



Does the Use of Lights and Sirens on Ambulances Affect Pre-hospital Time?

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Abstract

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BACKGROUND: The use of lights and sirens (L&S) alerts other drivers of the presence of an ambulance and that they are required yield, increasing the speed and safety of emergency medical services (EMS) operations. However, there have been no studies examining the effect of L&S on pre-hospital time conducted in Thai EMS agencies.

AIM: The aim of the study was to compare the operation times of ambulances with and without the use of L&S.

METHODS: This was a cross-sectional study consisting of patients over 18 years of age assessed and treated through the Srinagarind Hospital EMS between April 2019 and March 2020. Data were collected from the Srinagarind Hospital EMS operation database and hospital information database system.

RESULTS: A total of 1764 patients were enrolled, 1426 (80.8%) of whom were transported in an ambulance that used L&S. The mean age of patients in the L&S group was 45.2 ± 6.2 years and 742 (52.0%) were male. The average response times in the L&S and non-L&S groups were 10.2 min and 18.2 min, respectively ($p < 0.001$). Average L&S transport time was 11.1 min and non-L&S transport time was 17.1 min ($p = 0.008$).

CONCLUSIONS: The use L&S reduced the response and transport times of EMS operations but not affect on-scene time.

Introduction

The role of emergency medical services (EMS) is to care for patients with urgent health problems at the scene of an incident. In Thailand, The National Institute for Emergency Medicine (NIEM) is the agency responsible for EMS. There are currently over 15,000 ambulances in operating Thailand, a number which increases annually. The standard operating procedure is to use lights and sirens (L&S) to alert other vehicles that they need to yield. The red and blue lights can be seen at a distance of at least 500 feet, and the siren is at least 120 decibels. Section 76 of Thailand's 1979 Road Traffic Act requires that drivers who see on-duty emergency vehicles must pull over to the left side of the road. The use of L&S has been shown to access pre-hospital patients rapidly and increase safety of staff on the ambulance [1], [2], [3], [4], [5].

However, the use of L&S is not always beneficial. One reason is that drivers do not always comply with these rules. A study in India, for example, found that only 27.5% of car users on the road gave way to ambulances using L&S [6]. Many studies have also shown that the

use of L&S may actually cause more accidents due to the fact that drivers may increase their speed to avoid an approaching ambulance [7], [8]. In addition, the use of L&S has been deemed inappropriate in the delivery of non-urgent patients [9], and it may not affect the outcomes of trauma patients [10]. However, this is the first study conducted to compare the operation times of ambulances with and without the use of L&S in Thailand.

Methods

Study population and design

This was a cross-sectional study consisting of patients over 18 years of age assessed and treated through Srinagarind Hospital EMS between April 2019 and March 2020. The exclusion criteria were missing data and having been referred from other hospitals. Ethics approval was provided by the Khon Kaen University Ethics Committee for Human Research (HE631279). The requirement for informed consent from the patients was waived since patient confidentiality

protection had been guaranteed by identifying them by unique study numbers rather than by name. Data were recorded using the operation national standard checklist for EMS in Thailand. Data were collected from the Srinagarind Hospital EMS operation database and hospital information database system.

Statistical analysis

The sample size was calculated based on the findings of a Ross study [10]. To achieve a significance level of 5% and power of test of 0.8, we determined that a sample size of 1764 would be required. Statistical analysis was performed using SPSS for Windows version 16.0 (SPSS Inc., Chicago, IL, USA). Categorical data were presented as percentages, and continuous data were presented using means and standard deviations. Univariable analysis was performed using a two-sample t-test for numerical data and a Chi-squared test or Fisher's exact test for data comparison between the two groups.

Definitions

Response time was defined as the time from the 1669 center call receipt to arrival on scene. On-scene time was defined as the time between the responding ambulance arriving on location and its departure with the patient to the emergency department. Transport time was defined as the time from departure from the scene to arrival at the hospital.

