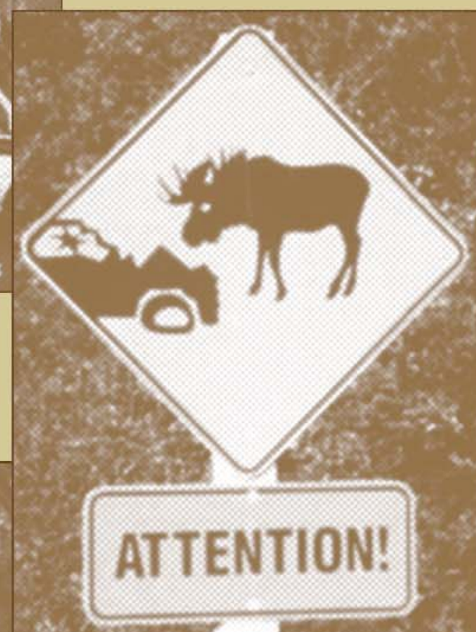
RURAL AMBULANCE CRASH:

LITERATURE REVIEW



U.S. Department of Health and Human Services
Health Resources and Services Administration (HRSA)
Office of Rural Health Policy (ORHP)

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Foreword

EMS professionals face many risks – exposure to infectious diseases, violence, hazardous scenes, and oncoming traffic, to name a few. However, none of these risks compares to the potential for death and injury that is associated with driving an ambulance. Every year dozens of EMS providers are killed and many more seriously injured in ambulance crashes. Rural EMS providers are at even greater risk because when the ambulance they are driving or riding in crashes, there is a greater likelihood that they will be killed or sustain a serious injury than is the case in urban areas.

There is a high degree of variability among EMS agencies when it comes to emergency vehicle operations training. Some agencies require such training during initial training, others may provide it as an option for continuing education, but many, many others do not require it at all. In a rural environment, where the dangers are high and the frequency of use is low, it is imperative that emergency vehicle operators be given all of the skills that they need to survive.

This document is not an emergency vehicle operations training program; there are many of those available. Contact your State or Commonwealth EMS agency for information concerning the location and availability of such training.

Marcia K. Brand, PhD
Associate Administrator for Rural Health, HRSA

This report is a review of the published research pertaining to ambulance crashes with a special emphasis on the rural environment. It is provided to give the reader an understanding of the magnitude of the risk that rural ambulance operators face every time they respond to an illness or injury. Armed with this knowledge, it is our hope that local EMS leaders in rural America will understand the need to screen prospective drivers, to implement training strategies, to adopt and enforce policies pertaining to warning light and siren responses, and to look for potential technological adaptations to improve driver performance.

If your agency does not have a policy pertaining to emergency vehicle operations, we hope that you will adapt, adopt, and enforce the sample that is provided in this report.

An ambulance crash that kills or maims a crew member can devastate a rural EMS agency. At a time when the sustainability of many volunteer EMS agencies is in doubt, such a tragedy can result in the loss of a critical health care resource within the community – that of timely, safe, and effective emergency medical care. We hope that this paper will be a call to action for your rural EMS agency.

Nels D. Sanddal
Director Rural EMS and Trauma Technical Assistance Center

INTRODUCTION

Unfortunately, ambulance crashes are relatively common. A lack of vehicle performance standards, maintenance, and proper safety restraint contribute to the human toll caused by at least 6,500 ambulance crashes a year (Zagaroli & Taylor, 2003). A study conducted in 2002, documented that the occupational motor vehicle fatality rate for emergency medical personnel was four times the national average for other occupations (Levick & Swanson, 2005).

Rural ambulance crashes are of great concern. They are usually much more severe than urban crashes because rural ambulances travel at higher speeds and thus there is greater potential for harm if a crash occurs. Further, the roadway typology, with narrower roads, few dividers, limited lighting, and no shoulders, in addition to slower emergency response times in the event of an ambulance crash, can make an already dangerous crash scene worse (Weiss, Ellis, Ernst, Land, & Garza, 2001). Ambulance crashes occurring on rural roadways are more likely to result in death to emergency medical personnel, the patient, and occupants of other vehicles. When a rural crash does not involve fatalities, there are often significant delays associated with the continued transportation of the initial patient. Often times, multiple ambulances must be dispatched from surrounding communities, resulting in transportation delays for the original patient as well as the "new" patients resulting from the ambulance crash itself.

Little is known about ambulance crashes in general and rural ambulance crashes specifically. This paper will review the current literature, discuss the implications for rural emergency medical service (EMS) agencies and personnel, and provide a sample policy or protocol that could be adapted for use in most communities.

LITERATURE SEARCH AND SELECTION

The literature search was conducted in a step-wise process. The purpose of the search was to identify published literature that describes the frequency, epidemiology, etiology, typology, and cost (human and fiscal) of ambulance crashes generally and rural ambulance crashes specifically.

The primary database selected for the literature search was MEDLINE (1996-2007). A secondary search was conducted using Academic Search Premier and Comprehensive Index of Nursing and Allied Health Literature. A final search was conducted using ProQuest Dissertation International. MeSH search terms used in MEDLINE included, ambulance; accident, traffic; emergency medical technician; occupational health; and rural in descending combination. The primary, secondary, and tertiary searches yielded 31 articles on the subject. Of those, four published in trade magazines and one appearing in a foreign medical journal were not retrievable on-line. Staff reviewed the remaining articles for relevance and, ultimately, included 26 in this review. A brief annotated bibliography follows.

ANNOTATED BIBILIOGRAPHY

Barishansky, R.M. (2005). Next generation ambulance puts safety first. *Emergency Medical Services,* 30, 34.

This descriptive article discusses the features of a "2nd" generation ambulance design that "puts safety first." Among the updated design functions, are external cameras for better driver visibility, improved seat placement and restraints systems for rear crew members, safety cargo netting to reduce the possibility of striking the bulkheads during a crash, more secure equipment storage, turn and brake signal indicators in the rear compartment to provide a visual warning of impending turns or stops, and changes in exterior paint and lighting. Additionally, the new vehicles come with "black box" monitoring and recording systems as standard equipment. The author concludes that these modifications may have an impact in both the avoidance of crashes and in the reduction of injury in the event of a crash.

Calle, P., Fonck, K., & Buylaert, W. (1999). Collisions involving mobile intensive care unit vehicles in Flanders, Belgium. *European Journal of Emergency Medicine, 6*(4), 349-353.

(Full-text not available on-line.)

Centers for Disease Control and Prevention (CDC). (2003). Ambulance crash-related injuries among emergency medical services workers–United States, 1991-2002. *MMWR: Morbidity and Mortality Weekly Report, 52*(8), 154-156.

The authors analyze the Fatality Analysis Reporting System for an 11-year period and describe the attributes of 300 fatal crashes involving ambulances that occurred during that time period. The 300 crashes resulted in 82 deaths among the 816 ambulance occupants (patients and emergency personnel). There were an additional 275 deaths to occupants of other vehicles and/or pedestrians.

Although acknowledged to be an imprecise estimate, the authors conjecture that 27 of the deaths were emergency personnel. The authors also cite Maguire, Hunting, Smith, & Levick (2002) estimated fatality rate of 12.7 per 100,000 EMS personnel; more than double the national average of on-the-job motor vehicle related mortality. The significant findings were: (1) the risk to unrestrained occupants; (2) one-third of the fatalities occurred in the front seats of the ambulance where seat belts were available, could have been used, but were not; and (3) 22 percent of the workers killed were in working unrestrained in the patient compartment. The report also illustrates three case examples gleaned from the National Institute for Occupational Safety and Health database. In each of the three case reports, the emergency care worker who died was unrestrained at the time of the fatal event.

Custalow, C., & Gravitz, C. (2004). Emergency medical vehicle collisions and potential for preventive intervention. *Prehospital Emergency Care, 8*(2), 175-184.

