal injuries due to it every year.[1] RTI has emerged as one of the leading causes of death, especially among young people aged 15-29 years.[1,2] Despite having similar number of vehicles, deaths due to RTI occur twice as much in low and middle income countries than the high income countries.[1] The gross disparities in mortality rates between the countries of different socioeconomic statuses can be attributed to the level of care received immediately post-crash and later in a health care facility.

Time is of critical importance in road traffic trauma injuries. Proper and timely pre-hospital care can reduce RTI mortality.[3,4] In potentially fatal accidents, survival of victims often depend on the time of starting an intravenous drip (IV) or receipt of basic life support.[5,6] Many trauma experts consider "golden hour" - the first 60 minutes after injury occurrence - as the most effective for saving lives, beyond which, the risk of death or injury severity rises significantly.[7] This "golden hour" consists of various time intervals, such as notification time, activation time, response time, on-scene time, and transport time.[7,8] Shortening the response time – the time for emergency medical personnel to arrive at the accident scene site after notification, is therefore crucial to ensure that the patient receives prompt paramedical support on scene and gets transported properly to hospital settings for advanced care as soon as possible.

In less resourced settings, in addition to a specialized emergency medical service (EMS), the World Health Organization (WHO) recommends utilizing first responders for pre-hospital care after a traffic accident.[2] Traffic police have been identified as one of such first responders,[2,9,10] along with community volunteers, laypeople and taxi drivers, whose prompt response might increase the victim's chances of survival and lessening severe morbidities.[3,4,11-14] Therefore, increasing general awareness of first responders with first aid training and practical demonstrations to improve the quality of their responses when called upon, can be beneficial in low and middle income countries.[11,15-18] Due to their significant role in pre-hospital care, first responders are often considered as important members of the responding team at the accident site.[19,20]

Thailand is a middle income country which has seen a dramatic increase in level of motorization, spurred by economic growth, leading to an adverse road traffic situation.[21] In 2015, WHO estimated in excess of 24,000 fatalities due to road traffic accidents in Thailand, with more than 70% of deaths occurring among motorbike users.[2] The estimated mortality rate in Thailand due to RTI (36.2 per 100,000 people) is the second highest in the world,[2] and creates a huge burden on the country's economy, accounting to as much as 3% of its gross domestic product.[1,2] Although emergency care systems in Thai hospitals have been bolstered following quality improvement measures in the hospital settings, lowering mortality rates by up to 50% in some regions,[22,23] there exists a gap in pre-hospital care and a need for multi-disciplinary approach to improve the quality of care in pre-hospital setting has been recognized.[1,24,25] A study based on EMS database, estimated that a 1-minute improvement in response time to traffic accidents in Thailand would save up to 23.2 lives and 145.4 severe inju-

ries per year, and a yearly cost-benefit of nearly 14 million USD.[26]

EMS service in Thailand is less mature in comparison to other Asian countries such as Japan, Korea and Singapore.[27,28] In 1995, Narenthorn EMS was the first established EMS center in Thailand under the Ministry of Public Health.[29] Only in 2008, a statutory lead agency, Emergency Medical Institute of Thailand was established, which has helped in making some gains in expanding coverage of pre-hospital care and shortening response times.[30] In Thailand, after a road traffic accident occurs, pre-hospital care responses are sent out by an EMS radio control room which is located, depending on the province, either in the provincial health office, police station or the provincial hospital. Although basic life support are carried out by many foundations in pre-hospital settings, advanced life support are performed only in the hospitals.[31]

Across Thailand, policemen are usually the first personnel to arrive at accident scenes.[32] However, traffic police play only a supporting role in treatment of RTI victims: helping to remove the injured from their vehicles and controlling traffic. Thai traffic police receive some emergency medical training during police academy years.[32] After they join the force, they are equipped with emergency first aid kits, and some get trained in basic life support and patient transfer, to handle post-crash rescue cases. This potentially enables traffic police to play a bigger role in RTI management. Therefore, a multi-disciplinary approach with involvement of traffic police in pre-hospital care, might bring better outcomes on dealing with the road traffic injuries cases.[25,33]

In light of the current scenario of road traffic accidents in Thailand and the potential role of traffic police in handling RTI cases, we assessed Royal Thai traffic police's knowledge, experience, and practice of responding to RTI. We also examined the association of traffic police's characteristics with their response time to RTI.

