

Rig

What you need to know about
ambulance safety & standards

Safety 9-1-1

>> BY NADINE LEVICK, MD, MPH

What is it that we need to know about ambulance safety? How do we digest the information that's put forward by manufacturers? Does KKK-A-1822 compliance mean the ambulance can endure a crash? What's safe and what isn't? What works and what doesn't? And where do we go to find out?

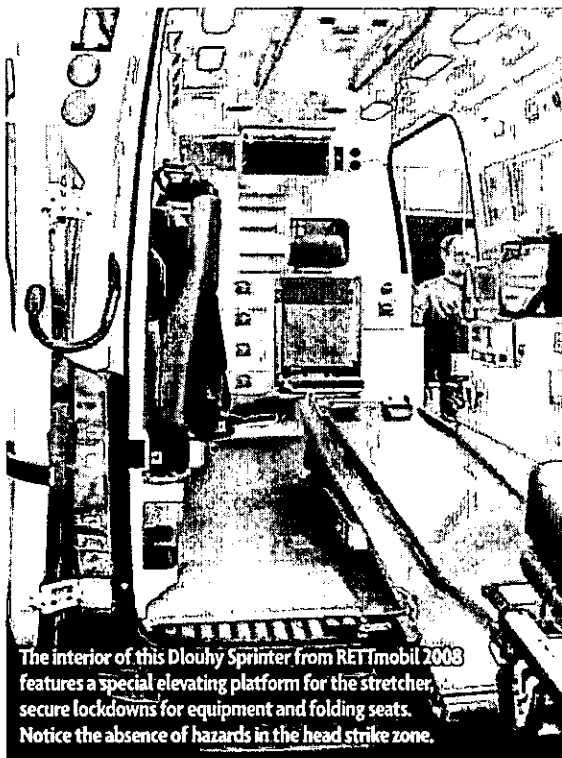
A DISCONNECT

Since the 1960s, when we left the Cadillac and went into the "box," we essentially lost the safety oversight of the automotive industry. What has been the status quo in the ambulance vehicle industry since then hasn't matched what's standard in the automotive and transportation industry.

Extensive data now highlights some of the strengths and weaknesses of how we address the transportation safety aspects of EMS. Data currently demonstrate that per mile traveled per vehicle, ambulances are one of the most hazardous vehicles on the road.¹

Concept vehicles are on the market, but where are the data and automotive safety oversight to support these modifications? Automotive safety experts have raised serious concerns about the safety of these vehicles built outside the purview of technical experts in occupant protection and vehicle crashworthiness.²

Would you dare to administer medication that was demonstrated by clinical experts to be unacceptably toxic? Would you use equipment that had been known for 10 years to be unsafe or, worse yet, lethal? No.



The interior of this Dlouhy Sprinter from RETTmobil 2008 features a special elevating platform for the stretcher, secure lockdowns for equipment and folding seats. Notice the absence of hazards in the head strike zone.

So why aren't we holding ourselves to the same standard when it comes to the vehicles we ride in every shift?

A SHIFT IN STANDARDS

It might come as quite a surprise, but neither the KKK Ambulance Specification nor the Ambulance Manufacturers Division (AMD) Standards are standards of occupant crash protection or vehicle crashworthiness. In fact, in some areas, they even conflict with current technical automotive safety engineering practices.³

KKK- or AMD- compliance doesn't demonstrate that an ambulance is crashworthy or will protect occupants in the rear patient compartment in the event of

a crash. Although KKK and AMD default to the Federal Motor Vehicle Safety Standards (FMVSS), these standards have a special exemption for ambulances.⁴ So once we're positioned in the rear compartment, just 600 mm (2 ft.) behind the seating reference point of the driver's chair, the FMVSS are largely exempt from protecting us. Thus, our safety choices—such as effectively securing equipment, wearing lapbelts and applying safe vehicle operations—are paramount.

Bigger isn't always better. The rest of the world is moving toward compact vehicles that offer fuel economy and lower price tags. These ambulances are designed by automotive safety experts

and create an environment in which providers can easily reach patients and equipment while belted and which are demonstrated to be crashworthy. Fortunately, what has historically been considered safe is being challenged in the U.S., and in a fashion that's strongly driven by data and evidence.