The authors draw on a database from the Paramedic Division of the Denver Health and Hospital Authority for a 9-year period. During that time period, there were 192 moving collisions involving ambulances. Thirty-nine of these resulted in injuries or death to 81 individuals. These injuries were sustained by 18 emergency vehicle operators, 19 emergency medical providers who were not drivers, 27 civilian drivers (including 2 deaths), 11 civilian passengers, and 2 patients being transported. While this article does not specifically discuss rural ambulance crashes, it does provide insight into the vectors involved in a crash, identifying the emergency vehicle driver, civilian driver, and environment as each contributing, to some varying degree, to ambulance crashes. The authors note that a disproportionate share (91 percent) of the crashes occurred while the vehicle was operating with lights and sirens. The study also noted that in 71 percent of the collisions the emergency vehicle operator had a record of multiple collisions.

The authors also note that crash-related vehicular claims constitute the greatest liability risk for an EMS agency. They report that in many States Good Samaritan laws exempt crashes involving emergency vehicles.

De Graeve, K., Deroo, K., Calle, P., Vanhaute, O., & Buylaert, W. (2003). How to modify the risk-taking behaviour of emergency medical services drivers? *European Journal of Emergency Medicine, 10*(2), 111-116.

This article represents the first of several that have reported the impact of "black boxes" on emergency vehicle driving behavior. The black box is an electronic device that monitors, in real time, several vehicle parameters such as speed, acceleration, braking and cornering. It is designed to provide auditory feedback to the driver when pre-defined limits are exceeded. The authors of this seminal work reported only moderate change resulting from the black box with ongoing feedback and performance monitoring. Interestingly, the authors also note that the change from a Volvo sports wagon to a more traditional ambulance vehicle resulted in less aggressive driving behavior.

Eckstein, M. (2004). *Primum non nocere*–first do no harm: An imperative for emergency medical services. *Prehospital Emergency Care, 8* (4), 444-446.

In this editorial the author reminds EMS providers that their first responsibility is to "do no harm" and challenges aggressive driving response tactics as violating that tenet. He notes that compared to other vehicles, ambulances are 13 times more likely to be involved in a crash and these crashes are five times more likely to result in an injury. He notes that the cost of these crashes exceeds $500 million annually. He suggests that alternative deployment and response characteristics of EMS units may result not only in fewer crashes, but also in better outcomes.

Erich, J. (2000). Wheels of fortune. Every time you hit the streets, you take your life in your hands–how can you improve your chances? *Emergency Medical Services*, *29*(11), 43.

Several case reviews are included in this essay that outline various factors, (emergency vehicle operator error, faulty maintenance, the urgency of a potentially life-saving response, and poor driving habits in the civilian population) involving emergency vehicle crashes. After discussing each of these in some depth the author concludes that “human error” is the most common and most difficult factor to modify.

Hayes, T. (2003). The story behind the story. Interview by Mike Taigman. *Emergency Medical Services*, *32*(5), 28-29.

(Full-text not available on-line.)

Ho, J., & Casey, B. (1998). Time saved with use of emergency warning lights and sirens during response to requests for emergency medical aid in an urban environment. *Annals of Emergency Medicine*, *32*(5), 585-588.

This prospective study examines the entire response continuum (leaving the station or deployment area until arrival at the hospital). The authors conclude that there is a 38.5 percent total time reduction when lights and sirens were used in this urban environment with a response distance of 0.20 – 8.00 (mean 2.3) miles. The authors draw no conclusion about the importance of this time savings on patient outcomes, but note that other studies have been very vague about what conditions warrant such a time saving response. The primary limitation of this study is that it is small, representing 64 emergency responses.

Hunt, R.C., Brown, L.H., Cabinum, E.S., Whitley, T.W., Prasad, N.H., Owens, C.F, et al. (1995). Is ambulance transport time with lights and siren faster than that without? *Annals of Emergency Medicine*, *25*(4), 507-511.

This is one the earliest of several studies that have looked at the time savings of responding with lights and sirens, in this case, specifically during the transport (rather than response) phase of care. In this mid-size community of 46,000 people the average time savings was 43.5 seconds. The authors conclude that such a minimal time savings does not warrant a lights and siren transport except under very narrowly prescribed circumstances. The authors do note, however, that results of lights and siren transport need to be examined in other venues, specifically mentioning rural environments where transport distances may be much greater.

Hunjadi, D. (2005). From provider to patient. *Emergency Medical Services*, *34*(8), 157-160.

This personal account of the results of an ambulance crash that occurred in rural Wisconsin provides the reader with details of the physical, psychological, social, and economic toll that each ambulance crash can have on those involved. The Emergency Medical Technician (EMT) involved was providing care in the rear compartment of an ambulance that skidded into the median on a rain soaked highway and rolled. The EMT was in critical condition immediately following the crash and currently is paralyzed below the waist. The economic burden of ongoing medical care on his family has been only partially covered by workers compensation due to the volunteer nature of the EMS agency and to the fact that a 34-year-old family man does not wish to go to a nursing home to live out his remaining years.

Kahn, C., Pirrallo, R., & Kuhn, E. (2001). Characteristics of fatal ambulance crashes in the United States: An 11-year retrospective analysis. *Prehospital Emergency Care*, *5*(3), 261-269.

The authors provide a descriptive analysis of fatal ambulance crashes over an 11 year period from 1987-1997, using data derived from the U.S. Department of Transportation's Fatality Analysis Reporting System (FARS). The study's hypothesis was "…that there is no association between emergency use vs. non-emergency use and other fatal ambulance crash characteristics…" (p. 262). There was an inability to reject the null hypothesis for most crash characteristics with only the relationship to an intersection and the manner of the collision showing differences between emergency and non-emergency use. However, the true value of this analysis lies in the descriptive tables that describe seasonal, temporal, atmospheric, and roadway characteristics in fatal crashes involving ambulances. The authors also note that most ambulance crash fatalities occur to those traveling in the rear compartment where the patient may not be securely fixed to the chassis and where other occupants are less likely to be wearing seat belts. The FARS data also revealed that many emergency vehicle operators had poor driving histories.

Kupas, D.F., Dula, D.J., & Pino, B.J. (1994). Patient outcome using medical protocol to limit “lights and sirens” transport. *Prehospital and Disaster Medicine, 9*(4), 226-229.

The authors examine the outcome of patients following the implementation of a protocol governing the use of lights and sirens during transport of the patient from the scene to the hospital. The setting was a rural/suburban county with a mixed EMT-P, EMT-B crew configuration. There were 1,625 patients enrolled in the study. Of these 130 (8 percent) met the criteria for transport using lights and sirens. Of the 92 percent of transports that did not involve the use of lights and sirens, nearly one-half received some advance life support intervention either prior to, or during transport. There were no adverse events associated with the non lights and siren transports. Based on these findings, the authors recommend the establishment of protocols concerning lights and siren transport and the ongoing medical oversight of those protocols. (The protocol used in this study is similar to the one that is included as an appendix to this report).

Larmon, B., LeGassick, T., & Schriger, D. (1993). Differential front and back seat safety belt use by prehospital care providers. *The American Journal of Emergency Medicine, 11*(6), 595-599.

This article was among the first to look at the behavior of safety belt use among emergency medical personnel in ambulances. The self-reported data indicated a high use (approaching 100 percent) of seat belt use when emergency medical personnel are in the front of the ambulance. This was at a time when the civilian seat belt use rate nationally was reported to be 49 percent. However, when the emergency personnel were in the rear compartment of the ambulance providing patient care, the use rate fell substantially and approached zero, if the patient was deemed to be in a “critical” condition. The authors conclude that the findings point to a need for additional training, investigation of which clinical conditions might warrant the provider being unrestrained, and the need for ambulance redesign to accommodate the needs of the emergency provider in the care of the injured/ill patient.

Levick, N.R. (2005). An optimal solution for enhancing ambulance safety: Implementing a driver performance feedback and monitoring device in ground emergency medical services vehicles. *Annual Proceedings / Association for the Advancement of Automotive Medicine, 49*, 35-50.

