Is Ambulance Transport Time With Lights and Siren Faster Than That Without?


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Is Ambulance Transport Time With Lights and Siren Faster Than That Without?

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Study objective: To determine whether ambulance transport time from the scene to the emergency department is faster with warning lights and siren than that without.

Design: In a convenience sample, transport times and routes of ambulances using lights and sirens were recorded by an observer. The time also was recorded by a paramedic who drove an ambulance without lights and siren over identical...
routes during simulated transports at the same time of day and on the same day of the week as the corresponding lights-and-siren transport.

Setting: An emergency medical service system in a city with a population of 46,000.

Participants: Emergency medical technicians and paramedics.

Results: Fifty transport times with lights and siren averaged 43.5 seconds faster than the transport times without lights and siren \( t=4.21, P=.0001 \).

Conclusion: In this setting, the 43.5-second mean time savings does not warrant the use of lights and siren during ambulance transport, except in rare situations or clinical circumstances.


INTRODUCTION

The use of warning lights and siren (L&S) by prehospital emergency medical service (EMS) vehicles is a long standing, accepted practice for emergency medical vehicle response and patient transport. Use of L&S by ambulances is a daily occurrence in most communities in the United States. There is substantial risk associated with ambulance crashes in terms of injury, death, and financial costs. [1] A national press clipping service documented 298 emergency medical vehicle collisions from October 1, 1989, to September 30, 1990, that resulted in 537 injuries and 62 deaths (Jeff J Clawson, MD, written communication, February 14, 1994). Despite the widespread use of L&S, no study has demonstrated or strongly suggested that use of L&S saves time or lives. [1] [2] Indeed, a recent study suggests that use of medical protocols to dictate use or nonuse of L&S during transport results in infrequent use of L&S without adverse patient outcome. [3] The National Association of EMS Physicians (NAEMSP) and the National Association of State EMS Directors (NASEMSD) 1994 position paper "Use of Warning Lights and Siren in Emergency Medical Vehicle Response and Patient Transport" notes the need for studies demonstrating that the use of L&S saves significant time over routine driving methods. [1] The purpose of this study was to determine whether ambulance transport time from the scene to the emergency department is faster with L&S than without L&S.

MATERIALS AND METHODS

We prospectively studied ambulance transport time from the scene to the ED by comparing a control group using L&S with an experimental group that did not use L&S. In the L&S group, an observer on the ambulance recorded the route using a city map and transport time by stopwatch from the scene to the ED during patient transports. In the non-L&S group, time was recorded by a paramedic for identical routes when he drove the ambulance during simulated transports. The driver in the non-L&S group was instructed to obey the speed limit, traffic laws, and traffic signs. Each non-L&S transport was performed at the same time of day ±5 minutes.

TABLE 1 -- Mean and ranges of transport times, in seconds.
<table>
<thead>
<tr>
<th>Type of Transport</th>
<th>Mean±SD</th>
<th>Range</th>
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<tbody>
<tr>
<td>L&amp;S</td>
<td>362±167</td>
<td>104-927</td>
</tr>
<tr>
<td>Non-L&amp;S</td>
<td>406±183</td>
<td>129-881</td>
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</table>

and on the same day of the week as the corresponding L&S transport. All transports were to a university medical center's ED located within the city limits and involved distances of 8 miles or less. The citywide speed limit is 35 mph unless otherwise posted. The city has a population of 46,000.

The L&S transports were performed by the municipal EMS system in response to calls to the community's emergency 911 service. During the study period, the system had no policy regarding use or nonuse of L&S during transport. All vehicles were certified as ambulances complying with the rules and regulations of the North Carolina Office of Emergency Medical Services. External identifying markings regulated by the state on each ambulance include the Star of Life, the word "ambulance," and red flashing warning lights on each side of the ambulance. Each ambulance was painted white, with red lettering and trim. The siren on each ambulance was capable of varying its pitch.

Because ambulance routes were identical and the time of day and day of the week were matched, we performed a \( t \) test for dependent means to compare the mean transport times of ambulances with and without L&S. An alpha level of .05 was used to determine the statistical significance of the obtained \( t \) value.

RESULTS

Emergency medical technician drivers in the L&S group had lived in the driving area an average of 5.49±4.53 years (range, 1 to 18 years); their years of EMS driving experience averaged 7.06±4.98 years (range, 1 to 18 years). The driver for all non-L&S transports had lived in the driving area 6 years and had 9 years of EMS driving experience at the time of the study. The mean and range of transport times for each group are presented in Table 1. The 50 transport times with L&S averaged 43.5 seconds faster than the transport times for the non-L&S group \( [t=4.21, P=0.0001] \). The time differences between each L&S transport and its corresponding non-L&S simulated transport ranged from 311 seconds (5 minutes, 11 seconds) faster with L&S to 169 seconds (2 minutes, 49 seconds) slower with L&S. The 5 minutes, 11 seconds--faster transport with L&S was an outlier in the time differences; the second greatest time savings with L&S was 162 seconds (2 minutes, 42 seconds). Thirty-eight (76%) of the transport times were faster with L&S, 11 (22%) were faster without L&S, and 1 (2%) was the same for each group.

