A solution to head injury protection for Emergency Medical Service providers

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Abstract

The purpose of this study is to identify applicable standards and potential devices for head protection for the ground ambulance transport environment. Occupational health and safety standards for Head Protection for Emergency Medical Service (EMS) providers in USA, Australia and Europe were reviewed. Existing helmets intended for, or adopted for use by EMS personnel were identified, and unique design elements determined via focus groups and expert panels. The findings demonstrated that there are no USA head protection standards for this population, although such standards exist in Australia and Europe. Unique design features, suggested by providers were: communications capability (with patients, 85%; and driver 69%) and stethoscope auscultation (89%); Expert panels added: Effective in high horizontal G forces; Identify the responder; Biohazard protection and Image enhancing. Although there is demonstrated risk for serious and/or fatal head impacts in the ambulance environment, there is an absence of standards or guidelines for occupational head protection, for USA ground EMS providers. An head protection device should include communication capacity, and address comfort, visibility and aesthetics and be protective for automotive crash forces.

Keywords: Head protection, ambulance safety, Personal protective equipment, safety standards, emergency medical service provider safety

1. Background

Occupational risks for ground EMS providers include head injury both in the vehicle environment and at the emergency scene, however there are limited detailed epidemiological and biomechanical data pertaining to these risks in this work environment. Recently published ambulance crash test data demonstrate risk of serious head injury to EMS providers in the event of an ambulance crash [1, 2, 3, 4]

The recent epidemiology data identifies ambulance crashes as a high risk event per mile travelled by ambulance in the USA and that ambulance crashes are also the highest cause of mortality in the EMS occupational environment [5, 6, 7, 8, 9, 10, 11], with being struck by another vehicle as a pedestrian at the scene the next highest mortality risk [11]. There is no comprehensive data base for identifying ambulance crash related injury in detail. However the reports of EMS crashes in the press frequently identify serious head injury [12, 13] as the injury sustained by the EMS providers in the setting of an ambulance crash. There are a number of factors that contribute to the EMS provider sustaining a head injury in a vehicle crash. These include: the interior design of the vehicle and

any hostile surfaces in the head strike zone, use of seat belts fitted in the vehicles and driving policies with respect to risky driving practices, which are the primary determinants [5, 8, 15, 16]. There are over 50,000 ambulance vehicles in the current USA EMS fleet [15] – and clearly modification of this existing fleet of vehicles to minimize hostile interior surfaces is a major undertaking, considering the time the vehicles would be out of service, general costs and logistics.

As new vehicles are designed for this market, it would be valuable for the issues of hostile interior surfaces, and hazards in head strike zones, as identified in biomechanical and crash test research [1, 2, 3, 4] to be addressed proactively. However in the interim there is a pressing need for augmented head protection in the interior vehicle environment and also, head protection may also offer medics some additional injury protection when working at an emergency scene.

2. Scope of Project

The scope of this project was to identify which standards apply to head protection in the emergency services and to determine what standards, if any, apply to head protection in the USA ground ambulance environment. Existing helmets for use in all Emergency services were examined by an expert panel, and focus group of medics conducted to determine and to identify the design elements to consider for specific helmets designed for use by ground ambulance transport personnel.

3. Methods

A review of occupational health and safety requirements for head protection in all Emergency Service providers, including Emergency Medical Service (EMS) providers in air and ground vehicles was conducted. Additionally head protection standards were identified for other USA environments that had some similarities to the ground ambulance environment, in that there was either an environmentally hazardous or automotive related scope for mechanical injury. A review of relevant peer-reviewed biomechanical and epidemiological studies was performed to identify potential mechanisms of head injury risk for the providers in ground ambulance transport. Focus groups of experts in the field of EMS occupationally related impact and injury biomechanics and also by groups of EMS personnel were conducted to evaluate desirable features for EMS helmet design. The attitudes to EMS head protection were evaluated for a pilot sample of suburban and urban EMS providers, both pre and post a brief but graphic one hour intervention. This intervention described general risks and hazards for the EMS environment and specifically addressed the need for and the benefit of head protection in the EMS environment. The providers were attending a mandatory safety seminar.

4. Results

4.1. Standards

There are numerous detailed and specific standards and requirements for head protection in the USA for fire fighters, search and rescue providers and air EMS providers. There are no USA standards or requirements specifically for head protection for ground ambulance providers. There are also USA standards for head protection for extreme sports and for bicycle riders, as well as for motorcycle riders. European and Australasian standards identified a similar spectrum of applications, however the number of standardizing bodies was far more contained. Also both in New Zealand and the UK helmets with a specific application to the ground ambulance personnel market were manufactured, meeting the search and rescue or the fire helmet standard. There appeared to be no specific standards to meet the unique needs of ground ambulance transport head protection.

Table 1
A summary of existing head protection standards:

USA
- Snell B90/B95; Snell M2000/M2005;
- CPSC Standard (16 CFR Part 1203);
- FMVSS 218;
- ASTM F1045-04
- ANSI Z89.1-1997; ANSI Z90.1; ANSI Z87.1 2003
- NFPA 1971-2000; NFPA 1951
- MIL-H-87174.