This pre/post (repeated measures) comparison examined the pre-and post-deployment of a "black box" in an urban ambulance fleet. The black box (onboard computer-monitoring device) was placed in the fleet without driver identification and without turning on the auditory alert signal for a period of 3 months. A number of vehicle operation parameters were measured during this "blind" data gathering period. The second phase of the research began with an orientation of all personnel to the system, the issuance of key fobs for driver identification, and the activation of the auditory alert signaling component of the black box. The auditory alert signal was activated when the driver approached pre-selected speed, braking, and vehicle handling parameters. When the auditory alert signal threshold was exceeded, "penalty points" were also recorded in each individual driver's record. The linear distance interval for auditory alert and penalty point awards went from a baseline low of 0.018 miles to a post deployment high of 15.8 miles. Significant improvements in front seat belt use were noted, going from 13,500 seat belt violations pre-deployment to four post-deployment. There was also a substantial cost savings in maintenance costs, netting enough to pay for the acquisition and installment of the black boxes within a short time frame.

In a very brief discussion of the limitations of the study the authors note that the technology should be further tested across a broad spectrum of systems, including rural/volunteer agencies. However, they also question whether additional research is warranted, or even ethical, considering the dramatic results reported in this paper.

Lindsey, J.T. (2004). *The effects of computer simulation and learning styles on emergency vehicle drivers' competency in training course.* (Doctoral dissertation, University of South Florida, 2004).

The focus of this research is the impact of a driver simulator on emergency vehicle operator's performance as measured during a subsequent hands-on driving course. In a comprehensive review of the impact of simulation technology across both the medical and broad vehicle operations field, the author notes that ambulance drivers operate in an environment with multiple distractions, including the patient care activity occurring in the back of the vehicle itself. He notes that simulators provide a "safe" environment for training emergency medical personnel without endangering themselves, other crew members, the patient, or the public. While the long-term impact of simulator training, coupled with hands-on experience behind the wheel has not been measured, the author notes that the short-term impact is substantial and represents both safety achievements and cost savings.

Maguire, B.J., Hunting, K.L., Smith, G.S., & Levick, N.R. (2002). Occupational fatalities in emergency medical services: A hidden crisis. *Annals of Emergency Medicine, 40*(6), 625-632.

This article is based on data from multiple sources and extrapolates the occupational fatality frequency, rate, and typology of on-duty fatal events involving EMS providers. The primary findings include a fatality rate of 12.7/100,000, more than double the average occupational fatality rate of 5.0/100,000 and approaching the fatality rates for law enforcement and firefighters. When stratified by cause, transportation injury fatality rates for EMS workers was 9.6/100,000 for EMS personnel, exceeding transportation fatality rates for law enforcement (6.1) and firefighters (5.7). The EMS rate is more than four times the average transportation fatality rate for all U.S. workers at 2.0/100,000. The article clearly supports the need for safer driving practices across both rural and urban environments.

Maio, R., Green, P., Becker, M., Burney, R., & Compton, C. (1992). Rural motor vehicle crash mortality: The role of crash severity and medical resources. *Accident; Analysis and Prevention*, *24*(6), 631-642.

This work examines the Michigan Accident Census database for a 1-year period of time. The unadjusted relative risk of dying in a motor vehicle crash was 1.96 times greater in the rural area than in an urban area when comparing Metropolitan Statistical Areas (MSA) and non-MSAs. Much of the variation can be described by crash characteristics and age of the occupant. Among the implications noted by the authors is a discussion of the need for additional specificity in rural/urban definitions.

National Association of EMS Physicians (NAEMSP) and the National Association of State EMS Directors (NASEMSD). (1994). Use of warning lights and siren in emergency medical vehicle response and patient transport. *Prehospital and Disaster Medicine*, *9*(2), 133-136.

This formal position paper by two prominent national organizations concerned with emergency medical care discusses the risks associated with emergency responses involving the use of warning lights and sirens. The paper includes a series of 11 recommendations. Among these recommendations are the need for judicious use of warning lights and sirens based on the patient’s medical condition, the need for close oversight by the EMS agency’s medical director, and the need for a national reporting system for emergency vehicle collisions. The paper was formally adopted in 1994 and reaffirmed in 2002.

O’Brien, D.J., Price, T.G. & Adams, P. (1999). The effectiveness of lights and siren use during ambulance transport by paramedics. *Prehospital Emergency Care, 3*(2), 127-130.

This study involves a convenience sample of 75 ambulance calls that, in the opinion of the emergency medical personnel at the scene, required the use of lights and sirens during transport to the hospital. The same route was followed by a second vehicle traveling within the normal transportation flow. The authors conclude that there was a significant time savings using lights and sirens. The mean times savings was 230 seconds. From these 75 runs, receiving physicians conjectured that four may have clinically benefited from the time savings. There is a correlation between the number of stoplights encountered and traffic intensity with the total time savings. Likewise, there is a relationship between distance traveled and time saved. The authors conclude that lights and siren transports are warranted under certain circumstances and that availability of advanced life support personnel can reduce the frequency of such responses. The patients enrolled in this convenience sample had emergencies of a predominately medical etiology, and the findings may not generalize to a more trauma oriented setting such as may be common in some rural communities.

O'Connor, P., & Osborne, C. (1986). An EMT's guide to ambulance operation. *Emergency Medical Services, 15*(2), 14.

(Full-text not available on-line.)

Pratt, S.G. (2003). *NIOSH Hazard Review. Work-related roadway crashes: Challenges and opportunities for prevention.* Washington, DC: DHHS, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.

This comprehensive analysis of multiple data sources describes work-related motor vehicle crashes from a variety of perspectives. While it does not specifically address ambulance crashes, it is important to note that trucks (all types) account for 64.9% of all fatal work-related crashes in rural areas. Ambulances, by the nature of their design, would be captured in this category, again confirming the high risk nature of rural emergency vehicle operations. Of note, the report discusses in great detail the increased risk associated with both driver fatigue and driver distraction. The report offers employers a set of recommendations to reduce work-related crashes including fatigue management, vehicle operations training, and graduated implementation of driving responsibilities for young drivers.

Proudfoot, S. (2005). Ambulance crashes: Fatality factors for EMS workers. *Emergency Medical Services, 34*(6), 71.

This article is a more focused summary of Ambulance crash-related injuries among Emergency Medical Services workers in the United States from 1991-2002 (CDC, 2003) as reported above. The conclusions are more prescriptive, stressing the need for driver screening for previous moving violations coupled with initial and ongoing training.

Ray, A.M. & Kupas, D.E. (2005). Comparison of crashes involving ambulances with those of similar-sized vehicles. *Prehospital Emergency Care, 9*(4), 412-415.

In this analysis of data from the Pennsylvania Department of Transportation from 1997-2001, it was noted that road surface conditions and weather factors were similar between the ambulance and other truck type configurations. However, differences were noted in crashes at intersections and traffic signals with ambulances being more likely to be involved in such events. More people were involved in each ambulance crash, with 3 or more persons in 84 percent of the events. There was also a greater preponderance of ambulance crashes occurring during evening and weekend hours. The authors conclude that additional driver training and policies concerning the use of lights and sirens, including enforcement of the “complete stop” rule at intersections and traffic signals, could result in a reduction of ambulance crashes.

Ray, A.M. & Kupas, D.F. (2005). Comparison of rural and urban ambulance crashes in Pennsylvania. [*Research Forum* Abstract]. *Annals of Emergency Medicine*, *46*(3), S113.

This poster presentation summarizes findings from the Pennsylvania Crash Outcome Data Evaluation System database, which is a probabilistically linked data set involving a number of separate data systems, for the time period of 1997-2001. The analysis identified 1745 ambulance crashes of which 311 occurred in rural areas. The authors noted that rural crashes were more likely to involve snowy roadway conditions and unlit nighttime roadways. Operator error was the most prevalent contributing factor in both urban and rural crashes although it was less often the cause in rural environments (75 percent rural vs. 93 percent urban). Rural crashes were more likely to involve striking a fixed object. Criteria for distinction between rural and urban were based on the Pennsylvania Department of Transportation Roadway Management System, in which rurality is based on traffic volume and municipal population criteria.

Shanaberger, C.J. (1993). Field operations and written policy. What you don't know can hurt you. Greater Houston Transport v. Zrubeck. *JEMS: A Journal of Emergency Medical Services*, *18*(11), 25.

(Full-text not available on-line.)

