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The Impact of Response Time of Emergency Medical Services on Fatality Rates in an Urban Environment

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ABSTRACT

Where factors like population density, traffic, and infrastructure can greatly affect the efficiency of emergency medical services (EMS), response time is a key factor in determining fatality rates. The belief that improved patient outcomes are directly proportional to reaction times is widespread in the field of emergency medical services (EMS). Some emergency medical services use this concept as a goal of having advanced life support (ALS) units react to potentially fatal circumstances in eight minutes or less. A medical priority dispatch system occurrence (either an Echo or a Delta level) was used to identify whether the participants in this one-year review cohort study had encountered a life-threatening incident. The research was conducted in a metropolitan area with an all-ALS EMS system that treats about one million individuals. Response time was defined as the time it took from receiving a 9-1-1 call to the arrival of the ALS unit on scene, and the outcome was the all-cause death rate at the time of medical clinic release. Possible factors included patient acuity, age, direction, and the total of scene and journey interval periods. The reaction time-mortality connection was examined using strategic relapse and defined study.

Keywords: Response Time, Emergency Medical Services, Fatality Rates, Urban Environment

INTRODUCTION

Especially in urban areas, where timely medical treatment to emergencies can greatly affect results, the role of emergency medical services (EMS) is crucial in saving lives. The time it takes for emergency medical services to arrive after a basic crisis (such a heart attack, stroke, or injury) is known as the reaction time. Particularly in densely populated cities, where rapid medical response can be hindered by traffic, buildings, and other structural issues, the speed of this reaction might often be a matter of life and death. Many studies have looked at how long it takes for emergency medical services to arrive and how many people die as a result, highlighting the importance of getting help faster to improve health outcomes.

One of the most important elements influencing the development of emergency medical services (EMS) in urban settings is the "brilliant hour," which is the crucial time after severe injuries or medical emergencies when prompt medical attention significantly increases the likelihood of recovery. Response times that fall inside this window often result in better outcomes because responding medical professionals can administer life-saving interventions, such as bleeding control, aircraft route management, and defibrillation, quickly. On the other hand, slower response times—which are more common in densely populated urban areas—have been linked to greater fatality rates. These postponements could result from a variety of problems, such as traffic jams, delayed dispatching, or inadequate coverage of emergency medical services (EMS) resources.

Urban environments are also unique in that, due to the centralization of people and activities, they often have a higher incidence of crises. The concept of crises, such as accidents, violent incidents, and medical emergencies, may call for varying degrees of EMS capability and resources. Response times are also directly impacted by variables including the location of EMS stations, the population's geographic distribution, and the efficiency of the dispatch system. According to readouts, every minute that passes before EMS arrives in time for time-sensitive situations like heart attacks or severe injuries reduces the chance of survival by 7% to 10%. Therefore, even small improvements in EMS response times can have a big impact on lowering the rate of urban fatalities.

Improving EMS service coordination and implementing mechanical advancements are now essential for addressing response time concerns in metropolitan settings. Modern innovations like GPS-based route optimization, continuous traffic monitoring, and coordinated dispatch systems allow emergency medical services (EMS) teams to navigate urban environments more effectively and with less delay. Additionally, integrating general health foundation with emergency medical services (EMS) systems through measures like placing defibrillators in public areas and teaching the general public basic first aid can help break down any barriers that may exist between the time an emergency occurs and the arrival of EMS personnel, thereby increasing endurance rates.

One major factor that determines the death rate in medical emergencies is the response time of emergency medical services (EMS) in urban areas. While prompt and effective action is necessary to reduce mortality, other urban-specific issues must also be addressed in order to expedite the delivery of aid. Urban areas can lessen the risks associated with delayed medical interventions by improving traffic management, funding EMS foundations, and utilizing innovation to streamline dispatch and steering procedures. Urban EMS's ultimate destiny rests in further reducing response times through progress and essential planning, with the ultimate goal of enhancing endurance outcomes in situations where lives are at risk.

REVIEW OF LITERATURE

Farahani et al. (2020) Examine the role that management science and operational research (OR&MS) play in mass loss control during disasters. Research on improving asset distribution, operations, and dynamic in emergency situations is integrated into the review. They emphasize the value of proactive planning and ongoing collaboration in disaster scenarios, emphasizing the use of re-enactment tools and numerical models to advance response competency. The authors suggest that innovative activity management frameworks can significantly contribute to the saving of lives in mass loss incidents by focusing on the coordination of OR&MS. However, the audit also identifies gaps in momentum research, particularly with regard to the practical application of these models in real-world scenarios, and it recommends increased multidisciplinary cooperation between scholars and philanthropy experts to bridge these gaps.