In the L&S group, flashing red warning lights were used continuously during all transports. The siren was used continuously during none of the transports, was used intermittently in 41 (82%) of the transports, and was not used at all during 9 (18%) of the transports.

Forty-one (82%) of the L&S transports and their corresponding non-L&S simulated transports were performed on weekdays. Road conditions were dry, and visibility was unimpaired for all transports with and without L&S. Light conditions for each group are described in Table 2.

DISCUSSION

Use of L&S during patient transport by ambulances to the ED averages 43.5 seconds faster than transports without L&S. Although the mean difference is statistically significant, it is not clinically significant, except in rare circumstances.

An average time saving of 43.5 seconds with L&S during patient transport would be clinically significant if an assessment or intervention (or both) that was not performed by prehospital care providers could be accomplished at the time of arrival in the ED and would make a difference in outcome. However, in very few situations or clinical circumstances would a 43.5 second--faster transport time to the ED make a difference in outcome. Applicable outcome measures here include mortality, lifestyle before illness or injury, return to work, hospital days, and cost.

In what circumstances would the average time saving of 43.5 seconds with L&S make a difference in patient outcome? As an example, the 43.5 seconds saved might decrease the amount of anoxic brain damage in an infant with airway obstruction that cannot be relieved by prehospital care providers, assuming that the obstruction is relieved within 43.5 seconds of the child's arrival at the ED. The most time saved using L&S in our study was 5 minutes, 11 seconds (an outlier; the second greatest time
saved with L&S was 2 minutes, 42 seconds). Five minutes, 11 seconds may make a positive difference in outcome in a patient with a gunshot wound to the heart, in whom an ED thoracotomy might be lifesaving. A logistic circumstance that would warrant savings in transport time would be malfunction of a defibrillator during care of a cardiac arrest patient. These uncommon situations must be considered in view of the dangers associated with L&S transport.

Many EMS responses are to patients who do not have conditions requiring advanced life support (ALS) care or interventions. A retrospective study published in 1991 showed that ALS EMS units were spared from initial dispatch in 14,100 of 35,075 (40.2%) EMS incidents when EMS dispatchers used a few questions to identify calls requiring ALS. Only 1.8% (254) of those cases subsequently required or involved ALS procedures. [4] Another study published in 1990 demonstrates that by using a priority medical dispatching system, patients who sustain prehospital arrest or a critical condition can be successfully differentiated from less critical patients. [5] Clearly those patients without conditions requiring ALS do not require L&S transport.

For those patients who do require ALS, the EMS system in this study and those in many others perform ALS interventions before the patient arrives in the ED. The ALS capability frequently precludes the need for transport with L&S that results in only minimal time savings.

One published study suggests that medical protocols can be used to determine which patients can be transported without L&S without adverse medical outcome. [3] Most patients (92%) were transported without L&S; there were no adverse patient outcomes related to those transports. [3]

In public safety trade journals, few studies have had findings similar to those reported here. One report compared the response times of an ambulance driven with L&S with the response times of an unmarked passenger car that followed all traffic laws. The ambulance was faster than the car by approximately 60 seconds. [6] The EMS system and geographic area for that study were not described. Another study of emergency vehicle response in Salt Lake City demonstrated that fire pumper and paramedic-staffed fire engines using L&S while responding within their initial-response districts in urban or suburban areas experienced a 9% to 28% reduction in response times. Reduction depended on the time of day and concentration of semaphores, or visual signaling apparatuses, encountered. It was found that the maximum saving occurred during rush hour, when emergency vehicles traveled in the same direction of main flow, and when there was a traffic light at every block. The average time saved in these responses was 30 seconds. [2]

<table>
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<tr>
<th>Time of Day</th>
<th>L&amp;S (%)</th>
<th>Non-L&amp;S (%)</th>
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<tr>
<td>Daylight</td>
<td>39 (78)</td>
<td>23 (46)</td>
</tr>
<tr>
<td>Dusk/daybreak</td>
<td>4 (8)</td>
<td>6 (12)</td>
</tr>
<tr>
<td>Night</td>
<td>7 (14)</td>
<td>21 (42)</td>
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*Although all non-L&S, simulated transports were carried out at the same time of day, the increased night and dusk/daybreak light conditions reflect a change from Daylight Savings Time for the L&S group to Eastern Standard Time for the non-L&S group.