The new Subcommittee on EMS Transportation Safety of the National Academies Transportation Research Board and the interdisciplinary Ambulance Transportation Safety Task Force are holding an Ambulance Safety Summit in November. Also, the non-profit EMS Safety Foundation has taken a delegation to Europe to look at safety practices at RETTmobil and will share highlights from its trip at the 2009

EMS Today Conference and Exposition and via Webinars. These are two examples of how organizations with technical experts are contributing to enhance our understanding of safer ambulance transport.

The importance of this issue is highlighted by the recent National Fire Protection Association focus on ambulance vehicle safety standards.⁵ Essential to the development of such vehicle standards is the need for input from transportation, automotive safety, injury and impact biomechanics, and human factors technical experts and data. Creating a standard takes time, even years, and it's imperative to have access to the best safety information available while these processes are underway.

WHERE WE'RE GOING

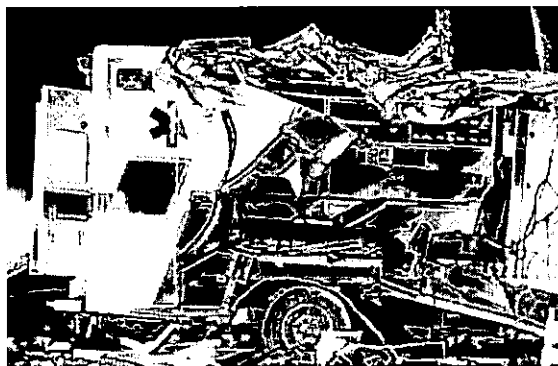
When it comes to crash safety, the accepted standard is dynamic crash testing, not static pull tests.¹⁻³ In the automotive world, crash testing is related to real-world injury data. The mechanism and data on how injuries occur in crashes is fed back into the development of the testing, and as a result, to the safety enhancements of the vehicle and, importantly, the standards.

Although dynamic crash testing is the method to test the occupant safety of a vehicle, not all dynamic crash tests are the same. Without standards for how tests should be conducted, some of these tests can be meaningless or misleading. Intrusion into the patient compartment cannot be determined from simple deceleration testing (sled tests). Although being thrown against the bulkhead is a serious hazard, intrusion into the patient compartment is one of the real risks that we face (see crash photo).

For optimal safety, current data suggests a compact vehicle, a well-designed interior with minimal possible injury hazards, forward- and rear-facing seats, and patients secured in over-the-shoulder belts in the longitudinal direction on the stretcher. Also, crashworthy, energy-absorbing features should be designed to address all occupants, not just those in the front. All essential equipment should be accessible and effectively secured. Manufacturers should ensure there are no head strike hazards present in the head-impact zone. Squad-bench occupants should wear the lap belt low over the pelvis

and avoid using four- or five-point harnesses on side-facing seating. Many serious crashes are frontal crashes, and such harnesses have been shown by the world's leading automotive safety engineers to be highly hazardous when seated sideways.⁶

Other aspects important to the overall safety of the vehicle are enhanced stability control, scientifically proven enhanced visibility markings, and operations policies



This fatal crash in June highlights the need for meaningful vehicle safety testing standards, based on injury and fatality data and crashworthiness performance. The patient and one provider died.

designed to optimize fleet safety performance, such as the ANSI/ASSE Z.15 Standard.⁷ We can learn a lot about fleet safety management from commercial fleet operations and the Federal Motor Carrier Safety Administration.

Independent studies demonstrating the effectiveness of aftermarket safety devices are rare. One such device that has been independently validated has demonstrated significant safety benefits in the EMS environment. This device monitors operator safety performance and provides immediate auditory feedback. Study results demonstrate a 1,000-fold improvement in safety proxies and a major decrease in crash rate and severity, as well as an improvement in vehicle maintenance expenses and response times.⁸

CONCLUSION

In the absence of meaningful federal standards, our challenge is to identify best practices in vehicle safety. Watch for new developments in vehicles, technology, policies and standards that will save lives, time and money. First, be sure your purchases pass muster with independent safety experts and

have been through meaningful testing. Our providers, patients and the public deserve the safest and most efficient vehicles available.

