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The Impact of Using Emergency Lights and Sirens During Noncritical Patient Transport

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Abstract

Introduction: Unnecessary use of lights and sirens during transport of noncritical patients is a major cause of vehicle crashes contributing to injury and death among emergency medical technicians (EMTs), patients and bystanders. This study examines whether EMT stress levels and ambulance transport times differ as a function of using lights and sirens, and whether EMTs support policies for their use.

Methods: Data for this quasi-experimental quantitative study was collected from 80 New Jersey EMTs using the Depression Anxiety Stress Scale. Results were assessed for ambulance transport times for noncritical patients and EMT stress levels, both with and without the use of lights and sirens. Data were analyzed using the *t* test and regression procedures.

Results: Analysis shows no statistically significant difference in transport times with lights and sirens in use compared to when they were not used. Findings are statistically significant in the undue and increased stress level of the EMTs when lights and sirens are used. Participants demonstrated support for a policy for their use.

Conclusion: Findings suggest that the use of lights and sirens in transporting noncritical patients is unnecessary.

Practical applications: Recommendations include the development of a state Emergency Medical Services policy to provide guidelines on the use of lights and sirens, or a system that allows for the objective evaluation of whether the situation warrants the use of lights and sirens. The implications for positive social change include savings of money, property and, most importantly, human lives.

Introduction

Lights and sirens used in responding ambulance calls by emergency medical services (EMS) have been regarded as acceptable practice among EMS providers aiming for a quicker response time [1]. However, responding to emergency calls using lights and sirens increases the chance of the responding ambulances being involved in vehicular accidents [1]. Emergency response may cause rescuers to experience panic and stress that may jeopardize public safety.

Objectives

The purpose of this study is to examine the use of emergency lights and sirens in nonemergency situations and any occupational stress experienced by emergency medical technicians (EMTs) and paramedics operating in the pre-hospital environment, i.e., transport.

Research sought to determine (a) Whether the use of lights and sirens results in significantly decreased transport times to hospitals; (b) Whether the stress levels of EMS providers operating ambulances with lights and sirens while transporting noncritical patients causes undue and increased stress levels on the EMS providers; and (c) Whether EMTs and paramedics operating in New Jersey support a policy dictating the use of emergency lights and sirens during noncritical patient transports.

Background

EMS transport has inherent risks to both patients and workers in emergency situations [2]. Work-related hazards such as injuries during lifting, assaults and biological exposure are among the documented risks [3]. However, ambulance operation by EMS professionals poses greater morbidity and mortality due to occupational stress [3-5].

On-duty fatalities recorded among EMS were from vehicle crashes [4]. The majority of these vehicular incidents are associated with ambulances with activated emergency lights and sirens, killing occupants in the ambulance.

Although there have been numerous studies on the use of emergency lights and sirens, there are no empirical studies that calculate and compare the transport times of ambulance services, with and without use of lights in sirens, in New Jersey. There are also no studies to explore the impact of lights and sirens on stress of EMS professionals.

Materials and Methods

Materials

Based on the theory of Lazarus [6], as adopted by Becker [4], relating to occupational stress among EMS because of the amount of exposure to disasters, suffering, catastrophe and difficult work schedules, this study used a quasi-experimental correlations study to measure the transport time and stress levels (dependent variables) of the participants with the transfer of noncritical patients to hospitals driving the same route with and without using emergency lights and sirens (independent

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variables.) Noncritical patients are defined as those who do not have a life-threatening condition.

The Depression Anxiety Stress Scale (DASS) was used to measure the stress levels of the EMS providers. (See Appendix for the 14 stress level questions from the DASS that were administered.) Participants were asked to circle the appropriate severity rating as follows;

- Did not apply to me at all.

- Applied to me some degree, or some of the time.

- Applied to me to a considerable degree, or a good part of the time.

- Applied to me very much, or most of the time.

- The following research questions (RQ) and hypotheses (H) were posed.

- RQ1: Does the use of lights and sirens result in a statistically significant decrease in transport times of noncritical care patients to the hospitals?

- $H_0 1$: The use of lights and sirens does not result in a statistically significant decrease in transport times of noncritical care patients to hospitals.

- H11: The use of lights and sirens results in a statistically significant decrease on transport times of noncritical care patients to hospitals.

- RQ2: What is the perspective of EMTs and paramedics employed by the Valley Hospital Emergency Services department regarding a policy dictating when they can use emergency lights and sirens during noncritical patient transports?