The minimal time savings with L&S demonstrated in this study must be balanced against the risks associated with its use. There are many reports of ambulance crashes during L&S responses and transports resulting in injuries or deaths, and dollar costs. It has been estimated that as many as 12,000 emergency medical vehicle crashes occur each year in the United States and Canada as a direct result of L&S use. [2] In addition, because of the "wake effect" of emergency units confusing and startling other drivers, up to five times as many accidents are caused by units responding with L&S that do not physically involve the emergency vehicle itself. [2]

In New York state, 1,412 ambulance crashes occurred between January 1, 1984, and December 31, 1987, resulting in 1,894 injured ambulance occupants and six fatalities. [8] In Tennessee, 102 ambulance crashes were reported to the Tennessee Department of Health and Environment's Division of Emergency Medical Services from January 1, 1983, to July 1, 1986.
Forty-eight ambulances (47.1%) were responding to an "emergency" (lights and sirens); 54 (51%) were responding to a "nonemergency." Forty-nine ambulances (48%) were responding to a call for help; 40 (39.2%) were transporting a patient to the hospital; 3 (2.9%) were returning from a call; and 10 (9.8%) were parked at the time of the crash. When the ambulance was responding or transporting on an "emergency traffic" basis (lights and siren), the crash was more likely to yield an injured victim than when the vehicle was responding or transporting on a "nonemergency traffic" basis (routine driving). Twenty-nine of those crashes contributed to a total of 65 injured victims and one death. The mean delay time to receiving hospital care after the crash was 9.4 minutes. [9]

The National Highway Traffic Safety Administration reported that in 1990, 25 ambulances were involved in crashes in which 31 persons were fatally injured. Twenty were occupants of the other vehicle in the crash, 6 were occupants of ambulances (1 driver and 5 passengers), and the remaining 5 were pedestrians struck by ambulances. Forty-eight percent of the ambulances were in "emergency use" at the time of the crash. [9] The NAEMSP and the NASEMSD have recommended that a national reporting system for emergency medical vehicle crashes should be established. [1]

Monetary losses from ambulance crashes have, in some venues, eclipsed those of any other negligence-related EMS problem. [1] One ambulance insurer suggests that the epidemic of ambulance crashes could dry up all sources of coverage; for every claim against an EMS service alleging defective medical care, there are seven related to ambulance collisions. [10]

The results from this study should prompt other EMS systems to evaluate the time savings with L&S use in their own area. This study showing minimal time savings with L&S transport was performed in a city with a population of approximately 46,000. Transport time savings may be different in rural or urban settings. Any time savings found with the use of L&S in other systems must be considered in the context of the clinical circumstances in which the time saved will make a difference in patient outcome and must be balanced against the risk of an ambulance crash with its potential for injury, death, and monetary costs. A limitation of this study was that EMT drivers knew that the observer was timing the transport time. However, the purpose of the study was not discussed with any of the EMTs, and other intervals were also timed by the observer.

Although the sirens on the ambulances in this study are similar to those used on other ambulances in the United States, the siren is a severely limited warning device, effective only at short ranges and very low speeds. [11] In this study the siren was never used continuously during any of the transports, was used intermittently in 82% of the transports, and was not used at all during 18% of the transports. This pattern of variable siren use is common practice in our system and other EMS systems. Further investigations should specifically address the impact of nonuse, intermittent use and continuous use of the siren on transport time.

Another limitation in this investigation was use of simulated patients when transports were repeated without lights and siren. The impact of transporting a real versus a simulated patient on driving is unknown. We did instruct the driver for the non-L&S group to obey the speed limit and traffic laws and signs, and we believe this would need to be part of any EMS system's policy for transport without L&S. Use of the simulated patient is a confounding variable but enabled us to control for time of day ±5 minutes, day of the week, and location.

Light conditions (Table 2) may have resulted in longer mean transport times for the non-L&S groups. Because of decreased visibility, non-L&S transports performed during night or dusk/daybreak conditions may have had longer transport times compared with their corresponding L&S transports performed in daylight.

CONCLUSION

We conclude that in the setting in which this study was conducted, the 43.5-second mean time savings with warning L&S does not warrant use of L&S during ambulance transport, except in extremely rare situational or clinical circumstances. We support the NAEMSP and the NASEMSD position that the use of warning L&S during an emergency response to the scene and during transport should be based on standardized protocols that take into account situational and patient problem assessments, and that EMS system medical directors should participate directly in the development of policies governing the use of L&S. Further studies to determine time savings with L&S in other EMS systems, especially those in urban and rural areas, are needed so that each system can rationally balance any time savings with L&S against the risks associated with their use.
REFERENCES


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