JEMS

Nadine Levick, MD, MPH, is an emergency physician, clinician and researcher. She has won many national and international awards for her studies in ambulance safety. She has published a large majority of the engineering literature in the field. She also conducted the world's first federally funded vehicle-to-vehicle ambulance safety crash tests and established the EMS Safety Foundation (www.emssafetyfoundation.org). Contact her at nlevick@objectivesafety.net.

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7. Safe Practices for Motor Vehicle Operations. ASSE/ANSI Z15. 2006. www.asse.org/shoponline/products/3387.php
8. Levick NR, Wiersch L, Nagel ME: "Real world application of an aftermarket driver human factors real time auditory monitoring and feedback device: An emergency service perspective." International Technical Conference on the Enhanced Safety of Vehicles. 2007. www.nrdnhtsa.dot.gov/pdf/nrd-01/esh/esh20/07-0254-O.pdf

RESOURCES

- National Academies Transportation Research Board: www.trb.org
- Federal Motor Carrier Safety Administration: www.fmcsa.dot.gov
- U.S. General Services Administration: www.gsa.gov/automotive
- Global EMS Forum: www.globalemsforum.org
- Ambulance Visibility: www.ambulancevisibility.com
- Objective Safety: www.objectivesafety.net
- EMS Safety Foundation: www.emssafetyfoundation.org

Ambulance Safety

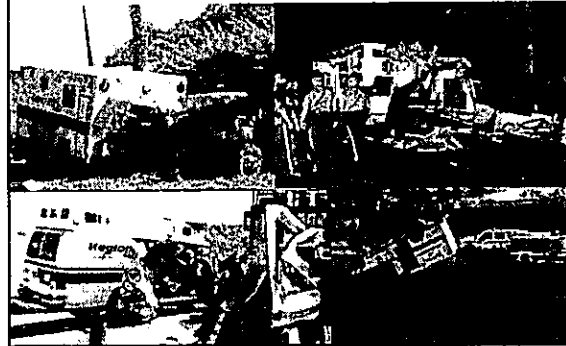
Brief for SEMSAC and the EMS Board



Robert R. Bass, MD, FACEP
Maryland Institute for EMS Systems

Ambulance Crashes in the US

Too Common and Too Serious



Factors that impact ambulance crashes

- * Human
- * Operational
- * Vehicle
- * Environment



Outline of Presentation

- How big a problem are ambulance crashes?
- Why are they such a big problem?
- What can we do about them?

WORKING IN AN

AMBULANCE IS DANGEROUS

- Estimated 6500 crashes per year which injure 10 people a day and kill 2 people a month in the US
- In Maryland 511 ambulance crashes per year from 2001 – 2005 (MARS)
- Nearly half of EMS providers in one survey reported being in ambulance crash
- Ambulance is 13X more likely to be in a crash and 5X more likely to have injury
- Overall – statistics likely under represent the magnitude of the problem

WORKING IN AN AMBULANCE IS

DANGEROUS

- EMS personnel in US – fatality rate 12.7 per 100K workers (> 2X national average which is 5 per 100K)
- Police and related protective service workers (10.8 per 100K) and firefighters (9.3 per 100K) also have markedly elevated rates

**TRANSPORTATION RELATED DEATHS ARE
GREATER FOR EMS THAN FOR LAW
ENFORCEMENT AND FIREFIGHTING**

- If stratified by transportation related:
EMS is 9.6/100,000 workers versus 6.1 for
police and 5.7 for fire
- Average for all US transportation workers
is 2.0/100,000 workers

**Causes of EMS Workforce Fatalities
2003 - 2008**

• Aircraft	36%
• Highway Incidents	34%
• Struck by vehicle	7%
• Other transportation	7%
• Assaults	8%
• Other	8%

US Bureau of Labor Statistics

**Ambulance Crashes in Maryland
Averages for 2006 - 2008**

- 390 crashes per year (more than one a day)
 - * 76% multiple vehicles
 - * 24% single vehicle
- 1 fatality per year
- 27 injuries per year (1 every 14 days)
- Most incapacitating injuries occurred in the
rear compartment
- Driver "at fault" in over 50%

