the paramedic

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STRESS AWARENESS

Report from this year's European Week for Safety and Health

MOTORCYCLES IN RESCUE MEDICINE

Improving response times.

New Frontiers in optimizing Ambulance Transport Safety

Dr. Nadine Levick gives us an insight to this prime goal of the Emergency Services.

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A primary goal of Emergency Medicine Services is to enhance the care and safe transport of critically ill or injured patients. However, the risks associated with these transports are only just beginning to be recognized. Ambulance vehicle crash fatalities and injuries have been reported worldwide with high rates per mile travelled, raising concerns about ambulance occupant safety. Extensive research undertaken by new multidisciplinary teams are opening up new avenues to enhance EMS safety. Ambulance crash data have recently revealed risks for EMTs and paramedics as well as patients being transported by ambulance and other road users. Recent USA data shows that more than 74% of all EMT and paramedic occupational fatalities are emergency vehicle crash related.

NEW FRONTIERS

in optimizing ambulance transport safety and crashworthiness

Dr. Nadine Levick, an emergency physician and injury researcher, the Director of Harlem Hospital Pediatric Emergency Department, Columbia University and formerly Faculty at Johns Hopkins has taken a lead role in multidisciplinary emergency vehicle transport safety research and the safe EMS transport of children. She is the only clinician investigator in the USA to receive a large federal research award (EMSC targeted Issues Grant EMSC Ped-Safe-T) for EMS transport safety research and she has published the majority of the scientific papers on the mechanics of the safety of ambulance transport nationally and internationally. She and her team have subjected the very first ambulance vehicle to vehicle crash tests to model the real world scenario of an intersection crash. The studies she conducted have identified opportunities to enhance safety practices in the rear ambulance compartment, such as optimizing the use of existing restraint systems, ensuring that occupants are in the most optimal seating configuration with regard to proper patient care and effective restraint practice. Her studies have demonstrated that serious risks to occupants include being unrestrained and sustaining serious head injuries, being struck by unsecured medical equipment or worse still being unrestrained and striking another adult or child occupant. Hostile interior surfaces in many ambulances suggest a need to modify the ambulance interior, including optimization of the restraint systems and improved head protection for the occupants. These data are now being analyzed in detail, and computer models being generated to assist in understanding and demonstrating the consequences of ambulance crashes.

Dr. Levick led a multidisciplinary team with The Emergency Medical Services for Children, which issued guidelines for transporting children that provided general advice with a plan to integrate more detailed information as it comes available. Dr. Levick also coordinated the first multidisciplinary international symposium on the Safety of Emergency Medical Service Vehicles under the auspices of the Society of Automotive Engineers. Dr. Levick has also developed an Emergency Medical Services Transport Safety Foundation at Columbia University to promote and enhance EMS safety.

Dr. Levick's work demonstrated the importance of testing the system as a whole, identifying risks and hazards related to the intact real world system. Dr. Levick has also explored the international developments in EMS Vehicle Safety, particularly the ambulance vehicle safety design initiatives in Sweden and Australia, and has supported the more global approach to sharing these innovations.

Stringent safety standards and safety testing protocols for passenger cars are well established and accepted globally. In contrast, research on the crashworthiness and biomechanics of occupant safety in the ambulance environment is a new field. EMS vehicles have not been required to meet crashworthiness or occupant protection

safety standards in many parts of the world, despite the fact that EMS vehicles have been identified as high risk vehicles. Recent initiatives by the Ambulance Association of America to establish a clearing house for ambulance safety information and to establish a task force to address the safety of ambulance vehicles are important steps forward.

Of the estimated 6.2 million ambulance patient transports annually in the USA, there is approximately 1 fatality per week related to ambulance crashes and many serious injuries occur daily. USA Federal transportation databases record approximately 5,000 ambulance crashes annually, approximately 10-15% of which are major crashes. These crashes are costly in every respect, from the burden of loss of life of our EMS providers, members of the public and huge financial payouts ($10-30 million per serious crash in the USA). This information is in contrast to the myth in the public's (and many EMS providers) mind of the safety of ambulance vehicles. In the EMS world, even though we are constantly exposed to and reminded of, in a most graphic way, the horrors of unrestrained occupants, risky driving practices and projectiles, in the event of a crash, it is ironic that the safety inside the EMS vehicle is seldom questioned. These misconceptions regarding ground EMS vehicle risks and hazards may to some degree explain the limited automotive safety research that has been undertaken in this area.

