ACCIDENT RATE OF THE INTEGRATED RESCUE SYSTEM IN THE KARLOVY VARY REGION IN 2011-2022

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Abstract: The study analyzes the frequency and causes of traffic accidents involving vehicles of the Integrated Rescue System (IRS) in the Karlovy Vary Region from 2011 to 2022. It primarily focuses on accidents that occurred during rides with priority rights. Data from the Fire Rescue Service, the Police of the Czech Republic, and the Emergency Medical Services of the Karlovy Vary Region were analyzed. The research aimed to identify patterns, causes of accidents, and outcomes such as injuries and property damage. The results show that insufficient attention to driving and incorrect maneuvers are common causes of accidents across all components of the Integrated Rescue System, with the highest risk observed in urban areas during afternoon and evening hours at a significance level of p=0.05. These findings emphasize the need for targeted safety training and preventive measures to reduce accident rates among rescue workers.

Keywords: traffic accidents; integrated rescue system; fire rescue service; police; emergency medical service; Karlovy Vary region.

1 Introduction

Traffic accidents have been part of road traffic since the beginning. The first traffic accidents happened while riding horses or stagecoaches. With the development of automobiles and their widespread use, traffic accidents are becoming more frequent and have more serious consequences due to higher design speeds, traffic patterns, pedestrian inattention and many other reasons (Pecherkova and Nagy, 2017).

To deal with a traffic accident at all levels, there is an integrated rescue system (IRS). In the Czech Republic, it includes three key components, which include the Fire Rescue Service of the Czech Republic, the Police of the Czech Republic and the Medical Rescue Service. These units work together to deal with emergencies such as traffic accidents, fires, natural disasters and other situations that endanger the health, lives and property of the general public. Although the main role of the IRS is to provide assistance and ensure safety, its members can also become victims of accidents or risky situations while performing their work.

Accidents involving members of the IRS may include various types of incidents, such as accidents and injuries in intervention, equipment failure, or service vehicle accidents. These accidents have significant consequences not only for the rescuers themselves but also for their ability to intervene quickly and effectively to protect the public. The analysis of these accidents is key to improving safety and providing better protection for members rescue services, but also for the citizens for whom the IRS is intended.

1.1 Reasons for traffic accidents

Traffic accidents have a variety of causes, which are important in preventing and understanding their occurrence. The main recurring factors include driver inattention, speeding, alcohol and the drivers' experience.

Driver inattention is one of the most frequent causes of road accidents, especially due to the use of mobile phones behind the wheel. This factor leads to impaired driver reaction times and a reduction in their ability to react to traffic situations in a timely manner. Distracted driving due to mobile phone use is a significantly increasing trend, especially among younger drivers. (Cai, 2020; Ortega et al., 2021)

Speeding is another of the most common factors affecting not only the number of accidents but also their severity. On average, statistics show that almost 1/3 of the fatalities in traffic accidents were related to high speed accidents. This factor is often related to young drivers who tend to underestimate the risk (Ortega et al., 2021; Macurova et al., 2024).

Driver intoxication with alcohol or other addictive substance is another major cause of accidents. Under the influence of alcohol, reactions are significantly slowed and decision-making is impaired. Even small amounts of alcohol can increase the likelihood of an accident, while the use of stimulants such as amphetamines can increase the risk of a fatal accident by up to five times. These factors have different impacts in different regions, with the highest number of fatal crashes in low - and middle-income countries facing limited resources to improve road safety (Shestan et al., 2017; Bary et al., 2022).

The experience and age of the driver are related to the previous factors and/or causes. Young and inexperienced drivers are a risk group. Although they make up only a small proportion of all drivers, their involvement in accidents is disproportionately high. Young drivers with up to two years of experience are involved in ~10% of road accidents. This is often due to a combination of speeding, underestimation of risk and lack of experience in driving in more challenging situations (Chen et al., 2021).

These figures illustrate how different factors contribute to road accidents and the importance of focusing on prevention through awareness campaigns and stricter enforcement of road rules.

1.2 Traffic accident of the integrated rescue system

A traffic accident is always a sudden, unexpected and stressful experience for all involved and for the witnesses. It can be even more stressful for a driver who was driving in the right-of-way to help another person in need. The experience can be so intense that it is not uncommon for a person to exhibit an acute stress reaction or post-traumatic stress disorder (PTSD). In both cases, it is a disorder in a person's psyche in response to a traumatic or stressful event. Symptoms include changes in emotional perception (e.g. drowsiness, inability to experience joy), sleep problems, conscious avoidance of situations that remind one of the event, anxiety and flashbacks, which are not controlled by the person's consciousness and occur randomly. Other symptoms include anxiety, attention disorders or hypervigilance. (Ralbovská and Otřísal, 2022)

PTSD can occur in or after any situation that is outside of a person's normal experience, so it can lead not only to a car accident but also, for example, an assault while on duty, intervention at a mass casualty incident, or even a general encounter with death. All EMS units have a system of psychological support, whether it is a system of collegial support or a system of professional psychological support. However, this system has its limitations, usually the fear of employees and officers of possible reprisals by the employer (e.g. removal from service), disclosure of information or mockery. In this case, it seems appropriate to use debriefing immediately after a difficult event, either with the whole team or just with a few colleagues in the vehicle on the way back from an assignment (Brecka, 2009; Andršová, 2012).

