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Second Generation AACN Injury Severity Prediction Algorithm: Development and Real-World Validation

Advanced automatic collision notification (AACN) based injury severity prediction (ISP) has great potential to improve post-crash care. The national Expert Panel for Field Triage set 20% risk of Injury Severity Score (ISS) 15+ injury as the threshold for urgent transport to a trauma center. Earlier, the authors published an Injury Severity Prediction algorithm (ISP v1) that was developed using data from the National Automotive Sampling System Crashworthiness Data System (NASS_CDS) for the calendar years 1999-2008. In a field trial published at ESV 2015, this ISP algorithm version 1 demonstrated better than predicted sensitivity to detect seriously injured (ISS15+) crash occupants. In the current study, the authors sought to a) update the ISP algorithm using more current NASS-CDS data, b) improve predictive accuracy by refining the granularity of the input data, and c) validate the ability of this updated algorithm (ISP v2) using real-world crash cases involving GM vehicles equipped with OnStar. NASS-CDS data (1999-2013) was used to develop a functional logistic regression model to predict the probability that a crash-involved vehicle would contain one or more occupants with ISS 15+ injuries in planar, non-rollover crash events involving Model Year 2000 and newer cars, light trucks, and vans. Two of the parameters used in the original ISP algorithm were modified (principal direction of force [PDOF], older occupant age) and a new parameter was created and involved the presence of a right-sided passenger. This study was approved by the IRB of the Michigan Department of Health and Human Services (formerly the Michigan Department of Community Health). The initial 924 occupants in 836 crashes published in the 2015 study were again opened for review and injury severity predictions from the updated algorithm were compared to the observed injury outcomes. The updated ISP v2, which employs the functional data analysis technique to model the effect of PDOF to ISS 15+ injury as a continuous cyclic function, showed an improved predictive performance (AUC 0.872, AIC 2370) over the original ISP v1 (AUC 0.865, AIC 2377) that used only 4 crash directions. The original elderly age cutoff of 55 performed better than an age cutoff of 60, so age ≥55 was retained as a parameter in ISP v2. Using field data for validation, the updated ISP algorithm had significantly improved sensitivity for detecting seriously injured (ISS 15+) occupants (72.7% vs. 63.4%) with minimal changes in specificity (93% vs 94%). The AUROC for ISP v2 was 0.946, an improvement over the AUROC for ISP v1 (AUROC 0.932). This study confirms under real world field conditions that occupant injury severity can be predicted using vehicle telemetry data. The updated ISP v2 algorithm's ability to predict a 20% or greater risk of severe (ISS15+) injury confirms ISP's utility for the field triage of crash subjects.

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