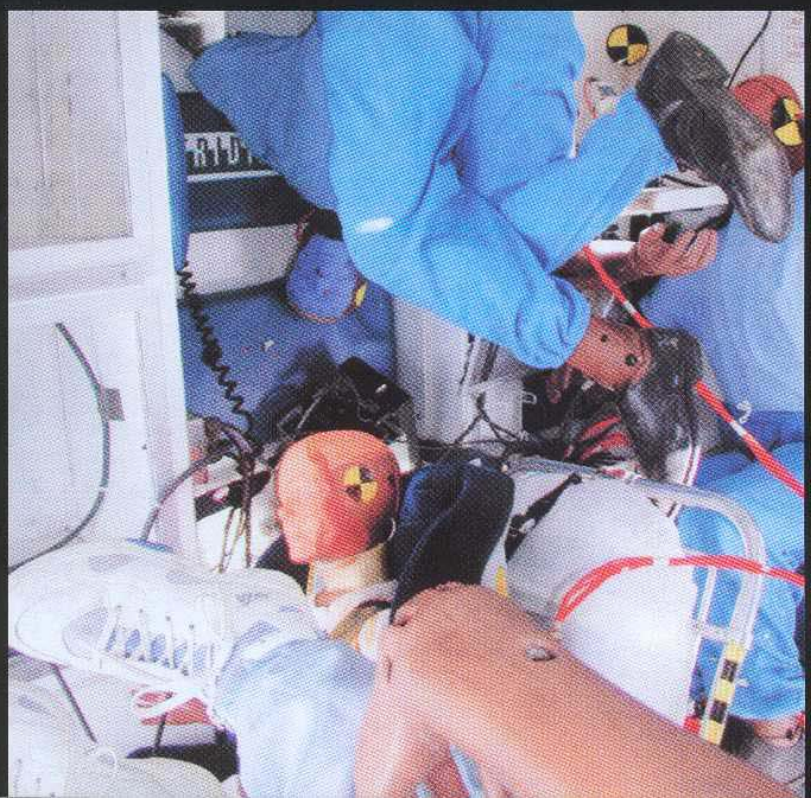
Unfortunately, limited resources are presently available to effectively study and prevent these adverse events in this aspect of Emergency Medical Services. Furthermore, data on EMS vehicle safety is scarce. EMS vehicles have few scientifically proven safety developments, few (if any) enforced occupant protective regulations in the USA and have not been subjected to formal crashworthiness evaluations outside of a few isolated independent studies.

Most research and outcome evaluations relating to ambulance transport have been focused on response times, use of lights and sirens, clinical care and equipment issues, with little emphasis on patient or occupant safety from an automotive safety perspective. In the EMS literature, there is increasing awareness developing of ambulance vehicle safety issues. Recent studies published in the academic literature both engineering and clinical have identified that individuals in ambulance patient compartments may be at a higher risk for crash related morbidity and mortality per mile travelled than occupants of passenger vehicles, and that many of these risks are predictable and likely preventable.

There are numerous parameters well understood to adversely affect the safety of a vehicle:

- high collision speed
- direction of impact (involving an unprotected part of the vehicle)
- increased vehicle stiffness (transmits energy to occupants)
- large compartment size & projectiles (allows vehicle occupants and contents to gather momentum and be major injury hazards)
- lack of passive protection (inadequate automotive grade padding over hard and sharp surfaces)
- inadequate occupant restraint (or failure to use available belts)

However, it would appear ironic that these very issues which are well known to be hazardous, are hallmark features of current USA ambulance design and performance.



