



H121 A Probabilistic Analysis of the Cause of a Traffic Death Following Two Crashes Using National Crash Data

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The goal of this presentation is to present the analysis of the most probable cause of a fatal head injury following two traffic crashes occurring in close temporal sequence.

This presentation will impact the forensic science community by illustrating a multidisciplinary, evidence-based assessment of cause of death in a fatal traffic crash investigation.

Medicolegal investigation of the mechanism and cause of death in most fatal traffic crashes is relatively straightforward; there is typically evidence of direct or indirect blunt force trauma to the head, neck, or chest that can be matched with a reconstructed crash injury mechanism; however, in some unique circumstances, there are plausible alternative explanations for observed injuries that require further investigation.

This presentation describes the death of a 19-year-old female driver of a Sports Utility Vehicle (SUV) that was involved in two crashes occurring in close temporal sequence. The collision series began when the decedent's Ford® Explorer® SUV carrying five restrained occupants swerved to avoid a semi-tractor/trailer that had entered its lane. The vehicle began to yaw clockwise, then tipped and rolled 2.5 times, coming to rest on its roof in the same lane in which it had been traveling. The Ford® sustained extensive roof crush. Two of the passengers were able to exit the vehicle, and none of the occupants recalled the driver verbally responding.

Approximately one minute after the vehicle had stopped moving, a southbound semi-tractor/trailer struck the SUV on the driver's side at 33.5mph. The driver, who was found inverted and hanging from her seatbelt with her head and left arm partially ejected, was pronounced dead at the scene. Autopsy revealed a comminuted transverse fracture through the temporal and occipital bones and a pontomedullary transection, as well as extensive abrasions, lacerations, and pressure marks noted about the head, face, neck, torso, and both upper and lower extremities.

There was no reliable evidence from either the autopsy or from an engineering/biomechanical perspective as to which of the crashes caused the fatal head injuries. From a common-sense perspective, it was reasonable to view the second collision as having a very high probability of causing serious head injury, as the decedent's inverted head and neck were at the level of the bumper of the approaching semi. At the same time, the high degree of roof crush sustained by the SUV in the rollover also suggested a high risk of head and neck injury.

An analysis of national crash data was undertaken to quantify the risk of death for each of the two crashes so that a determination of comparative risk could be made. To this end, data were abstracted from the United States National Automotive Sampling System-Crashworthiness Data System (NASS-CDS). The parameters for the analysis included all SUVs that underwent a rollover, and the outcome was risk of death for a belted, non-ejected driver with more than one foot of roof crush at their seating position. The risk of death in such rollover crashes was 1.8% for drivers, or 1 in 56.

The same type of analysis was performed for the second crash, using nearside impacts of a "T-bone" configuration, and adjusted for the severity of the collision, which, at 33.5mph impact speed placed it in the upper 1.5% of all side impacts for severity. The associated risk of death was 16%, or 1 in 6.3. The risk ratio between the two crashes was $16.0/1.8=9.0$; thus, a comparison based purely on risk indicated that the second crash was nine times more likely to have caused the fatal injuries.

Further review of the evidence indicated that the inverted driver was likely struck in the head by the bumper of the approaching semi, as there was a small amount of blood found on the bumper. This fact likely increased the risk of death from the second impact substantially, relative to the 16.0% estimated risk for upright occupants. Thus, it was more accurate to consider that the absolute risk of death from the first crash (1.8%) indicated that there was a >98% probability that the decedent survived this initial crash; thus, as the risk of death from the second crash approached 100%, the risk ratio would likewise increase.

Traffic Death, National Crash Data, Forensic Epidemiology