Results

A total of 1764 patients were enrolled between April 2019 and March 2020 (Table 1), 1426 (80.8%) of whom were transported in an ambulance using L&S. The mean age of the patients in the L&S group was 45.2 ± 6.2 years, and 742 (52.0%) were male. Operations were most commonly performed between 4:00 and 11:59 pm in both groups. Non-trauma patients accounted for 67.0% and 61.0% of all cases in the L&S and non-L&S groups, respectively. The severity

Table 1: Characteristics of the subjects

Characteristics	L&S (n = 1426), n (%)	Non-L&S (n = 338), n (%)	p-value
Age (years) Mean \pm SD	45.2 \pm 6.2	40.8 \pm 5.6	0.845
Sex: Male	742 (52.0)	176 (52.1)	0.936
Operation time			
8:00 am–3:59 pm	575 (40.3)	142 (42.0)	0.622
4:00 pm–11:59 pm	590 (41.4)	155 (45.9)	0.520
0:00 am–7:59 am	261 (18.3)	41 (12.1)	0.648
Type			
Non-trauma	956 (67.0)	206 (61.0)	0.322
Trauma	470 (33.0)	132 (39.0)	0.369
Severity according to the Thai Criteria Based Dispatch for EMS color code			
Red	120 (8.4)	35 (10.4)	0.842
Yellow	354 (24.8)	84 (24.9)	0.654
Green	952 (66.8)	219 (64.7)	0.752

L&S = Lights and siren, SD: Standard deviation, EMS: Emergency medical services.

of patients' signs and symptoms according to the Thai Criteria Based Dispatch for EMS color code in the L&S group was red in 8.4% of cases, yellow in 24.8% of cases, and green in 66.8%.

The average response times in the L&S and non-L&S group were 10.2 min and 18.2 min, respectively ($p < 0.001$; Table 2). The average L&S transport time was 11.1 min and non-L&S transport time was 17.1 min ($p = 0.008$). The average distance to the scene of an incident was 2.2 km (IQR 1.9–2.7) in the L&S group.

Table 2: EMS operation times

Operation time	L&S (n = 1426), n (%)	Non-L&S (n = 338), n (%)	p-value
Response time (min), median (IQR)	10.2 (7.5–13.4)	18.2 (15.1–24.2)	<0.001*
On scene time (min), median (IQR)	8.6 (6.4–22.1)	9.2 (7.5–31.4)	0.684
Transport time (min), median (IQR)	11.1 (9.3–13.5)	17.1 (14.1–22.4)	0.008*
Average distance to scene (km), median (IQR)	2.2 (1.9–2.7)	2.4 (2.1–4.1)	0.352

*Statistical significance, IQR: Interquartile range, L&S: Lights and siren, mins: Minutes, km: Kilometer.

Subgroup analysis of critical patients with cardiac arrest and trauma revealed that the average response time of ambulances using L&S was significantly lower than that of those not using L&S (9.4 vs. 17.6 min in cardiac arrest patients [$p < 0.001$] and 8.9 vs. 18.3 min in trauma patients [$p < 0.001$]; Table 3).

Table 3: Operation time in subgroup analysis

Operation time	L&S	Non-L&S	p-value
Cardiac arrest patients (n = 32)			
Response time (min), median (IQR)	9.4 (6.2–12.6)	17.6 (14.6–23.6)	<0.001*
Transport time (min), median (IQR)	14.2 (8.1–23.5)	21.8 (14.1–32.1)	0.020*
Trauma patients (n = 602)			
Response time (min), median (IQR)	8.9 (6.4–14.3)	18.3 (15.1–19.6)	<0.001*
Transport time (min), median (IQR)	14.4 (9.2–21.1)	22.3 (18.1–34.2)	0.014*

*Statistical significance, IQR: Interquartile range, L&S: Lights and siren, mins: Minutes.

Discussion

This study compared EMS operation time with and without the use of L&S. One of the critical functions of EMS is to provide rapid access to patients to assess their symptoms and provide emergency treatment. Although the use of L&S is intended to shorten access time, there is debate as to whether it actually does so [8], [9], [10].

We found that in Thailand, L&S reduces response and transport time in both general emergency patients and those with critical conditions (cardiac arrest and trauma). Previous studies have found that only 60% of vehicles yield to ambulances, which delays access to patients. When ambulances do not use L&S, drivers will often fail to yield, which negatively affects response and transport times. According to the 2013 NIEM guidelines, L&S should only be used when the ambulance is being dispatched to patients triaged by telephone as either red- or yellow-level severity. However, we found that not using L&S on the ambulance results in delays in

patient access and delivery to the hospital, regardless of severity code [1], [2] [3], [5], [8].

We also found that the use or non-use of L&S did not affect on-scene time, as this depends on the time it takes to assess of symptoms and provide treatment, rather than traffic conditions. According to the study, it is the duty of the operating unit to specify the way in which the EMS works should be used to reduce the time to reach patients. The present study was limited in that data were gathered from only one EMS center and in that the study design was retrospective, which may have resulted in incomplete data collection [11], [12], [13], [14], [15].

