

ROAD INCIDENTS INVOLVING SELECTED CATEGORIES OF EMERGENCY VEHICLES AS A SPECIAL TYPE OF THREAT TO ROAD SAFETY

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Abstract

Collisions and accidents involving emergency vehicles are an important element of road accidents in the world in the context of road safety. At the same time, there are no precise data that would allow assessing this phenomenon. The number of events, their social and economic costs have a dramatic impact on the functioning of, among others, emergency medical services and the ability of the state to provide emergency services to citizens at the appropriate level. Economic changes mean that the labour market for drivers of emergency vehicles undergoes changes that may affect the quality of human resources. Consequently, it is crucial to propose ways of achieving and maintaining an appropriate level of competence and skills of drivers of emergency vehicles. A full analysis of the risk related to this area requires knowledge of the current state, trends, changes and the severity of the problems, so that the proposed methods are economically justified and allow minimising the risk related to road incidents that involve “non-police” emergency vehicles to an acceptable level. The article will present the results of research aimed at understanding the current state of road safety related to road incidents involving “non-police” emergency vehicles. An attempt was made at identifying trends and changes in this area as well as ways to improve the competences of emergency vehicle drivers.

Keywords: emergency vehicles, medical rescue vehicles, road accidents, simulation training

1. Introduction

Road safety is an area that has been exhaustively recognised and studied on the basis of the many statistics available. Data are collected at many levels, from the European level, where data are available in the Eurostat database, to the national

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level. In Poland, data are made available by the Central Statistical Office and the National Police Headquarters as part of annual reports. Data on road incidents, however, in many areas do not allow a proper analysis of factors and variables that affect the phenomena of interest (Boldt et al., 2021). There is a major lack of variables concerning the causes of incidents and the accompanying weather and road conditions, as well as identification of the vehicle category. These data may be found in the literature, but it is very difficult to draw conclusions based on them due to several factors, the most important of which being the lack or fragmentation of data, the scarcity of standardized indicators allowing a real risk assessment (Orlicz-Szczesna et al., 2017), and the lack of comparisons with other vehicles. The actual assessment of the impact of events involving emergency vehicles on road safety may be based on quantitative information – concerning the number of events. However, it does not allow a real assessment of the causes of the phenomenon as such. The range of compiled data makes it impossible to know such variables, as: the required reaction time, the number of vehicles, the number of kilometres driven, the number of trips in a period, and as an effect the fatigue of drivers. Access and use of modern route selection systems, knowledge of the terrain and general functioning of the system, including the tasks of the control room transmitting instructions to the crews, should also be considered at this point (Orlicz-Szczesna et al., 2017). Aspects related to the use of privileged signals are also important (Missikpode et al., 2018). Without adequate data, it is difficult to indicate how the risks associated with the movement of a single emergency vehicle vary and which variables should be taken into account to minimise inherent risks. Current research indicates that one of the key risk factors for collisions and accidents involving emergency vehicles, in particular emergency medical services, is the human factor (Hsiao et al., 2018). One of the most important issues related to risk minimization is training and maintaining the competence of drivers of this type of vehicles (Hsiao et al., 2018). The risk-increasing effect is the high level of routine, as well as maintaining bad habits arising from the experience of drivers in driving standard vehicles (Bui et al., 2018). Another extremely important factor is the disproportionate increase in the number of accidents and collisions in the case of drivers who have previously been involved in other road incidents. They should mainly be sent to additional training and research (Biggers et al., 1996). Unfortunately, in many cases this is not the standard. These are often drivers with extensive experience who normally meet the requirements for the profession. Interestingly, phenomena of this type are observed all over the world and it seems that they are not significantly affected by the specificity of societies or ways of organizing road traffic (Norii et al., 2022). One of the solutions proposed, which experts say has high effectiveness and relatively low cost, is training using dedicated simulators (De Graeve, 2003).