**ECONOMIC AND PSYCHOSOCIAL
IMPACT IS UNKNOWN BUT LIKELY
SIGNIFICANT**

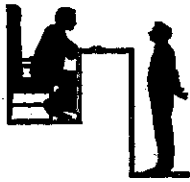
- | | |
|--------------------------------|------------------------------------|
| • Property damage | • Disability/Retirement
income |
| • Medical cost | • Market productivity
reduction |
| • Emergency services
cost | • Insurance administration |
| • Investigation cost | • Travel delay |
| • Legal cost | • Psychosocial impact |
| • Vocational
rehabilitation | • Functional capacity |
| • Replacement employees | • New operational costs |

More on Impact of Ambulance Crashes

- Greatest liability risk to providing EMS -
estimated \$500m per year
- Long term financial and psychosocial impact
- Costs related to deaths, injuries, and property
loss to civilians
- Some volunteers not covered by Workers
Compensation - paralyzed EMT in WI
- Good Sam protection may not apply
- Potential criminal liability



Choose a Skilled XXXX Ambulance Accident Attorney
After a person has been involved in a serious ambulance
accident, he/she will have to deal with immense emotional
devastation while trying to heal from his/her physical
injuries. These injuries will not only cost the person a great deal
of time and grief, but may also cause the person a great deal of
money. For this reason, ambulance accident victims in XXXX
should consider working with a knowledgeable motor vehicle
accident attorney who can help them recover monetary
compensation from negligent ambulance drivers and negligent
ambulance companies.



XXXX Ambulance Accident Attorney

If you or someone you know has been injured in an ambulance accident in XXXX, you may be able to file a lawsuit or claim to receive compensation for injuries and losses sustained. XXXX accident attorney XXXX is familiar with taking on ambulance accident claims and understands how they relate to state law.

Attorney XXXX uses this knowledge to assist his clients in reaching favorable outcomes to their lawsuits and claims - bringing the responsible parties to justice.

AMBULANCE CRASH DATA

Free legal consultation for injuries received in an ambulance crash

A speeding ambulance can cause a crash and serious injuries.

Ambulance crashes are one of many hazards faced by Emergency Medical Services (EMS) personnel and pedestrians. Although no complete national count of ground ambulance crashes exists, the total number of fatal crashes involving ambulances can be ascertained by using the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS).

WHY ARE TRANSPORTATION RELATED OCCUPATIONAL DEATH RATES HIGHER FOR EMS?

- The literature is evolving and picture becoming more clear



NO SEATBELTS

- MMWR Ambulance Crash-Related Injuries Among EMS Workers (US 1991 - 2002)
 - * 300 fatal crashes with deaths of 82 ambulance occupants and 275 of other vehicles and pedestrians
 - * Majority of EMS worker fatalities were in the front seat
 - * Majority of all occupant fatalities were in the rear and not restrained
 - * EMS worker fatalities with no restraints - 7/11 drivers; 2/5 right front; 6/7 patient compartment

NO SEATBELTS

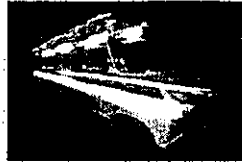
- Less than half (41%) of EMS workers use belts in patient compartment - "can't do patient care" - even less if CPR or chest pain
- Approaches 0% if critical patient
- Occupants more likely to be killed in an ambulance crash than in other similar sized vehicles likely due to multiple people in rear w/out restraints (providers, patients, family)

OVERUSE OF LIGHTS AND SIREN



- Majority of ambulance crashes occur during emergency use - 91% for Denver study
- Intersections are a greater risk for ambulances than other vehicles - expectation that others will yield to L&S
- Intersections crashes in PA: urban 67% versus rural 26%
- Majority of fatal crashes occur at non-intersections - 72% of fatal and 45% of all crashes

OVERUSE OF LIGHTS AND SIREN



- "Do no harm"
- Lights and sirens frequently do not save that much time and infrequently improve patient outcomes
 - * urban study: 75 runs/second ambulance/ 230 seconds saved/4 patients may have benefited/ALS can reduce need
 - * L&S saved 43.5 seconds in Greenville and rural Pitt County NC

OVERUSE OF LIGHTS AND SIREN

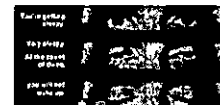
- 504 pediatric transports reviewed; 312 w/ L&S; 123 were deemed inappropriate; BLS runs more likely to be inappropriate
- Only 8% of patients met PA protocol criteria for L&S; no adverse outcomes with use of protocol