- $H_0 2$: Not greater than 50% of the EMTs employed by the Valley Hospital Emergency Services department support a policy dictating when they can use emergency lights and sirens during noncritical patient transports.

- $H_1 2$: Greater than or equal to 50% of the EMTs employed by the Valley Hospital Emergency Services department support a policy dictating when they can use emergency lights and sirens during noncritical patient transports.

- RQ3: Is the use of lights and sirens during noncritical patient transport statistically significantly correlated with an increase in the stress levels of EMTs and paramedics?

- $H_0 3$: There is no statistically significant correlation in the stress levels of EMS providers when they operate ambulances with emergency lights and sirens while transporting noncritical patients.

- $H_1 3$: There is a statistically significant correlation in the stress levels of EMS providers when they operate ambulances with emergency lights and sirens while transporting noncritical patients.

Data considered in the experiment were location of the emergency call, the time transport to the emergency department was initiated, and the time the ambulance arrived at the emergency department.

Methods

The population of the studies included EMTs and paramedics at a hospital in New Jersey. The EMS respond to approximately 7,500 transports. There are close to 100 EMTs and paramedics in the EMS. A sample of 80 EMS providers was gathered to investigate stress in order to achieve a power of at least 80%, or a medium effect size. A sample of 88 EMS providers was gathered for a survey regarding the development of a policy dictating when to use emergency lights and sirens during noncritical patient transport. Psychometric measures were used to ensure the questionnaires would be reliable in measuring constructs for the study.

A key distinction between the present study and most of the research on emergency personnel is that this study focuses on the transit to the site of the 911 call or the hospital as opposed to the scene or aftermath of the response. According to a nationwide study of Norwegian ambulance personnel, ambulance-specific stressors were rated as both more frequent and more severe than organizational stressors [7]. A stressor can be defined as any stimulus that causes a stress response from an individual, which taxes their physiological or psychological resources and possibly elicits a subjective physical or mental strain [8].

- This study made four assumptions about the survey instruments and the selected participants.

- The sampling method of selecting 100 EMS employees of a hospital in New Jersey will provide information regarding stress levels and the employees' perspective on the development of a policy dictating when they can use emergency lights and sirens during noncritical patient transports.

- All participants respond truthfully to the self-assessment of the DASS instrument and not use the assistance, contribution, evaluation or opinion of others.

- All participants give accurate responses.

- In the quasi-experimental study, all transport times are measured accurately and the same way for each sample.

The quasi-experimental correlation study is appropriate because allows for exploration of variables considering the assignment of participants to random groups. In this study, participants were randomly assigned to groups using and not using lights and sirens. The design is appropriate when there is manipulation of the predictor variable and treatments or interventions are considered for the setting of the study and the population [9]. Fraenkel and Wallen [10] stated that quasi- experimental research is "the only type of research that directly attempts to influence a particular variable and it is the best type for test hypotheses about relationships".

The study manipulated the conditions in which noncritical patients are transported to the hospitals. People were hired to act as noncritical patients. Participants who volunteered to participate were randomly assigned to two groups: Group 1 involved those who were asked to use the lights and sirens of their ambulances while Group 2 participants were restricted to not using them. All participants were asked to take the same route. People hired to act as patients came from the same pick-up point and were brought to the same hospital.

Discussion with EMS staff resulted in gaining their expressed written permission to conduct the study. The decision to approach the individual EMS staff members was important for the research, as the intent of the study was to reduce bias by providing non-threatening invitations to participate in the proposed study. All participants remained anonymous. Each was assigned a number to identify them in analysis.

Theory and Calculations

Theory

Factors considered in calculating sample size were the power, the effect size and the level of significance in the study. The power of the study is based on the probability of rejecting a false null hypothesis. Generally, the minimum power of a study that would be necessary to reject a false null hypothesis would be equal to 80% [11]. The effect size is the measurement of the strength of the relationship between the independent and dependent variables in the analysis [12]. A medium effect size was used since this is not too strict nor too lenient in statistically evaluating the responses of participants.

The correct calculation of the requisite sample requires the level of significance and the statistical procedure. The level of significance is usually set at an alpha equal to a 5% level of significance, which is typically the standard for statistical significance in the social sciences. The main analysis that was used to test the hypotheses posed for this study is a paired samples t test. For this test, the sample size also depends on whether the hypothesis is one-tailed or two-tailed. The hypothesis for this study suggests there would be a significant difference between the transport times to hospitals of ambulance services as well as the stress levels of EMS providers driving the exact same route, with and without using lights and sirens, indicating that a two-tailed test be used.

