

A Prospective and Interdisciplinary Study on Polytraumata in Traffic Accidents

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ABSTRACT

While many medical studies have dealt with the incidence, nature and treatment of polytrauma the injury-causing accident mechanisms are rarely discussed in detail, mostly due to the lack of documentation of the technical aspects. The present prospective study was started in late 2007 and collects data from traffic accidents with most severely injured in six south-German counties and two larger cities for the duration of one year. It is aimed at identifying and documenting all polytrauma cases (ISS \geq 16) caused by traffic accidents and their crash circumstances. The data collection is based on an interdisciplinary concept to include both the police, emergency dispatch centers, hospitals and fire departments in the region and is completely anonymous. Potentially relevant cases where an emergency physician was called to the scene of a traffic accident are provided by the dispatch center. All three hospitals in the region suited for the treatment of polytraumatized patients record injuries, major diagnostic and surgery data. Data and images from the accident scene are provided by the police and by fire departments. The latter provide information which is usually not available from the police, like deployed airbags, vehicle extrication measures and detailed views of car interiors. The main objective of the study is to determine the structure of road users who sustain a polytrauma, their crash opponents and the injury patterns found in relation to the collision configuration and the protection by seat belts, air bags and other devices. With detailed documentation of vehicle damage and extrication measures the study is also intended to support the development of injury predictors for pre-hospital treatment and provide field data regarding further improvement of technical rescue.

INTRODUCTION

In 2004, the German Highway Research Institute (Bundesanstalt für Straßenwesen BASt) presented the results of a pilot study that looked at the incidence rate of most severe injuries in traffic accidents [1]. The German statistics on road accidents do not use this term since only slightly injured (out-patient treatment of accident victims), severely injured (in-patient treatment for at least 24 hours) and fatalities (accident victims who deceased within 30 days after the accident) are defined. BASt described most severely injured as being those accident victims who – due to the severity and kind of their injury – bear a high risk of long-term or even permanent disability. Official statistics of the most severely injured from road traffic accidents do not exist in Germany, they are included in the number of seriously injured, according to the authority's definition. For the purpose of the pilot study, hospital diagnosis statistics, national statistics for the disabled and the trauma registry of the German Society for Trauma Surgery (Deutsche Gesellschaft für Unfallchirurgie DGU) were analysed. Based on these figures, BASt could not find a decrease in the number of cases over a 9-year period. An earlier study by Busch [2] on the number of disabled as a result of traffic accidents was based on an analysis of German data from compulsory health and accident insurers. It was estimated that most severe, but survived injuries have a share of approximately 10 % among the seriously injured as defined by national accident statistics.

Often, such kinds of injuries occur in connection with a polytrauma. The annual number of most severely injured or polytraumata is not known, likewise their distribution among the different kinds of road users (pedestrians, cyclists, motor-cyclists, passenger car and heavy vehicle occupants) and the circumstances of the accident, like the kind of collision and seating position in motor vehicles are unknown. This could be a starting point to develop counter measures targeted at polytrauma.

EPIDEMIOLOGY OF POLYTRAUMA IN GERMANY

The incidence rate of polytraumata in Germany was estimated by Kühne et al. [3]. The number of polytrauma patients treated in 2005 in hospitals participating in the DGU trauma registry was extrapolated to all hospitals in Germany which provide maximum level trauma treatment. They concluded that Germany would see approximately 35,000 new polytraumatised patients annually, caused by work accidents, falls, traffic accidents or other injury mechanisms. Haas et al. [4] estimated this rate to be 32,500 annually. The white book for care of severely injured [5] quotes the annual report of the German Ministry of Labor [6] with the estimate that the number of most severely injured has declined during the past 10 years by 5 % in average. Liener et al. [7] determined the incidence of severe multiple injuries in the city of Ulm and the neighbouring county of Alb-Donau-Kreis in Germany in a retrospective study for the period from 1996 until 2000. Their sampling tried to collect all cases, no matter which mechanism caused the polytrauma. Based on the number of inhabitants in the study area the extrapolated rate for Germany yielded 18,700 polytraumatised patients which is significantly lower than the figures in other studies. Therefore, it was concluded that the accident rate in the study region was below average. The largest share among the causes for life-threatening multiple injuries were traffic accidents accounting for 59 % of the cases. Otte et al. reported in their comparative study of traffic accidents in the period of 1973 until 1978 and 1994 until 1999 that life-threatening injuries were present in almost all body regions in the earlier study period, but could be found mainly in the head and thorax region in the later period [8]. It was hypothesized that this change in injury pattern was caused by the progresses in the passive safety of modern vehicles. This would allow significantly higher collision energies to be survived than in the 1970's. However, immediate death at the accident scene would be more likely once these thresholds were exceeded.

