Estimation of the number of seriously injured road traffic casualties in Germany based on GIDAS, using a decision tree method and the TraumaRegister DGU®

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I. INTRODUCTION

In line with the new definition introduced by the European Commission (EC), the number of seriously injured road casualties in Germany for 2014 is assessed in this study. The number of MAIS3+ casualties is estimated by two different methodological approaches. The first approach is based on data from the German In-Depth Accident Study (GIDAS), which is closely related to the German Road Traffic Accident Statistics. The second approach is based on data from the German TraumaRegister DGU® (TR-DGU), which includes many more hospitals but not all MAIS3+ injuries.

II. METHODS

So far, the German Road Traffic Accident Statistics have defined "seriously injured" as those casualties who are treated in a hospital as in-patients and survive for at least 30 days. According to the new definition by the EC, seriously injured road-users are casualties with an injury severity classified as MAIS3+, i.e. injuries of the maximum abbreviated injury severity of level {3, 4, 5, 6}, and who do not die within 30 days from the effects of the accident. The abbreviated injury scale (AIS) [1] is an anatomical-based coding system that classifies the injury severity by the AIS severity score on a six-point ordinal scale indicating risk for death.

Extrapolation based on GIDAS and the national accident statistics

The GIDAS [2] database is closely related to the Official German Road Accident Statistics and is – except for some well-known biases – representative for Germany. The approach for the estimation is two-fold:

1. using the decision tree method on GIDAS data to classify scenarios with a high and a low probability, respectively, for MAIS3+;
2. applying these probabilities on all hospitalised casualties (national data) for the purposes of extrapolation.

The main advantages of the decision tree method [3] are its ability to handle non-linear relations, its flexibility and its ease of use. Using variables available both in GIDAS and in the national data – such as the kind of accident, mode of traffic participation, etc. – the GIDAS dataset of all hospitalised casualties is split into subgroups that are similar with respect to the probability of suffering MAIS3+, which is the number of MAIS3+ related to all hospitalised in the respective category. This splitting into subgroups will be continued until groups get too small (less than 21 casualties), or until no further differentiation is possible. The subgroups and the probabilities gained from this method are applied to the group of all hospitalised persons included in the Official German Road Accident Statistics. This is the estimator for all MAIS3+ in Germany for 2014.

Some considerations have to be regarded for injury coding with MAIS9 (= unknown), since for these cases:

(A) the injury severity is entirely unknown, i.e. injuries for all body regions are unknown (AIS9). These data are excluded from the analysis;

(B) the injury severity is partially unknown and at least one of the known injuries is AIS3 or higher. These cases are included as MAIS3+.

Extrapolation based on TraumaRegister DGU®

The TraumaRegister DGU® [3] is a nationwide registry of severely injured patients with about 35,000 cases per year, of which 90% originate from German hospitals. Participation in the registry is mandatory for the approx. 600 certified trauma centres in Germany. The inclusion criteria of the registry (admission via trauma room plus

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need for intensive care) do not cover all MAIS3+ patients, thus the current estimator is extrapolated from the number of cases with Injury Severity Score (ISS) ≥ 16. The ISS is calculated as the sum of squares of maximum AIS severity scores in the three most injured body regions. It is the most frequently used score for quantifying injury severity. The number of patients of the few hospitals that do not participate in the registry is assumed to be similar to the numbers originating from participating hospitals, categorised as supraregional (level 1), regional (level 2) and local (level 3) trauma centres. However, non-member hospitals of level 3 are expected not to treat seriously injured trauma patients and thus are excluded from the estimation. Furthermore, the assumption is made that only half of the level 2 non-member trauma centres contribute to medical care of seriously injured patients. An under-reporting rate of 10% is assumed for all hospitals. The percentage of traffic-related cases is 51.9% among ISS16+ in 2014. From other trauma registries, with broader inclusion criteria (e.g. the British Trauma Audit and Research Network (TARN)), it is known that the number of patients with MAIS3+, but not ISS16+, is similar to the ISS16+ collective, therefore a factor of 2.2 is used to extrapolate the calculated number of ISS16+ to the total number of MAIS3+.

III. INITIAL FINDINGS

The employed GIDAS dataset of the period 2011–2014 contains 1,733 hospitalised persons, of which 348 were MAIS3+ (20.1%). The group of hospitalised persons is split by the "mode of traffic participation" in the first step: this separates powered two-wheelers (PTW), with a significantly higher probability for MAIS3+ of 31%, from all others, with a probability of 18%. Extrapolating the subgroups obtained in the complete splitting procedure on the Official German Road Accident Statistics, the share of seriously injured road accident casualties on all 67,732 hospitalised persons in 2014 is estimated to be 14,645 (21.6 %).

Passenger car users contribute about 35% to the MAIS3+ road casualties (compared to 50% of all road traffic fatalities), whereas PTW and cyclists account for about 50%. Pedestrians account for about 12% of the MAIS3+ seriously injured casualties, which is close to the share of 13–15% on all road traffic fatalities in recent years.

The TraumaRegister DGU® documents 33,265 patients from Germany in 2014, of which 14,290 are patients with ISS16+. Referred to an individual trauma centre, the average annual ratio of ISS16+ cases (without fatalities) is reported to be 68.1%, 21.0% and 4.4% in a hospital of level 1, level 2 and level 3, respectively. Taking the above-mentioned corrections into account, the estimator for all traffic-related surviving ISS16+ patients is 7,670 cases. Thus, using the factor 2.2, the estimator for MAIS3+ injured persons in Germany for 2014 is 16,874.

IV. DISCUSSION

We assume that the number of 14,645 obtained by the GIDAS approach is an underestimation of the 'real' number of MAIS3+ injured, as certain accidents are under-represented in police data (under-reporting).
For plausibility checks, the estimation of the number of traffic-related MAIS3+ injured patients from the TraumaRegister DGU® was taken into account. The estimator based on the hospital data of 16,874 casualties is higher, as this estimator presents an overestimation because the definition of an accident in this database is broader (e.g. inclusion of casualties due to single-pedestrian accidents or accidents on private grounds) than in the Official German Road Accident Statistics.

Further work with respect to validation through comparison to other data sources (e.g. cross-check of subgroups with insurers' accident data, e.g. with UDV data) and further developments of the two methods outlined here (e.g. time series) are in progress.

V. REFERENCES

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