D34 Head and Neck Trauma: BioMedical Engineering Analysis of Entrapment Testing

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Learning Overview: The goal of this presentation is to inform the forensic engineering community about the importance of integrating various components of a system and testing the design as a whole to prevent real-world head and neck risks of entrapment.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing attendees with a better understanding of the factors that increase risk of injury/death due to entrapment.

Introduction: Nearly one million Americans live in some type of senior living community and that number is expected to double by the year 2030. Between 2003 and 2012, there were 155 bed rail-related deaths in which 129 of the 155 deaths occurred in people who were 60 years or older. With the increasing number of seniors residing in assisted living care, there is a greater need to focus on medical research to reduce health risks and provide preventative measures. This includes research of the mechanics of injuries that lead to fatalities. Entrapment of the head and neck can occur as a result of the body being wedged between two objects, creating a mechanism for asphyxiation. Biomedical engineering analysis is important to determine what can be done from a preventive perspective to ensure a safer environment for every patient in this increasing population.

Case Study: A facility failed to ensure that half-side rails were safely applied for an immobile resident who was using an alternating pressure mattress. This failure created a real and present danger when her head and neck became wedged between the half-side rail and mattress, resulting in fatality due to asphyxiation.

Content/Methods: Tests were performed using the Food and Drug Administration (FDA) -approved Bed System Measurement Device in the seven different possible entrapment zones that have been outlined by the FDA. Testing was conducted to determine if an alternating pressure mattress with the approved half-length bed rail passed or failed in the various zones/settings.

Results: During the analysis of entrapment incidents, this study revealed that the interactions between the separately designed components of the bed system were more concerning than any one component alone. Currently, the bed system is under-optimized and leads to entrapment possibilities. Error rates were analyzed and contributing factors of these error rates were determined.

Conclusion: The results confirm that there are risks for entrapment even in a bed system unit in which all components individually passed the FDA regulations for entrapment. This is due to their specific interactions between various bed components that were not properly designed and tested as a system. One contributing factor to this current issue is having different manufactures design the mattresses, bed frames, and bed rails that are frequently used interchangeably. The customized testing, in which all components of the system were tested as a unit, resulted in identifying entrapment risks and presented an unnecessary risk for users.

Bed Rail, Entrapment, Mattress