Causes of most severe injuries in traffic accidents

As injuries and treatments in conjunction with a polytrauma are mostly well documented their incidence rate can be determined, especially when using the trauma registry of the German Society for Trauma Surgery (DGU) [9]. The outcomes of severe injury patterns are described by research in accident and rehabilitation medicine [10, 11]. Yet, for road traffic accidents, the detailed circumstances and the collision mechanism causing these injuries remain mostly unknown because it is difficult to determine and document these influential factors during the pre-hospital phase. Even completely filled-out emergency physician's protocols will usually not include detailed data on seating position, impact direction etc. The question to which degree modern occupant protection systems with air bags, belt pretensioner and force limiter or measures of pedestrian protection in a car can prevent such injuries are even harder to answer. Assessment of passive vehicle safety, on the other hand, relies mostly on standardised crash tests that utilize anthropomorphic test devices which represent the average adult in size and weight. Prediction of the incidence of certain injury patterns in real occupants is limited with the physical loadings measured on a crash test dummy. Due to the lack of suitable anthropomorphic test devices and a considerable test effort only little can be said about the injury risk for occupants in heavy vehicles and riders of motor-cycles and bicycles or pedestrians.

Interdisciplinary In-Depth Accident Research in Germany

Research at the scene of an accident which covers medical and technical issues is performed in Germany in the course of the German In-Depth Accident Study (GIDAS) by the Medical University of Hanover (MHH) and by the Technical University of Dresden in their surrounding areas [12, 13] and, to a smaller degree, at major German car manufacturers. The sampling in Hanover and Dresden includes all injury severities in principle, but shows some regional particularities like most accident research projects. For instance, the accident statistics for these regions reveal that severe collisions with involvement of motor-cycles or with heavy vehicles are underrepresented in comparison with other parts of Germany [14]. Investigations by car manufacturers usually take place in an area close to their R&D headquarters and focus on the newest car models of their own production. Often, the results are used only internally for the improvement of the crashworthiness of future models.

OBJECTIVE OF PRESENT STUDY

This research effort is designed as a multi-center, interdisciplinary study based on a prospective documentation of all polytrauma cases caused by traffic accidents in a defined geographical region. Accidents are recruited for the study when they occur in public space and when at least one of the accident victims sustained life-threatening multiple injuries. This could be any kind of traffic participant if some sort of vehicle is involved, too. This is in line with the definition used for the German accident statistics.

Beside the most important descriptors of the polytrauma patients like age, sex etc. and their injuries the technical parameters (e.g., equipment and type of air bag and seat belt, vehicle mass) and the circumstances of the collision (e.g., kind of road user, impact direction, collision opponent, depth of occupant compartment deformation) and the use of restraints and protective gear (e.g., seat belt, motorcycle helmet) should also be documented. The study does not record which party was primarily at fault or which misconduct contributed to the collision.

Injuries and their treatment are described and classified on the basis of the hospital documentation and the emergency physician's protocol. Single injuries should be coded according to the International Classification of Diseases ICD-10 [15], their severity according to the Abbreviated Injury Scale AIS-98. The total injury severity is described by the Injury Severity Score ISS.

In addition to these parameters, the following data are targeted for inclusion in the documentation from different sources:

- Time and place of accident
- Time needed for the medical staff and ambulance to reach the accident scene, duration of stay at the accident scene and transport to the hospital
- Target hospital, possible transfer to other medical facility and discharge of the patient
- Body mass and size of patient
- Pre-existing diseases
- Patient deceased in hospital
- Duration of treatment in intensive care unit (ICU) and in regular hospital care
- Vital parameters, especially those required for the calculation of the Trauma Injury Severity Score (TRISS) [16]
- Manufacturer and model designation, model year and body type of vehicles involved in collision
- Code of seat belt type for belted car or heavy vehicle occupants

STUDY POPULATION AND AREA

The data are collected in six counties and two larger cities in the southern part of Germany which form one coherent study region (see Fig. 1):

- County of Alb-Donau (-Kreis)
 - City of Ulm
- in the German state of Baden-Württemberg and
- County (Landkreis) of Günzburg
 - County (Landkreis) of Neu-Ulm
 - County (Landkreis) of Dillingen/Donau
 - County (Landkreis) of Aichach-Friedberg
 - County (Landkreis) of Augsburg
 - City of Augsburg
- in the German state of Bavaria.