2. Methods

The aim of the study was to learn the current state of road safety related to road incidents involving “non-police” emergency vehicles. A review was carried out of trends and changes associated with the listed road events. In addition, an attempt was made to propose ways to improve the competence of drivers of emergency vehicles. The research area was narrowed down by omitting emergency police vehicles and medical rescue air vehicles. Only ground vehicles were included in the study. The availability of data on road incidents recorded by the Polish Police allowed the authors to include the years 2019–2021 in the study. Considering the above, the main research problem was included in the question: What is the current state of road safety related to road incidents involving “non-police” emergency vehicles, in particular emergency medical and road rescue vehicles? Given the multidimensionality of the issue, to achieve the assumed goal it was necessary to adopt complementary research methods and techniques. This approach enabled obtaining the assumed research result, i.e. a comprehensive picture of the analysed issue. Appropriate research methods, techniques and tools were adapted to implement the research assumptions. Among the adopted methods, one can distinguish a study method consisting in a quantitative and qualitative analysis of the content provided by the documents, their ordering and interpretation in terms of the research objective. The research covered data on road incidents that involve emergency vehicles for the years 2019–2021 obtained from the National Police Headquarters, literature on the subject, scientific studies, domestic and foreign publications, materials contained in Internet collections, as well as normative acts related to the thematic area of scientific inquiries.

3. Results

Consideration of road accidents that involve ‘non-police’ emergency vehicles that have been scientifically investigated requires a definition of what such an emergency vehicle is. This definition will make it possible to define several important elements related to how vehicles of this type move in road traffic and how they are perceived by other drivers. According to the relevant valid Polish regulations, a vehicle identified as a priority vehicle must emit light and sound signals and have its dipped-beam or main-beam headlights on (Orlicz-Szczesna et al., 2017). These principles are practically the same worldwide, and the differences concern only minor details, such as the type of sound signal (JTIC, 2022). A “non-police” vehicle means a vehicle that is not operated by the police. Unfortunately, in the case of many studies, the available data fail to indicate whether during an incident, a vehicle, for example of the emergency medical service, was moving in the privileged mode. Practice shows that many collisions and accidents occur when the vehicle is moving without sound or light signals or only with the light signals

on (Custalow, Gravitz, 2004). This is a key factor that determines the visibility of a vehicle that, to save human health and life, may move inconsistently with the rules applicable to all other road users. A medical, road or other emergency vehicle that moves without its lights or sound signals turned on should not be treated as an emergency vehicle. There is no doubt that the generally available total numbers of collisions and accidents involving emergency “non-police” vehicles will comprise data on privileged and standard journeys, unless the author of a specific publication indicates otherwise. This generates significant problems in risk assessment. In this scientific study, data concerning only priority vehicles relating to the entire territory of Poland, from 2019–2021 were taken into consideration.

In the case of published data on road accidents involving emergency medical and road rescue vehicles operating under the supervision of the Houston Fire Department, two types of indicators were proposed to determine the frequency of accidents or collisions. The first is the number of events per 100,000 miles driven; the second is the number of events per 100,000 rescue trips of crews (Biggers et al., 1996). Despite the passage of time since the study, these indicators still appear to be relevant. However, these data are certainly outdated and there is no point in citing them. The discrepancy in the methodology adopted to assess the number of events can be seen in the case of another study conducted in Germany, Austria and Switzerland in 2021 (Boldt et al., 2021). The authors proposed here an indicator of the number of accidents to the number of inhabitants of individual countries. Based on such indicators, it is difficult to assess the risk to road safety in connection with emergency medical rescue vehicles. It is not known how many vehicles of this type were moving in each period, how many kilometres they travelled, and how often they were on the road. Ultimately, it is not clear whether they moved in the privileged mode and whether the event was an accident or a collision. Police statistics in Poland distinguish road incidents as collisions and accidents. These definitions are contained in Ordinance No. 635 of the Police Commander-in-Chief of 30 June 2006 on the methods and forms of keeping road accident statistics by the Polish Police. The definitions contained therein are as follows: road accident – “a road incident that resulted in human casualties, including the perpetrator of this event, regardless of the legal ending”, road collision – “a road incident that resulted in only material losses” (KGP, 2006). Such a division of road incidents allows quick identification of serious events in which participants have sustained injuries. For other European countries, these definitions may look completely different. In Germany and Great Britain there is no such term as a traffic collision. In each of these countries, a road collision meets the requirements for a road accident. As in Poland, a distinction is made of a fatal accident, a serious accident and a minor accident, and a fatality, a seriously injured person and a slightly injured person are also defined. Fatal accident and road fatality are defined in the same way in each considered country. The differences result from the distinction between a serious accident with a victim with severe injuries and a light accident with a victim with light injuries (pertains to a different number of days of convalescence and hospitalization of a person