Shanaberger, S.J. (1987). Running hot. *JEMS: A Journal of Emergency Medical Services, 12*(4), 75-76.

(Full-text not available on-line.)

Swanson, J. & Levick, N. (2005, March). Device improves ambulance drivers' performance: Cuts crashes and reduces costs for tires and maintenance. *EMS Insider.*

This is an expansion of Swanson and Levick's 2005 article discussed above. It is illustrated with quotes from the authors about both the methods of the deployment of the "black box" technology, the procedures for providing feedback to the drivers, and the early results of the project.

Vukmir, R.B. (2004). Medical malpractice: Managing the risk. *Medicine and Law, 23*(3), 495-513.

This article provides a review and analysis of previously published articles pertaining to the likelihood of medicolegal errors. The author describes high risk encounters for emergency physicians, and more germane to this discussion, notes that, in emergency medical services, the most frequent area for the increased incidence and recovery amounts in verdicts pertained, not to clinical care issues, but rather to ambulance crashes. The author further notes that attention to this high risk area could help reduce subsequent medicolegal risk, reduce costs, and improve patient care.

Weiss, S.J., Ellis, R., Ernst, A.A. Land, R.F. & Garza, A. (2001). A comparison of rural and urban ambulance crashes. *American Journal of Emergency Medicine, 19*(1), 52-56.

A database comprised of information from mandatory reporting forms required to be completed for all ambulance crashes occurring in the State of Tennessee was analyzed for a 5-year period from 1993-1997. This data set includes both fatal and non-fatal crashes. The primary hypothesis of this study was "Rural vehicle accidents will be more severe and have a higher rate of citations than urban accidents…" (p. 52). Rural was defined as a population equal to or less than the fifth largest county in Tennessee (Montgomery, population 102,000). The authors analyzed characteristics including injury severity, traffic citations, ambulance damage, other vehicle damage, ambulance impact site, temporal, meteorological, and roadway conditions. They also examined the number of people involved, the number of people injured, and use of safety belts at the time of the crash. The primary finding was that rural ambulance crashes were more likely to result in injury and that the injuries sustained during the crash were more likely to be severe. This finding was predominately attributed to the point of collision, which was more likely to involve a frontal impact in rural areas and a rear impact in urban.

Whiting, J., Dunn, K., March, J., & Brown, L. (1998). EMT knowledge of ambulance traffic laws. *Prehospital Emergency Care*, *2*(2), 136-140.

This research involves a survey of emergency medical personnel at a statewide conference. The survey measured knowledge of specific traffic laws pertaining to emergency vehicle operations in the State of North Carolina. The sample size was 295. Out of a possible score ranging from zero to five on the five question survey, the median response was one correct question. Volunteer emergency medical providers were twice as likely to miss the question pertaining to speed limits than their paid counterparts. Emergency medical personnel who had taken one or more emergency vehicle operations courses were more likely to score above the median and more likely to answer questions concerning yielding to traffic (same direction and oncoming) correctly. The authors conclude that additional emergency vehicle operation training is warranted.

Zagaroli, L. & Taylor, A. (2003). *Ambulance driver fatigue a danger: Distractions pose risks to patients, EMTs, traffic.* Washington, DC: Detroit News Washington Bureau, 1-8.

This newspaper article is based on a compilation of interviews augmented by other facts and accounts of ambulance crashes. The focus of the article is on the relationship between fatigue and ambulance crashes. While the information is anecdotal in nature, it is compelling. As an example, one person interviewed noted that each of the 40 preceding 24-hour shifts that he normally worked on Monday, Wednesday, and Friday had actually become 27-hour shifts, which he noted left him exhausted. Other emergency personnel relate similar stories of being awake for 20 hours of a 24-hour shift or being expected to drive immediately after being awakened to an emergency call.

DISCUSSION

There is an ever-increasing body of knowledge pertaining to crashes involving ambulances. One of the first conclusions that can be drawn from the extant literature is that driving an ambulance is a dangerous process (CDC, 2003; Eckstein, 2005; Erich, 2000; Maguire et al., 2002; NAEMSP & NASEMSD, 1994; Pratt, 2003; Proudfoot, 2005; Ray & Kupas, 2005; Zagaroli et al., 2003). This finding is, in and of itself, not surprising given the “emergency” nature of the work. Of note is that in comparison to other “emergency” responders, specifically law enforcement agents and firefighters, emergency medical personnel are at greater risk of a fatal vehicle incident then their public safety colleagues (Maguire et al, 2002). The reason for this increased risk is unknown but could include the fact that a large portion of the EMS workforce is volunteer in nature (IOM, 2006; Thompson, 1993; Chng, Collins & Eaddy, 2001). Additional factors may include, inadequate screening of vehicle operators for previous violations (Custalow & Gravitz, 2004; Kahn, Pirrallo, & Kuhn, 2001), non-existent or inadequate vehicle operations training (Custalow et al., 2004; Erich, 2000; Larmon, LeGassick, & Schriger, 1993; Lindsey, 2004; Maguire et al., 2002; NAEMSP et al., 1994; Pratt, 2003; Ray et al., 2005), fatigue and distraction (Custalow et al., 2004; Erich, 2000; Pratt, 2003; Zaragoli et al., 2003), poor vehicle design (Barishansky, 2005; Custalow et al., 2004; DeGrave, Deroo, Vanhaute, & Buylaert, 2003; Pratt, 2003), and poor knowledge concerning driving laws (Whiting, Dunn, March, & Brown, 1998).

A key factor in ambulance crashes is operations in an emergency mode with warning lights and sirens engaged. Implicit in the use of these warning devices is the fact that the ambulance is using certain privileges that may include traveling above the speed limit, expecting traffic to yield, and assuming the right of way at intersections. Arguably, the most heavily researched aspect of ambulance response is the time savings associated with the use of lights and sirens and the degree to which those savings “might” contribute to positive clinical outcomes. Several authors contend that the time savings is not significant and is unwarranted in all but the most extreme clinical circumstances (Custalow et al., 2004; DeGraeve et al., 2003; Eckstein, 2004; Ho et al., 1998; Hunt et al., 1995; Kahn, 2001; NAEMSP et al., 1994; Ray et al., 2005, Kupas et al., 1994). O’Brien et al. (1999) concluded that the use of warning lights and sirens did result in significant time saving (230 seconds) and that there were at least 4 of 75 cases in which those time savings resulted in improved clinical outcomes. Only Kupas et al. (1994) specifically define the clinical conditions under which response or transport might warrant the use of warning lights and sirens.

The reluctance of emergency care providers to wear safety restraints, particularly while delivering care in the patient compartment is also noted by several authors to contribute to the risk of injury or death (Baker, Whitfield, & O'Neill, 1987; Barishansky, 2005; CDC, 2003; Custalow et al., 2004; Hunjadi, 2005; Kahn et al., 2001; Larmon et al., 1993; Levik, 2005; Maguire et al., 2002; Maio, Green, Becker, Burney, & Compton, 1992; NAEMSP et al., 1994; Weiss et al., 2001). Ray & Kupas (2005), note that more individuals are likely to be injured or killed in each ambulance crash than in crashes of similarly sized commercial vehicles. They conclude that this is due to multiple people (providers, patients, and family) traveling unrestrained in the rear compartment. Limited discussion is available in the literature about making ambulances more "user friendly" to encourage restraint use for all occupants (Barishansky, 2005; Ferreria & Hignett, 2004).

Less is known about rural ambulance crashes, although several of the studies have been conducted in communities of 100,000 or less (Hunjadi, 2005; Hunt et al., 1995; Maio et al., 1992). Two studies specifically compared rural and urban crashes (Weiss et al., 2001; Ray et al., 2006). Weiss, Ellis, Ernst, Land & Garza (2001) in their seminal work described and compared the characteristics of rural ambulance crashes from a variety of factors. They concluded that rural crashes were more likely to result in injuries and that the injuries were more serious. This finding compares well to Pratt's (2003) work, concerning the incidence of fatal crashes in rural areas and, in particular, with those involving "truck like" vehicles. Ray et al. (2006), in the preliminary presentation of their findings, concluded that rural crashes were more likely to involve snowy roadway conditions and poorly lit night-time roads. Both Weiss et al. (2001) and Ray et al. (2006) noted that, during rural crashes, the ambulance is more likely to strike a fixed object such as a tree, guard rail or signpost. While ambulance-specific data are limited, additional information pertaining to rural driving, in general, supports many of the findings pertaining to poorer road design, longer travel distances, higher rates of speed, inclement weather and road surface conditions (Maio et al., 1992; Baker et al., 1987; Pratt, 2003; Moretti, 2005).