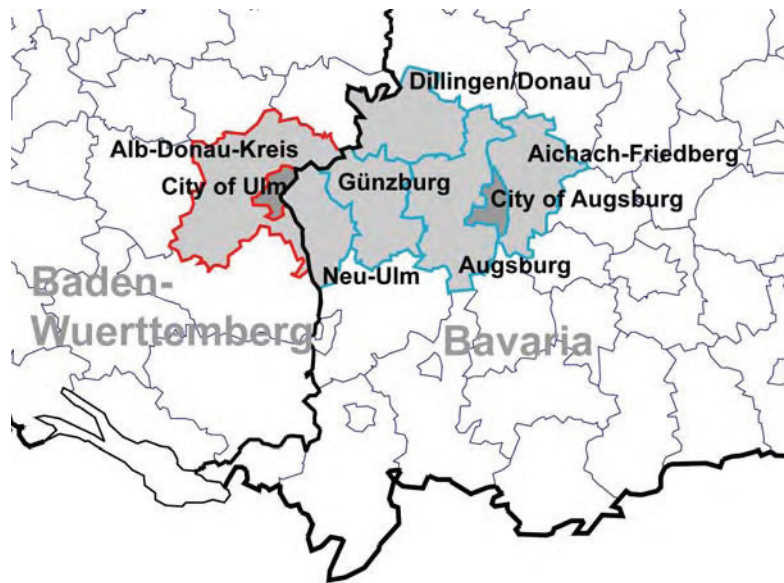


Figure 1. Counties and cities of the study region in southern Germany

The study region covers an area of 5545 km² with approximately 1.32 million inhabitants [17, 18] and ranges from urban areas to very rural regions with a low population density. Apart from all kinds of inner-city and country roads the study region features several major highways and two motorways (Autobahn) crossing it in the east-west and north-south direction. With a considerable amount of traffic volume on these roads it can be expected that all relevant kinds of traffic participation will be included in accident data from the study region.

Three regional emergency dispatch centers cover these eight administrative areas to answer medical emergency calls and to dispatch ambulances, emergency physicians and other means of medical rescue. They are located at the

- German Red Cross (DRK) dispatch center in Ulm (for the area of the city of Ulm and the county of Alb-Donau-Kreis)
- Bavarian Red Cross (BRK) dispatch center in Krumbach (for the area of the counties of Günzburg and Neu-Ulm)
- Dispatch center at the Augsburg Fire Department (for the counties of Dillingen/Donau, Aichach-Friedberg, Augsburg and the city of Augsburg)

Three large hospitals in the area are trauma centers suited for the treatment of polytrauma patients:

- University Hospital of Ulm (Universitätsklinikum Ulm)
- Hospital of the German Armed Forces in Ulm (Bundeswehrkrankenhaus Ulm)
- Augsburg Hospital (Klinikum Augsburg)

All other hospitals in the study region provide basic medical care [19] and are not equipped to handle severe multiple injuries. The Günzburg Regional Hospital, however, has a large neurological and neurosurgical department to treat isolated traumatic brain and spine injuries.

Therefore, it can be expected that the large majority of polytrauma patients from traffic accidents will be transported to one of the three aforementioned hospitals and treated in their emergency rooms. Data about patients' injuries are collected from these three and the Günzburg Regional Hospital. However, a small number of victims may be brought to more remote trauma centers, especially by rescue helicopter. It is planned to collect these singular cases later in the project where persons sustained a polytrauma in a traffic accident within the study region, but were treated outside of it.

Pre-hospital care is provided by ground ambulance with an emergency physician joining the scene by car (so-called "rendez-vous" system) if the emergency call suggests so. A rescue helicopter is stationed at the Hospital of the German Armed Forces, Ulm, staffed by an emergency physician from the hospital, that is dispatched to urgent medical calls in an area of ca. 50 km radius around Ulm

during daylight conditions. The region around Augsburg forms an area which is just touched by the response areas of this and three other rescue helicopters stationed in Ingolstadt, Munich and Murnau. The data collection started on November 1, 2007, and will continue at least until October 31, 2008. Based on the number of casualties from accident statistics for the respective counties and cities [20, 21, 22] and the factor determined by Busch approximately 110 most severely injured survivors can be estimated for the region annually.

Representativeness of study region

Based on statistical data for the counties and cities and for Germany as a whole, the study region was analysed regarding its representativeness. The average population density is 238.5 inhabitants per km² for the region and almost equals that of Germany (230.4 inhabitants per km²) [17, 18, 23]. The density of the road network outside of built-up areas averages 0.64 km per km² for the region and 0.62 km per km² for Germany [24]. The shares of different road categories, ranging from motorways (Autobahn) to secondary roads, are also very similar to those in Germany although they sometimes differ significantly between individual counties.