Many ground EMS providers state that being restrained interferes with their ability to provide patient care. However, the reality is that their air EMS colleagues provide patient care to many very ill or unstable patients, whilst restrained. Moreover, as the recent safety testing has demonstrated, an unrestrained EMS provider in the event of a crash is potentially a life-threatening projectile to other occupants in that ambulance including to the patient.

International standards

Internationally, the first ambulance occupant safety guidelines to be developed were in Australia (ASA 1999). These rudimentary standards address the need for automotive style safety standards and testing to be developed to address the unique requirements of EMS vehicles and their occupants. By contrast, dynamic automotive safety standards for testing occupant or equipment restraint systems in the ambulance patient compartment are lacking in the United States. A consensus panel assembled by the Emergency Medical Services for Children and the National Highway Traffic Safety administration recently developed preliminary guidelines for safe ambulance transport of children. Subsequent to the Australian standard, Europe has developed safety standards for occupant protection for ground ambulance vehicles.

Ambulance safety testing conducted

Ambulances have different performance needs and structural design compared to standard passenger vehicles. Also, occupants in the ambulance rear patient compartment may be side facing, rear facing or recumbent, and clearly have different needs to passengers in a standard passenger car. These issues substantively complicate the development and conduct of EMS vehicle safety research.

There are two basic types of vehicle crashworthiness testing that are conducted: full vehicle crash testing and sled testing. Full vehicle crash testing, although expensive, time consuming and labor intensive provides valuable information that is essential to understanding the forces and mechanics of what occurs to the vehicle and its occupants during impact in a measurable fashion. It also allows for determination of the interaction of occupants and equipment in a real world crash scenario. Sled testing is a modular testing system; vehicle chassis or components of the vehicles to be studied are tested under controlled impact conditions, usually into a barrier or wall.

research on the crashworthiness and biomechanics of occupant safety in the ambulance environment is a new field

The full vehicle to vehicle crash tests conducted in July 2000 by Dr. Levick's team were a major step forward in advancing the multidisciplinary collaboration essential for optimizing the safety of the EMS transport environment. The findings clearly demonstrated the importance of this form of safety testing to advancing EMS vehicle safety, and specifically demonstrated the risks of unrestrained equipment and unrestrained occupants to all occupants of the rear of the ambulance. Hostile interior surfaces suggest a need to modify the ambulance interior, including optimization of the restraint systems and improved head protection for the occupants.

The only other recorded EMS full vehicle testing was in Canada by Dan Berry in the 1980s (barrier sled tests); Australia a rollover test in the 1980s; and sled tests in Sweden by Thomas Turbel in 1980. Unfortunately, the Australian and Canadian studies have not been published in peer reviewed literature. One Australian group in 1993 (Best, Zivcovic), and a group in Ohio, have conducted some sled testing of separate components of the patient compartment. Also, two companies in the USA EMS related industry have conducted limited sled testing. However, this too was outside the reach of external peer review, and these studies are not based on or supported by data from ambulance full vehicle crash testing.

SAE symposium Sept 11 Overview

This conference, held in Arizona on September 11 2001, under the auspices of the Society of Automotive Engineering, featured key experts from around the globe who shared their ideas on making Emergency vehicle environments safer. The horrific, tragic events of September 11th occurring 45 minutes prior to the conference commencing almost brought the meeting to a halt. However, it was decided it was in the interests of the safety of EMS that the conference should proceed. There was extensive discussion on emergency vehicle safety research and international vehicle design and safety standards and future developments. There was a standout presentation from Deborah Lockhart, RN, a former board member of the National EMS Memorial Service. Lockhart's brother, an EMT, was killed in an ambulance crash whilst providing patient care. She gave the most outstanding presentation at the conference, which included video of her late brother being pulled out of the ambulance wreck and unsuccessfully resuscitated. No amount of stats and numbers could have the impact of watching her EMT brother being dragged dying out of that ambulance wreck.....that sort of information is very powerful. The three main issues that the conference brought to focus were: how best to optimize the safety of the current fleet of ambulances, what safety specific changes to make to the ambulances of the future and most importantly, under whose oversight, and supported by which funding infrastructure should EMS safety be properly addressed and managed. Panel discussion addressing all the aspects of Emergency Medical Vehicle Safety covered during the symposium addressed seven specific issues relating to enhancing EMS safety: data systems, oversight, safety standards, vehicle design, research funding, international advances, and sustainable infrastructure.