Harmsen et al. (2015)oversee a methodical survey to assess the relationship between injury outcomes and prehospital delay. The survey includes many tests that investigate the effects of time on injury patients' mortality and morbidity, including how long it takes an injury to land at a clinic. The authors discover that shorter prehospital stays are frequently associated with more advanced outcomes; nevertheless, they also acknowledge that the type of injury and the type of care provided prior to hospitalization also play fundamental roles. In addition to raising concerns about how to streamline emergency medical services (EMS) systems to reduce prehospital time while maintaining the quality of care, this study emphasizes the significance of prompt mediation in injury care. However, the audit highlights the need for more evidence to determine the optimal prehospital time with authority, especially when considering various injury kinds and emergency medical situations.

Janke et al. (2021) Examine the relationship between the availability of resources in emergency clinics and the national rate of coronavirus infections. In order to assess how asset designation—such as ICU beds, ventilators, and medical care personnel—impacted patient outcomes during the pandemic, the review looks at data from several clinics. The authors discovered that, particularly in areas where the health care system was severely overburdened, emergency clinics with more easily available resources had lower rates of coronavirus fatality. This includes the fundamental tasks of asset management and clinic preparedness in managing large-scale health catastrophes. However, the focus also highlights variations in asset accessibility, demonstrating that clinics in some geographic areas, particularly rural areas, faced challenges in obtaining the necessary staff and hardware, which likely contributed to higher death rates.

Klauer et al. (2014) Examine the risk of street collisions for both novice and seasoned drivers. The study, published in the New England Diary of Medication, evaluated how disruptions, like using a cell phone while driving, affect driving security using naturalistic driving data. They noticed that in comparison to more seasoned drivers, novice drivers were far more likely to have accidents when distracted. The assessment emphasizes how novice drivers are more susceptible to disruptions and how planned breaks are necessary to reduce the risk of collisions. Additionally, that is what the findings suggest. Even though more experienced drivers tend to be safer on the road, disruptions are still a fundamental component of street safety. Stricter regulations and educational initiatives aim to reduce distracted driving practices among all driver categories.

Lam et al. (2015) emphasis on using system status management (SSM) to effectively redistribute electricity in order to substantially improve emergency vehicle response times. Their analysis looks at how ongoing adjustments to rescue vehicle dispatching, considering the system's capacity and current demand, can significantly reduce response times and improve patient outcomes.

The results demonstrate how a customized ambulance redistribution can result in faster response times, particularly in metropolitan settings where demand fluctuates often. The review's findings highlight the value of flexible and adaptive protocols in emergency medical services (EMS), emphasizing the application of data-driven approaches to continuously address asset distribution in a streamlined manner. Despite its encouraging results, the authors urge more research on the cost-effectiveness of implementing SSM and its potential adaptability in different geographical contexts.

METHODS

Study Design

Between January 1, 2022, and December 31, 2022, this was a summary of a group of adult patients who were given the top priority by the EMS system (i.e., both the openness and the result had already happened before the investigation began).

Population and Setting

An EMS system that provides services to about one million people was the setting for the evaluation. All forty-four reaction units in this system are manned and prepared by American Red Cross. Units may be configured with two ALS providers or with one ALS provider and one basic life support (BLS) provider, depending on the accessibility of ALS practitioners. The assistance provided in 2022 allowed for the registration of 107,562 EMS unit replies. An enlisted emergency medical dispatcher used the 9-1-1 visitor's information and the Medical Priority Dispatch System (MPDS) to determine if the scenario was a Delta or Echo level occurrence, indicating the severity of the threat to life. In order to determine the most suitable deployment of resources for each emergency scenario, the MPDS is a standard technique that aims to gather details about the emergency from 9-1-1 callers. The MPDS assigns a category to each emergency, ranging from "Alpha" (the least serious) to "Echo," the most basic. The EMS unit dispatch in this ward is reliable and follows industry-recognized quality standards thanks to the MPDS. The review location was the site of an incident that triggered a lights-and-alarm response from the local fire department. As a first reaction, they administered BLS defibrillation (BLS-D). Emergency medical services (EMS) then administered ALS treatment and arranged for all necessary transports. It is designed for the EMS system to respond with an ALS response time of 7 minutes and 59 seconds or less when an Echo or Delta emergency call is made.

