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Medical interventions of the Fire Service during the COVID-19 pandemic in Poland.

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ABSTRACT

INTRODUCTION: The rescue services which take interventions in the scene of accidents include the Fire Service officers. The tasks of the Fire Service carried out to serve the society include the cooperation with units of the Emergency Medical Services and performance of medical operations. The spreading of the COVID-19 pandemic led to many changes in daily public and private life, in the functioning of institutions, public offices, the healthcare system and the uniformed services.

MATERIAL AND METHODS: The study included a retrospective analysis of departures of Polish fire-fighting units (FFU) for isolated events of medical emergency (IEMEs) in a two-year period: from March 2019 to the end of February 2021 (one year before the pandemic and one year during the pandemic in Poland). The data come from the EWID event recording programme and the Decision-Making Support System of the State Fire Service. The quantitative data were prepared depending on the distribution of the variable: the mean and the standard deviation (if the distribution was normal) and the median and the interquartile range (if the distribution was not normal).

RESULTS: The studied period included 5272 events meeting the criteria for inclusion in the analysis. An increase by over 56% was seen in IEMEs in the pandemic year compared to the previous year. The dynamics of the IEME increase are identical to the waves of the pandemic occurring in Poland. A statistically significant correlation ($p < 0.001$, $R = 0.93$) was demonstrated between the number of coronavirus infections and the number of IEMEs in the pandemic period.

CONCLUSIONS: The studied period included 5272 events meeting the criteria for inclusion in the analysis. An increase by over 56% was seen in IEMEs in the pandemic year compared to the previous year. The dynamics of the IEME increase are identical to the waves of the pandemic occurring in Poland. A statistically significant correlation ($p < 0.001$, $R = 0.93$) was demonstrated between the number of coronavirus infections and the number of IEMEs in the pandemic period.

KEY WORDS: Pandemic, COVID-19, State Fire Service, isolated events of medical emergency, medical interventions.

INTRODUCTION

In the last months of 2019 in China, a new type of coronavirus – SARS-CoV-2 – was revealed which spread over to a lot of countries in the months to follow. The virus reached Poland: the first registered case of infection dates back to 4 March 2020 [1]. This infectious disease spread by droplets threw down the gauntlet to the entire society, the economy, all healthcare facilities, particularly the Emergency Medical Services (EMS) – medical rescue teams (including air medical rescue teams) and Accident & Emergency Departments. The spreading of the COVID-19 pandemic led to many changes in daily public and private life, in the functioning of institutions, public offices or the uniformed services, to name of few. The growing number of cases considerably burdened the healthcare system.

The analysis included the functioning of FFUs in the initial period of the epidemic. The observations focused on the tasks carried out in service of the society and in cooperation with EMS units. The analysis covered the medical rescue operations (MRO) carried out by FFUs during isolated events of medical emergency (IEMEs).

IEME is defined as an event covered by the scope of responsibility of the EMS system, during which event FFU rescue workers carry out MRO until the responsibility for the casualty is taken over by a Medical Rescue Team (MRT), including an Air Medical Rescue Team (AMRT), in the following situations:

- when the NRFES means and forces dispatched at the request of the emergency medical dispatcher arrive to the individuals in medical emergency before the specified/dispatched EMS units (MRT/AMRT),
- when MROs are started in the individuals at the request of outsiders (e.g. after the given medical emergency was reported to the control station of the fire service headquarters),
- when MROs were started when the FFU means and forces were moving (e.g. during the comeback from the events or from training) [1,2].

Under the EMS Act, the units cooperating with the EMS system include the services appointed under the statutory law for providing aid to people in medical emergency, particularly the organisational units of the State Fire Service (SFS) and the fire service units covered by the National Rescue and Fire-Extinguishing System (NRFES). In addition to the performance of their statutory tasks, namely organising and carrying out rescue operations during fires and natural disasters or removing local risks, the Polish fire fighters are more and more frequently dispatched for IEMEs [3].

EMS system load

The COVID-19 epidemic caused by the spread of the SARS-CoV-2 virus considerably and widely impacts the operation of the entire healthcare system, including EMS. Before the figures are analysed, it might be expected that the number of IEMEs covered by FFUs was higher in the pandemic period. This could result in a considerable strain put on the EMS system.

Purpose

Assessment of the characteristics, number and duration of IEMEs by NRFES units in connection with the state of the COVID-19 epidemic in Poland. To achieve that purpose, the authors stated the following research hypotheses:

1. The number of isolated events of medical emergency to which SFS officers were dispatched increased significantly during the pandemic compared to the period before it,
2. The mean duration of IEMEs became longer.