The number of casualties (fatally, seriously and slightly injured) was determined from regional accident statistics for 2005 and 2006 for the respective administrative areas and compared with the German national statistics. Specific values were calculated for this purpose. Fatalities had a share of 1.8 to 1.9 % among the casualties in the study region (2005 and 2006) which was 0.3 % higher than the national level. The percentages of seriously injured and slightly injured were also very similar to those for entire Germany. A differentiation of these figures by urban and country roads and motorways provides a similar picture. The share of fatal injuries on urban roads in the study region was almost identical to that in Germany. The incidence of fatalities among all casualties was 0.4 % more frequent on country roads and approximately 0.6 % fewer on motorways compared to the national statistics. However, the small absolute number of victims killed on motorways in the study region (eight in 2005 and five in 2006) is not suited for a detailed statistical evaluation of accidents on this kind of road. When comparing the number of casualties per 1000 inhabitants it appears that the number of fatalities in the study region overestimates the situation for Germany (0.076 for the study region vs. 0.062 for Germany in 2006) and that for seriously injured the incidence is slightly underestimated (0.851 for the study region vs. 0.905 for Germany in 2006) (Fig. 2 and 3).

Fatalities per 1000 inhabitants in 2006

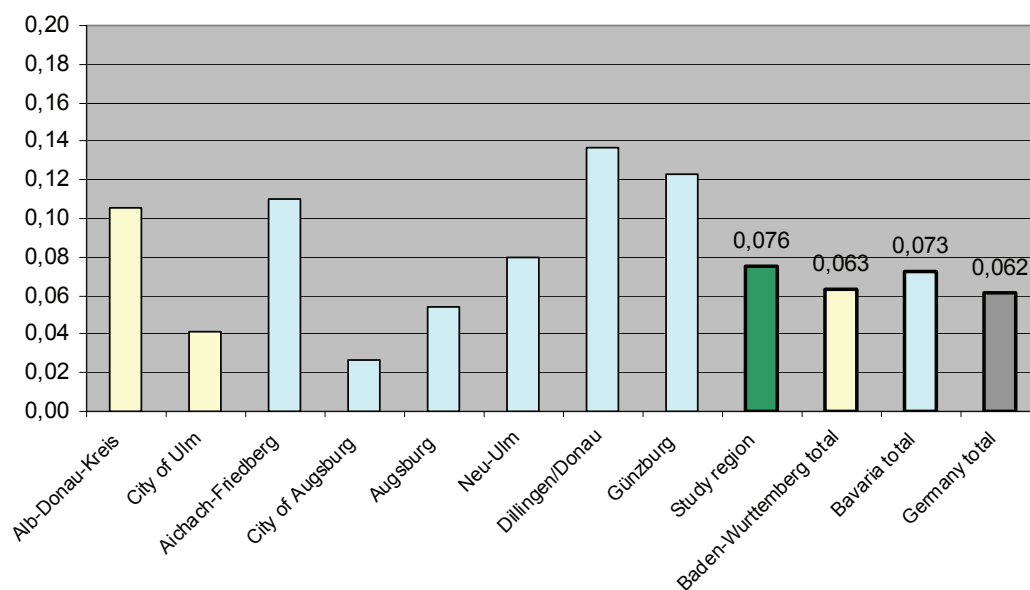


Figure 2. Incidence of fatalities per 1000 inhabitants

Seriously injured per 1000 inhabitants in 2006

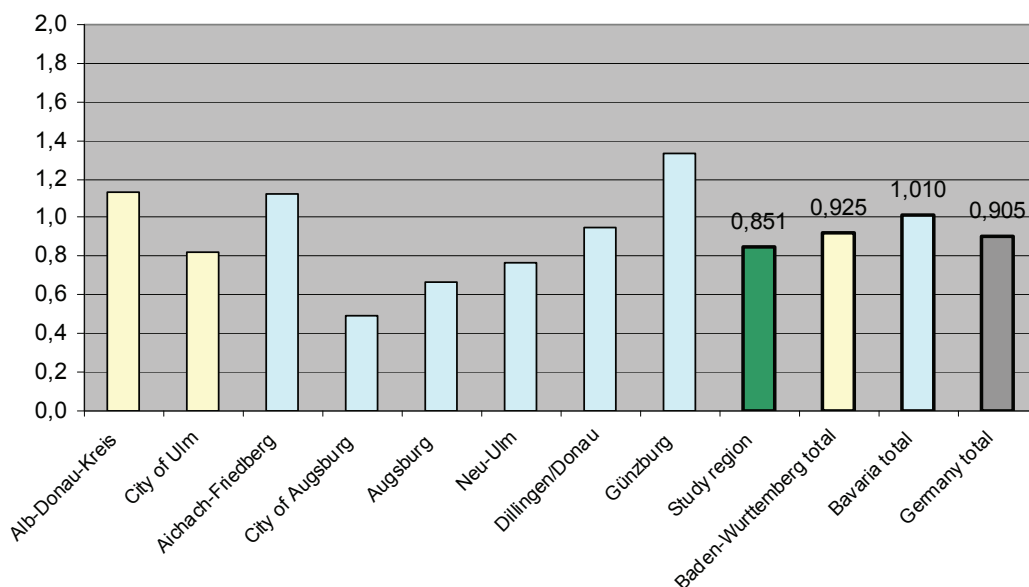


Figure 3. Incidence of seriously injured per 1000 inhabitants

Altogether, the demographic, infrastructural and traffic accident data suggest that the study region can be regarded as a good representation of the situation in Germany when analysing accidents with most severely injured.

METHODOLOGY FOR CASE IDENTIFICATION AND DATA RETRIEVAL

A complete on-the-spot accident research was not possible for the planned duration and due to the size of the study region. A different method was therefore pursued to obtain detail data on the collisions, vehicle damages and injuries. The concept to identify potential polytrauma cases from traffic accidents was carried over partially from the methodology applied by Liener et al. [3] in their study of polytrauma incidence in the Ulm region and refined for the present purpose. All three emergency dispatch centers in the study region provide data sets of calls to traffic accidents which required the presence of an emergency physician. The dispatch centers in Bavaria (Krumbach and Augsburg) index cases in their electronic alarm protocols if the dispatcher considers them to be potentially relevant. The dispatch center in Baden-Wuerttemberg (Ulm) uses a different software to protocol their alarms which allows to filter by the cue words “traffic accident” and “emergency room admission”. All centers then provide the relevant data sets for the study which include the date and time of the in-coming emergency call, the approximate location of the accident, the dispatched type of ground ambulance, emergency physician’s car or rescue helicopter and the hospital the patient was