The economic impact of rural ambulance crashes is not known. However, line-of-duty deaths are estimated to cost between $900,000 and $1.2 million per occurrence (National Safety Council, 2005; Rice, MacKenzie, & Associate, 1989). These economic costs are increased by long term economic costs of survivors and further exacerbated by psychosocial impact (Hunjadi, 2005). The impact of a fatal crash in a rural environment can be devastating to a volunteer EMS agency (Hunjadi, 2005). Additional costs are evident in legal fees associated with injuries, fatalities and property loss to civilians (Custalow et al., 2004; Vukmir, 2004).

One of the persistent challenges in answering any questions about rural ambulance crashes is the application of a consistent definition of rural. Some studies have used a non-Metropolitan Statistical Areas (Maio et al., 1992), others have used highway department definitions (Ray et al., 2006) and still others have more arbitrarily determined the cut off in population density in their State (Weiss et al., 2001). None of the research identified in this literature search used definitions of rural that are more consistent with current thinking in rural health care, such as Economic Research Service Rural-Urban Continuum Codes (IOM, 2005).

The general findings for reducing crashes and improving outcomes of crashes that do occur rely on three general strategies: education, policy development, and technological applications.

Many authors suggest the need for additional emergency vehicle operations training (DeGraeve et al., 2003; Eckstein, 2004; Erich, 2000; Kahn et al., 2001; Larmon et al., 1993; Lindsey, 2004; NAEMSP et al., 1994; Pratt, 2003; Ray et al., 2005). Unfortunately, there is a high degree of variability in emergency vehicle driver training programs and little is known about the effectiveness of such courses although the general injury prevention literature questions the effectiveness of driver's education courses. Additional study of such courses is essential. Simulator training holds great promise in augmenting traditional, "hands-on" courses (Lindsey, 2004). One challenge associated with this technology is ensuring that rural and frontier EMS providers have access to such simulators.

Policy development, implementation, and enforcement have been shown to have an effect on the "culture" of safety within an organization. Standard policies concerning the use of safety restraint systems and warning lights and sirens should be adopted and enforced by all departments (NAEMSP et al., 1994; Pratt, 2003). This intervention is immediately available to all rural EMS agencies and does not require a large outlay of funds to implement. For that reason, we have included the NAEMSP/NASEMSD policy on emergency driving and a sample agency protocol that can be modified and adopted by any service wishing to do so.

Technology has begun to have an impact on ambulance operations. In particular the deployment of "black box" and "drive cam" technologies hold great promise in creating a safer driving environment (Barishansky, 2005; De Graeve et al., 2003; Levick, 2005; Swanson & Levick, 2005). Vehicle modification including crash avoidance technologies also holds promise (Barishansky, 2005). Intelligent transportation systems research also has the potential to contribute to emergency vehicle safety such as the animal detection and avoidance system created and tested by the Western Transportation Institute (USA Today, 2006). As rural EMS agencies go through their normal ambulance purchase cycle, new vehicles should have "black box" or similar technology installed or services should consider installing these in their existing vehicles. However, the effectiveness of these devices is dependent on their consistent use and feedback to all drivers.

Summary

Ambulances are a dangerous place to work. If you happen to work in a rural environment, they are doubly dangerous. Findings from a review of the extant literature suggest that there are educational, policy, and technological interventions that can decrease the risk of death and disability to rural and frontier emergency care providers as well as the patients and public that they serve.

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APPENDIX A: ACKNOWLEDGEMENTS

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Nels D. Sanddal, MS, REMT-B, Co-chair
Director
Rural Emergency Medical Services and Trauma Technical Assistance Center

Steve Albert, Co-chair
Director
Montana State University
Western Transportation Institute

CONTRIBUTORS AND REVIEWERS:

Drew Dawson, Chief, EMS Division
National Highway Traffic Safety Administration

Joseph D. Hansen, Assistant Director
Rural Emergency Medical Services and Trauma Technical Assistance Center

Douglas F. Kupas, MD
Rural Committee
National Association of EMS Physicians

Tommy Loyacono, MPA
National Association of Emergency Medical Technicians

Jerry Overton, Executive Director
Richmond Ambulance Authority

Jacob L. Rueda III, PhD, Project Officer
U.S. Department of Health and Human Services
Health Resources and Services Administration
Office of Rural Health Policy

Chris Tilden, PhD, Director
Kansas Department of Health & Environment
Office of Local & Rural Health

Gary Wingrove, Technical Consultant
Technical Assistance and Services Center
Rural Health Resource Center

APPENDIX B: REMSTTAC STAKEHOLDERS GROUP

Katrina Altenhofen, MPH, REMT-B
State Coordinator
Emergency Medical Services of for Children
Iowa Department of Public Health

Jane W. Ball, RN, DrPH
Executive Director (Retired)
EMSC National Resource Center
Trauma-EMS Technical Assistance Center

Bethany Cummings, DO
Rural Committee
National Association of EMS Physicians

Drew Dawson, Chief, EMS Division
National Highway Traffic Safety Administration

Tom Esposito, MD, MPH, FACS
Medical Director
Rural EMS and Trauma Technical Assistance Center

Blanca Fuertes, Past Project Officer
U.S. Department of Health and Human Services
Health Resources and Services Administration

Christian L. Hanna, MPH
Michigan Public Health Institute
Child and Adolescent Health

Bob Heath, EMS Education Coordinator
Nevada State Health Division
Intermountain Regional EMS for Children Coordinating Council

Marilyn Jarvis
Assistant Director for Continuing Education
Extended University
Montana State University

Douglas F. Kupas, MD
Rural Committee
National Association of EMS Physicians

Fergus Laughridge, Program Manager
Nevada State Health Division
EMS Bureau of Licensure & Certification

Tami Lichtenberg, Program Manager
Technical Assistance and Services Center
Rural Health Resource Center

Tommy Loyacono, MPA
National Association of Emergency Medical Technicians

Patrick Malone, Director
Initiative for Rural Emergency Medical Services
University of Vermont

N. Clay Mann, PhD, MS
Professor, Associate Director of Research
Intermountain Injury Control Research Center
University of Utah

Evan Mayfield, MS
U.S. Department of Health and Human Services
Center for Disease Control and Prevention
Office of the Commissioner

Charity G. Moore, PhD
Research Assistant Professor
Cecil G. Sheps Center for Health Services Research
Univ. of North Carolina at Chapel Hill

Carol Miller, Executive Director
National Center for Frontier Communities

Kimberly K. Obbink, M.Ed., Director
Extended University
Montana State University

Jerry Overton, Executive Director
Richmond Ambulance Authority

Daniel Patterson, PhD
AHRQ-NRSA Post-Doctoral Research Fellow
Cecil G. Sheps Center for Health Services Research
Univ. of North Carolina at Chapel Hill

Davis Patterson, PhD, Research Scientist
Battelle Centers for Public Health Research and Evaluation

Ana Maria Puente, Past Project Officer
U.S. Department of Health and Human Services
Health Resources and Services Administration
International Health

Jacob L. Rueda III, PhD, Project Officer
U.S. Department of Health and Human Services
Health Resources and Services Administration
Office of Rural Health Policy

Kristine Sande, Project Director
Rural Assistance Center
University of North Dakota Center for Rural Health

Mary Sheridan, Director
State Offices of Rural Health
Idaho Department of Health and Welfare

Dan Summers, RN, BSN, CEN, EMT-P
Director of Education
Center for Rural Emergency Medicine
West Virginia University

Chris Tilden, PhD, Director
Kansas Department of Health & Environment
Office of Local & Rural Health

Robert K. Waddell II
Secretary /Treasurer
National Association of EMS Educators

Bill White, President
National Native American EMS Association

Gary Wingrove, Technical Consultant
Technical Assistance and Services Center
Rural Health Resource Center

Jill Zabel Myers, Healthcare Consulting
Wipfli LLP

APPENDIX C: NAEMSP, NASEMSO POLICY ON DRIVING

USE OF WARNING LIGHTS AND SIREN IN EMERGENCY MEDICAL VEHICLE RESPONSE AND PATIENT TRANSPORT

National Association of Emergency Medical Services Physicians (NAEMSP) and the National Association of State EMS Directors (NASEMSD)

This paper was developed for NAEMSP by the Emergency Medical Response Task Force: Jeff J. Clawson, MD, Chair; Robert Forbuss; Scott A. Hauert; Fred Hurtado; Alexander E. Kuehl, MD; W.H. ABill@ Leonard; Peter A. Maningas, MD; Joseph L. Ryan, MD; and Donald R. Sharpe. It was reviewed and adopted to the position paper format by the NAEMSP Standards and Clinical Practice Committee, Herbert G. Garrison, MD, MPH, Chair.