A lesser-known "sirene syndrome" is described in the literature. It describes a situation in which the driver of a vehicle with the right of way with a special audible and light warning signal (SAWS) on tends to drive more aggressively and quickly and more often overestimates his/her abilities. The situation can lead to a large amount of adrenaline being released and a feeling of invincibility. This style of driving usually works until one of the other drivers fails to react adequately and the driver of the

vehicle with the right of way (ROW) no longer has time to react to the situation and a serious accident can result. "Siren syndrome" is a risk for every driver. It can be minimised by effective practical driving training and psychological intervention. It is recommended by authorities that emergency services drivers should undergo training with their sirens on when possible (U.S. Fire Administration, 2014).

The aim of this thesis is to analyse the frequency of traffic accidents of the integrated rescue system in the Karlovy Vary Region (Czech Republic) with a focus on traffic accidents that occurred while driving vehicles with right of way in the years 2011 to 2022 inclusive. Based on the analysis of available data from the integrated rescue system units on traffic accidents, the following will be determined: frequency, consequence (injuries/material damage), type of accident, cause, and culprit of the accident.

2 Materials and Methods

The research focused on the accident rate of the integrated rescue system in the Karlovy Vary Region (Czech Republic). Quantitative research was created by means of retrospective analysis of accident data of individual units. The cohort study included only the basic components of the integrated rescue system according to the Czech Act 239/2011 Sb., on the Integrated Rescue System - the Fire Rescue Service of the Czech Republic, the Medical Rescue Service and the Police of the Czech Republic in the territory of the Karlovy Vary Region.
Requests for access to data were sent to individual units on 11 November 2022 (namely the Directorate of the Emergency Medical Service of the Karlovy Vary Region p.o., the Directorate of the Fire Rescue Corps of the Karlovy Vary Region and the Traffic Inspectorate of the Police of the Karlovy Vary Region. The request concerned the provision of data on traffic accidents involving the vehicles of the given unit for the years 2011 to 2022.

Traffic accidents included in the research were subject to the established criteria based on the Decree of the Ministry of Transport and Communications No. 32/2001 Sb., on the registration of traffic accidents. The criteria that were subsequently analysed, revised and established in the research were as follows: time of the accident, district, location of the accident, GPS coordinates of the accident site, specific identification of the location of the accident (city, intersection, out of town), whether or not the vehicle was driving under the right of way regime, consequences of the accident, cause, culprit, quantified damage and type of accident.

2.1 The Data Obtained

Data from the Karlovy Vary Region Health Emergency Service (hereinafter referred to as the Health Emergency Service) were obtained from 24 January 2016. Previously, no records were kept. The obtained data contained in Table 1 include all damages to vehicles of the Karlovy Vary Emergency Medical Service, including damage caused by vandalism. The data analyzed included what type of call group it was (RRV or Ambulance), whether the damage to the vehicle was caused by an EMS driver or another driver, whether the accident was with injury or just property damage, and what the damage was to. Some accidents could be found in a publicly available accident database to add additional information. The research did not include the reference vehicles of the Ambulance Service as they are not equipped with a CPR or CPR) - these vehicles were excluded from the lists.

The Fire Rescue Service of the Karlovy Vary Region (HZS) provided data including accident rates of fire protection units of volunteer fire department included in the area coverage plan of the region (JPO SDH). Applications were received on 17 April 2023, the last file for the year 2021 was received on 10 May 2023. The Fire Department records traffic accidents in a file called *Fire Vehicles Accident Report*, in great detail. To preserve anonymity, the files were supplied without the names of the driver and crew. The DN report includes vehicle details, location of the accident, date, time and day of the week, details of injuries to the parties involved, fault, total damage, cause of the accident and a multi-sentence description of the accident. The Fire Department also records the measures taken in relation to the accidents in question; this information was not the subject of the investigation.

The Regional Directorate of the Police of the Czech Republic of the Karlovy Vary Region (Department of Traffic Police Services) sent a reply to the request on 27 December 2022, stating that they do not record the requested data in their statistics, due to the fact that for all traffic accidents involving service vehicles of the Police of the Czech Republic, police officers are obliged to call a traffic accident investigation group from the traffic inspectorate, which will register the accident according to normal practice. Further information was obtained by analysing the public database of the Centre for Traffic Research, which records general statistics of traffic accidents in the Czech Republic and it is also possible to search for data of individual traffic accidents with specific identification of place, date, time. It is also possible to search for traffic accidents by vehicle owner - where the Police of the Czech Republic is the only one of the IRS units registered under its own name.

