Improving Restraint Feasibility through Ambulance Layout Redesign

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1. Introduction

This study examined the duties performed by emergency medical service workers with the goal of increasing the time EMS workers are restrained while providing patient care during transport. An optimal layout of equipment and materials in the rear patient cabin of an ambulance was created to increase seatbelt restraint feasibility for working medics. Over 13,000 EMS agency calls were evaluated to identify medical procedures frequently performed during patient transports, which were then filmed and analyzed using Pareto and link analysis to measure restraint feasibility. An alternative ambulance layout was developed following focus group meetings, and the adjusted tasks restraint feasibilities were calculated for the alternative layout. Restraint feasibility was significantly increased for the 5th percentile female, 50th percentile male, and 95th percentile male anthropometric populations. The proposed patient compartment design increased overall restraint feasibility from 47 percent to 90 percent. The proposed design would increase safety for medics and patients during patient transports by increasing the number of tasks that could be performed from a belted and seated position.

Ambulance-crash-related injuries to emergency medical service (EMS) workers could be greatly reduced if medics were restrained more often while riding in the patient compartment. With so many factors affecting the likelihood of an ambulance crash, there is no definite means of reducing crash risk. This study examined the duties performed by EMS workers with the goal of increasing their restraint time. Work inefficiencies were considered to develop an improved layout for the ambulance patient compartment.

2. Methods

Archived patient care records (PCRs) detailing 13,252 ambulance calls between 2005 and 2010 were examined to identify EMS procedures most commonly performed while providing patient care. An EMS worker was recorded performing procedures on a mock patient in a type III ambulance to understand the specific tasks associated with the common procedures identified in the Pareto analysis. Each activity was broken down into "tasks," which were evaluated relative to the medic's ability to perform the task from a seated and belted position, using reach envelopes constructed from primary medic seat locations.

Once the alternative layout was designed, a full-scale mockup of the proposed layout was constructed at the EMS group headquarters where the EMS staff was invited to participate in a focus group.

3. Results

For all populations (95th percentile male, 50th percentile male, and 5th percentile female), the average restraint feasibility was increased significantly in the revised layout. A paired t-test was conducted to compare the restraint feasibility for the different tasks between the current and proposed layout: the 5th percentile female group increased from 37 percent to 78 percent (p = 0.001), the 50th percentile male average restraint feasibility increased from 53 percent to 96 percent (p < 0.001), and the 95th percentile male average restraint feasibility increased from 53 percent to 97 percent (p = 0.007).

For 6 of the 11 analyzed procedures (primary survey, monitoring of vitals, IV peripheral, blood draw, pulse oximetry, cardiac monitor, glucometer, and 12-lead EKG), the proposed layout enabled 100 percent of needed equipment to be placed within reach of a seated, belted medic.

Percent of Equipment Within Reach of a 50th Percentile Male, Restrained and Seated

4. Conclusions

By designing an ambulance to meet the needs of the worker, restraint feasibility was significantly increased. The primary medic seat should be located to support eye contact and open communication between the medic and patient, while remaining restrained, an aspect identified as necessary by medics. The most commonly used equipment should also be moved to be located nearer to the worker for a more efficient work flow. Since there are no standards in place for the location of equipment in the patient compartment, safety and comfort of the medic should be considered when placing equipment.

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