after a road accident) (Dyraga et al., 2017). However, it is worth recalling the gross results. The data cover the period from 2014 to 2019. During this period, there were 597 accidents in Germany (0.719 per 100,000 inhabitants), 453 people sustained injuries. This means that, according to the Polish definition, we were dealing with 144 collisions and 453 accidents. There were 62 events in Austria (1,294 per 100,000 inhabitants). 47 of them were accidents and 15 were collisions. In Switzerland, there were a total of 25 events (0.293 per 100,000 inhabitants), of which 14 were accidents and 11 collisions. The accident-to-collision ratio is interesting. It is 3.14 for Austria, 3.13 for Germany and only 1.27 for Switzerland. In practice, this means that the ratio of major accidents to minor accidents is very high. For comparison, this indicator for passenger cars in Germany in 2022 is 0.14 and is 22-fold lower (Destatis Statistisches Bundesamt, 2022).

Statistics concerning road accidents in Poland are published by the National Police Headquarters and often in various types of scientific publications. They usually concern the general analysis of cities in terms of road traffic, including emergency vehicles (Marcinkowska et al., 2016). Some of them relate directly to emergency medical vehicles, but the scope of research is strongly limited territorially, for example to one city (Orlicz-Szczesna et al., 2017). In this extent, there is a lack of research results considering wide scope of current data.

The authors of the article conducted a study based on current raw data obtained directly from the Collision and Accident Records System (SEWIK) of the Polish National Police Headquarters. The data was made available in accordance with the Polish Act on Access to Public Information, i.e. Art. 2 sec. 1 and art. 10 sec. 1 of the Act on Access to Public Information of September 6, 2001 (Polish Journal of Laws of 2001, No. 112, item 1198). The obtained data have been divided into three tables. They are related to the main objects – event, person or vehicle. For the purposes of the conducted analyses, the data have been consolidated. The main problem that occurs in the case of data obtained from the SEWIK system is the content of the “special vehicle” field. This is the only place where diversification into the type of emergency vehicle that was involved in the road accident or collision can take place. The contents of this field are Emergency Vehicle, Other Emergency Vehicle, Hazardous Goods Vehicle and Police Emergency Vehicle. In practice, this means that all other privileged vehicles in Poland remain in the pool “Other Emergency Vehicle”. These are vehicles of fire protection units, medical rescue teams, Military Police, chemical rescue units, Border Guard, Internal Security Agency and State Protection Service. Due to the impossibility of separating emergency medical vehicles from other types, except for the Police, the statistics will be presented collectively. Police vehicles, which are relatively numerous, have been removed from the statistics. In 2020 their number was 17,948. For comparison, only 7,966 emergency medical vehicles were registered in the last decade (CEPIK, 2019). In addition, police vehicles caused a significant number of road accidents. As one can see, they account for as much as 58.22% in 2019, 57.89% in 2020 and 50.32% in 2021, respectively.

Table 1. Share of “non-police” vehicles in the total number of road incidents

Type/Year	2019	2020	2021
"Non police" emergency vehicle	526	507	987
Police emergency vehicle	733	697	1000

Source: own study based on the SEWIK system database

This statistic clearly differs from other data available in the literature. The data provided by many other authors point to a much higher share of police vehicles in road accidents in comparison to other emergency vehicles. Their share in studies conducted in San Francisco, USA in 2002–2010 ranged from 70 to 80% in individual years (Abdelwanis, 2013). These data are confirmed by other studies conducted in the USA (GAO, 2020). This may arise from the number of vehicles of the relevant services and the standards related to the performance of tasks by the Police, including the tendency of using vehicles in pursuits or as a means of direct coercion. An accurate assessment of this phenomenon requires further research, which is beyond the scope of this publication. At the same time, it is clear that the removal of police vehicles from the statistics will allow a more in-depth examination of issues related to road incidents that involve “non-police” emergency vehicles. In addition, one can make an initial assessment of the number of vehicles owned by individual entities and the number of kilometres they drive. There is no doubt that in Poland, medical rescue teams and fire protection units carrying out road rescue tasks will lead the way among these entities. The table below presents the number of incidents involving emergency vehicles other than the Police. The total increase in the number of events in 2021 is clearly visible, which is over 52% compared to the previous year.