Conclusion

The use L&S on ambulances reduced response and the transport times for EMS operations but did not affect on-scene time.

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References

1. Murray B, Kue R. The use of emergency lights and sirens by ambulances and their effect on patient outcomes and public safety: A comprehensive review of the literature. *Prehosp Disaster Med* 2017;32(2):209-16. <https://doi.org/10.1017/s1049023x16001503>
PMid:28134063
2. Neulander MJ, Siddiqui DI, Mountfort S. *EMS Lights and Sirens*. Treasure Island, FL: StatPearls Publishing; 2020.
3. Prohn MJ, Herbig B. Evaluating the effects of a simulator-based training on knowledge, attitudes and driving profiles of German ambulance drivers. *Accid Anal Prev* 2020;138:105466. <https://doi.org/10.1016/j.aap.2020.105466>
PMid:32087394
4. Andrew E, Jones C, Stephenson M, Walker T, Bernard S, Cameron P, *et al*. Aligning ambulance dispatch priority to patient

- acuity: A methodology. *Emerg Med Australas* 2019;31(3):405-10. <https://doi.org/10.1111/1742-6723.13181>
PMid:30232835
5. Nehme Z, Andrew E, Smith K. Factors influencing the timeliness of emergency medical service response to time critical emergencies. *Prehosp Emerg Care* 2016;20(6):783-91. <https://doi.org/10.3109/10903127.2016.1164776>
PMid:27487018
 6. Modi PD, Solanki R, Nagdev TS, Yadav PD, Bharucha NK, Desai A, *et al*. Public awareness of the emergency medical services in Maharashtra, India: A questionnaire-based survey. *Cureus* 2018;10(9):e3309. <https://doi.org/10.7759/cureus.3309>
PMid:30456003.
 7. Watanabe BL, Patterson GS, Kempema JM, Magallanes O, Brown LH. Is use of warning lights and sirens associated with increased risk of ambulance crashes? A contemporary analysis using national EMS information system (NEMESIS) data. *Ann Emerg Med* 2019;74:101-9. <https://doi.org/10.1016/j.annemergmed.2018.09.032>
PMid:30648537
 8. Missikpode C, Peek-Asa C, Young T, Hamann C. Does crash risk increase when emergency vehicles are driving with lights and sirens? *Accid Anal Prev* 2018;113:257-62. <https://doi.org/10.1016/j.aap.2018.02.002>
PMid:29444480.
 9. Burns B, Hansen ML, Valenzuela S, Summers C, Van Otterloo J, Skarica B, *et al*. Unnecessary use of red lights and sirens in pediatric transport. *Prehosp Emerg Care* 2016;20(3):354-61. <https://doi.org/10.3109/10903127.2015.1111477>
PMid:26808349.
 10. Ross DW, Caputo LM, Salottolo KM, Coniglio R, Mayfield TR, Mains CW, *et al*. Lights and siren transport and the need for hospital intervention in trauma patients. *Prehosp Emerg Care* 2016;20(2):260-5. <https://doi.org/10.3109/10903127.2015.1076094>
PMid:26382707
 11. Apiratwarakul K, Srimookda N, Phungoen P, Ienghong K, Tiamkao S, Bhudhisawasdi V. Presepsin levels in emergency patients with bacterial and viral infection. *Open Access Maced J Med Sci* 2020;8:20-3. <https://doi.org/10.3889/oamjms.2020.3204>
 12. Apiratwarakul K, Jumroenkhetpratheep K, Ienghong K, Ruttanaseeha W, Buranasakda M, Bhudhisawasdi V. Hand hygiene of emergency medical service healthcare providers. *J Med Assoc Thai* 2020;103:8-10.
 13. Ienghong K, Kulsutcharit K, Apiratwarakul K, Gaysonsiri D, Mitsungrern T, Bhudhisawasdi V. Characteristics and mortality in high, intermediate, and low-risk acute pulmonary embolism patients in the emergency department. *J Med Assoc Thai* 2020;103:42-6.
 14. Apiratwarakul K, Mitsungrern T, Thatphet P, Ienghong K, Ruttanaseeha W, Bhudhisawasdi V. Management of anaphylactic patients by emergency medical services. *J Med Assoc Thai* 2020;103:11-4.
 15. Apiratwarakul K, Ienghong K, Gaysonsiri D, Buranasakda M, Bhudhisawasdi V, Tiamkao S. Role of motorcycle-based ambulance (motorlance) in major sporting events. *J Med Assoc Thai* 2020;103:15-7.