## Material and methods

### *Study setting*

Nakhon Ratchasima is the largest province in Thailand. It has one of the most frequently used highways in Thailand - National Highway No. 2, which is the main road heading towards Northeastern region of Thailand. The highway, 508 kilometers long, connects Thailand to Laos via the Thai-Lao Friendship Bridge.[34] The highway is highly vulnerable for road traffic injuries with top causes being: over speeding, drunk driving and dangerous lane changing without signaling.

### *Study population*

We conducted a cross-sectional survey in January 2014, using self-administered questionnaires among all 140 traffic policemen employed at 12 different police stations of Nakhon Ratchasima Province along the highway numbers 2 and 24. Traffic police who were voluntarily willing to participate in the study were included, while those who did not give consent or were unavailable on the day of data collection were excluded from the study.

### *Survey instrument*

The survey questionnaire was divided into four parts: Part 1 enquired about general characteristics, Part 2 consisted of nine questions pertaining to knowledge of post-crash, pre-hospital care in terms of detection

of case types and severity, handling procedure, communication guidelines and first aid information based on the expectation and role of a first responder according to WHO road traffic injury prevention training manual,[35] Part 3 asked participants about their experience on training and on-site rescuing, and Part 4 dealt with their current practice of responding to RTI. The survey instrument was translated into Thai and pretested among 20 traffic policemen for clarity and acceptability. Participants needed only 30 minutes for completing the self-administered questionnaire. We made appropriate adjustments and assessed the quality of the instrument. The instrument demonstrated an acceptable reliability for knowledge on post-crash RTI care (Cronbach's $\alpha = 0.708$).

***Data analysis***

Data were entered in Epi data version 3.1 (The EpiData Association, Odense, Denmark) and verified by manual comparison with the original questionnaire. SPSS version 18 (SPSS Inc., Chicago, IL) was used for data analysis. The main outcome of the study was self-reported response time of traffic policemen to accidents. Since there wasn't a standard response time for traffic police in case of RTI, we considered the target response time of Narenthorn EMS center of within 10 minutes[29,32] to be an adequate response. We modified Bloom's original cut off points[36] to classify participants' knowledge on RTI into three categories, such that eight or more correct answers represented "good knowledge", six to seven correct answers meant "fair knowledge" and less than 6 correct answers was considered as "need improvement". We performed descriptive statistical analysis and used Pearson's chi square test as the test of association. Statistical significance was set at $p<0.05$.

***Ethical considerations***

Respondents were clearly explained about voluntary nature of participation and their rights to avoid answering uncomfortable questions. Written informed consent was sought from the participants. Personal information or identity of the respondents was not disclosed anywhere and was kept strictly confidential. Permission was obtained from the head of traffic police department of Nakhon Ratchasima Province for the study, and the study protocol was approved by the ethical committee for human research, Faculty of Public Health, Mahidol University (COA No. MUPH 2014-022).

## Results

***Response rate***

Out of 140 traffic policemen in Nakhon Ratchasima, 17 were not available on the day of data collection, while written consent was obtained from all others. Thus, 123 responses were obtained, achieving an overall response rate of 88%. However, some of the questions remained unanswered by few respondents, so the total responses varied across different items.

***General characteristics***

The respondents were aged 27 to 60 years and their mean age was 46.6 years, with an average of 13 years of service (range: 1-37 years) in the traffic police department (Table 1). There were no female traffic police officers. A majority of respondents were married (88.2%), and one-third of the respondents had attained bachelor's degree or above (35.8%).

**Table 1** General Characteristics of 123 traffic policemen

| Characteristic | Number | Percent |
|---|---|---|
| **Age (in Years)**[1] | | |
| <40 | 18 | 14.7 |
| 40-49 | 60 | 49.2 |
| ≥50 | 44 | 36.1 |
| *Mean =46.6, S.D.= 7.4, Range: 27-60* | | |
| **Marital Status**[2] | | |
| Married | 105 | 88.2 |
| Single | 9 | 7.6 |
| Divorced | 4 | 3.4 |
| Separated | 1 | 0.8 |
| **Highest educational attainment** | | |
| Below bachelors | 79 | 64.2 |
| Bachelors and above | 44 | 35.8 |
| **Years of working as traffic police**[3] | | |
| <10 | 57 | 50.0 |
| 10-19 | 22 | 19.3 |
| ≥20 | 35 | 30.7 |
| *Mean= 13, S.D.= 10.1, Range: 1-37* | | |