All analysed traffic accidents were verified with the given IZS unit and in a publicly available database.

In the third phase of the research (running from April 2023 to May 2024), the Fire and Rescue Service was contacted with a request to supply data on traffic accidents for the year 2022. The Health and Rescue Service was contacted with a request to complete the overall information supplied. At the same time, a request was sent to the statistics staff at the Police Department requesting clarification of the information, with further questions, and a request for the provision of "Police President's Instruction No. 50 dated March 8, 2019, on the policy on the use of the ZVS and radio equipment," which was granted. Additional data was provided from the ZZS by the damage committee, which contains information from 2012, but also includes data on refueling of the wrong fuel and damage to vehicles not caused by the accident. The information was supplemented with the date, a brief description of the event and the total amount of damage.
The data obtained were analysed in the statistical program R (free license).

3 Results

In the Karlovy Vary Region, from 1 January 2011 to 31 December 2022, a total of n = 26,825 traffic accidents occurred that were under investigation by the Police of the Czech Republic. According to the data obtained, n = 1,029 traffic accidents involving the involvement of the emergency services took place, of which only n = 829 are recorded in the official statistics of the Centre for Traffic Research, which amounts to 3.09% of the total number of traffic accidents that occurred in the Karlovy Vary Region.

Table 1: Traffic accidents of all vehicles of the integrated rescue system in the Karlovy Vary Region (2011-2022)

RTC in KV region	Total (n)	RTC with consequences to life or health (n)	RTC with consequences to life or health (%)	RTC without consequences to healt or lifes (n)
	26.825	6.362	23,71 %	20.463
Fire	85	4	4,70 %	81
Police	700	35	5,00 %	665
EMS	244	10	4,09 %	225

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

During the same period of time, $_{nx}$=177 people died in the Karlovy Vary Region[1]. Two persons died in traffic accidents

[1] Statistics on the website nehody.cdv.cz report 176 deaths. The number 177 is based on the finding of one traffic accident of the KVK Health Centre from 2015 with a

involving an EMS vehicle, in both cases it was an ambulance vehicle. In the first case from 2012, it was a cyclist and besides that another woman (pedestrian) was seriously injured. In the second case from 2015, a pedestrian was killed and two other people were slightly injured on the pavement. No personal injuries were recorded in the ambulance vehicle or in the other vehicle involved in these two accidents. In both cases, the ambulance vehicle was travelling with the SAWS switched on. There were a total of four serious injury accidents between 2011 and 2022, two involving an EMS vehicle and two involving police vehicles. In the case of the EMS vehicle, both serious injury accidents occurred in 2022 and both resulted in 1 person being injured who was also was found to be at the cause of the accident. Both accidents occurred while driving with the SAWS on. One police officer-passenger was seriously injured in a traffic accident with the police vehicle driver determined to be responsible. In the second case it was a pedestrian who entered the roadway in front of a passing Police of the Czech Republic vehicle, which was driving with the SAWS switched on. A total of $_{nx=90}$ persons were slightly injured in n=43 traffic accidents with vehicles of the IRS, which is 1.17% of the total number of slightly injured persons in the territory of the Karlovy Vary Region. The highest number of injured persons, 9 in total, was reported in a traffic accident between a vehicle of the Police of the Czech Republic and a bus of public transport.

Table. 2: Number of persons injured in traffic accidents involving Integrated Rescue System vehicles (2011-2022)

	Deaths (n_x)		severe injuries (n_y)		minor injuries (n_z)	
	IRS	others	IRS	others	IRS	others
Fire	0	0	0	0	3	1
Police	0	0	1	1	39	30
EMS	0	2	0	2	8	8

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

Another category examined was whether the vehicles of the IRS forces were travelling with the SAWS switched on during the accident. In the following Table 3 only the accidents for which this information is available will be used, also for percentage calculations.

Table 1 Traffic accidents of integrated rescue system vehicles in the Karlovy Vary Region with and without right of way (2011-2022)

	with RoW (n)	% of total (%)	without RoW (n)	% of total (%)
Fire	35	41,17 %	50	58,82 %
Police	135	19,28 %	565	80,71 %
EMS	34	56,67 %	26	43,33 %

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

The most reliable statistics in this respect can be considered to be those of the Fire and Rescue Service of the Karlovy Vary Region, because they are based on their own "Traffic Accident Reports," which are written by drivers after a traffic accident has occurred.

It is difficult to put anything into a broader context from the perspective of the EMS unless we know this figure for all traffic accidents. The police, who are the only ones who also carry out patrol work and do not just go out from base on reports received, logically have a much higher mileage in normal operation.

In terms of the location where the accident occurred, traffic accidents were classified according to three aspects, namely whether the accident occurred in a built-up area, outside the city or at an intersection (regardless of the location within or outside the built-up area).

death that was not registered with GPS or with the indication of the region, thus it does not appear in the statistics of deaths in the Karlovy Vary Region.