taken to. Two of the centers can provide additional data on the time of rescue vehicles responding, reaching the accident site, leaving with the patient and arrival at the hospital. Furthermore, information on the communication path of the emergency call (whether reaching the dispatch center directly or via police etc.) and the rough type of collision (whether involving motorists, cyclists or pedestrians) is available in a number of cases. All data sets are sanitized from any patient or other personal data before they are provided to the project coordinator (see Fig.4).

The data are transferred into a common format for further evaluation by the project coordinator. Collisions that occurred outside of the study region are removed as well as cases that indicate that the accident did not classify as a traffic accident because it happened in a non-public location (e.g., on the premises of a company or facility). Cases where the patient was taken to a hospital of basic care are also deemed to be of less severe nature and are excluded from the analysis in the first step. Reports of

the regional police and media available through the internet are constantly monitored, documented and evaluated by UDV to obtain more early information on severe accident occurrences. This facilitates the interpretation of the very concise data from the dispatch centers and sometimes provides a few photos from accident sites.

With the enhanced data of potentially relevant accident events medical staff at the trauma centers review their patient data to identify the matching cases. Once a patient is identified, his or her injuries, vital parameters and treatment at the accident scene and at the hospital and the duration of stay in care are documented in an electronic form that is provided by the project coordinator. The form includes more than possible 200 fields for data entry, most of them being identical to those in the documentation sheets (“Erhebungsbogen Schwerverletzte”) A to D of the German Society for Trauma Surgery (DGU) [25]. Personal data are limited to information about gender, month and year of birth, and – where possible – body height and weight. The amount of patient data and the collection method for this study was reviewed and accepted by the ethics committee at the University of Ulm.

After the sustained injuries have been documented and coded according to AIS-98 the injury severity score is calculated and the injury pattern categorized as a polytrauma with $ISS \geq 16$, as a severe monotrauma or as an injury pattern of lower severity. Polytrauma or severe monotrauma cases define accidents which are followed up at the police. In both the federal state of Baden-Wurttemberg and Bavaria the police provide sanitized data from police accident reports. In Baden-Wurttemberg, they are requested to fill out a special form for these kinds of accidents to determine the year of first registration, deployed airbags and the exact seating position of occupants for vehicles involved in the collision. In case of children in cars the use and type child restraint systems should be specifically reported and for injured motor-cyclists the use and type of helmets should be documented. In addition, photos from the accident scene and damaged areas of the involved vehicles from the police files are requested.