BAD DRIVING

- Operator error – 75% rural 93% urban
 - * Driving too fast and/or in wrong lane cited in 60% of fatal crashes
 - * Not trained and young - NIOSH
 - * Poor knowledge of driving laws in NC survey
- 71% of crashes in Denver – driver had a record of multiple crashes
- Many drivers of the ambulances (44%) have poor driving histories (crash or citation w/in 3 years – some multiple) – from FARS

FATIGUE AND DISTRACTION

- Fatigue and distraction are issues NIOSH review
- 24+ hour shifts a potential danger
- Higher likelihood of crash if reported sleep disorder
- Impact of waking up for a call – similar to DWI



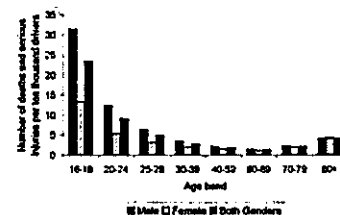
Distractions account for 20 – 30% of passenger car crashes – likely more in ambulances

- * Radios, computers, controls for L&S
- * Patients, family members, and noise



LESS EXPERIENCE AND YOUNGER

- Young drivers more likely to be in a crash



LACK OF POLICIES AND PROCEEDURES

- Many services do not have policies or procedures that sufficiently address ambulance safety issues



POOR VEHICLE DESIGN

- Ambulance crashes killed the majority of EMS workers, yet ambulances are exempt from Federal Motor Vehicle Safety Standards.
- The National Transportation Safety Board has recommended vehicle design safety standards, occupant protection and driver training for ambulances, but its recommendations have never had the force of law.

Barriers to Safety Improvements Not Unique to Ambulances



Costs

Anatomy of a \$133,000 Ambulance

By MIKE McINTIRE



Los Angeles buys them for \$85,000 apiece. Detroit pays \$84,000. Closer to home, a major New York hospital system spends less than \$80,000.

But the New York City Fire Department has them all beat, spending more \$133,000 each for custom-made ambulances — all 480 of them. At \$65 million, the department's new contract to replace its front-line fleet over five years is the largest and most costly municipal ambulance purchase in United States history, according to industry executives.

Politics and Legal Challenges to Change In Safety Standards

- Despite high liability exposure, changes in the US have been slow in coming and are still being challenged and debated



AMBULANCE CRASHES ARE NOT "ACCIDENTS" – MOST CAN BE PREVENTED

- Six P's (Kurt Krumpnerman IOM Ambulance Transport Safety Summit Nov 2008)
 - * – Procurement
 - * – Policies
 - * – Protocols
 - * – Personnel
 - * – Performance
 - * – Political Action

What can we do to prevent ambulance crashes?

- Ambulance Crash Prevention Strategies (adapted from Nels Sanddal PEC 2008)
- Adapted in turn from 4 E's of highway safety – Education, Enforcement, Engineering, and EMS

4E's - EDUCATION

- Emergency driver education, but... there is little evidence on relative effectiveness of various training programs
 - * Should include lecture, "hands on" training in the ambulance, use of certified instructors, and testing
 - * Simulator training may augment "hands on" courses
- Change the culture – crash versus accident and "Do No Harm"
- Educate emergency vehicle operators on traffic laws
- Continuously reinforce safety policies and protocols

4E's - ENFORCEMENT

- Standard policies that address:
 - * safety restraints
 - * L&S (certified EMDs for response and field protocols for transport)
 - * stopping at all red lights and stop signs
 - * excessive speed
 - * high visibility clothing
 - * securing equipment
- Include medical director in policies and reviews
- Monitor compliance through peers, supervisors, and "black box"
- Crash review committee

4E's - ENFORCEMENT

- Screen new emergency vehicle operators for
 - * previous moving violations
 - * drugs and alcohol
 - * risk related behaviors and attitudes
 - * physical impairments to safe driving
- Continue to monitor after employment
- Predict and prevent driver fatigue
- Graduated implementation of driver responsibilities... especially for young drivers
- Need for a national system to collect data on emergency vehicle collisions

4E's - ENFORCEMENT

CDC MMWR recommends the use of restraints whenever possible for all ambulance occupants...