The minimum sample size required for this study would be 34 (specified as a medium effect size, a power of 80% and a level of significance equal to 3%). The sample size for this study was calculated in G* Power using the Paired Samples t test. The target population for this study was large enough to provide the sample size desired. There were 100 EMS providers. The study sought to gather at last 80. As only 34 participants were necessary for the paired sample analysis, only 34 trials were conducted for the measurement of transport times. However, the rest of the 100 EMS providers ware surveyed regarding their stress levels and whether or not they use sirens and lights when transporting medical patients. This determined whether there was a statistically significant relationship between the variables considered.

The exact same route, departure time and arrival time were used to measure transport times. The same clock was used to record times. Participants travelling the same route at the same time were identified as a pair, ensuring that their transport times were compared in the paired samples analysis. Transport time was calculated as the difference between the arrival time and the departure time. The control group used lights and sirens, while the quasi-experimental group did not. The quasi-experimental group was asked to used lights and sirens in the whole process of transporting their patients.

This research can lay the groundwork for future researchers to collect similar data, but with a different analysis procedure; specifically, an independent samples t test to establish the existence of statistically significant differences between the stress levels of EMTs when emergency lights and sirens are used or not used. Data could be used to identify a specific impact of the use of emergency lights and sirens in the transport of noncritical patients on EMTs and paramedics.

Another avenue for further exploration is the civilian response to the use of emergency lights and sirens in transporting noncritical patients. Related literature reveals that vehicular collisions involving ambulances are associated with the driving public's response to ambulances driving in emergency mode [13].

Calculations

Scores for stress scale were calculated using a range of 0 to 41. If the total score fell within 0 to 13, he or she was classified as "normal." If the score fell within the range of 14 to 17, this indicated "mild stress." If between 18 to 25, it indicated a moderate stress level; between 6 to 33, severe stress level; between 34 and 42, extremely severe stress level. Stress scale of the DASS was determined to have a Cronbach's alpha value of 0.91, implying that it is reliable in measuring the symptoms of stress among participants.

In addition, participants were asked to rate their perspective on developing a policy dictating when they can use lights and sirens on a scale of 0% to 100%. Responses to this question were used to assess whether the EMTs and paramedics support such a policy.

Data analysis in this study included summary statistics, paired sample t test, one-sample t test, independent samples t test and linear regression. Descriptive statistics were computed and include frequency distributions as well as measures of central tendency. For the frequency distributions, the number and percentage off each occurrence were presented for demographic variables in the study. The measures of central tendency included presenting the mean, standard deviation, minimum and maximum values for the dependent variables in the study. The dependent variables included the stress levels of participants and the transport times measured. The independent variables were the classification of participants to group 1, wherein they used lights and sirens when transporting noncritical patients, and group 2, wherein they did not use lights and sirens when transporting noncritical patients to the hospitals.

For research hypothesis 1, a paired samples t test was used to assess whether there was a statistically significant difference between ambulance services that have used the same route at the same time using or not using lights and sirens. If a significant difference was identified, it determined which method resulted in shorter transport times. For research hypothesis 2, a one-sample t test was used to compare the responses of participants asked to rate their support of a policy dictating when they can use emergency lights and sirens during noncritical patient transport. The rate of the responses was compared to 50% to determine the outcome. For research hypothesis 3, an independent samples t test was used to assess whether the stress levels for those participants classified under Group 1 (using) were statistically significantly different from the stress levels of those participants classified under Group 2 (not using). A two-tailed analysis and a significance level of 0.05 were used for all statistical analyses.

Results and Discussion

Measurement of stress levels with and without the use of emergency lights and sirens in the transport of non-critical patients. Results are based on the responses of 80 participants.

In a frequency analysis of 14 DASS responses (See Appendix or Table 1 for the 14 DASS questions) measuring reactions ranging in four levels from "not at all" to "very much, most of the time," data shows a statistically significant difference between the distribution of respondents' scores with and without the use of emergency lights and sirens. When lights and sirens were used, the scores were more evenly divided among the four responses. When lights and sirens were not used, the distribution of the responses were mostly composed of scores 1 and 2, indicating lower levels of stress when working.