Correspondence: Executive Director, National Association of EMS Physicians, P.O. Box 15945-281, Lenexa, KS 66285-5945.

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Abbreviations: EMS = emergency medical services; EMV = emergency medical vehicle; L&S = lights and siren

Introduction

The use of warning lights and siren (L&S) by prehospital emergency medical services (EMS) vehicles is a basic component of emergency response and patient transport. This public-safety practice predates modern EMS by 50 years.[1] Despite the long-term reliance on L&S, it is not a risk-free practice. There are many reports of emergency medical vehicle (EMV) collisions during L&S responses and transports.[2-4] These collisions often result in tragic consequences for the EMV occupants and those in other vehicles, and may cause significant delays to medical care for the patient the EMV was responding to or transporting.[5] While there is no systematic collection of EMV collision data, some authors have suggested that the available information underestimates the extent of the problem.[6,7] In addition, to date there have been few published analyses regarding the effectiveness of L&S as a modality that improves response times or, more important, patient outcome.

Despite the lack of data, it generally is accepted that the use of L&S is a privilege granted to emergency medical responders that should be reserved for those situations in which patient welfare is at stake. To provide guidance to the states' EMS medical directors and system managers, the National Association of EMS Physicians (NAEMSP) and the National Association of State EMS Directors (NASEMSD) endorse the following positions regarding the use of warning L&S in EMV response and patient transport.

Position Statements

1. *Emergency medical services (EMS) medical directors should participate directly in the development of policies governing EMV response, patient transport, and the use of warning lights and siren.*
Emergency medical vehicle response policy decisions involve many medical care and medical direction issues including patient outcome, quality improvement, patient and emergency medical provider safety, and risk management. Therefore, EMV response and patient transport decisions should be guided, reviewed, and approved by the EMS medical director.

2. *The use of warning lights and siren during an emergency response to the scene and during patient transport should be based on standardized protocols that take into account situational and patient problem assessments*.
Written protocols and guidelines should delineate when to use L&S during scene response and patient transport. These protocols should be based on a reasonable identification of situations for which a reduction in response and transport times might improve patient outcome. The protocols should be developed in conjunction with local emergency response practices and statutes and should receive approval from the EMS medical director. Final protocols should be distributed to all dispatch and EMS entities. Warning lights and siren protocols should be enforced, and inappropriate use of L&S by EMS personnel will be limited.

3. *EMS dispatch agencies should utilize an emergency medical dispatch priority reference system that has been developed in conjunction with and approved by the EMS medical director to determine which requests for prehospital medical care require the use of warning lights and siren.*
Sound dispatch prioritization systems establish a patient’s level of severity, which then allows the determination of the type of vehicle(s) that should respond and the urgency of that response. Emergency medical dispatch centers should institute the protocols and monitor adherence to them.

4. *Except for suspected life-threatening, time-critical cases or cases involving multiple patients, L&S response by more than one EMV usually is unnecessary.*
Guidelines for the multi-EMV L&S response should be outlined in emergency medical response policies and dispatch procedures.

5. *The utilization of emergency warning L&S should be limited to emergency response and emergency transport situations only.*

Alternative practices, such as returning to a station or quarters using warning L&S or using L&S for Astaging or moving to designated areas to stand-by for a response, should be discontinued. Exceptions to such a policy would include extraordinary circumstances such as a disaster, or situations in which patient outcome could be affected.

6. *All agencies that operate EMVs or are responsible for emergency medical responders should institute and maintain emergency vehicle operation education programs for the EMV operators.*
Initial and continuing education of EMS personnel should include instruction in safe and appropriate EMV driving techniques and should take place prior to initial EMV operation. Knowledge and demonstrated skill in EMV operation are prerequisites for all public-safety vehicle operators.

7. *Emergency medical vehicle-related collisions occurring during an emergency response or transport should be evaluated by EMS system managers and medical directors.*
Such evaluations should include an assessment of the dispatch process, as well as initial (at the beginning of the transport) and final patient conditions.

8. *A national reporting system for EMV collisions should be established*.
Data are needed regarding the prevalence, circumstances, and causes of EMV collisions, including related injuries and deaths, and "wake effect" collisions. Collection of the information should start at the State and local levels; the information collected should include uniform data elements for tabulation and nationwide comparison.

9. *Scientific studies evaluating the effectiveness of warning L&S under specific situations should be conducted and validated.*
These important research efforts should be supported by both public and private resources.

10. *Laws and statutes should take into account prudent safety practices by both EMS providers and the monitoring public.*
The major emphasis and focus should remain on the exercise of prudent judgment and due regard by EMV operators. Laws and statutes also should emphasize the motoring public's responsibility to clear a lane or access way for EMVs.

11. *National standards for safe EMV operation should be developed*.
Such standards should mandate that EMV operators should approach intersections safely and have a clear view of all lanes of traffic before proceeding through. Standards also should set appropriate speed limits for emergency responses and transports in urban and rural settings, and for responses that occur under adverse road, traffic, and weather conditions.

Discussion

The Risk of the Emergency Response

Response to and transport of emergency patients are integral components of the EMS chain of care. Since the beginning of modern EMS, the usual vehicle response mode has involved the use of L&S. Since this type of response was consistent with the practices of other public-safety agencies that use emergency vehicles (i.e., law enforcement and the fire service), the practice was implemented initially without question. As an understanding of EMS call histories and patient outcomes has evolved, it has become evident that the use of L&S by EMS vehicles is not necessary for every response or patient transport.[4]

There is risk associated with the use of warning L&S: emergency medical vehicles running "hot" (with L&S) have been involved in many collisions that have resulted in injuries and death in a high number of cases.[2,4,6] The monetary loss derived from EMV collisions, including property damage, increased insurance premiums, and liability payments in some venues, have eclipsed that of any other negligence-related EMS problems.[7,8] This situation exists at a time when published data demonstrating the use of L&S in response or patient transport is effective in improving patient outcomes are lacking. In fact, the U.S. Department of Transportation has reported that sirens may never become an effective warning device.[9] Even if warning L&S eventually are shown to be useful in certain time-critical situations (e.g., cardiac arrest or penetrating chest injuries), it is unlikely that L&S will be proven beneficial for each and every EMS response and transport.

Concern about patient welfare, combined with inadequate information on a patient's actual condition, often pressures emergency medical technicians and paramedics to rush to and from scenes in order to "save lives." As Auerbach[5] states, "...loose interpretation of what constitutes an emergency has essentially given [EMV operators permission] to operate their vehicles as they see fit while carrying victims who are essentially stable by anyone's definition."

Medical Director Involvement

Since EMS response and patient transport are prehospital medical "tools," accountable EMS medical directors should be involved in the development of emergency response and transport policies.[10] Additionally, EMS medical directors should evaluate EMV collisions for the medical correctness of the dispatch process, the patient's condition on arrival at the scene, when the transport began, and the patient's eventual outcome. For those medical directors who may need assistance with this aspect of prehospital care, advice is available from colleagues in NAEMSP, NASEMSD, and other EMS organizations.