Table 2. Statistics of events involving “non-police” emergency vehicles

Year	No. of events	No. of collisions	No. of accidents	Killed	Wounded
2019	533	477	56	4	28
2020	520	444	76	2	41
2021	983	919	64	3	34

Source: own study based on the SEWIK system database.

An important aspect arising from the presented data is the number of accidents and collisions. As one can see, this proportion is as follows: 2019 – 11.74% (index – 0.1174), 2020 – 17.11% (index – 0.1711), 2021 – 6.96% (index – 0.0696) respectively. In studies concerning medical rescue vehicles accidents in Germany, this indicator was found to be as high as 3.13 and was 18-fold higher. As for the national average of all vehicles in Poland, in 2019 this indicator was 0.0665, in 2020 – 0.0616, and in 2021 – 0.0539. This means that the accident rate of “non-police” emergency vehicles in Poland is closer to the national average for all vehicles. It is worth bearing in mind the information on the number of fatalities. It allows

an assessment of the share of serious accidents in the total number of accidents. For “non-police” emergency vehicles, this indicator was 0.0714 in 2019, 0.0263 in 2020 and 0.0468 in 2021, respectively. The national average of all vehicles was 0.0983 in 2019, 0.1058 in 2020 and 0.0983 in 2021. These indicators for “non-police” emergency vehicles are therefore lower than for all vehicles. This means that drivers of “non-police” emergency vehicles cause slightly more accidents than collisions as compared with other drivers in Poland, while the number of fatalities in these accidents is significantly lower.

There is no doubt that among the indicated accidents and collisions there are those whose perpetrators were not the drivers of “non-police” emergency vehicles. The table below presents data showing that in approximately 50% of incidents the drivers of emergency vehicles were the perpetrators.

Table 3. Statistics of incidents in which drivers of “non-police” emergency vehicles were the perpetrators of incidents

Year	Yes	No
2019	47.84%	52.16%
2020	52.12%	47.88%
2021	49.85%	50.15%

Source: own study based on the SEWIK system database

Drivers of emergency vehicles can be the perpetrators of accidents and collisions even if they drive a privileged vehicle. The driver of a privileged vehicle in Poland may exercise his/her powers on condition that he/she exercises the required caution and makes sure that other road users have picked up the signals he/she gives. This is confirmed by relevant court decisions [25]. Therefore, in almost 50% of the incidents, drivers of “non-police” vehicles in an emergency failed to exercise due caution and/or failed to ensure that other road users would be able to react appropriately to sound and light signals. Drivers of such vehicles must therefore be trained in proper conduct on the road and reducing speed or even stopping in certain situations despite the pressure. The solution in this regard may be, for example, simple procedural simulators.

Also noteworthy is the characteristics of accidents and collisions regarding the type of event site.

Table 4. Events involving non-police emergency vehicles – type of event site

Type of location	2019	2020	2021
Straight road	52.18%	48.16%	62.93%
Intersection	39.28%	42.72%	27.19%
Turn	6.83%	7.77%	9.67%
Acclivity	0.95%	1.17%	0.10%
Slope	0.76%	0.19%	0.10%

Source: own study based on the SEWIK system database.

The statistics point to a clear dominance of straight road sections and intersections. This means that these elements should be particularly emphasized in the training of drivers of this type of vehicles. Crossing roads is a high-risk activity. Despite the high awareness of this risk among drivers of emergency vehicles, avoiding a collision or accident is extremely difficult and requires an adapted training process.

Other factors worth paying attention to are the condition of the surfacing, weather conditions and lighting. Data on these issues are presented in tables 4–6.

Table 5. Events involving “non-police” emergency vehicles – condition of the surface

Road condition	2019	2020	2021
Dry	71.29%	73.46%	60,02%
Wet	24.02%	22.50%	24,01%
Other	4.69%	4.04%	15,97%

Source: own study based on the SEWIK system database

Table 6. Events involving “non-police” emergency vehicles - weather conditions

Weather conditions	2019	2020	2021
Good	69.79%	69.23%	61.04%
Other	30.21%	30.77%	38.96%

Source: own study based on the SEWIK system database.