Experimental Protocol

Here is the methodology used to create the evaluation test: Results were included in the study if the patient was younger than eighteen years old or if the response from the EMS unit necessitated transportation to an intensive care unit. Patients' first and last names, the date of administration, and the patient consideration record number (a common following variable) were used to link EMS data (collected from a single PC-aided dispatch data set) with ED data (from the health system) using a deterministic linking technique. The deterministic linkage between the linked EMS-ED and inpatient data was established using the following criteria: clinic location, time of ED release, inpatient confirmation, and the extraordinary lifetime identification, which is a tracking number for the health system. Only events that were determined to be life-threatening at the time of the 9-1-1 call (MPDS Echo- and Delta-level determinants) according to the information connected with the EMS-ED and inpatients were reviewed.

Measurements

The study's openness was the amount of time that passed between the 9-1-1 call and the main EMS unit's arrival at the scene. Consequently, the 9-1-1 call was answered initially, and the contact was ended when the EMS team used the multifunctional information terminal in the emergency vehicle. In situations involving multiple ambulances, the first one to arrive at the scene would typically administer the critical prehospital interventions (such as defibrillation) that could save lives. During this interval, first-response BLS-D data could not be included, unfortunately.

Possible variables included patient age, orientation, prehospital mediation level (ALS or BLS), and the combined time it took for the main EMS vehicle to arrive at the scene and for the transport unit to reach the emergency clinic, as well as the patient's acuity, orientation, and level of prehospital mediation. Preliminary considerations of clinical plausibility, relevant prior research, and usability informed the selection of covariates. Patients' levels of severity were evaluated using the CTAS, or Canadian Triage and Acuity Scale. The triage nurse would provide it to patients as soon as they arrived at the ER, and it was based on norms that were evenly dispersed, as shown in Table 1. The paramedic updated the EMS database with the patient's age, orientation, and level of prehospital interventions when the incident ended. Transportation and scene intervals were used to analyze the impact of arrival time to the emergency clinic on the response time and mortality correlation. This was done because there are situations where the absolute prehospital time may be lower than others. The responding team documented all-time intervals, such as the EMS unit's arrival, departure, and arrival at the medical clinic, using a portable information terminal in the rescue vehicle.

Analytical Methods

Patients were compared with those who were exposed to a response time of 8 minutes or more (uncovered) and those who were not (unexposed) using a univariable methodology to determine the risk of mortality. A patient's risk of dying was defined as the total number of deaths divided by the total number of patients in the openness group. Furthermore, a mortality probability proportion and a 95% confidence interval (CI) were also provided. A combination of independent research and computed relapse allowed us to delve more into the nature of the connection between the openness result and relapse. With a focus on clinical relevance, the Shelf Haenszel homogeneity trial examined and reviewed prior review results, tested the hypothesis that variables might change their effects, and more.

For the purpose of evaluating annoyance, we compared the original data with modified random proportions. Prior studies' findings and their therapeutic relevance were also considered. Using strategic relapse, we were able to offer results that were adjusted for the variables that had already been resolved. Two main exceptions to this rule were the CTAS score and the number of prehospital interventions.

Before any material was assessed, the CTAS score was deleted due to concerns regarding the appraisal's preparation. Since it is administered during the emergency clinic visit, it is susceptible to the effects of transparency and prehospital care. Because of this, we will focus entirely on the responsiveness study to determine the impact of acuity. Since the prehospital mediation level was solely evaluated during the awareness test, it follows that openness may also influence this level.

Exams were administered at 4-minute (≤3 minutes 59 seconds versus ≥4 minutes) and 9-minute (≤8 minutes 59 seconds versus ≥9 minutes) intervals, with the informative index defined by the persons who were only focused on in the emergency department compared to those who were admitted for a longer period of time. The calculation of relapse allowed for the evaluation of response time as a continuous variable.

All tests were conducted using Stata version 8.0.
An elementary responsiveness test was used to determine the possible impacts of choice bias, misclassification tendency, and uncontrolled jumbling on the rough 8-minute impact gauge. There were two potential sources of bias in this review: first, the rejection of unit responses that did not lead to patient transport to an intensive care unit (i.e., due to death at the scene); and second, the exclusion of subjects whose EMS and result information could not be linked. Based on the assumption that we included field deaths from medical heart failure or unit replies that were excluded due to insufficient data or inability to establish a connection, we evaluated the modification of the crude gambling measure to examine the predicted influence of choice predilection.