MATERIAL AND METHODS

The study included a two-year retrospective analysis of departures of FFUs for IEMEs in the period from March 2019 to March 2021. The article was prepared in April 2021 directly after the full data for the 1st quarter of 2021 were obtained. The authors decided to analyse the data from March instead of January as it was in March 2020 that the first case of COVID-19 infection occurred in Poland. Thanks to this move, the authors compared the operation of FFUs in the area of medical rescue in the periods of 12 months before the epidemic and of 12 months during the epidemic in Poland.

The data come from the EWID event reporting programme and the Decision-Making Support System of the State Fire Service (DMSS SFS), made available by the National Centre for Rescue Coordination and Population Protection (NCRCPP) with consent of the Head of NCRCPP granted on 04.05.2021. The cases which did not have features of IEMEs and cases entered in the DMSS SFS system by mistake were excluded from further analysis.

The results were statistically analysed with the STATISTICA 12 software (StatSoft Polska). The quantitative data were prepared depending on the distribution of the variable: the mean and the standard deviation (if the distribution was normal) and the median and the interquartile range (if the distribution was not normal). The normality was tested with the Shapiro–Wilk test and the dependencies between the groups were tested by the Spearman's rank correlation. The correlations and differences at the significance level of $p < 0.05$ were regarded as statistically significant.

RESULTS

In the analysed period, the Polish fire fighters intervened 1,107,986 times, where 176,058 were defined as local medical emergencies, including 109,584 cases connected with the SARS-CoV-2 coronavirus (Fig. 1). In the study divided into 2 periods 5272 IEMEs in total were reported, where:

- one year before the pandemic in Poland (01.03.2019 00:01 – 01.03.2020 00:00) – 2054 IEMEs,
- one year of the pandemic (01.03.2020 00:01 – 01.03.2021 00:00) – 3218 IEMEs.

In the latter period the number of IEMEs was higher by over 56 percent.