Table 4: Localization of traffic accidents involving Integrated Rescue System vehicles in the Karlovy Vary Region (2011-2022)

	Build up areas (n)		outside the town (n)		Intersection (n)	
	with RoW	without RoW	with RoW	without RoW	with RoW	without RoW
Fire	15	31	13	12	7	7
Police	81	383	28	119	26	63
EMS	15	13	10	9	9	4
total	111	427	51	140	42	74

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

It was found that the largest number of traffic accidents (total n=538) occurred in built-up areas, i.e. in towns and villages or in cottage settlements. Of these, n=111 were accidents involving vehicles driving with the right of way. For the EMS, only n=60 accidents were traced with location designation and use of a special warning light. The remaining accidents did not contain these data and cannot be assessed in this respect. Outside the city, there were a total of n=51 accidents with the SAWS switched on and n=140 without the SAWS switched on. At intersections, there were a total of n=116 accidents, of which 36.21% were with the SAWS on.

Table 5: Localization of traffic accidents of integrated rescue system vehicles by districts in the Karlovy Vary Region (2011-2022)

	Karlovy Vary (n)	Cheb (n)	Sokolov (n)
Fire	33	26	26
Police	314	197	189
EMS	111	62	58
total	458	285	247

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

From the EMS data we were able to determine the location of the traffic accident by district in n=231 cases out of a total of n=245 found traffic accidents.

The frequency of traffic accidents in individual districts of the Karlovy Vary Region was analysed and marked in Table 5. The Karlovy Vary district has the highest number of accidents, which has the largest area and the largest population, with a total of n_{zy}=23 and both light and severe injuries. The accident rate for IZS units was the second highest in the Cheb district and the lowest in the Sokolov district. The only two traffic accidents that are registered with death of the participant happened in the Cheb district and directly in the town of Cheb.

The highest number of traffic accidents with serious injuries and deaths is registered in the Cheb district, specifically in the town of Cheb. Other traffic accidents with minor injuries occurred in the town of Mariánské Lázně (both by the Police of the Czech Republic), one in Františkovy Lázně (also by the Police of the Czech Republic) and two near Aš (one by the Police of the Czech Republic and one by the Fire Department). One traffic accident is located on the D6 motorway near Cheb, where the driver of another vehicle was slightly injured when he crashed into a parked Fire Department vehicle during intervention.

In the Sokolov district, one traffic accident with serious injuries occurred on the D6 motorway where, at exit 136, the driver of a single-track vehicle overlooked a KVK ambulance travelling with right of way. Following the accident, this driver was seriously injured. Traffic accidents with minor injuries are also located in the town of Sokolov, in Kraslice and near Chodov.

The total number of traffic accidents registered in front of buildings belonging to the Police of the Czech Republic in the whole Karlovy Vary Region was n=61 (8.70%) of all traffic accidents involving a Police vehicle. The Fire Department reported one traffic accident in front of a fire station and the Emergency Medical Services managed to trace a total of n=12 traffic accidents (4.92% of all accidents involving the

Emergency Medical Services) that were proven to have occurred at the dispatch bases. The real number of these accidents is likely to be much higher.

Most accidents involving vehicles of the IRS forces are caused by drivers themselves. Firefighters caused a total of n=56 accidents, 42.86% of which were caused by vehicles using the right of way. Of the n=28 accidents caused by other drivers, 35.71% were caused by a Fire Service vehicle that was driving with the SAWS switched on. Police officers were at fault in a total of n=346 accidents, of which n=3 were not found to be the culprit, although it must have been a police officer. Under the right of way regime, police officers were at fault in 19.36% of accidents and other drivers were at fault in 20.88% of accidents with a Police vehicle that was driving with the SAWS on. In total, other drivers were at fault in n=273 accidents involving police vehicles and in n=29 of these accidents the driver was not found at fault. In n=67 cases, the accident occurred after a collision with wildlife and n=14 accidents were caused by another road user such as a pedestrian or road defect and other causes. The drivers of the EMS caused n=107 accidents and other drivers caused n=33 accidents. For a total of n=22 accidents, there was a note of unknown, but no indication of whether the other driver or the EMS driver was unknown In 13.08% of the accidents caused by the drivers of the Emergency Medical Services (EMS) happened in the right-of-way mode, but this figure is recorded only for n=60 of the total n=246 accidents. Other drivers caused 39.40% of accidents with an EMS vehicle driving in the right of way. Wildlife was the cause of RTC in n=28 cases and in n=76 cases other culpability is recorded, most frequently "stone" culpability in n=49 cases.