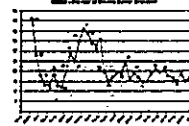
... of all ages.



4E's - ENGINEERING

- Improved design and use of technology driven by engineering science and testing
- Improved restraint systems and ergonomics to enable EMS providers to do patient care
- Black box monitoring (must be enforced)
- Improved vehicle markings for better visibility
- Regularly maintain vehicles

How The Feedback Box Works



- Recorders installed on each unit to measure:
 - * Speed against user set limits – both running hot & cold
 - * Cornering velocity / hard braking / acceleration
 - * Use of seat belts, lights & sirens

CRASHES ARE NOT THE ONLY DANGER TO EMS PROVIDERS

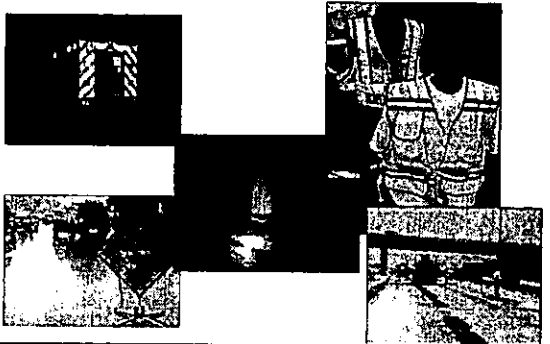
- Between 1992 and 1997, Maguire (2002) found 114 EMTs and paramedics were killed on the job
- Of the 114 deaths
 - * 67 were from ground transportation accidents
 - * 19 from air ambulance crashes
 - * 13 from heart attacks, strokes and other cardiovascular problems
 - * 10 from homicides, most of them shootings
 - * 5 from other causes, such as needlesticks, electrocution and drowning

2007 NTSA Report

Feasibility for an EMS Workforce Safety and Health Surveillance System

- We need a better system of surveillance for EMS occupational related illnesses and injuries

SCENE SAFETY IS AN IMPORTANT CONSIDERATION



Mission Statement

Created as a Committee of the Cumberland Valley Volunteer Firemen's Association, the Institute serves as an informal advisory panel of public safety leaders committed to reducing deaths and injuries to America's Emergency Responders. Members of the Institute, all highly influential and expert in their fields, are personally dedicated to the safety of the men and women who respond to emergencies on or along our nation's streets, roads and highways. Members of the Institute include trainers, writers, managers, government officials, technical experts and leaders who through their individual efforts and collective influence in the public safety world can bring meaningful change.

TIMS - 2008



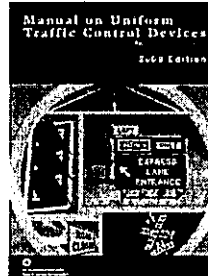
U.S. Fire Administration
Traffic Incident
Management Systems
April 2008



- USFA with US DOT Federal Highway Administration
- IFSTA at Oklahoma State University

US DOT

Federal Highway Administration



- Includes standards for control of traffic through incident management areas (chapter 61)

FACTORS THAT IMPACT SCENE SAFETY

- Lack of training
- Lack of situational awareness
- Failure to establish a proper Temporary Traffic Control (TTC) zone
- Improper positioning of apparatus
- Inappropriate use of scene lighting
- Failure to use PPE and high-visibility apparel and safety equipment
- Careless, inattentive, or impaired drivers
- Reduced vision driving conditions
- Altered traffic patterns

Safety Vests

- On November 24, 2008, a provision in the Manual on Uniform Traffic Control devices (MUTCD), administered by the Federal Highway Administration (FHWA), goes into effect requiring public safety officers, including volunteer firefighters and EMS personnel responding to an incident on the side of a federal aid highway, to wear a safety vest that meets the Performance Class II or III requirements of the American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) 107-2004 publication.

Regional TIMS Committees

- Multidisciplinary – LE, F&R, EMS, Transportation, Towing, Hazmat, PSAP, Media
- Use to preplan, train and coordinate resources in responding to and clearing traffic incidents
- Helps to protect responders and reduce effects of incidents on traffic flow and congestion
- Activities include developing procedures, training, incident reviews, special-event planning, and interagency collaboration