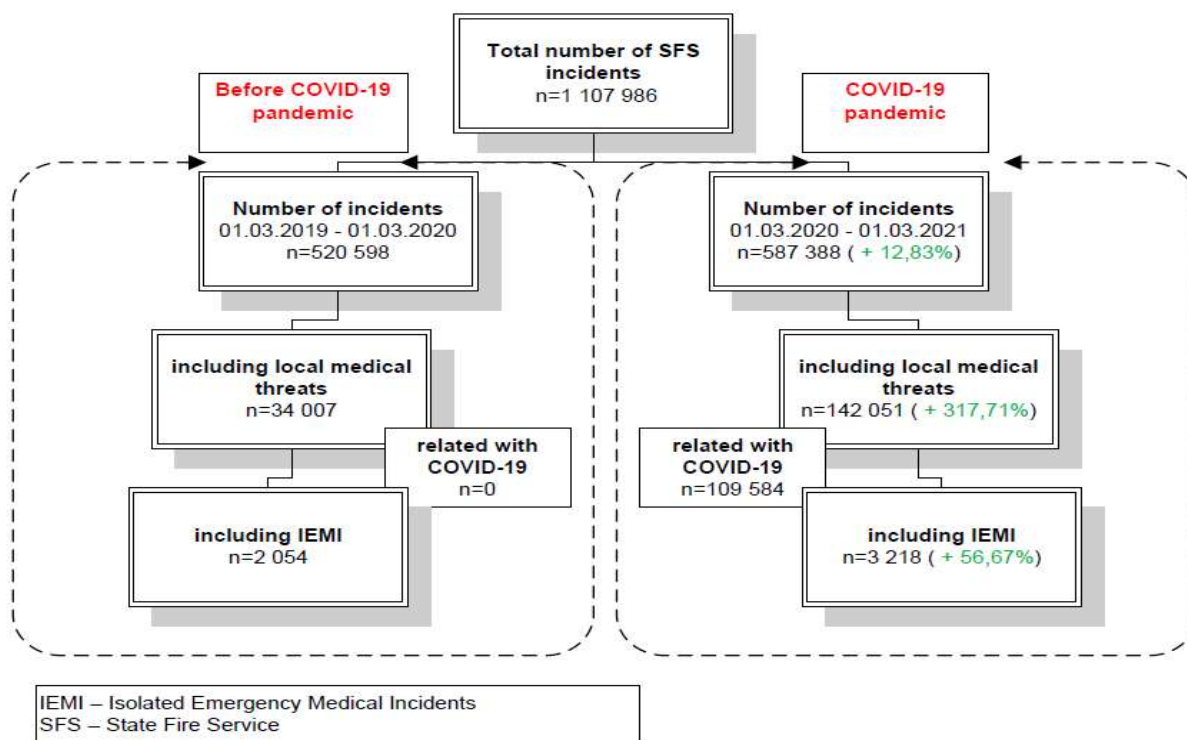


Figure 1. Flow chart of study stages

According to the JHU CSSE COVID-19 data, 1,683,524 cases of coronavirus infection were reported in Poland from March 2020 to March 2021 (Med=22913,00; IQR/2=110290.50). A statistically significant correlation ($p < 0.001$, $R = 0.93$) was demonstrated between the number of coronavirus infections and the number of IEMEs in the pandemic period (Table 1).

Table 1. Description of the analysed variables.

Variable	n	Mdn	IQR/2	R*	P-value
Number of infections COVID-19	1,683,524	22,913,00	110,290,50		
		M	SD	0.93	<0.001
IEMI	3,218	268,17	141,94		

Mdn – median, IQR/2 – semi-interquartile range, M – mean, SD – standard deviation, *RSpearman

The study also analysed the operating time for IEMEs – the difference between the time of departure of the first FFU for IEME and the time of transfer of the casualty to MRT. In the pre-pandemic period, the average event time was 37 minutes and 40 seconds, while during the pandemic – 78 minutes and 56 seconds (an increase by nearly 110%).

The dynamics of the IEME increase are identical to the waves of the pandemic occurring in Poland. The peak of the first wave of infections occurred in September 2020 with 231 IEMEs and the peak of the second wave fell on November 2020 with 588 IEMEs (Fig. 2).

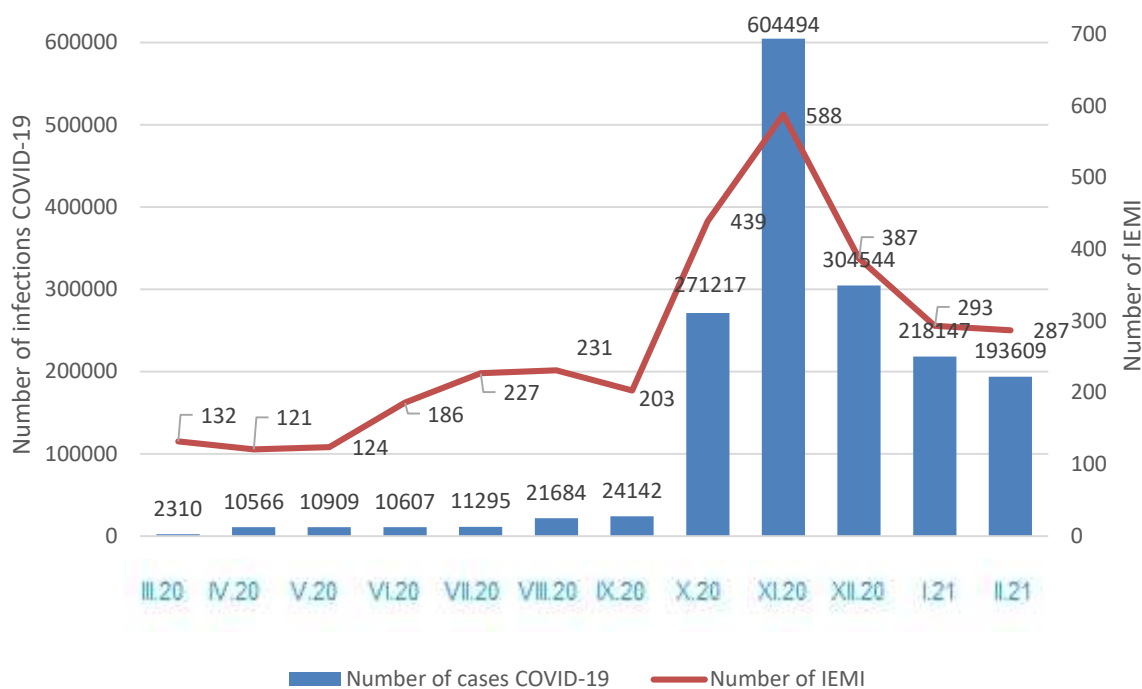


Figure 2. Number of IEMEs depending on the number of COVID-19 cases.
[COVID-19 data: JHU CSSE COVID-19]