Standardized Dispatch, Response, and Transport

Sound emergency medical dispatch protocols should be established and used as the basis for determining those situations that would benefit from the appropriate use of warning L&S. Research is emerging that supports the concept that medically sound protocols safely delineate which patients do and do not require emergency advanced life support.[11,]

[12] Such protocols, as well as proper emergency medical dispatcher and EMV operator training, should be integral parts of a local dispatch agency's emergency medical dispatch system. The American Society for Testing Materials state in their Standard Practice for Emergency Medical Dispatch document that "this practice may assist in overcoming some of the misconceptions...that red lights, siren, and maximal response are always necessary."[13] Ideally, the use of L&S should be reserved for those situations or circumstances in which response and transport times have been shown to improve a patient's chances for survival or quality of life. Examples of such situations include cardiac or respiratory arrest, airway obstruction, extreme dyspnea, critical trauma, childbirth and problems with pregnancy, drowning, and electrocution. In some of these cases, a rapid response is important (e.g., cardiac arrest), whereas in others rapid transport is necessary (e.g., breech birth).

Nevertheless, a large number of calls to 9-1-1 are for non-emergency problems that require neither rapid response nor rapid patient transport.[14, 15] Systems utilizing non-L&S response modes for such low-priority calls have experienced few problems.[16] This issue, however, requires more in-depth study in order to determine the specific positive and negative effects of L&S utilization on patient outcome in the various types of high- and low-priority cases.

In the typical EMS model, once a patient is evaluated and provided appropriate emergency treatment, transport by an EMV is initiated to move the patient to a definitive care facility. Many patients to whom EMS respond do not require L&S for patient transport. However, many EMS systems do not have protocols governing L&S use during patient transport, and few endorse contact with an on-line medical control base-station for advice or consent on the use of L&S transport.

Response of Multiple Emergency Medical Vehicles
The use of warning L&S by all EMV's responding to a single incident has been scrutinized in many systems, and many of those systems have adopted a modified approach.[12, 17] From a medical point of view, the response of more than one unit utilizing L&S is necessary only in those situations involving suspected life-threatening, time-critical cases, or multiple patients. Likewise, the practice of returning to a station or quarters using L&S so as to "be in position" for the next call has no support in most responsible public-safety communities.

The Emergency Medical Vehicle Operator
While prevention of EMV collisions will depend on the application of sound dispatch protocols, dispatcher training, and direct involvement of the EMS medical director in developing dispatch and transport policies, attention also should be directed at the EMV operator. Before a driver of an emergency vehicle takes the wheel, their driving records should be carefully screened, and each should be trained in the proper use of EMV's. Rigorous education and control of EMV drivers should reduce EMV collisions, create a more standard approach and practice to EMV operation, and improve EMV longevity. Fortunately, there are detailed instruction guides for proper EMV operation.[18, 19]

Emergency medical services provider education should include instruction in "low force" driving techniques. In addition, all personnel operating EMS vehicles should be involved in agency quality improvement programs including continuing education courses on EMV operation.

Some State laws require that EMV operators exercise what is called "due regard." New Jersey law (N.J.S.A. 39:4-91) states it "...shall not relieve the driver of any authorized emergency vehicle from the duty to drive with due regard for the safety of all persons, nor shall it protect the driver from the consequences of his reckless disregard for the safety of others." Using laws of this nature, a number of prosecutors recently have charged and convicted ambulance operators of involuntary manslaughter.[14] Most state laws, however, fail to place clear responsibility for the use of L&S on the EMS operators themselves.[20] While much talk has ensued regarding the public's responsibility to "watch out" or "get out of the way," EMS should not blame the public for the problem of EMV collisions.

The EMS Profession

Responsibility rests with the EMS profession and local governments to establish minimum standards for the safe operations of EMS vehicles and to monitor the use of such standards. An example of such a standard would be a formal policy stating that EMV's should not exceed the locally posted speed limit in urban settings, should not exceed the speed limit by more than 10 miles per hour in rural areas, and that EMV's should not travel at any speed that is unsafe for current road, traffic, or weather conditions.

Nationally, EMS-related organizations should work together in helping to create standards that detail the positions in this document. Organizations that should be involved in a effort to set standards for emergency medical response and transport include the American Ambulance Association, the American College of Emergency Physicians, the Association of Public Safety Officers, the International Association of Fire Chiefs, the International Association of Fire Fighters, the National Association of Emergency Medical Technicians, the National Association of EMS Physicians, the National Association of State EMS Directors, the National Association of State EMS Training Coordinators, the National EMS Alliance, and the National Fire Protection Agency.

Reimbursement

The reimbursement profiles of many EMS agencies contain an extra charge for the use of warning L&S. This occurs because the Federal Centers for Medicare and Medicaid Services (the Health Care Financing Administration during the time of the study) reimbursement policies recognize L&S use as a special circumstance. Insurance reimbursement for "emergencies" also may be predicated on L&S use, further perpetuating this problem. Unless these types of policies and profiles are modified by the government, insurance companies, and the EMS profession itself, adjustments in L&S use (as recommended in this document) may be viewed as adversely affecting EMS reimbursement. Therefore, without reimbursement policy modifications, the L&S reform process may be slowed.

Emergency Medical Vehicle Collision Reporting
The amount of data available on EMV collisions in general is fragmented and has not been obtained using any systematized or scientific format.[4, 5] The Fatal Accident Reporting System (FARS) may underestimate EMV collision occurrence and outcome. In 1990-1991, a national press clipping service documented 303 EMV collisions in 1 year resulting in 711 injuries and 78 deaths. (Clawson, unpublished data). The number of fatalities discovered in this newspaper review eclipses those reported by FARS involving EMVs for the same time period.

An acknowledged, but little-studied result of L&S use is the "wake effect," in which use of L&S results in collisions that involve only civilian vehicles and not the EMV itself. The ratio of wake effect collisions to those actually involving an EMV may be as high as five to one.[6] However, this only can be adequately assessed with a comprehensive EMV collision reporting system.

There are models for EMV collision reporting systems. The National Fire Protection Agency has had in place a uniform process for reporting and quantifying fire fighting-related collisions and injuries for many years. Utah and Tennessee have "ambulance accident" reporting systems. As Auerbach[5] has reported about Tennessee's system: "Before the requirement for accident reporting was imposed, [EMV collisions] analysis would have been impossible. Prehospital [EMV collision] data collection is essential if emergency medical services physicians are to exert reasonable control and make knowledgeable recommendations involving clinical care and professional regulations." Ideally, the federal government will initiate a national reporting system for EMV collisions. Any reporting system should be uniformly structured. It should track the multiple different types of responding agencies and vehicles, including both volunteer and fire-based first responders (not just "ambulances"), and also provide a mechanism for the identification and reporting of wake effect collisions.

Research
Regrettably, there currently are few published investigations of dispatch protocols for L&S use. Also, there are no published studies attempting to evaluate the effectiveness of L&S use in terms of patient outcome. Worse still, there are no studies in either refereed or public safety trade journals that demonstrate that the use of L&S saves significant time over routine driving methods. In 1987, Auerbach[5] demonstrated that the mean delay to hospital care after an EMV collision in Tennessee approached 10 minutes.
The use of warning L&S in EMS rests primarily on the unsupported tradition that has evolved from police- and fire-response practices. In some cases, these practices may adversely affect EMS patients and providers. Therefore, a series of objective, well-structured, scientific studies aimed at identifying both the positive and negative effects of L&S use should be pursued.

Conclusion
In order to ensure that we "first do no harm," 20 sound rationale and corresponding protocols and policies for the use of warning L&S in EMV response and patient transport should be developed and instituted in all EMS systems. All EMV operators should be

trained adequately and regulated. The judicious use of warning L&S in the initial response and subsequent transport of patients likely will result in a more balanced system of appropriate care with minimization of iatrogenic injury and death.

