

Poster: 0161

Evaluation of Emergency Service Vehicle Occupant Safety

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Broad Importance of the Research Problem: Working in the patient compartment of an ambulance in transit exposes emergency medical service (EMS) personnel to a high-risk of crash-related injury or death on every call. All occupants of ambulance patient compartments are at a 5-fold higher risk of suffering fatal crash-related injuries than the front seat ambulance occupants. Ambulance drivers and front seat passengers are protected from vehicle crash-related injuries by occupant protection systems required by Federal Motor Vehicle Safety Standards (FMVSS). However, similar protection for the patient compartment occupants is not addressed by FMVSS and research related to crash protection for these occupants is sparse. A key contributor to the increased risk among EMS staff in the patient compartment is lack of use of available lap belts or other occupant restraint systems. Seat belts currently provided in ambulances do not allow the mobility that EMS workers need to care for patients. As a result, EMS workers routinely work unrestrained in the patient compartment.

Purpose or Objectives of the Study: This project seeks to prevent work-related EMS vehicle crash injuries to emergency service workers in ground ambulance patient compartments. This objective will be accomplished through the development of mobile occupant restraint systems that allow EMS personnel the mobility to provide appropriate patient care while simultaneously providing a level of crash protection similar to that available for front seat occupants.

Summary of Methods: Crash-related injury mechanisms for EMS staff in patient compartments were identified through NIOSH Fatality Assessment and Control Evaluation investigations and National Highway Traffic Safety Administration reconstructions of ambulance crashes. Engineering interventions were identified through an announcement in FedBiz ops for potential solutions to the problem. From this announcement, four occupant restraint systems that provide user mobility and restraint were chosen for evaluation. NIOSH, in cooperation with public and private sector partners, evaluated these mobile restraints using accepted automotive industry methods that included mathematical models; a 29-run, laboratory-based sled-testing program; and a four-vehicle crash test program. Each sled and crash test included four instrumented anthropomorphic test devices (ATD), or crash test dummies, in the patient compartment. The test data was compared with Injury Assessment Reference Values (IARV) used by the automotive industry to relate force and moment data from ATDs to the potential for human injury.

Summary of Findings: The crash investigations and reconstructions show that regardless of occupant location within the ambulance patient compartment, secondary collisions between unrestrained occupants and compartment bulkheads and cabinets is the primary injury risk. During the sled and crash tests, the mobile restraints which proved structurally sound at acceleration levels between 25 and 30 Gs, prevented the ATDs from secondary collisions in the patient compartment. Comparison to the IARVs for head, neck, and chest injury indicated that the restraint systems were capable of providing protection similar to that afforded front seat occupants by FMVSS requirements. Use of mobile restraints has the potential to significantly reduce crash-related injuries to EMS workers in ambulance patient compartment.

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