European
- EN 397:1995; EN 443:1997;
- ECE 22-05

Australian/New Zealand
- AS/NZS 1800:1998; AS/NZS 2063:1996; AS/NZS 4067:2004

4.2.Epidemiology

Review of limited preliminary data suggests that fatal head injury is involved in greater than 60% of ground ambulance provider fatalities in vehicle crashes and that fatal injury is more frequent for the providers in the rear compartment of ambulances [9]. Biomechanical studies of the impact dynamics of the rear patient compartment of the ambulance demonstrate the potential for high G force head impacts from hostile surfaces or structures in the ambulance vehicle interior. This involves primarily unrestrained occupants, (and in the some situations and types of impact also restrained occupants) [1, 2, 3, 4] – as well as from unsecured patient care equipment in the rear compartment of EMS vehicles [12, 13, 16]. The vehicle interior also has poor ergonomics [17]. Approximately 1/5 of vehicle related provider fatalities occurred at the scene of an emergency involving a provider being struck as a pedestrian by another vehicle [10, 11].

4.3. Survey and focus group data

Evaluation of EMS personnel safety awareness and attitudes to head protection pre and post the brief EMS training intervention, demonstrated a dramatic change in attitude, with a major increase in safety concern, as described in Figure 1.a) before and Figure 1.b) after the graphic risk and hazard presentation.

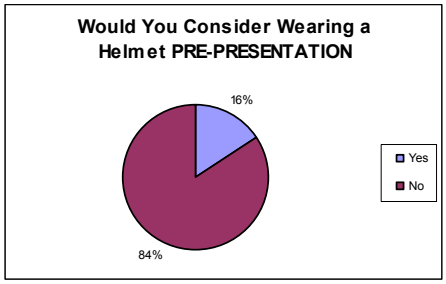

Figure 1a): Pre-presentation attitudes

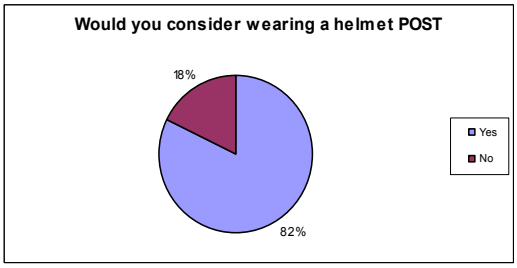

Figure 1b): Post-presentation attitudes

EMS personnel surveyed in focus groups, identified the following desired helmet attributes:

- communications capability
  - with patients (85%)
  - with driver (69%)
- stethoscope auscultation (89%)

EMS occupational and injury expert opinion identified these following desired helmet attributes:

- Effective in high horizontal G forces, such as an automotive crash
- Communications capacity
- Identify the responder
- Lightweight and low profile
- Biohazard protection
- Image enhancing/ 'cool'

5. Discussion

Head protection is an accepted, well recognized, standard and standardized aspect of PPE for all Emergency Services, except for ground ambulance transport providers.

In a setting of new enhancements to ambulance transport safety – and a realistic understanding of time frames for such changes to fleet vehicles – head protection is a simple and cost effective initiative to minimize injury risk.

5.1 The role of head protection in ground EMS.

From the combined epidemiological and biomechanical data it is clear that head injury is a predictable occupational injury risk. A helmet is a simple, immediate and inexpensive adjunct – a protective device that an EMS provider can utilize to address these risks and hazards:

- To protect EMS provider occupants from hazardous interiors that have yet to be retrofitted with safer interior designs
- As a safety adjunct as general EMS vehicle crashworthiness design advances
- As driver training advances and improves to minimize driver related vehicle safety risks
- To decrease risk and hazard should any equipment become unsecured
- As safety standards are developed, for both EMS vehicles and EMS occupational safety

5.2 Limitations of this study

This study focussed on head protection standards for USA, Europe, UK, Australasia for Emergency Services, and thus may not be representative of such head protection standards globally outside of these regions.

The sample size for EMS personnel attitudes to helmets is small, and thus may not be generalizable. Additionally the sample size for desirable helmet characteristics, both focus groups and experts were small. With no actual device available, medics' opinions regarding desirable and acceptable features may be confounded.

Some military standards may not have been included across the spectrum of standards evaluated, and military helmets were not described in the graphic presentations, neither was the issue of ballistic head protection.

5.3 Standards development

As a result of this study a collaborative relationship has been established with the International Safety Equipment Association (ISEA) for the development of a standard for ground EMS head protection and PPE to meet the specific needs of the EMS occupational environment [18, 19, 20]. It is anticipated that with a collaborative approach bringing together field data, injury hazard data, experts in standards development and industry partners that effective and appropriate head protection standards for ground EMS will be achievable in the short term.

6. Conclusion

There is an absence of standards or guidelines USA, Europe, UK, Australasia specifically for occupational head protection for ground EMS providers. Previously published studies demonstrate that exposure to serious head injury is an occupational hazard for ground EMS, yet there is no PPE device specifically designed to meet these defined head injury hazards, which include both automotive occupant and pedestrian head injury risk in addition to other environmental hazards of an emergency scene.

Despite these serious head injury risks, and that there are no approved standards and no protective devices that specifically address the head protection needs of ground EMS providers, there are numerous detailed and specific standards and requirements for head protection for fire fighters, search and rescue providers and air EMS providers.

This study also demonstrated that EMS personnel are responsive to risk and hazard information and explanation with respect to the acceptability of the use of head protection.

The findings in this study suggest that there is a pressing need for ground EMS head protection device and standard development, and that with minimal training and education that initial reluctance to accept a new device can rapidly be overcome. Also that a purpose designed head PPE device for the ground EMS environment should include communication capacity, address comfort, visibility and aesthetics and be protective for automotive crash forces in addition to scene safety.

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