The most frequent causes of accidents for all drivers of the IRS services overall were not paying attention to driving and incorrect turning or reversing, which were the cause of n=245 accidents out of n=509 accidents caused by all drivers of the IRS services together. Not paying attention to driving was the most frequent cause for both the Police (n=105) and the Emergency Medical Services (n=15). For the Fire and Rescue Service, improper turning was the most frequent cause of accidents caused by Fire and Rescue Service drivers in 10 cases. For the Czech Police and Fire Department, the third most common cause was failure to adjust speed (to road conditions, weather conditions, etc.). In the case of the Police Department it was n=39 cases (11.27%) and in the case of the Fire Department it was n=5 cases (8.92%). The third most frequent cause of accidents caused by the drivers of the Fire Department was in n=6 cases failure to yield the right of way, which included running a red 3-colour traffic light and failure to yield the right of way at traffic signs "Stop, yield" and "Yield."

Other drivers caused a total of n=334 accidents with vehicles of the IRS forces. The most frequent cause was improper turning, in a total of n=69 cases, which is 20.66%. The second most frequent cause was not paying attention to driving, in a total of n=67 cases. Traffic accidents caused by failure to keep a safe distance between vehicles and failure to yield the right of way were caused by other drivers in n=37 cases. The results vary for the individual components. With the Fire Department vehicles, the most frequent accident was caused by drivers who did not give way (n=5). The most frequent accident caused by another driver with the Police Department vehicles was due to improper turning (n=67), and with the Emergency Medical Services the most frequent cause was not paying attention to driving (n=6). Other causes include e.g. avoidance without sufficient lateral clearance or spontaneous starting of an uninsured vehicle, which was the cause of accidents with the Police Department vehicles caused by other drivers in ten cases.

The most frequent type of traffic accident was a collision with a moving non-rail vehicle at the Fire Department (n=29) and the Police Department (n=246). The most frequent collision with a fixed obstacle was with the Emergency Medical Service (n=32). The EMS records in its statistics n=51 cases in which the windscreen was damaged (probably due to a flying stone from a vehicle travelling in front of the EMS vehicle). Official statistics do not record this type of traffic accident, so it is not possible to distinguish this accident from other traffic accidents in other components of the EMS. For the Fire Department, the second most frequent type of traffic accident is a collision with a parked or parked vehicle in n=28 cases. For police, the second most common type is collision with a fixed obstacle, in n=182 cases. The second most frequent type of accident recorded by the ambulance was collision with wildlife (n=25). In the case of the ambulance, the type of accident was identified in 142 cases, partly thanks to the descriptions in the supplied data, which indicated, for example, damage to a garage or another vehicle, and so it was possible to identify the type of accident.

When driving vehicles with the right of way, the most frequent type of traffic accident overall is a collision with a moving vehicle, which happened in n=61 cases in the case of the Police and in n=16 cases in the case of the Emergency Medical Service. For the Fire Department, the most frequent type of traffic accident was a collision with a parked or parked vehicle in n=13 cases. Police officers were at fault in the highest number of collisions with a fixed obstacle while driving vehicles with right of way, in n=29 cases out of n=34. The remaining five cases were caused by other persons or other drivers. Drivers of emergency medical services vehicles were at fault for the most collisions with fixed obstacles (7 out of 7). Other drivers were most often at fault in "collision with a moving non-vehicle" that was traveling with the right-of-way. Thus, overall, other drivers are most likely to crash into a moving IRV with the right-of-way, whereas drivers of these vehicles are more likely to crash into a parked vehicle or other fixed obstacle.

Table 6: Total damage caused by traffic accidents involving vehicles of the Integrated Rescue System in the Karlovy Vary Region (2011-2022)

	total (v EUR)	Average per 1 RTC (in EUR)	Highest single damage (in EUR)
Fire	545 525	6 418	356 435
Police	708 127	1 012	27 723
EMS [2]	129 437	1 681	19 802
Total	1 383 089		

Process: own; source: nehody.cdv.cz, ZZS KVK, HZS KVK

Another data examined was the total damage to the vehicles of the IRS forces due to traffic accidents. Most of the damages are covered by the obligatory liability insurance of the guilty party or the accident insurance of the vehicles of the IRS units, for which the individual units only pay the co-payment. The figures are therefore only indicative, as it has not been possible to ascertain exactly whether the amounts mentioned were paid in full by the IRS or by insurance. For the regional Fire Department, the figures are fairly accurate as they are based on their own records. In the case of the Police of the Czech Republic, the data was based on the public database of traffic accidents, where the data is written only by the estimate of the police officer on the spot. In reality, therefore, they may be different. In the case of the Emergency Medical Services, only partial information could be analysed. The Police of the Czech Republic recorded the highest damages for all years, totalling EUR 1 383 089, while having the lowest average. The highest damage to a single vehicle was recorded by the Fire and Rescue Service in 2021, when a firefighting enigne rolled over onto its roof after a traffic accident.