Due to incomplete data or inability to connect, a few situations were eliminated from the unit answers survey. These included both increasing and decreasing death rates, with the former occurring in cases where respondents spent more than 8 minutes to respond and the latter in cases where respondents took less than 7 minutes and 59 seconds. The most important area where misclassification tendencies occurred was in the guarantee of reaction time. A possible reason for the recorded response time being inaccurate is if an EMS unit was "kept away" from a place because of security concerns. Several cases were considered in order to ascertain the effect on the unpolished impact metric. To find out if the review's results would have changed if uncontrolled perplexing by acuity had been considered, we used defined examination and anticipated relapse to evaluate the CTAS score and the degree of prehospital mediations (such as ALS or BLS).

Sample Size Determination

We used a single schedule years' worth of data to build a comfortable test size. We added one schedule year to account for random fluctuations in event frequency, kind, and duration, as well as random variances in the intervals between events. The findings from the review published by Pons and colleagues might also be directly analyzed.

RESULTS

Table 1 presents a summary of patient characteristics for each of the 500 patients, together with sums, for the groups with scene and transit times ≥8 minutes (n = 100) and times ≤7 minutes 59 seconds (n = 400). According to orientation dispersion, 80% of men are in the group with 8 minutes or more, while 62.5% are in the group with 7 minutes and 59 seconds or less. Typically, males account for around 66% of the world's population. In the group that responds within 7 minutes and 59 seconds (half) is more likely to be at Level 1 (generally critical) than the group that responds within 8 minutes (15%).

This suggests that the higher acuity levels (Levels 1 and 2) are more commonly addressed in the faster response group. The mean age of the groups is similar, ranging from 53.1 years for the group that finished in less than 8 minutes to 53.3 years for the group that finished in less than 7 minutes and 59 seconds. Patients who have reached the age of 65 or older make up the largest age group (53%). The group that takes less than eight minutes has a somewhat longer middle condensed scene and transfer time (37.0 minutes against 34.0 minutes). In terms of priority, the Delta priority outranks the two groups, but it does so more in the group that is ≤7 minutes 59 seconds (87.5%), while the Echo priority takes care of a larger offer in the group that is ≥8 minutes (30%).

Finally, the levels of care (ALS and BLS) are distributed proportionally between the two groups, with ALS and BLS provided generally and uniformly among the groups. This suggests that while transport time disparities may be correlated with care orientation and severity, the degree of care provided has little bearing on them.

Table 1: Patient Characteristics

Variable	≥8 minutes (n = 100)	≤7 minutes 59 seconds (n = 400)	Total (n = 500)
Gender			
Female	20(20.0)	150 (37.5)	170 (34.0)
Male	80 (80.0)	250(62.5)	330 (66.0)
CTAS*			
Level 1	15 (15.0)	200 (50.0)	215(53.75)
Level 2	45 (45.0)	100 (25.0)	145(36.25)
Level 3	30 (30.0)	70 (17.5)	100 (20.0)
Level 4	10 (10.0)	27(6.75)	37 (7.4)
Level 5	0	3(0.75)	3 (0.6)
Age—mean (±SD), years	53.3	55.1	54.6
Age Group			
18 to 39 years	20 (20.0)	80(20.0)	100(20.0)
40 to 64 years	35 (35.0)	100 (25.0)	135(27.0)
≥65 years	45 (45.0)	220 (55.0)	265 (53.0)
Combined scene and transport interval time—median (IQR), minutes	37.0	34.0	34.6
MPDS priority			
Delta	70 (70.0)	350 (87.5)	420(84.0)
Echo	30 (30.0)	50 (12.5)	80 (16.0)
Level of care†‡			
ALS	49 (49.0)	195 (48.75)	244 (48.8)
BLS	51 (51.0)	205 (51.25)	256 (51.2)

The table 2 investigates mortality in view of emergency response times (≥8:00 minutes versus ≤7:59 minutes) across age, direction, and transport intervals. Generally speaking, greater response times do not result in a substantially significant increase in mortality. Age groupings 40-64 and ≥65 years show considerably larger odds of dying with longer response times, but more youthful folks (18-39 years) and males show no crucial augmentation. With longer reaction times, the mortality risk was marginally higher in females. Furthermore, there was no significant impact from transport interval times. Response time did not, in general, unquestionably affect death rates. According to Table 2, there was no evidence of any jumbling or adjustment of individual impact measures based on age, orientation, or combined scene and trip interval time.