A descriptive analysis to identify the measures of central tendency for both data sets (with and without) resulted in an overall score of 28.30 (Table 1). As this falls within the 26-33 range, it indicates a "severe stress level." When emergency lights were not used, the average score drops

to 19.03 (Table 2), meaning the stress level drops from a "severe" to a "moderate" classification. Based on the analysis of variance (ANOVA) shown in Table 2, this decrease is statistically significant.

- Measurement of perception about a policy dictating when lights and sirens can be used (Table 3).

The majority of participants (81.8%) supported a policy dictating when lights and sirens can be used during transport of noncritical patients with the condition that medical expense and clinical judgment dictates the use. Based on results, 95.4% showed support for a policy. The 95.4% proportion was statistically significantly different from 50% (z (87)=20.33, p<0.001). Therefore, Null Hypothesis 2 was rejected.

Table 4 presents descriptive statistics on the length of trips (in minutes) using emergency lights and sirens or not. These statistics are based on a sample of 34 trips. The time of each trip was measured using emergency lights and sirens and not using them. The average number of minutes was only slightly lower when using lights and sirens (M=14.026) than when not using them (M=14.882).

- Measurement of the difference between transport times by ambulances driving the exact same route, with and without the use of emergency lights and sirens. (Research Question 1) (Significance level was set at 0.05.)

The difference in trip length between trips using lights and sirens and not using them was not statistically significant (t (33)=-1.160, p=0.254). Therefore, Null Hypothesis 1 could not be rejected (Table 5).

An analysis of variance was conducted to determine if the use of

Answer Options	Frequency	Percent
I support a policy dictating when emergency lights and sirens can be used during noncritical patient transport	12	13.6%
I support a policy dictating when emergency lights and sirens can be used during noncritical patient transport with the condition that my medical expertise and clinical judgment dictate their use	72	81.8%
I do not support a policy dictating when emergency lights and sirens can be used during noncritical patient transport	3	3.4%
I do not have an opinion either way regarding when emergency lights and sirens can be used in noncritical patient transport	1	1.1%

Table 3: Perceptions about policy dictating when emergency lights and sirens can be used (n=88).

Variables	Min	Max	M	SD
With lights & sirens	8.00	24.00	14.206	3.89078
Without lights & sirens	9.00	22.00	14.882	3.60778

Table 4: Descriptive statistics of length of trips to hospital in minutes (n=34).

Difference	M	SD	t	df	p-value
Using lights & sirens- Not using	-0.67647	3.39983	-1.160	33	0.254

Table 5: Paired samples t test comparing transport times to hospital.

emergency lights and sirens accounts for the difference in transport times (Table 6). The results of the ANOVA corroborate the results of the t test previously conducted and indicate that the use of emergency lights and sirens does not account for differences in the transport times of noncritical patients to hospitals (F (1,66)=0.553, p=0.460).

Similarly, results of the linear regression shown in Table 7 indicate the proposed model is not statistically significant and only accounts for 0.8% of the variance in the transport times (p=0.460) and that the use of emergency lights and sirens has no significant effect on transport times.

- Measurement of the perspective of EMTs and paramedics employed by The Valley Hospital Emergency Services department regarding a policy dictating when they can use emergency lights and sirens during noncritical patient transport (Research Question 2).

A z test of proportions was conducted to compare the proportion of individuals who supported the policy with 50%. The significance level was set at 0.05.

Results of the data analysis indicate that there are no statistically significant differences between the transport times when emergency lights and sirens are used and when they are not used. This resulted in the validation of the first Null Hypothesis, which stated that there are no significant differences between the transport times to hospital emergency rooms of ambulances driving the exact same route, with using emergency lights and sirens or without using them.

The survey of EMTs and paramedics who participated expressed support for the policy dictating when emergency lights and sirens are to be used during noncritical patient transport. Their agreement stipulates that their individual medical expertise and clinical judgment dictate when emergency lights and sirens should be used. A test of proportions was conducted to determine if the percentage of respondents who agreed was statistically significantly different from 50%, the percentage stated in the null and alternative hypotheses. Based on the results, the percentage who supported the policy (95.4%) is significantly different from 50% at *p<0.001.*