Traffic accidents were divided according to the time of fault into five categories. The categories were morning (6-8am), mid-morning (8-12am), afternoon (12-6pm), evening (6-10pm) and night (10-6pm). The normal shift length varies from one IRS unit to another. In the Fire Department (on-call staff), they usually start work at 6 a.m. and the shift is 24 hours long, including sleeping time if there is no call-out. In the Police Department, both the length of individual shifts and the time of

[2] The average and total damage are calculated from only 76 accidents for which an indication of damage to the vehicle was found.

starting work vary, which is usually between six and eight in the morning. As a rule, if it is a riot police service, the start time is 7:30 a.m. or 7:30 p.m. and the shift lasts 12 hours. In certain cases, the shift may last up to 24 hours (e.g. guard duty). The EMS has a maximum shift length of 12 hours for all drivers and the start time is 7:00 a.m. or 7:00 p.m. In rare cases during a coronavirus epidemic, the shift length has been extended to 24 hours. Time data could be obtained for accidents involving ambulances in a total of n=61 cases. The statistical differences between the times of day are statistically significant, the level is less than p=0.05 for all the IRS units. Overall, the models show that the highest accident rate is in the afternoon and the lowest in the morning. The coefficients for the EMS were calculated as follows. A coefficient of -1.7918 was determined for the morning category, indicating a significantly lower frequency of events in this category compared to the reference category night. This means that there is very strong evidence to suggest that the expected number of accidents that happened in the morning is much lower than those that happened at night. In the other categories, the coefficient was not statistically significant.

A closer look at traffic accidents involving vehicles of the IRS services in the Karlovy Vary Region that were driving with right of way shows that the time of day with the highest number of accidents is different. The most risky time of day for the Fire Department is afternoon and evening. The police report the highest number of accidents when driving with right of way in the morning, however, accidents are also frequent in the afternoon and at night. Emergency Medical Services has the highest number of traffic accidents in the evening.

4 Discussion

The aim of the study was to analyse the frequency of traffic accidents of the basic components of the integrated rescue system in the Karlovy Vary Region between 2011 and 2022. The data sources were internal documents of the Health and Rescue Service, the Fire Department, the Police of the Czech Republic and the traffic accident statistics maintained by the Centre for Traffic Research. From the analysed internal documents of the IRS units in the Karlovy Vary Region, a total of n=1029 traffic accidents involving IRS vehicles occurred in the period 2011 - 2022. However, a total of n=829 (81%) were found in official databases, which is also 3.09% of all traffic accidents that occurred in the Karlovy Vary Region and were recorded in official statistics. This difference may be due to accidents that were caused, for example, by leaving the garage and damaging the car, i.e. there was a claim by the insurance company, but the situation had no impact on the health and life of the crew or patients.

Stratton (2020) draws attention to the space given to death in the media and particularly on social media. The aim is to arouse emotions or outright shock the reader, thereby increasing viewership. However, the presented research shows that the majority of accidents involving vehicles of the IRS forces (n = 971, 94.36%) are injury-free. The reason for this phenomenon may be due to the fact that a relatively common type of traffic accident is a collision with a parked or parked vehicle. This raises the question as to how many of these vehicles were parked or parked in places where it is prohibited by law, thus preventing the safe passage of the vehicles of the emergency services. It is not possible to trace this figure.

The assumption that the EMS will have the highest number of traffic accidents in the right of way mode of all IRS units in the Karlovy Vary Region could not be confirmed or denied due to insufficient data. The assumption of the highest accident rate was based on the data when the EMS has the highest number of kilometres travelled of all IRS units in the right of way mode. Neither mileage nor relevant accident data could be obtained. Of the total n=244 accidents, it was possible to determine when the vehicle was or was not driving in the right of way in 60 cases. If the conclusions were based only on these 60 accidents, it can be concluded that 56.67% of the accidents involving the EMS vehicles occurred when the vehicle was driving with the right of way. The trend is reversed for the Police and Fire Department, i.e. a greater number of accidents happen without the use of the Light warning system and SAWS.

The assumption that most accidents involving EMS vehicles happen between 6am and 8am due to more vehicles on the roads on the way to work was not proven. Most of the accidents involving EMS vehicles happened consistently in the afternoon (12-6 pm) and evening (6-10 pm). When driving with the right of way, most accidents happened between 6 pm and 10 pm. Abdelvanis (2013) conducted retrospective research in South Carolina between 2001 and 2010. His research included a total of 11531 traffic accidents involving vehicles of the integrated emergency services (known as emergency vehicles in the USA). For comparison, South Carolina has an area of 82,931 km2, and Carlsbad County occupies 3,310 km2. South Carolina also has 17 times the population of Carlsbad County. Abdelwanis (2013) reports that 79.7% of traffic crashes involved police vehicles, 11.7% involved emergency vehicles, and 8.4% involved fire department vehicles. The results of the presented research are practically minimal in percentage and differ for police (68.02%) and ambulance (23.71%). The percentage is practically identical for firefighter vehicle accidents (8.25%). For fatal accidents, a comparison can only be made for ambulance vehicles, where Abdelwanis (2013) calculated that ambulance vehicles were responsible for 20.25% of fatal accidents (compared to accidents involving integrated rescue system vehicles). In the present research, if we use the percentage, it was 100% (n=2) of accidents involving ambulance vehicles in which the participant was killed. Overall, there were 79 (0.69%) fatal traffic crashes in South Carolina, whereas there were two (0.19%) in the Carolinas involving IRS vehicles Abdelwanis (2013) identified intersections, curves, crash time between 12-18 hours, and high speed as the most significant factors for the occurrence of crashes with integrated emergency services vehicles. In contrast, in the present research, urban environments can be identified as the most critical locations. There is agreement in the time of the crashes and this is between 12-18 pm (for all crashes and those without RoW). The risk causes are already diverging, in the presented research the causes were found to be: not paying attention to driving and improper turning or reversing.