DISCUSSION

The SARS-CoV-2 pandemic affected the entire healthcare system significantly. Own studies show that the number and duration of IEMEs increased. Please note that the fire fighters outside the EMS system are the leading services dispatched by emergency medical dispatchers to life-threatening emergencies and are not worse in terms of competence and equipment than other services, e.g. the police, the army or the Volunteer Water Rescue Service. The authors specify 3 significant arguments thanks to which fire fighters have the highest probability of carrying out effective medical operations:

- 1. PROCEDURES** – medical rescue operations run by fire fighters are based on 22 procedures of qualified first aid [3].
- 2. FFU LOCATION** – fire fighters owe an efficient deployment of FFUs for instance to volunteers. The Voluntary Fire Service (OSP) is often the first service to arrive at the scene of the event, especially in rural areas, where most voluntary fire service units are located. The role of NRFES in rural areas and the efficient deployment were noticed in the analysis of 2014. The authors stated that the time required to reach the scene of an event is sometimes too long, most often in non-urban areas, and that the arrival and the gaining of access to threatened or injured individuals as well as the provision of qualified first aid and evacuation out of the danger zone are often the roles of NRFES [4]. The significant participation of NRFES in IEMEs were stated by Gulbas P. et al. in 2020. The study showed that the network of fire service units enables the rescue services to reach the threatened people within 15 minutes in 85% of the population of Poland [5].

3. MEDICAL EDUCATION OF SFS – all fire fighters undergo professional training in medical rescue, can implement medical procedures and use the equipment from rescue kits. However, what is more important is that over 2400 medical rescue workers serve in the State Fire Service, 30% out of whom also works in the EMS system or in hospitals [6]. Medical rescue workers who have gained clinical experience in EMS system units share their knowledge and skills during qualified first aid courses and trainings and are the pillars of medical aid during actual interventions. It needs to be added that FFUs do not transport casualties to hospital, they carry out operations in the scene of an event/call while waiting for MRTs.

Without a doubt, the SARS-CoV-2 pandemic affected NRFES not only by increasing the number of IEMEs for which fire fighters were dispatched. In addition to the assistance in the statutory operations of the EMS system, fire fighters have been imposed with a lot of new duties to fulfil. The analysis of 2020 showed changes in the operations and tasks in the first months of the SARS-CoV-2 virus activity. The authors noticed that the operations carried out against the escalation of the threat had evolved. And FFUs had to adapt their duties accordingly on an ongoing basis [7].

According to the authors, the EMS system, including ambulance teams, were burdened with the state of epidemic to a degree. Table 2 shows the main causes of delays in dispatching ambulances and them departing for the scenes of accidents in connection with the SARS-CoV-2 pandemic. These are subjective observations resulting from the experience of the authors (own study), but depending on the region of Poland (locally) specific phenomena may have different intensity, which to a varying degree affects the availability of MRT and the possibility of dispatching them by the emergency medical dispatcher (EMD) to the next event. Due to the limited availability of MRTs specified in Table 1, the authors would like to refer to the analysis carried out by Drozd A. et al. in 2021, which examined how personal protective equipment (protective overalls, goggles, double gloves) make it difficult to carry out medical procedures – placement of peripheral venous catheter, required in many cases to administer drugs – and how they affect the duration of the procedure of peripheral venous catheterisation. The study results overlap with the own observations of the authors that the usage of PPE extends the duration of medical interventions, as a result of which moving on to the next call can be delayed [8].

Apart from the above study, observations on the difficult and the specific nature of medical rescue operations in the face of biological threat were conducted by Trzos A. et al. in 2017, which described operations, personal protective equipment and equipment decontamination procedures. The researchers even mention SARS – severe acute respiratory syndrome – but in the context of terrorist operations, not in the context of the pandemic [9]. The study published by Pasam T. et al. in 2021 showed that the COVID-19 pandemic caused fear and uncertainty. Healthcare professionals, working on the first line of attack, who are more exposed to SARS-CoV-2 infection, suffer from more intense deficits in the psychophysical sphere. This corresponds to the own observations: the mental stress of MRT members decreases their performance at work and leads to temporary inability to work; in turn, less efficient MRTs translate into a higher number of IEMEs indirectly. [10]

Table 2. Limitations in the availability of MRTs during the pandemic.