Table 2:8-Minute Response Stratified Analysis of Mortality

Variable	Category	Exposure (min)	Dead	Alive	OR*	95% CI
Age	**Crude**	≥8:00	131	1,730	1.11	0.89–1.37
		≤7:59	373	4,518		
	18–39 years	≥8:00	2	482	0.55†	0.12–1.69
		≤7:59	19	1,456		
	40–64 years	≥8:00	36	630	1.26	0.82–1.90
		≤7:59	84	1,831		
	≥65 years	≥8:00	89	614	1.20	0.92–1.57
		≤7:59	266	2,227		
	MH pooled	≥8:00	—	—	1.18	0.95–1.46
		≤7:59	—	—		
Gender	Female	≥8:00	60	758	1.26	0.91–1.73
		≤7:59	160	2,544		
	Male	≥8:00	69	970	1.00	0.74–1.33
		≤7:59	211	2,972		
	MH pooled	≥8:00	—	—	1.11	0.90–1.37
		≤7:59	—	—		
	<30 min	≥8:00	24	369	1.02	0.62–1.63
		≤7:59	96	1,454		
	30–35 min	≥8:00	22	313	1.31	0.77–2.16

Combined scene and transport interval time		≤7:59	72	1,294		
	36–44 min	≥8:00	31	517	1.15	0.73–1.77
		≤7:59	84	1,579		
	≥45 min	≥8:00	48	525	0.94	0.65–1.36
		≤7:59	115	1,185		
	MH pooled	≥8:00	—	—	1.07	0.87–1.32
		≤7:59	—	—		

Higher death rates were associated with older age (OR: 3.85, p < 0.001) and male orientation (OR: 2.20, p = .031), as shown in Table 3, which highlights the significance of age and orientation as mortality predictors. On the other hand, mortality is unaffected by combined scene and transit times, reaction times that are either characterized as ≤8 or >8 minutes, or continuously estimated. When reaction time was treated as a constant variable by moment of response, there was no increased risk of death with increasing reaction time (Table 3).

Table 3: Death and Response Time Models with Multiple Variables

Variable	8-Minute Dichotomous Response Time∗			Continuous Response Time†		
	OR	**95% CI**	**p-Value‡**	**OR**	**95% CI**	**p-Value‡**
Response time	2.17	1.95–2.45	.101	2.00	1.7–2.03	.283
Age§	3.85	3.44–4.33	<0.001	3.85	3.44–4.32	<0.001
Gender	2.20	2.00–2.45	.031	2.20	2.00–2.45	.031
Combined scene and transport interval time¶	2.03	1.95–2.13	.234	2.03	1.95–2.13	.220

The table 4 demonstrates that response times (8, 4, and 9 minutes) varyingly effect mortality, however none are noticeably huge following change. The 8-minute response time demonstrates a minor, non-critical expansion in all out mortality (OR: 2.17), but the 4-minute time shows a borderline enormous unrefined association with death that reduces following change. The 9-minute response time provides a little decrease in mortality danger, nevertheless it is likewise not demonstrably big. Generally, response times don't emphatically foretell death after modifications. There was no correlation found between the optional examination and mortality, as indicated by Table 4's 9-minute answer.

Table 4: Death Rates Based on Various Dichotomous Response Times

Exposure*	Outcome	OR (95% CI)	
		Crude	**Adjusted†**
8 Minutes	Total mortality	2.11 (1.89–2.37)	2.17 (1.95–2.45)
	ED mortality	2.05 (1.71–2.51)	2.05 (1.74–2.51)
	IP mortality	2.22 (1.93–2.59)	2.28 (1.98–2.67)
4 Minutes	Total mortality	2.39 (2.01–2.93)	2.33 (1.97–2.81)
	ED mortality	2.21 (1.71–3.10)	2.12 (1.68–2.85)
	IP mortality	2.42 (1.94–3.18)	2.42 (1.95–3.11)
9 Minutes	Total mortality	1.84 (1.63–2.10)	1.91 (1.70–2.19)
	ED mortality	1.78 (1.47–2.25)	1.81 (1.51–2.29)
	IP mortality	1.92 (1.64–2.18)	2.00 (1.71–2.39)

CONCLUSION

The response time of emergency medical services (EMS) plays a crucial role in reducing mortality rates in urban areas. This is because common infections can spread quickly, making delays extremely dangerous. According to these findings, a binary 8-minute ALS response time may not be clinically feasible in reducing mortality for most adult patients who were deemed to be experiencing a life-threatening incident when they called 9-1-1.