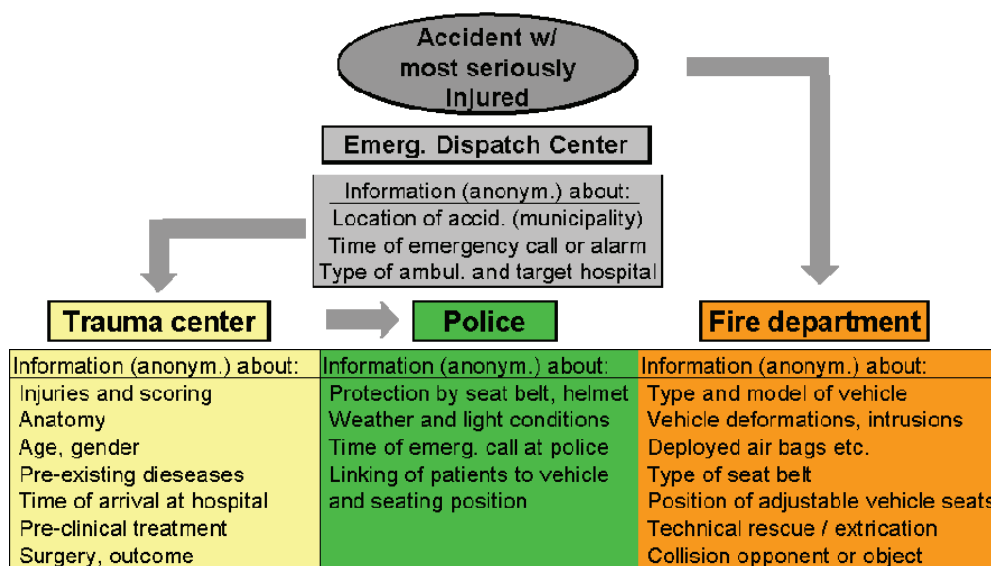


Figure 4. Process of data retrieval after severe road accident

Pilot study on documentation by fire departments

Depending on the accident situation only a limited number of photos and technical data may be available since one of the main purposes of documentation by the police is to determine the accident cause and the party at fault. In accidents where this is obvious, e.g., in single vehicle accidents with only one injured driver, there may be no need for an extensive documentation. A lack of photos of the vehicle interior and the absence of a reference to evaluate vehicle damage and intrusion was found to be a special hindrance for the analysis of injury causes in car or truck occupants. Since many local fire

departments in Germany maintain internet homepages which sometimes include pictures of special alarms a concept was developed to include these organisations in the documentation for the study, too. A pilot study with seven German volunteer fire departments was run in 2006 over six months to try-out and improve the concept [26]. The fire chiefs or other representatives of the fire department were approached and educated about the study purpose and the most important parameters when documenting severe accidents at the scene. Each department received a clipboard, a set of paper forms to provide information about crashed vehicles, a check list with photo examples to illustrate which views at the accident scene would be most important and a folding yardstick to be used as a dimensional reference in photos of vehicle deformations. The test phase showed that the fire departments could provide valuable information and photos to complement police documentation. Concerning measures taken for technical rescue or vehicle extrication, fire departments are the only reliable source. On the other hand, it turned out that a complete documentation could not be expected under all circumstances. Sometimes not all desirable photos could be taken due to limited technical resources or personnel. In some cases during the pilot study the documentation had simply been forgotten due to the fact that no relevant traffic accident alarm had occurred for several months.

With the lessons learned from this pilot the concept to involve the local fire departments was enhanced for the polytrauma study. The fire chiefs responsible for the six counties and two larger cities were approached and organised meetings with representatives of the largest departments in their area. The meetings served to explain the motivation for the study, the required information from the accident scene and how to use the documentation equipment. It was stressed that the information and pictures taken of a traffic accident serve scientific purposes and is made anonymous (license plate numbers removed from photos etc.) either directly by the fire department or immediately after being received by the project coordinator. Each of the more than 100 participating departments received a backpack containing the items for documentation and the presentation material in electronic and paper form. The backpack is intended to be stored on one of the emergency vehicles which respond to traffic collisions. In addition, adhesive stickers were provided to be placed on the dashboard to remind rescue staff of the study on their way to the accident site. They also list the criteria under which an accident should be documented. Departments participating in the study receive irregular newsletters via e-mail from the coordinator to update them on the state of the project and discuss questions and challenges that may arise during actual accident documentation.