DASS Item	With L & S		Without L & S	
	M	SD	M	SD
I found myself getting upset by quite trivial things	2.1	0.963	1.4	0.65
I tended to over-react to situations	2.2	1.084	1.54	0.693
I found it difficult to relax	1.7	0.833	1.28	0.499
I found myself getting upset rather easily	2.3	1.017	1.23	0.42
I felt that I was using a lot of nervous energy	1.8	0.999	1.0	0.0
I found myself getting impatient when I was delayed in any way (e.g. traffic, civilian vehicles, triage nurses)	2.61	1.097	1.73	0.795
I felt that I was rather touchy	1.96	1.073	1.31	0.542
I found it hard to wind down	1.53	0.695	1.23	0.42
I found that I was very irritable	2.01	1.044	1.22	0.444
I found it hard to calm down after something upset me	1.81	0.915	1.45	0.571
I found it difficult to tolerate interruptions to what I was doing	2.32	1.087	2.32	1.087
I was in a state of nervous tension	1.85	1.057	1.14	0.347
I was intolerant of anything that kept me from getting on with what I was doing	2.04	1.163	1.15	0.359
I found myself getting agitated	2.19	1.126	1.11	0. 318
DASS Overall Score	28.3	9.86	19.03	2.960

Table 1: Descriptive statistics on DASS Items (n=80).

Variables	Group	M	SD	F (1,158)	p-value
DASS Scores	With lights & sirens	28.19	2.95954	64.35	---
	Without lights & sirens	19.03	9.77739	---	---

Table 2: Results of analysis of variance-DASS Scores.

Variables	Group	M	SD	F (1,66)	p-value
Transport times	With lights & sirens	14.2059	3.89078	0.553	0.460
	Without lights & sirens	14.8824	3.60778	--	--

Table 6: Results of analysis of variance-Transport times to hospital.

Model	B	Std. Error	t	Sig.
Constant	14.882	0.643	23.129	--
Use of lights & sirens	-0.676	0.910	-7.43	0.460

Table 7: Regression results-Effects of using lights and sirens on transport times.

The last data analysis used data from the DASS, measuring the stress levels of the EMTs and paramedics with using emergency lights and sirens and without using them. A mean score of $M - 28.30$ indicates a severe stress level of the EMTs and paramedics when lights sirens are used. A mean score of $M - 19.03$ indicates moderate stress levels when lights and sirens are not used. The results of the ANOVA indicate the differences between the two scores are statistically significant, and the use of emergency lights and sirens accounts for the difference. Results of the linear regression also indicate that the use of emergency lights and sirens significantly affects the stress levels of EMTs and paramedics resulting in higher stress scores when emergency lights and sirens are used.

Conclusion

Based on the findings of the data analysis and the review of the related literature, the use of emergency lights and sirens when transporting noncritical patients to a hospital emergency room is unnecessary. The findings are consistent with the conclusions of prior researchers, who found that the use of emergency lights and sirens does not reduce transport times [14-16]. While the analysis on the data collected for this study reveals a decrease in transport time, results of the *t* test confirmed that these differences are not statistically significant.

Previous researchers also have stated that the use of emergency lights and sirens not only does not decrease transport time, but also increases the risk of vehicular collisions [17-21]. As these patients are not in a life-threatening condition, the reduced transport time that results from the use of emergency lights and sirens is not seen as a benefit worth the cost of causing vehicular accidents that may result in worse injuries or loss of life for the patient, the EMTs or paramedics and other bystanders. Results of the data analysis indicate there are no statistically significant differences between the transport times when emergency lights and sirens were used and when they were not used. This resulted in the validation of the first null hypothesis, which stated that there are no significant differences between the transport times to hospital emergency rooms of ambulances driving the exact same route, with or without using emergency lights and sirens.

The survey of EMT and paramedic participants demonstrates support for a policy dictating when emergency lights and sirens are to be used during transport of noncritical patients. However, their agreement stipulates that their individual medical expertise and clinical judgment dictate their use.

Practical applications

This study indicates that the current Emergency Medical Services (EMS) policy of using emergency lights and sirens in the transport of noncritical patients is ineffective in terms of safety and efficiency. The findings should be presented to emergency medical personnel with the goal of creating awareness that the current policy does not result in better healthcare for patients and, indeed, poses a greater danger to them, the emergency providers and bystanders.

Previous researchers have stressed the importance of changing policies related to the use of emergency lights and sirens transport noncritical patients and the need for additional research, education and training on the subject. This study adds to the body of knowledge supporting the idea that existing policies do not improve patient outcomes. Conclusions may be used to guide policy makers, both in the government and in the medical field when it comes to preventing vehicular accidents associated with transport of noncritical patients resulting in the injury of additional people. Through the findings and recommendations in this study, the number of injuries and accidents involving ambulances may be reduced significantly.

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