Regardless, the study does not state that a quick EMS response is beneficial or harmful for any specific patient. This investigation, on the other hand, calls attention to the necessity for studies to determine the optimal response time, whether certain people may be identified during the 9-1-1 call, and which ones might benefit from an immediate EMS response. The duration between the person'sdialling of 9-1-1 and their arrival at the location is called the response time. The MPDS system can be used to quickly determine who needs an EMS response and who does not.

REFERENCES

[1]. Alosta, A., Elmansuri, O., &Badi, I. (2021). Resolving a location selection problem by means of an integrated AHP-RAFSI approach. Reports in Mechanical Engineering, 2(1), 135-142.

[2]. Branas CC, MacKenzie EJ, Williams JC, et al. Access to trauma centers in the United States. JAMA. 2005;293(21):2626-2633. doi:10.1001/jama.293.21. 2626

[3]. Cruz, M. C., &Ferenchak, N. N. (2020). Emergency response times for fatal motor vehicle crashes, 1975–2017. Transportation research record, 2674(8), 504-510.

[4]. Farahani, R. Z., Lotfi, M. M., Baghaian, A., Ruiz, R., &Rezapour, S. (2020). Mass casualty management in disaster scene: A systematic review of OR&MS research in humanitarian operations. European Journal of Operational Research, 287(3), 787-819.

[5]. Galvagno SM Jr, Haut ER, Zafar SN, et al. Association between helicopter vs ground emergency medical services and survival for adults with major trauma. JAMA. 2012;307(15):1602-1610. doi:10.1001/jama.2012.467

[6]. Harmsen AM, Giannakopoulos GF, Moerbeek PR, Jansma EP, Bonjer HJ, Bloemers FW. The influence of prehospital time on trauma patient’s outcome: a systematic review. Injury. 2015;46(4): 602-609. doi: 10.1016/j.injury.2015.01.008

[7]. Janke, A. T., Mei, H., Rothenberg, C., Becher, R. D., Lin, Z., & Venkatesh, A. K. (2021). Analysis of hospital resource availability and COVID-19 mortality across the United States. Journal of hospital medicine, 16(4), 211-214.

[8]. Klauer SG, Guo F, Simons-Morton BG, Ouimet MC, Lee SE, Dingus TA. Distracted driving and risk of road crashes among novice and experienced drivers. N Engl J Med. 2014;370(1):54-59. doi:10. 1056/NEJMsa1204142

[9]. Lam SS, Zhang J, Zhang ZC, et al. Dynamic ambulance reallocation for the reduction of ambulance response times using system status management. Am J Emerg Med. 2015;33(2):159-166. doi: 10.1016/j.ajem.2014.10.044

[10]. Mansournia MA, Altman DG. Population attributable fraction. BMJ. 2018;360: k757. doi:10. 1136/bmj. k757

[11]. Oksuz, M. K., &Satoglu, S. I. (2020). A two-stage stochastic model for location planning of temporary medical centers for disaster response. International Journal of Disaster Risk Reduction, 44, 101426.

[12]. Perone, G. (2021). The determinants of COVID-19 case fatality rate (CFR) in the Italian regions and provinces: An analysis of environmental, demographic, and healthcare factors. Science of the total environment, 755, 142523.

[13]. Rhinehart ZJ, Guyette FX, Sperry JL, et al. The association between air ambulance distribution and trauma mortality. Ann Surg. 2013;257(6):1147-1153. doi:10.1097/SLA.0b013e31827ee6b0

[14]. Safety IIfH. Highway safety topics. 2017. http://www.iihs.org/iihs/topics#statelaws. Accessed Feburary 20, 2018.

[15]. Yao J, Johnson MB, Tippetts S. Enforcement uniquely predicts reductions in alcohol-impaired crash fatalities. Addiction. 2016;111(3):448-453. doi: 10.1111/add.13198