Returned documentation from the fire departments confirms that their photos and data can improve the quality of information particularly about the vehicles and damages (see Fig. 5). Whenever extrication of occupants is necessary the circumstances, rescue equipment used and possible difficulties are researched at the fire department. However, it turns out that fire departments are not necessarily called to accident scenes if the police and medical rescue staff can handle the situation alone. Fire fighters may be required only to mop up spilled liquids, to illuminate the accident site at night or may not be alerted at all. Accordingly, the pictures and information contributed to this study by fire departments pertain mostly to severe auto accidents and rarely to collisions with pedestrians, cyclists or motorcyclists.



Figure 5. Example of documentation by fire department using yard stick for reference (source: Kreisbrandinspektion Günzburg)

Data collection and analysis

All relevant data are entered into an ACCESS data base. Data fields provide pre-defined entry options and only rarely free text in order to avoid spelling errors or use of synonyms and to facilitate later data analysis. Some 500 data fields are available to describe the accident site, light and weather conditions, involved vehicles and their technical specifications as well as casualties with their detailed injury descriptions, use of restraint system or protective gear and the key data from the emergency call, the pre-hospitalisation phase and technical rescue.

In 2007, the concept for the case identification of polytrauma patients was tested in the Augsburg area for the duration of one month [27]. The emergency dispatch center at the Augsburg city fire department indexed all alarm protocols where emergency physicians responded to traffic accidents. In parallel, local media articles and police reports on traffic accidents were studied over the internet and information collected. 26 patients were reported for the month of April who were involved in traffic accidents, had been treated by an emergency physician at the scene and transported to the Augsburg Hospital. All of these patients could be identified at the hospital. Twelve of them had a confirmed polytrauma, the remaining had injuries of lower severity. The trauma surgery department reviewed all of their data for the respective month and found no other polytrauma cases caused by traffic accidents. However, three patients were taken to trauma centers outside of the region by rescue helicopter which would have required follow-up.

The Schwaben precinct of the Bavarian Police checked their files and identified accident reports for all cases provided by the rescue dispatch center, except five accidents. Two of those cases did not meet the criteria for an traffic accident, two others were cyclist falls without a polytrauma and one was a reported accident on a motorway which may have occurred outside of this police precinct's boundaries.

The cases were also researched through the county fire chiefs, with the exception of the Augsburg city fire department, whether local fire departments had been called to the scene. Only in eight out of 22 accidents, the presence of fire fighters could be confirmed, too. These were mainly severe car collisions and only few of them required technical rescue.

In summary, this pilot indicated that all polytrauma patients from traffic accidents were captured with the criteria used at the dispatch centers and that their information enabled hospitals and the police to identify the relevant cases. The majority of polytrauma patients were treated in one of the trauma centers of the study region. Documentation by fire departments is limited largely to severe crashes involving cars or heavy vehicles and cannot be expected to take place under all circumstances. However, the information provided, then, is valuable and supplements accident data from other sources.

DISCUSSION

The data collection in the course of this study combines a prospective and retrospective approach in order to document the traffic accidents involving polytrauma as completely as possible. This pertains particularly to the number of polytrauma patients in a given geographical area and key descriptors of the collision. The chosen study region was determined by the necessity to have a sufficient frequency of severe accidents in order to obtain data in a relatively short period of time (12 to 24 months) and to level possible distortions due to local peculiarities. The presence of a limited number of trauma centers and the absence of hospitals above basic care level was the pre-requisite for easier identification of patients while all patient data remained anonymous to the project coordinator. On the other hand, this represents a specific situation of medical care which may not be representative for Germany. Due to the given structure of pre-hospital care, e.g., regarding organisation of medical rescue or emergency dispatch centers in southern Germany, a bias may exist, too. Currently, it has not been analysed whether the chosen region is representative for the medical care situation of polytraumatised in Germany. Regarding population, frequency and structure of accidents and road network the study region mirrors the national situation quite well. A comparison of the economical situation and the motor vehicle fleet with data on national level has not been carried out, yet.