Delays in the availability of MRTs in connection with COVID		Causes of delays
1	Longer travel to the scene of the event.	MRT team putting on personal protective equipment (PPE) in the cases involving patients with suspected SARS-CoV-2 infection.
2	Longer waiting time for intervention in relation to covid patients.	Difficulties in transferring the patient to A&E due to the lack of space – waiting or transport to another healthcare facility, even several dozen kilometres away.
3	Longer intervention times in relation to patients without SARS-CoV-2 infection.	The lack of (the so-called "clean") places for patients without SARS-CoV-2 infection, hospital department transformed into infectious departments for SARS-CoV-2 patients or entire hospitals transformed into "homogeneous" facilities for SARS-CoV-2 patients only – which means that the patient has to be transported to other healthcare facilities, often several dozen kilometres away.
4	Longer intervention times in relation to patients without SARS-CoV-2 infection.	A closed department of the specific specialisation in the closest healthcare facility due to diagnosing a SARS-CoV-2 infection among patients in the department.
5	Longer intervention time in relation to a patient warranting imaging diagnostics.	The imaging diagnostics institute in the given healthcare facility is infected and temporarily unavailable due to the performance of imaging diagnostics (X-ray, computed tomography) for SARS-CoV-2 patients.
6	Disinfection time after an intervention involving a SARS-CoV-2 patient.	According to the procedures in place in the given healthcare facility, depending on the possessed equipment and the concentration of the disinfection medium. After the disinfection process, the ambulance has to be aired so that the interior is safe for the personnel and next patients.
7	Waiting time for the disinfection procedure.	It mainly pertains to larger cities where there is a higher number of MRTs which exceeds the number of devices for disinfection.
8	Longer intervention time for each patient – infected and not infected with SARS-CoV-2.	After the decision of the fact that a patient warrants transport to hospital – waiting for the emergency medical dispatcher to determine the place for the patient.
9	Additional medical procedures in the case of all patients.	Carrying out smear tests confirming SARS-CoV-2 infection by MRTs or – at A&E – waiting 15 minutes for the result.
10	Unavailability of MRTs after comeback from an intervention for a SARS-CoV-2 patient.	The MRT team and the ambulance warrant disinfection, they cannot accept another call to a patient without a confirmed positive Sars-CoV-2 result. An MRT could take another order if the emergency medical dispatcher were sure that it will be a call to a patient with a positive SARS-CoV-2 result.
11	Higher number of calls.	A high number of patients with chronic diseases who frequently warrant control of their condition or preparation of prescriptions do not receive effective aid from the general practitioner and the primary healthcare (POZ) facility. The EMS system receives a lot of notifications in connection with the failure of the primary healthcare to fulfil its basic duties and the provided telephone consultations are an insufficient source of medical service. This is accompanied by the aversion of general practitioners to appointments at the patient's house.
12	Locally – shortages of the MRT team.	Diseases (isolation) among medical professionals and quarantine imposed on the personnel in the first period of the epidemic (the obligation was lifted under the Regulation of the Minister of Health of 3 November 2020 on determination of certain limitations, orders and bans in connection with the occurrence of the state of epidemic) led to the situation where some MRTs were not available in the system due to the lack of personnel.

Wiszniewski R. et al., in their study of 2019, analyse the medical operations of fire fighters and confirm that if there are no medical services in the scene of accident yet, fire fighters can carry out the necessary procedures in the area of qualified first aid before MRT arrives [11]. As the study authors, we agree with the observations of Tomaszewski P. et al. from 2020 that the fire service is vital in rural areas, that volunteer fire fighters are most often called for traffic accidents and that the fire fighters the most frequently use dressing kits and equipment for setting the casualties free, taking them out and immobilising them [12].

Observations on rescue operations in the pandemic are described by Nadolny K. et al. in a study published in 2021, which involved a retrospective analysis of departure order cards. According to the results, the total number of MRT interventions went down during the pandemic. Those results confirm our own observations and the limitations specified in Table 1. A much longer time of the single intervention in the case of a SARS-CoV-2 patient and a longer time of unavailability of MRT after an intervention (disinfection) lead to a lower number of orders which a MRT can take within a specified time interval, e.g. 1 day [13].

CONCLUSIONS

Study results show the significant role FFU play during the EMS system overloaded with the number of infections, which system deals with the service of medical emergencies and with implementing MROs. The increased number of IEMEs in the pandemic year compared to the previous year shows a frequent lack of availability of MRT during the COVID-19 pandemic in Poland. The prolonged duration of IEMEs is caused by longer waiting periods for EMS units to transport a casualty due to the inability to transport them to a healthcare facility by FFUs resulting from the statutory law.

SUPPLEMENTARY INFORMATION

Funding: *This research received no external funding.*

Institutional Review Statement: *The study was conducted according to the guidelines of the Declaration of Helsinki.*

Informed Consent Statement: *Informed consent was obtained from all subjects involved in the study.*

Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*

Conflicts of Interest: *The authors declare no conflicts of interest.*

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