*Valid cases: [1]122, [2]119, [3]114. S.D. = Standard Deviation*

***Knowledge of post-crash RTI care***

Most of the respondents recognized that among RTI, bone fracture cases should be transported with stability (95.1%), bleeding should be seized (93.5%), and injured patients should be taken to the nearest health facility (91.1%) (Table 2). There were 83.7% of traffic police who knew about case detection for triage, and nearly 70% correctly identified that head and cardiovascular injuries are more severe and should be given priority when other types of trauma victims are also present. In regards to handling injured patients while transporting to the hospital, fewer respondents (32.5%) reported knowing the proper transfer technique (immobilizing the entire spine and maintaining immobilization until the patient has been transported to a medical facility), and recovery position (rolling the victim onto his/her side with the head tilted back) for maintaining victim's airway (45.5%). Half of the respondents (52.8%) acknowledged that dialing 1669, the hotline for emergency medical services in Thailand, needs to be done immediately after the accident, and 40.7% of them were aware of using global positioning system (GPS) to locate the accident site. Overall, based on the number of correct responses, 23% of the respondents were categorized to have good knowledge, 39% of them had fair knowledge, and 38% of them needed improvement (Table 3).

**Table 2** Respondents' affirmative responses to each item of knowledge on post-crash RTI care

| Knowledge on post-crash RTI care | Number | Percent |
|---|---|---|
| Fracture cases should be transported with stability | 117 | 95.1 |
| Blood flow should be seized when seen in accidents | 115 | 93.5 |
| RTI patients have to be taken to the nearest health Facility | 112 | 91.1 |
| Triage should be done to sort patients into those who need critical attention and immediate transport to the hospital and those with less serious injuries | 103 | 83.7 |
| Head and CVS injuries should be given priority over other injury victims | 86 | 69.9 |
| Should call 1669 immediately after accident | 65 | 52.8 |
| Recovery position should be used if victim's airway is obstructed | 56 | 45.5 |
| Accident sites should be located using GPS | 50 | 40.7 |
| Transfer Technique should be proper (immobilizing entire spine) while handling RTI cases | 40 | 32.5 |

*RTI: Road Traffic Injuries; CVS = Cardio-Vascular System; 1669: Emergency Ambulance Hotline for Thailand; GPS: Global Positioning System.*

**Table 3** Respondent's knowledge, experience and practice of post-crash response to RTI

| Characteristic | Number | Percent |
|---|---|---|
| **Knowledge on post-crash RTI care** | | |
| Need Improvement | 47 | 38.2 |
| Fair | 48 | 39.0 |
| Good | 28 | 22.8 |
| **Received training on handling RTI cases**[1] | | |
| Yes | 65 | 56.1 |
| No | 51 | 43.9 |
| **Experience of post-crash rescuing**[2] | | |
| Yes | 83 | 76.1 |
| No | 26 | 23.9 |
| **Dealt with RTI cases in previous year** | | |
| Yes | 94 | 76.4 |
| No | 29 | 23.6 |
| **Response time of Police** | | |
| ≤ 10 minutes | 93 | 75.6 |
| >10 minutes | 30 | 24.4 |
| **Common modes of information about RTI**[3] | | |
| From main office (including GPS information) | 69 | 57.5 |
| Calls from general public | 16 | 13.3 |
| By 1669 | 12 | 10.0 |
| **Carry first aid kits on duty**[3] | | |
| Yes | 10 | 8.3 |
| No | 110 | 91.7 |

*Valid cases: [1]116, [2]109, [3]120; RTI: Road Traffic Injuries; 1669: Emergency Ambulance Hotline for Thailand*

***Experience***

More than half of respondents (56.1%) had received training on handling road traffic accident sites and cases, and more than three quarters of the respondents (76.1%) had a firsthand experience of onsite rescuing (Table 3). A majority of traffic police reported dealing with RTI cases in the previous year (76.4%), with the average of 13 cases of RTI in a month.

***Practice of responding to RTI***

Most of the respondents (75.6%) reported a response time of within 10 minutes after getting notified about an accident. The commonest mode of receiving information about the accident was through the main office (57.5%). However, 91.7% of respondents stated that they don't carry first aid kits along with them when responding to an accident.

