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

Korakot Apiratwarakul¹, Kamonwon Ienghong¹*, Vajarabhongsa Bhudhisawasdi¹, Dhanu Gaysonsiri², Somsak Tiamkao³

¹Department of Emergency Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand; ²Department of Pharmacology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand; ³Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand

Abstract

BACKGROUND: The use of lights and sirens (L&S) alerts other drivers of the presence of an ambulance and that they are required to 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
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 0:00 am–7:59 am and 2019–2020 (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 0:00 am–7:59 am and 8:00 am–3:59 am 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 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 groups 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.

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).

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

Table 1: Characteristics of the subjects

| Characteristics | L&S (n = 1426) | Non-L&S (n = 338) | p-value |
|-----------------|---------------|------------------|---------|
| Age (years) Mean±SD | 45.2 ± 6.2 | 40.8 ± 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 | 950 (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.

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 |

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

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

Acknowledgments

The authors would like to thank Jirananh Thedmee, Thanyaporn Simsen, and Siwaporn Kwansanei for their data analysis and statistical review and Dylan Southard for acting as English consultant.

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