Conference participants grappled with the following key issues:
What data systems should be in place for monitoring crashes and associated morbidity and mortality;
What is the role of organizations such as CAMTS, ASTM, GSA, NHTSA, NTSB, NIOSH and SAE (and international organizations) in EMS safety;
Who is responsible for safety standards for vehicles and vehicle occupants in EMS;
What vehicle design issues should be addressed to enhance safety;
Who should be funding research and development;
How can international advances and safety initiatives be disseminated;
What is the next step to sustainable

infrastructure for ensuring appropriate EMS vehicle safety.

Much progress was made toward answering these questions, however, much work remains to be done.

Conclusions

In recent years there have been major developments in EMS vehicle safety understanding and the development of some safety standards in Europe and Australia. The studies conducted in the USA have clearly demonstrated that the ambulance transport environment, while hazardous, includes predictable and likely preventable occupant risks and injury mechanisms for occupants in the patient rear compartment. Failure to use the restraint systems currently fitted to vehicles creates risk for serious injury to both the occupant who is not restrained and can also create hazards for other restrained or unrestrained occupants. The restraint practices for these high-risk vehicles need to be reviewed and effective systems need to be designed and appropriately tested under impact conditions. The absence of validated safety testing standards for these modified vehicles must be addressed. Re-evaluation of the design of ambulance vehicles with a cross disciplinary team including EMS providers, automotive engineers, industry and public health researchers is crucial to optimizing the safety of EMS transport. Specific standards for ambulance vehicle occupant safety need to be developed. There is an urgent need for improvements to ambulance crash safety and to develop performance based safety standards and safety designs. Sustainable infrastructure and funding base for the conduct of EMS safety development and enhancement are now both overdue and time critical.

Important Principles!
1. EMS vehicles are NOT standard passenger vehicles
2. Standard automotive passenger safety practices cannot be applied directly to EMS vehicles
3. Design, performance and practice policy should be based on properly conducted science

Very Important Principle
EMS transport safety is part of a SYSTEM; the overall balance of risk involves the safety of all occupants and the public

Take home messages
1. Drive cautiously
2. Wear your belts & restrain all occupants
3. Secure all equipment

Make safety your priority and encourage this awareness amongst your peers

References available from author at nadine.levick@columbia.edu.

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PROFILE:
Nadine Levick MD

Dr. Nadine Levick MD, MPH, FACEM, FRACGP, FABFP, Director of Pediatric Emergency Medicine, Harlem Hospital Center, Columbia University, New York City. She is an Australian trained and board certified emergency medicine physician and family medicine practitioner with a Masters in Public Health from Johns Hopkins University, with a focus on injury prevention. Dr. Levick has been in the USA for 6 years, she spent 5 years at Johns Hopkins, as Faculty in pediatric Emergency Medicine. She has been awarded a number of national and international research awards and is the recipient of competitive Federal funding for her EMS safety and injury biomechanic research. Dr. Levick has conducted the first USA ambulance vehicle crash tests and has published in medical and engineering literature. Dr. Levick is active on a number of USA Federal and national committees and organizations.

Dr. Levick is also the Principal Investigator of PEDNET, a large federally funded Pediatric Emergency Care research infrastructure, based in the northeast region of the USA. Dr. Levick's medical background in Australia includes senior positions in the Emergency Departments of major public university affiliated teaching hospitals in metropolitan Melbourne and in regional Victoria, a University appointment in the Medical Faculty at the University of Melbourne, as a Medical Officer in outback Western Australia with the Royal Flying Doctor Service and also a Medical Officer with the St. John's Ambulance Service, a partnership in a Family Medicine clinic, in addition to the Nuku'alofa Hospital, Tonga in the South Pacific.

Dr. Levick's research emphasizes the importance of the scientific basis for the development of safety strategies and dissemination of injury prevention strategies and the interface of scientific data with EMS safety guidelines and policy development.