***Bivariate analysis***

In a bivariate analysis of association between categorical independent variables and main outcome – the traffic police's self-reported response time to RTI, we found the traffic policemen who were trained on handling road traffic injuries cases were more likely to respond within 10 minutes (85% versus 69%, p-value 0.04). Other factors did not demonstrate any significant relationship with the traffic police's practice of responding within 10 minutes to RTI (Table 4).

## Discussion

We surveyed 123 Royal Thai traffic police of Nakhon Ratchasima Province and found that more than three quarters of them had prior experience of managing RTI and reported a response time of 10 minutes or less to a road traffic accident. More than half of the traffic police had been trained to manage road traffic injuries, and that was associated with responding within 10 minutes. However, only one out of every four traffic police had good knowledge of pre-hospital care to be given to victims of road traffic accidents, and fewer than 10% of them actually carried first aid kits with them while responding to an accident site. Given appropriate training and reinforcements, traffic police have the potential to play a significant role in emergency medical response to RTI in Thailand.

In our study, despite a higher proportion of traffic police were experienced in handling RTI cases, their knowledge about proper pre-hospital care for RTI was found lacking and needed improvement. Nevertheless, research has shown that training given to first responders who had no previous knowledge, such as community leaders and lay persons can still benefit in RTI management.[4,11,12,14-17,20,37] Importantly, we found that the traffic police who had received training on post-crash RTI management were more likely to respond within 10 minutes of an accident. There was also a general recognition among them that they needed to reach the accident site as fast as possible. These findings can be seen in a similar light as previous studies where policemen were recognized as first responders and showed positive outcomes in RTI management upon training.[13,16,18,23] Therefore, traffic police should be given training, encouraged to carry first aid kits and respond appropriately to road traffic accidents.

Furthermore, the most common mode of receiving information about accidents were from the main office of police and calling 1669 (the emergency ambulance

**Table 4** Relationship between respondent characteristics and response time to RTI

| Characteristics | Responding to RTI within 10 minutes | | | | Chi square | p-value |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| | n | % | n | % | | |
| Age (in years) | | | | | 4.57 | 0.102 |
| <40 | 13 | 72.2 | 5 | 27.8 | | |
| 40-49 | 41 | 68.3 | 19 | 31.7 | | |
| ≥50 | 38 | 86.4 | 6 | 13.6 | | |
| Highest Education | | | | | 0.31 | 0.579 |
| Below bachelors | 61 | 77.2 | 18 | 22.8 | | |
| Bachelors and above | 32 | 72.7 | 12 | 27.3 | | |
| Years of Working as Traffic Police | | | | | 3.49 | 0.175 |
| <10 | 34 | 68.0 | 16 | 32.0 | | |
| 10-19 | 22 | 75.9 | 7 | 24.1 | | |
| ≥20 | 30 | 85.7 | 5 | 14.3 | | |
| Level of Knowledge on post-crash injury | | | | | 3.59 | 0.165 |
| Need Improvement | 39 | 82.9 | 8 | 17.0 | | |
| Fair | 32 | 66.7 | 16 | 33.3 | | |
| Good | 22 | 78.6 | 6 | 21.4 | | |
| Trained on handling | | | | | 4.20 | 0.040* |
| Yes | 55 | 84.6 | 10 | 15.4 | | |
| No | 35 | 68.6 | 16 | 31.4 | | |
| Experience of post-crash rescuing | | | | | 0.01 | 0.915 |
| Yes | 63 | 75.9 | 20 | 24.1 | | |
| No | 20 | 76.9 | 6 | 23.1 | | |

**p-value< 0.05; RTI: Road Traffic Injuries*

hotline for Thailand), highlighting the importance of a central communication system for RTI response. Centrally controlled communication network is integral for the appropriate use of resources and prompt action to reduce the morbidities and mortalities in RTI, as also seen in a Nigerian study.[13]

Our study provides a general overview of Royal Thai traffic police's knowledge and practice of responding to RTI. However, our findings have some limitations. Our study was a cross-sectional survey, so we cannot infer any causal relationship. As our study was a self- assessed questionnaire survey, there may be a possibility of information bias as participants could have provided socially desirable answers. Also, we took only participant-reported response time as our main outcome, and did not asses the overall quality

of the response. Although it would have been difficult to measure, different variables might affect the quality of response such as level of coordination with EMS, severity and nature of accident, ability to perform emergency medical procedures and distance to the nearest hospital. On the other hand, as evidenced by the fact that only a handful of them carried first aid kits, the traffic police may not perceive themselves as alternate providers of basic emergency medical care in case of specialized medical help arriving late. More research is required among traffic police to identify their role; measure and monitor their response time; evaluate quality of their response and coordination with EMS; and explore the barriers and facilitators when dealing with RTI cases in Thailand.