In Illinois (USA) in 2014, a retrospective research of traffic accidents involving emergency vehicles in 2012 was conducted by the Illinois Department of Transportation. The state of Illinois is 45 times larger than Carlsbad County. Since my research included 2012, only data for that year will be compared. From the ZZS, the 2012 data is likely not complete, yet usable. In Carlsbad County, there were n=57 crashes involving emergency medical services vehicles (4.08% of all crashes in Carlsbad County). In Illinois, there were 2,376 crashes involving emergency medical services vehicles, 0.9% of the total. While the number of traffic fatalities in Illinois was 0.4%, Carlsbad County accounted for 9.9% of the total number of traffic fatalities. Police officers were involved in RTCs in Illinois 79.16% of the time, while in Carlsbad County they were involved in 87.72% of the time. It is also interesting to compare the location of the accident, as in Illinois 36.2% of the accidents occurred at intersections, while in Carlsbad County only 22.81% of the time. The number of accidents in Illinois with on-call (loosely translated as on-ramp) was 312, which is 13.13%, while in Carlsbad County it was more, a full 21.05%. In 84 cases, a police vehicle was involved in a vehicle pursuit accident in Illinois, 4.51% of all police-involved accidents. In Carlsbad County, according to official statistics, there was one traffic accident while conducting official business in 2012, which is 1.75% of the total number of traffic accidents. The question is how often this cause is used by traffic officers in the accident investigation group or if it is confused with other causes such as "other improper driving style" (Illinois Department of Transportation, 2014).

Symmons et al. (2005), looked at ambulance accidents in New South Wales, Australia, between 1996 and 2000 inclusive. New South Wales covers 801,150 km2 and is therefore approximately 242 times the size of the Carolinas. Over this period, Symmons

et al. (2005) included 1027 emergency vehicle accidents in their research of which 51% involved injury and 1% involved fatality. In the present research, a smaller number of accidents with injuries was found, only 4.57%. With such a difference, one may wonder whether Symmons et al. (2005) do not count among injuries also minor abrasions and scratches, e.g. from broken glass, which are not recorded in the databases in the Czech Republic. The present research also has a lower percentage of road accidents with death of the participant, only 0.19%. In their research, Symmons et al. (2005) also focused on high speed as a cause of road accidents, finding that the most frequent cause of road accidents is by the emergency medical vehicles (21%), followed by police vehicles (16%) and the Fire Department only 6%. In terms of fire department vehicles, Symmons et al. believe that the lower percentage of accidents caused by high speeds may be related to fire department vehicles not being capable of higher speeds due to their weight and size. In the present research, the most common cause of accidents caused by drivers of IRS vehicles was inattention to driving and improper turning or reversing. Despite the fact that the cause of the accident could only be determined in n=30 cases for the EMS vehicles, speeding was proven to be the cause of the accident by the driver of the EMS vehicle in one case (3.34%); overall, out of n=85 accidents; the remaining n=55 were not caused by the driver but by animals or other objects. Nor do police officers in the Carlsbad region cause traffic accidents due to high speed more often or at least as often as in the research of Symmons et al. (2005). Out of a total of n=346 traffic accidents caused by police officers, n=42 (12.14%) were due to high speed. Thus, firefighters who caused a total of n=56 traffic accidents were at fault due to high speed in n=4 cases (7.14%), which is relatively the same in percentage with the result of Symmons et al. (2005).
Muir et. al. al. (2020) investigated road traffic accidents in an unspecified organisation with approximately 2,000 employees and 55,000 volunteers in Australia. Rather than systematically treating traffic accidents, they focused on identifying challenges in reducing traffic accidents overall. The most common traffic accident he recorded was a crash while reversing into a garage at the end of a shift. This sounds logical given the potential driver fatigue after a twelve hour shift and often due to the lack of support systems such as reversing cameras. In the Karlovy Vary Region, it is not possible to say the exact number of accidents when reversing into a garage, as not all IRS units have a garage. When analysing the traffic accidents that happened at the firefighters' and rescue workers' outposts or at the district police departments, it was found that these are not the most frequent places of traffic accidents.