Table 7. Events involving non-police emergency vehicles - lighting

Lightning	2019	2020	2021
Daylight	76.92%	74.81%	73.45%
Night - illuminated road	14.07%	15.77%	13.53%
Night - unlit road	3.75%	4.81%	8.55%
Dawn, dusk	5.25%	4.62%	4.48%

Source: own study based on the SEWIK system database

Most events took place in good weather conditions, during the day, on a dry surfacing. These data are confirmed by the conclusions of many studies conducted in the last decade (Yasmin et al., 2014). It follows that the training of drivers of this type of vehicles conducted in regular driving techniques in standard conditions can have the greatest effect.

Summary and discussion

In conclusion, the presented research shows that the problem of collisions and accidents involving “non-police” emergency vehicles in Poland has remained at a similar level over the past three years. This is an unfavourable trend, which has been changing in the years 2008–2016. During this period, the number of

incidents involving emergency vehicles, for example emergency medical services, became significantly reduced (Orlicz-Szczesna et al., 2017). At the same time, the number of incidents to the number of vehicles of this type is disproportionately high in relation to other road users. However, there are certain discrepancies. The results of research conducted in Lublin in 2017 indicate a 70-fold higher accident rate (Yasmin et al., 2014). The results of research carried out by the authors of this publication indicate that for road accidents the vehicle accident rate was approximately 0.00457 and was 5-fold higher than for other road users (0.00093). These differences may be due to the limitations of the studies performed. The research conducted in Lublin was on relatively small scale, while the research presented in this publication included all “non-police” emergency vehicles in Poland for 3 years. Regardless of these differences, we are faced with a relatively small scale of events in a quantitative context. However, in the context of the importance for personal safety and the ability of rescue entities to provide services to the public, this indicator is certainly important. The solution may be to start with proper training for drivers of ‘non-police’ emergency vehicles (Bui et al., 2017). The characteristics of events involving these vehicles presented in the article indicate that simulation training is possible using relatively simple simulator systems. However, the selection of specific solutions requires the execution of additional research.

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ZDARZENIA DROGOWE Z UDZIAŁEM WYBRANYCH KATEGORII POJAZDÓW RATOWNICZYCH JAKO SZCZEGÓLNY RODZAJ ZAGROŻENIA BEZPIECZEŃSTWA RUCHU DROGOWEGO

Abstrakt

Kolizje i wypadki z udziałem pojazdów służb ratowniczych stanowią istotny element wypadków drogowych na świecie w kontekście bezpieczeństwa ruchu drogowego. Jednocześnie brak jest precyzyjnych danych pozwalających na ocenę tego zjawiska. Liczba zdarzeń, ich koszty społeczne i ekonomiczne mają diametralny wpływ na funkcjonowanie m.in. służb ratownictwa medycznego oraz zdolność państwa do zapewnienia obywatelom usług ratowniczych na odpowiednim poziomie. Zmiany gospodarcze powodują, że rynek pracy kierowców pojazdów ratowniczych ulega zmianom, które mogą wpływać na jakość kadry. Dlatego ważnym aspektem jest zaproponowanie sposobów osiągnięcia i utrzymania odpowiedniego poziomu kompetencji i umiejętności kierowców pojazdów ratowniczych. Pełna analiza ryzyka związanego z tym obszarem wymaga znajomości stanu obecnego, trendów, zmian i natężenia problemów, tak aby proponowane metody były uzasadnione ekonomicznie i pozwalały na zmniejszenie ryzyka związanego ze zdarzeniami drogowymi z udziałem „niepolicyjnych” pojazdów ratowniczych do akceptowalnego poziomu. W artykule przedstawione zostały wyniki badań, których celem było poznanie aktualnego stanu bezpieczeństwa ruchu drogowego związanego ze zdarzeniami drogowymi z udziałem „niepolicyjnych” pojazdów ratowniczych. Podjęto próbę określenia trendów i zmian w tym zakresie, a także sposobów podnoszenia kompetencji kierowców pojazdów ratowniczych.

Słowa kluczowe: pojazdy ratownicze, pojazdy ratownictwa medycznego, wypadki drogowo, trening symulacyjny