Traffic police have a multifold response in ensuring road safety: strict enforcement of traffic laws, prohibiting illegal activities, tackling congestion and taking care of vulnerabilities. In this domain of taking care of the vulnerabilities, we opine that traffic police can be vital for reducing RTI casualties in Thailand. In the event of an accident, the main duty of traffic police is to provide regulatory authority and document the wrong doing for legal aspects. However, they can also be rescuers and assist in first aid when required. Nevertheless, the main responders should be the EMS and every effort should be made to improve the EMS system. We do not recommend duplication of work by the EMS, but rather view traffic police and other responders as complementary to the main EMS. Traffic police should function as a part of the bigger system for management of RTI where all work together as a unit.

## Recommendations

In conclusion, traffic police are one of the important first responders whose prompt action can potentially help EMS team in rescuing and post-crash care of victims in Thailand. Our study suggests that trained traffic police have better response time to road traffic injuries. Therefore, adequately training traffic police on road traffic injuries handling guidelines and basic life support may result in a faster and more effective response to road traffic accidents which, in coordination with emergency medical services, may help to reduce the burden of road traffic injuries in Thailand.

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## References

1. World Health Organization. *Global status report on road safety 2013: supporting a decade of action.* Geneva: World Health Organization; 2013.
2. World Health Organization. *Global status report on road safety, 2015: Summary.* Geneva: WHO Press; 2015.
3. Hussain LM, Redmond AD. Are pre-hospital deaths from accidental injury preventable? *BMJ.* 1994;308(6936):1077-1080.

4. Henry JA, Reingold AL. Prehospital trauma systems reduce mortality in developing countries: a systematic review and meta-analysis. *J Trauma Acute Care Surg.* 2012;73(1):261-268.
5. Williams FL, Lloyd OL, Dunbar JA. Deaths from road traffic accidents in Scotland: 1979-1988. Does it matter where you live? *Public Health.* 1991;105(4):319-326.
6. Brodsky H. Delay in ambulance dispatch to road accidents. *Am J Public Health.* 1992;82(6):873-875.
7. Carr BG, Caplan JM, Pryor JP, Branas CC. A meta-analysis of prehospital care times for trauma. *Prehosp Emerg Care.* 2006;10(2):198-206.
8. Bigdeli M, Khorasani-Zavareh D, Mohammadi R. Pre-hospital care time intervals among victims of road traffic injuries in Iran. A cross-sectional study. *BMC Public Health.* 2010;10:406.
9. Sasser S, Varghese M, Kellermann A, Lormand JD. *Prehospital trauma care systems.* Geneva: World Health Organization; 2005.
10. World Health Organization. *Post-crash response: supporting those affected by road traffic crashes.* Geneva: World Health Organization; 2016.
11. Husum H, Gilbert M, Wisborg T, Van Heng Y, Murad M. Rural prehospital trauma systems improve trauma outcome in low-income countries: a prospective study from North Iraq and Cambodia. *J Trauma.* 2003;54(6):1188-1196.
12. Tiska MA, Adu-Ampofo M, Boakye G, Tuuli L, Mock CN. A model of prehospital trauma training for lay persons devised in Africa. *Emerg Med J.* 2004;21(2):237-239.
13. Adeloye D. Prehospital trauma care systems: potential role toward reducing morbidities and mortalities from road traffic injuries in Nigeria. *Prehosp Disaster Med.* 2012;27(6):536-542.
14. Vakili MA, Mohjervatan A, Heydari ST, et al. The efficacy of a first aid training course for drivers: an experience from northern Iran. *Chin J Traumatol.* 2014;17(5):289-292.
15. Wisborg T, Murad MK, Edvardsen O, Husum H. Prehospital trauma system in a low-income country: system maturation and adaptation during 8 years. *J Trauma.* 2008;64(5):1342-1348.
16. Jayaraman S, Mabweijano JR, Lipnick MS, et al. First things first: effectiveness and scalability of a basic prehospital trauma care program for lay first-responders in Kampala, Uganda. *PLoS One.* 2009;4(9):e6955.
17. Geduld H, Wallis L. Taxi driver training in Madagascar: the first step in developing a functioning prehospital emergency care system. *Emerg Med J.* 2011;28(9):794-796.
18. Khorasani-Zavareh D, Khankeh HR, Mohammadi R, Laflamme L, Bikmoraki A, Haglund BJ. Post-crash management of road traffic injury victims in Iran. Stakeholders' views on current barriers and potential facilitators. *BMC Emerg Med.* 2009;9.
19. Elmqvist C, Brunt D, Fridlund B, Ekebergh M. Being first on the scene of an accident--experiences of 'doing' prehospital emergency care. *Scand J Caring Sci.* 2010;24(2):266-273.
20. Sun JH, Wallis LA. The emergency first aid responder system model: using community members to assist life-threatening emergencies in violent, developing areas of need. *Emerg Med J.* 2012;29(8):673-678.
21. World Bank. *Thailand: Making Transport More Energy Efficient.* 2009.