More experienced drivers tend to have better adaptation to stress and time pressure, better focus of attention, and are better able to anticipate situations and make quicker decisions, as confirmed by Hsiao (2018). He also points out that drivers with overconfidence are more prone to drive in a risky manner while driving a vehicle with the right of way, which can lead to an accident. Hsiao (2018) reports that drivers with less than three years of driving experience are more likely to be involved in a road accident. Based on the analysis of the data collected from the various emergency services, we can only draw conclusions for the police who collect the data. It shows that police officers with 0 to 3 years of driving experience inclusive caused n=31 accidents out of n=346 accidents caused by police officers (8.96%). Police officers in the category of 4 to 7 years of age inclusive caused a total of n=88 traffic accidents (25.43%) and police officers with driving experience of 8 to 11 years inclusive caused n=77 traffic accidents (22.25%). For an adequate assessment, it is necessary to know the exact numbers of police officers in each category, which is not possible to analyse from publicly available sources.

The American study by Graham et. al. (2023) states that for safer driving of ambulances, certain rules need to be followed, which include at the institutional level setting an internal policy on when to use both the Emergency Lights system and the SAWS. At the driver level, it then recommends that drivers limit the use of both ELS and SAWS and use these devices particularly in situations where there is clearly a greater benefit to the patient if they get to the hospital sooner, and also that even if they are driving with ELS and SAWSon, they should come to a full stop at a 'Stop, Yield' traffic sign or a red 3-colour traffic light. It also encourages drivers to observe the maximum speed limit at the location even if they are driving in right of way mode, not to use any phones or other electronic devices while driving ambulances. The study also recommends that drivers think about the route they want to take before they start driving. In other respects, they recommend adjusting the shift to a maximum of 24 hours, sufficient training for employees and educating them in the potential risks. Drivers should also, ideally, receive training in safe driving in the vehicles they normally drive. An analysis of the internal regulations of the EMS regarding the use of the ELS nas SAWS did not find any guidance that directly specifies under which circumstances it is appropriate to use the audible signal. A practical problem may be the inconsistent operation of the special audible warning signal by drivers of the EMS vehicles in different types of vehicles, thus reducing concentration on driving. (ZZS KVK, 2022)

4.1 Limits of research

The work did not deal with the distinction whether the vehicle with the right of way was driving with only the special warning light on or also with the special warning sound signal. This information is neither in public databases nor in the records of the individual IRS units. In the case of the emergency medical service, there was insufficient recording of accidents in the materials provided and it was often not possible to distinguish from the materials provided whether or not the accident was a road traffic accident within the meaning of Act No 361/2000 Sb. The work also included traffic accidents in which the windscreen was broken (e.g. by a flying pebble), as they meet the definition of a traffic accident. At the same time, the date of the accident was found to be incorrectly recorded in at least one case. For the police, it is likely that some accidents are also just windscreen breakages but cannot be distinguished from others. The thesis did not deal with specific accidents and their detailed analysis. Another limitation of the research was the actual recording of traffic accidents in public databases. Until January 1, 2023, the records did not distinguish police, fire and ambulance accidents from other owners. As a result, accidents involving EMS vehicles were recorded as belonging to a private company, sometimes as freight vehicles (despite the fact that all vehicles in the EMS are up to 3.5 tonnes), or vehicles that were different and without any indication of the make. It is not possible to distinguish whether these were vehicles of the Emergency Medical Services or of the Medical Transport Service. Police vehicles were in most cases entered correctly, as this data existed before 2023. Fire department vehicles were most often entered as Ministry of Interior vehicles, and unless complete internal data were provided by the Fire Department, it would be impossible to distinguish their accidents from those of, for example, the Czech Post (also under the Ministry of Interior).

5 Conclusion

The research dealt with the analysis of traffic accidents of the Fire Rescue Service of the Karlovy Vary Region, the Karlovy Vary Region Emergency Medical Service p.o. and the Police of the Karlovy Vary Region. The data were obtained from individual components of the integrated rescue system and from public databases. A total of n=1029 traffic accidents involving vehicles of the emergency services were included in the research. The assumption that the EMS would have the most accidents was not confirmed. A significant relationship at the p=0.05 level of increased accident frequency of the EMS was revealed, the established coefficient of -1.7918 indicates a significantly lower frequency of events in the reference category "night". This means that there is very strong evidence to suggest that the expected number of accidents that happened in the morning is different compared to those that happened at night. In the other categories, the coefficient was not statistically significant.

From the analysis of the data, the most common causes of crashes for the drivers of the emergency services were determined to be a lack of attention to driving and for other drivers, improper turning or reversing. The results of the research then indicate that the most frequent type of traffic accident is a collision with a moving non-road vehicle.
Working in the integrated rescue system requires constantly developing your skills and abilities and learning new things. Responsibility and humility are essential elements of accident prevention and can be reduced by adequate driver training.

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