EVALUATION OF INNOVATIVE
EMERGENCY VEHICLE ALERT SYSTEM (EVAS)
PREPARED BY
WAYNE STATE UNIVERSITY/TRANSPORTATION RESEARCH GROUP
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INTRODUCTION

Emergency vehicles, including police cars, fire trucks, and ambulances, are often subjected to substantial risks while traveling to and from incidents, particularly at intersections. To minimize that risk, an Emergency Vehicle Alert System (EVAS) has been developed to warn motorists of approaching emergency vehicles. E-Light, LLC has developed a system that utilizes 235 high output amber LED lights mounted on a fixture that is 28.375 inches wide and 13.875 inches high and displays an image of a fire truck to alert drivers to the presence of an emergency vehicle approaching an intersection. This system requires the emergency vehicles to be equipped with a transmitter that can be activated on demand and a receiver located on the light assembly that can detect the presence of approaching vehicles. When an emergency vehicle begins a run, the transmitter inside the vehicle is activated and a signal is relayed to the receiver as it approaches the intersection. The transmitted signal can be detected from a distance of up to 2,000 feet. The City of Dearborn Heights, Mi. and Wayne County, agreed to participate in the experimental use of these innovative traffic control device based upon their concerns to minimize emergency vehicle involved incidents and emergency vehicle related delay through an advanced warning system at intersections.

Three intersections were selected in the City of Dearborn Heights, Michigan for testing of the EVAS. The study sites were selected in consultation with Wayne County and the Dearborn Heights Police Department. WSU-TRG assisted the Dearborn Heights Police Department (DHPD) in developing a procedure for experimental testing at the selected intersections. The DHPD conducted experimental trial runs at each of the three selected intersections “before” and “after” the installation of the EVAS. Data collection was

conducted for 6 hours at each location during the “Before” period and for an additional 6 hours at each location during the “After” period. Emergency personnel were instructed to conduct the simulated runs in an identical manner prior to and after installation of the EVAS. The data collection team consisted of four members of the WSU-TRG who simultaneously recorded motorist and pedestrian behavior on all four intersection approaches using video cameras. The video recordings were used to document both the safety and operational characteristics at each intersection during the emergency vehicle runs with and without the EVAS at the study intersections.

The installation of the EVAS is expected to improve the safety characteristics of the test intersections. Principally, the system was designed to increase safety at intersections by warning approaching drivers of an approaching emergency vehicle. The most direct measure of effectiveness for such a safety device is the number of traffic crashes experienced at each treated location. Consequently, the request for permission to experiment submitted to the FHWA initially stated that “before” and “after” crash data would be analyzed in order to determine system effectiveness.

STATISTICAL ANALYSIS

Table 1 presents the summary statistics for each of the variables collected as a part of the study. The statistics represent the total data from all three study intersections and the data values were obtained by examining each of the videos recorded as a part of the six field studies. The effect of the EVAS was then examined using appropriate statistical techniques as presented in the following section.

Table 1. Data Summary Table

Variable	"Before"	"After"
Number of Runs	41	38
Percentage of Vehicles Yielding	76.6%	97.4%
Percentage of Vehicles Yielding in Right Lane	78.9%	98.6%
Percentage of Vehicles Yielding in Center Lane	59.3%	93.2%
Percentage of Vehicles Yielding in Left Turn Lane	80.0%	100.0%
Percentage of Vehicles Yielding Early	36.6%	77.1%
Percentage of Vehicles Yielding Late	14.8%	6.7%
Violations	56	6
Crossing Violations	49	6
Right Turn Violations	3	0
Left Turn Violations	4	0
Traffic Conflicts	3	0
Time between First Yield and Emergency Vehicle Arrival (sec)	5.91	19.34
Time between Last Violation and Emergency Vehicle Arrival (sec)	3.33	6.00
Clearance Time for Emergency Vehicle (sec)	5.27	4.21
Time Until Traffic Restarts (sec)	8.78	9.03

PERCENTAGE OF VEHICLES YIELDING

In an optimal situation, all vehicles arriving at an intersection while an emergency vehicle is approaching will yield the right-of-way by pulling over to the side of the right side of the road and allowing the emergency vehicle to pass. As the percentage of vehicles yielding to the emergency vehicle increases, the safety potential of the intersection increases, as well. Results of the z-Test for the percentage of vehicles yielding are presented in Table 2. The percentage of compliant motorists (or yielding vehicles) was increased from 76.6% to 97.4% after the EVAS was installed.

Table 2.Percentage of Vehicles Yielding

Lane(s)	**All Lanes**	
Condition	**"Before"**	**"After"**
Number of Vehicles Observed	242	229
Percentage of Vehicles Yielding	75.6%	97.4%
z-statistic	6.843	
Significant Difference?	Yes	

Vehicles were classified as yielding even if they yielded immediately after crossing the intersection. However, in an optimal situation, vehicles would yield prior to crossing the intersection. By examining the proportion of vehicles which yielded after crossing the intersection, or "yielded late", "before" and "after" the EVAS was installed, further insight is provided as to the effectiveness of the devices. Results of the z-Test for the percentage of vehicles yielding late are presented in Table 3. During the "before" period, 14.75% of vehicles yielded after crossing the intersection. In the "after" period, this percentage was reduced to 6.73%. Consequently, the EVAS was shown to effectively increase the proportion of yielding motorists and decrease the proportion of motorists who yielded after crossing the intersection.

Table 3. z-Test for Percentage of Vehicles Yielding Late

Lane(s)	Left Through Lane	
Condition	**"Before"**	**"After"**
Number of Vehicles Yielding	183	223
Percentage of Vehicles Yielding Late	14.75%	6.73%
z-statistic	2.643	
Significant Difference?	Yes	

SUMMARY AND CONCLUSIONS

The objective of this study was to determine the effectiveness of an Emergency Vehicle Alert System (EVAS) at improving intersection safety during emergency vehicle runs. A field experiment was conducted at three intersections in the City of Dearborn Heights, Michigan to assist in the determination of effectiveness. Driver behavior was recorded at each location "before" and "after" the installation of the EVAS. The statistical significance of the effectiveness of the EVAS was tested in order to better understand whether the changes observed in the measures of effectiveness are attributable to the utilization of the EVAS. A summary of the findings is as follows:

- The EVAS was found to consistently improve those measures of effectiveness associated with safety.
- The number of violations was reduced from 56 in the period "before" EVAS installation to only 6 in the period "after" installation.
- Driver compliance with the EVAS experienced a substantial increase from 76.6% in the "Before" period to 97.4% in the "After" period.

- Drivers were also found to yield sooner and, if they violated the EVAS, they tended to do so sooner. Both of these findings indicate that the drivers are becoming aware of the approaching emergency vehicle sooner and can consequently make a quicker and more well-informed decision when reaching the intersection.
- The amount of time necessary for emergency vehicles to clear the intersection was found to decrease after EVAS installation, which may be partially explained by increased confidence on the part of the emergency vehicle driver.
- Drivers tended to resume moving approximately 9 seconds after the emergency vehicle exited the intersection. Consequently, this appears to be a reasonable cutoff point for the EVAS.

Overall, the Emergency Vehicle Alert System (EVAS) was found to be effective at improving safety of both the traveling public and the emergency vehicle drivers at the test intersections. The EVAS led to greater driver compliance and fewer violations. Furthermore, even when violations occurred, this generally happened much earlier, mitigating the hazard posed to both drivers. Based on the evidence collected, it appears the EVAS is an effective means of improving motorist awareness of approaching emergency vehicles and, consequently, an effective means of improving safety.