

Calibration of Injury Severity Prediction Algorithm for Nissan Vehicles

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I. INTRODUCTION

The Guidelines for the Field Triage of Injured Patients includes the criterion “vehicle telemetry consistent with high risk of injury” to facilitate the use of advanced automatic collision notification (AACN) data in the standardized assessment and treatment of crash occupants [1]. The Guidelines were developed utilizing a 20% risk of ISS15+ injury as the threshold for “high risk of injury.” In 2010, Kononen published the Injury Severity Prediction (ISP) algorithm, the first algorithm to follow the Expert Panel’s specifications [2]. The ISP was based on the NASS-CDS data available at that time. The safety performance of vehicles has improved substantially over the past several decades and this may affect the field performance of algorithms such as ISP based on NASS-CDS as the database contains primarily older vehicles. Vehicle safety systems and occupant populations also vary between vehicle manufacturers. These differences may substantially affect the accuracy of injury risk prediction using vehicle telemetry when comparing one manufacturer to another. In order for field triage to function properly for the optimal care of current crash victims (minimizing over-triage as well as under-triage), it is essential that each manufacturer’s injury severity prediction based on vehicle telemetry data be calibrated to the 20% risk of ISS15+ injury specified by the Expert Panel.

II. METHODS

Data from NASS-CDS for 2002-2010 were used. The variables in which we were most interested were: vehicle class, impact direction, belt use, airbag status, change in velocity (ΔV) and injury severity score (ISS). We identified the Nissan and Infiniti vehicles in the dataset and excluded any cases with missing data in our selected variables. This resulted in 2,565 occupants of Nissan/Infiniti manufactured vehicles with complete data. All Nissan vehicles were matched to non-Nissan vehicles based sequentially on vehicle class, crash direction, belt use, airbag status and crash severity. The ISP was calculated and compared to the observed injury outcome for the Nissan versus best-matched non-Nissan vehicles.

III. INITIAL FINDINGS

TABLE 1. Predictability of ISP for ISS for all Nissan cases

	ISS <15	ISS > 15	Totals
ISP <.2	2312 (2367.8)	109 (53.2)	2421
ISP >.2	98 (87.2)	46 (56.8)	144
Totals	2410	155	2565

TABLE 2. Predictability of ISP for ISS for non-Nissan cases in E

	ISS <15	ISS > 15	Totals
ISP <.2	2303 (2374)	125 (54.0)	2428
ISP >.2	80 (81.5)	57 (55.5)	137
Totals	2383	182	2565

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In tables above, the observed outcomes are shown in **bold**. The predicted outcome based on cumulative ISP injury risk for each row is shown in *(italics)*. The performance of ISP>.2 in predicting ISS>15 among the Nissan occupants is summarized below.

	Estimated Value	95% Confidence Interval	
		Lower Limit	Upper Limit
Prevalence	0.060429	0.051668	0.070532
Sensitivity	0.296774	0.227547	0.376266
Specificity	0.959336	0.950466	0.966706
For any particular test result, the probability that it will be:			
Positive	0.05614	0.047698	0.06594
Negative	0.94386	0.93406	0.952302
For any particular positive test result, the probability that it is:			
True Positive	0.319444	0.245662	0.403031
False Positive	0.680556	0.596969	0.754338
For any particular negative test result, the probability that it is:			
True Negative	0.954977	0.945748	0.962729
False Negative	0.045023	0.037271	0.054252

IV. DISCUSSION

The ISP algorithm published by Kononen et al. performs as expected in this retrospective analysis of NASS crashes directly comparing Nissan to matched non-Nissan vehicles. Based on the estimated difference of proportions of ISP >.2 and ISS >15, it appears that the ISP does a better job of predicting ISS scores in Nissan vehicles than it does in non-Nissan vehicles. There appears to be a trend toward occupants of Nissan vehicles having slightly less severe injuries than occupants of similar non-Nissan vehicles which leads to a slightly higher false positive rate for ISP > .2 in Nissan vehicles. The false negative rate for ISP > .2 also trends lower in Nissan vehicles than non-Nissan vehicles. These findings will inform the risk prediction algorithms applied when new Nissan vehicles equipped with AACN are involved in crashes.

Overall, less than 6 percent of the cases analyzed would have met the criteria to be designated a crash with “high-risk of injury.” This will allow emergency medical services to prioritize rapid transfer of this small subset of crash occupants to trauma care facilities. At the same time, it is important to remember that the sensitivity of ISP for ISS>15 injuries is approximately 30%. Therefore, careful on-scene evaluation by emergency medical services personnel remains essential until ISP sensitivity can be increased with improved vehicle crash sensing and telemetry.

V. REFERENCES

- [1] Sasser SM, *et al.*, MMWR Recomm Rep, 2009.
- [2] Kononen DW, *et al.*, Accid Anal Prev, 2011.