22. World Health Organization. *Strengthening care for the injured: success stories and lessons learned from around the world.* Geneva: WHO press; 2010.
23. Fuangworawong P, LaGrone LN, Chadbunchachai W, Sornsrivichai V, Mock CN, Vavilala MS. Assessment of trauma quality improvement activities at public hospitals in Thailand. *Int J Surg.* 2016;33, Part A:88-95.
24. Yongchaitrakul T, Juntakarn C, Prasartritha T. Socioeconomic inequality and road traffic accidents in Thailand: comparing cases treated in government hospitals inside and outside of Bangkok. *Southeast Asian J Trop Med Public Health.* 2012;43(3):785.
25. Chadbunchachai W. Road traffic accident management system. *Bangkok Medical Journal.* 2014;5.
26. Jaldell H, Lebnak P, Amornpetchsathaporn A. Time is money, but how much? The monetary value of response time for Thai ambulance emergency services. *Value Health.* 2014;17(5):555-560.
27. Ong ME, Cho J, Ma MH, et al. Comparison of emergency medical services systems in the pan-Asian resuscitation outcomes study countries: Report from a literature review and survey. *Emerg Med Australas.* 2013;25(1):55-63.
28. Rahman NH, Tanaka H, Shin SD, et al. Emergency medical services key performance measurement in Asian cities. *Int J Emerg Med.* 2015;8:12.
29. Yeeheng U. Factors Associated With Successful Resuscitation of Out-of-Hospital Cardiac Arrest at Rajavithi Hospital's Narenthorn Emergency Medical Service Center, Thailand. *Asia Pac J Public Health.* 2011;23(4):601-607.
30. Suriyawongpaisal P, Aekplakorn W, Tansirisithikul R. A Thailand case study based on quantitative assessment: does a national lead agency make a difference in pre-hospital care development in middle income countries? *Scand J Trauma Resusc Emerg Med.* 2014;22(1):75.
31. Mahaisavariya B. Musculoskeletal trauma service in Thailand. *Clin Orthop Relat Res.* 2008;466(10):2323-2328.
32. Brown TR, Geyer JA, Taghavy A, Mitchell BP, Ragland DR. Prehospital Care of Road Traffic Injuries in Chiang Mai, Thailand. *Safe Transportation* Research & Education Center. 2004.
33. Phusavat K, Anussornnitisarn P, Meeampol S, Sooksmarn S, Rassameethes B, Siripachana T. Roles of public participation in developing and sustaining a networked government. Management, Knowledge and Learning International Conference; 19-21 June 2013; Zadar, Croatia. http://www.toknowpress.net/ISBN/978-961-6914-02-4/papers/ML13-471.pdf Accessed Janaury 12, 2017.
34. Thailand Accident Research Center and Toyota Motor Thailand Co. L. *Road Safety Audit on Mittraphap Road.* 2008.
35. Mohan D, Tiwari G, Khayesi M, Nafukho FM. *Road traffic injury prevention training manual.* World Health Organization; 2006.
36. Bloom BS. Taxonomy of educational objectives. Vol. 1: Cognitive domain. *New York: McKay.* 1956:20-24.
37. Pullum JD, Sanddal ND, Obbink K. Training for rural prehospital providers: a retrospective analysis from Montana. *Prehosp Emerg Care.* 1999;3(3):231-238.