Ideally, on-the-spot research teams would document and analyse collision events that involve polytraumata with standard data quality and quantity for each accident. However, this would have required a vast amount of human and technical resources to cover the area and respond to accidents in an acceptable time frame. The chosen methodology uses existing data that are available from police, emergency dispatch centers and hospitals and tries to enhance them with additional information for the purpose of the study. The local fire departments are requested to document collision-involved vehicles and technical rescue specifically according to the criteria of this research. Almost all organisations and responsible authorities which were contacted have agreed to support the study and engage strongly in the provision and processing of relevant information. Careful and time-consuming preparation of the data collection phase and a clear definition which patients and related accident events should be documented were necessary to ensure that the work load for individuals remains acceptable. The fact that a few local organisations in the region denied their participation in the study has not caused a major lack of information and could be compensated in another way.

The study is limited with regards to the detail information that can be retrieved from the accident site and the rescue chain and sometimes depends on the available resources at the supporting organisations. Regardless of these potential shortcomings, the contributing organisations and their staff have provided a wealth of information in a short time frame already which would not have been possible with a conventional accident research approach. Nevertheless, the follow-up of cases during the data collection requires intensive efforts to coordinate the study, to transfer all data into a common format and to close gaps where information is missing in individual cases.

SUMMARY AND OUTLOOK

The presented study is intended to determine the incidence and characteristics of polytraumata from traffic accidents in a large geographical region in Germany. It was started in late 2007 and data collection is continuing. The method is based largely on the provision of information and pictures by public authorities and organisations involved in medical and technical rescue of victims after a vehicle collision. It combines the retrospective retrieval of information from standard protocols of the police, emergency dispatch centers and trauma centers with the prospective data collection of parameters specifically related to polytrauma and vehicle damage resulting from such accidents. The latter are provided by the police and hospitals, too, but also by local fire departments. All patient data are anonymous when they are delivered to the project coordinator.

Relevant accident events with potential polytrauma patients are identified from data sets of regional emergency dispatch centers. With information about the approximate time and place of accident and the medical facility that a severely injured person is taken to the patients are identified at the hospital by medical staff. If a polytrauma is confirmed, the project coordinator follows-up the case at the police to obtain further information and photos from police accident reports. Local fire departments are requested to take pictures of the damaged vehicles and possible collision objects at the accident scene to complement information from the police and to report measures taken for technical rescue.

Injuries and vital parameters are documented in close conformity with the data sheets for most severely injured patients as recommended by the German Society for Trauma Surgery. ISS values of 16 and over define a polytrauma and represent the criterion for the inclusion of patients and related accidents in the study. In contrast to earlier plans, it is intended to document also collisions where traffic victims deceased at the scene of the accident. However, the definitive fatal injury may often remain unknown as autopsies are rarely conducted after accidents in Germany.

The study will deliver further insight into the structure of polytrauma patients and their injuries and the circumstances of the traffic accident which caused them. Particularly, their kind of traffic participation, whether as a vehicle occupant, cyclist or motor-cyclist or pedestrian and their protection by seat belt, airbags or helmets will be evaluated. A general description of the collision and impact direction for crash opponents will also be available in most cases. Depending on the individual detail level, an analysis of the rescue chain including emergency call handling, response times and time spent at the accident site will be possible.

An electronic data base has been set-up to enter all relevant and accessible information. Besides medical information, it includes a general description of the conditions about the place and time of accident and technical specifications as well as the extent of damage of the involved vehicles.

Comparisons of the incidence rate of accidents and key descriptors for the chosen study region suggest good conformity with the corresponding data for entire Germany. If an evaluation with respect to other important parameters confirmed this finding the study results could be extrapolated to a national level. Whether the chosen study region is also comparable with other German areas where accident research takes place has yet to be evaluated.

For the future, analysis of typical injury patterns of polytraumatised and their relevance among different kinds of road users can be addressed with this data base as well as the collision mechanisms causing them. Furthermore, as the average time of medical rescue reaching the accident scene has been rising in Germany during the last years [28] the data from this project could help to analyse the timeline of the rescue chain or estimate the impact of automatic vehicle crash notification systems, for instance.

ACKNOWLEDGMENTS

This study is funded by the Loss Prevention Commission of the German motor insurers. The authors would like to thank all supporting organisations and individuals who have either given permission to access data or have actively contributed with information, documentation and expertise. Special appreciation is extended to the Ministries of Interior of Baden-Württemberg and Bavaria, the police headquarters Ulm and Schwaben and the fire departments of the Alb-Donau-Kreis, the Landkreis Neu-Ulm, Günzburg, Dillingen/Donau, Augsburg, Aichach-Friedberg and the cities of Ulm and Augsburg, the emergency dispatch centers in Ulm, Krumbach and Augsburg and the staff at the hospitals at the University Hospital and Hospital of the German Armed Forces in Ulm and the Augsburg Hospital. This study would not be possible without their dedication.

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