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APPENDIX D: MODEL LIGHTS AND SIREN RESPONSE PROTOCOL

LIGHTS AND SIREN USE GUIDELINES

Adopted from Pennsylvania Statewide
Basic Life Support Protocols
Pennsylvania Department of Health
Bureau of Emergency Medical Services, November, 2006

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Criteria:

A. All EMS incident responses and patient transports. [1]

System Requirements:

A. These guidelines provide general information and "best practice" guidelines related to the use of lights and sirens by EMS personnel during incident response and patient transport. Ambulance services may use these guidelines to fulfill the service's requirement for a policy regarding the use of lights and other warning devices as required by state regulation, or regions may use these guidelines in establishing regional treatment and transport protocols.

Policy:

A. Use of lights and other warning devices:

1. Ambulance may not use emergency lights or audible warning devices, unless they do so in accordance with standards imposed by state regulation (relating to Vehicle Code) and are transporting or responding to a call involving a patient who presents or is in good faith perceived to present a combination of circumstances resulting in a need for immediate medical intervention. When transporting the patient, the need for immediate medical intervention must be beyond the capabilities of the ambulance crew using available supplies and equipment.

B. Response to incident:

1. The EMS vehicle driver is responsible for the mode of response to the scene based upon information available at dispatch. If the PSAP or dispatch center provides a response category based upon EMD criteria, EMS services shall respond in a mode (lights and siren (L&S) or non-L&S) consistent with the category of the call at dispatch as directed by the dispatch center. [2] Response mode may be altered based upon additional information that is received by the dispatch center while the EMS vehicle is enroute to scene.

2. L & S use is generally NOT appropriate in the following circumstances:
    a. “Stand-bys” at the scene of any fire department-related incident that does not involve active interior structural attack; hazardous materials (see below); known injuries to firefighters, or other public safety personnel; or the need for immediate deployment of a rehabilitation sector.
    b. Carbon monoxide detector alarm activations without the report of any ill persons at the scene.
    c. Assist to another public safety agency when there is no immediate danger to life or health.
3. Special circumstances may justify L&S use to an emergency incident scene when the emergency vehicle is not transporting a crew for the purposes of caring for a patient:
    a. Transportation of personnel or materials and resources considered critical or essential to the management of an emergency incident scene.
    b. Transportation of humans or materials and resources considered critical or essential to the prevention or treatment of acute illness/injury at a medical facility or other location at which such a circumstance may occur (i.e. transportation of an amputated limb, organ retrieval, etc).

C. Patient transport:

1. The crewmember primarily responsible for patient care during transportation will advise the driver of the appropriate mode of transportation based upon the medical condition of the patient.
2. L&S should not be used during patient transport unless the patient meets one of the following medical criteria: [4,5]
    a. Emergent transport should be used in any situation in which the most highly trained EMS practitioner believes that the patient’s condition will be worsened by a delay equivalent to the time that can be gained by emergent transport. Medical command may be used to assist with this decision. The justification for using this criterion should be documented on the patient care report.
    b. **Vital signs**
        1. Systolic BP < 90 mmHg (or < 70 + [2 x age] for patients under 8 years old).
        2. Adults with respiratory rate > 32/min or < 10/min.
    c. **Airway**
        1. Inability to establish or maintain a patent airway.
        2. Upper airway stridor.
    d. **Respiratory**
        1. Severe respiratory distress. (Objective criteria may include pulse oximetry less than 90%, retractions, stridor, or respiratory rate > 32/min or < 10 min).
    e. **Circulatory**

1. Cardiac arrest with persistent ventricular fibrillation, hypothermia, overdose/ or poisoning.

   Note: Most other cardiac arrest patients should not be transported with L&S.[6]

f. **Trauma**
   1. Patient with anatomic or physiologic criteria for triage to a trauma center (Category 1 Trauma). Refer to Trauma Triage Protocol

g. **Neurologic**
   1. Patient does not follow commands (motor portion of GCS < 5).
   2. Recurrent or persistent generalized seizure activity.
   3. Acute stroke symptoms (patient has Cincinnati Prehospital Stroke Scale findings) that began within the last 3 hours. See Stroke Protocol

h. **Pediatrics**
   1. Upper airway stridor.

i. **When in doubt**, contact with a medical command may provide additional direction related to whether there is an urgent need to transport with L&S.

3. No emergency warning lights or siren will be used when ALS care is not indicated (for example, ALS cancelled by BLS or ALS released by medical command).[7]
4. Mode of transport for interfacility transfers will be based upon the medical protocol and the directions of the referring physician or medical command physician who provides the orders for patient care during the transport. Generally, interfacility transport patients have been stabilized to a point where the minimal time saved by L&S transport is not of importance to patient outcome.
5. Exceptions to these policies can be made under extraordinary circumstances (e.g., disaster conditions or a back log of high priority calls where the demand for EMS ambulances exceeds available resources). These exceptions should be documented.

D. Other operational safety considerations:

1. The following procedures should be followed for safe EMS vehicle operations:
   a. Daytime running lights or low-beam headlights will be on (functioning as daytime running lights) at all times while operating EMS vehicles during L&S and non-L&S driving.
   b. L&S should both be used when exercising any moving privilege granted to EMS vehicles that are responding or transporting in an emergency mode. (Examples include, proceeding through a red light or stop sign after coming to a complete stop or opposing traffic in an opposing land-or one-way street)
   c. When traveling in an opposing traffic lane, the maximum speed generally should not exceed 20 miles per hour.

d. EMS systems are encouraged to cooperate with the dispatch centers in developing procedures to “downgrade” the response of incoming units to Non-L&S when initial on-scene units determine that there is no immediate threat to life.
e. The dispatch category (e.g., “code 3,” “ALS emergency”, etc.) that justifies L&S response should be documented on the patient care report. The justification for using L&S during transport should also be documented on the patient care report (e.g., “gunshot would to the abdomen,” “systolic BP<90,” etc.).
f. Seat belts or restraints will be securely fastened to the following individuals when the vehicle is in motion:
    1. All EMS vehicle operators
    2. All patients
    3. All non-EMS passengers (cab and patient compartment)
    4. All EMS practitioners (when patient care allows)
    5. All infants and toddlers (these children should be transported in an age appropriate child seat if their condition allows). Children should not be placed in cab passenger seat with airbag.

Notes:

1. These guidelines are secondary to and do not supercede the state Motor Vehicle Code.
2. Dispatch centers/PSAPs and EMS regions are encouraged to have medically approved EMD protocols that differentiate emergent responses (for example, “emergency,” “code 3,” “red,” “Charlie,” “Delta,” etc…) from a lesser level of response (for example, “urgent,” “code 2,” “yellow,” “Alpha,” “Bravo,” etc…) based upon medical questions asked by the dispatcher. The dispatch category classification or determinant that justifies L&S use should be documented on the patient care record.
3. Firefighters cross-trained as EMS personnel who respond in an EMS vehicle to a fire station or fire incident in order to complete a fire apparatus crew are considered an exception to this policy.
4. In most cases (up to 95 percent of EMS incidents), EMS personnel can perform the initial care required to stabilize the patient’s condition to a point where the small amount of time gained by L&S transport will not affect the patient’s medical condition or outcome. In previous studies and in most situations, L&S transport generally only decreases transport time by a couple of minutes or less.
5. Each of these criteria refers to an acute change in the patient’s condition. For example, a patient who is chronically comatose would not automatically require L&S transport because the individual does not follow commands (criterion 2.g.1). Additionally, if the patient improves with treatment and no longer meets the criteria, L&S transport is not necessary.
6. The American Heart Association gives a class III recommendation to L&S transport of patients in cardiac arrest. A Class III indication is not helpful and is potentially harmful. Providing CPR during L&S transport may increase the risk for injury to EMS personnel. L&S may be indicated in some situations where

ALS is indicated, but not available or cancelled, because the ALS crew can not rendezvous with the BLS crew prior to transport to the closest appropriate medical facility.

Performance Parameters:

A. Review for correlation between dispatch classification/category and documented mode of response to scene.
B. Monitor percentage of "911" calls using L&S during response to EMS calls. Routine or scheduled transports should be excluded. [Potential benchmark less than 50 percent of responses with L&S].
C. Review for documentation of reason for L&S transport when patient does not meet criteria listed in section A.13.b – A.13.h.
D. Monitor percentage of urgent/emergent ("911") calls using L&S during transport. [Potential benchmark more than 90 to 95 percent of patients transported without L&S]