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ORIGINAL ARTICLE

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Impact of COVID-19 pandemic on emergency medical service response to emergency calls — a retrospective analysis of data from Emergency Medical Service station in Bydgoszcz

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ABSTRACT

Introduction: Emergency medical systems, as the first line of management of infectious patients, were affected by the 2019 coronavirus acute respiratory disease (COVID-19) pandemic. The aim of the study was to analyze the impact of the COVID-19 pandemic on the Emergency Medical Service (EMS) with emphasis on response time.

Material and methods: Retrospective analysis of dispatch card from EMS in Bydgoszcz between January 2018 and December 2020. The differences regarding the EMS response were analyzed between the pre-pandemic (2018–2019) and the pandemic (2020) period in three time-points: from call to Emergency Medical Team (EMT) departure (T1), from departure to arrival at the scene (T2), and from arrival to reaching the emergency department (T3).

Results: There were 47783 EMT departures in 2018, 47113 in 2019 and 40835 in 2020. In 2020 mean (SD) monthly number of interventions was significantly lower [3403 (349) *vs.* 3954 (182), $p < 0.001$] compared to the 2018–2019 period. During the pandemic period the mean T1 [0.9 (1.49) *vs.* 0.63 (1.12) min, $p < 0.001$], T2 [9.91 (6.33) *vs.* 8.25 (5.07) min, $p < 0.001$], and T3 interval [40.45 (19.84) *vs.* 36.56 (14.63) min, $p < 0.001$] were prolonged in comparison to the pre-pandemic period. The differences in response time were the largest in October–December.

Conclusions: During the first year of the pandemic, the number of EMT interventions decreased and the response time was prolonged compared to the pre-pandemic period. The largest differences were observed at the end of the year, which overlapped with the peak of the second wave of COVID-19 infections in Poland.

Key words: COVID-19, emergency medical service, pandemic, response time

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Introduction

The spread of the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to a global pandemic and became a huge burden for health care systems worldwide. According to the data published by World Health Organization, by 30th January 2022, over 370 million confirmed cases of the 2019 coronavirus acute respiratory disease (COVID-19) were reported [1]. The first patient in Poland was diagnosed with COVID-19 on March 4th, 2020 and up to date, the number of confirmed SARS-CoV-2 infections exceeded 6 million cases [2].

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The COVID-19 pandemic significantly changed the functioning of health care systems worldwide. The emergency systems, as the first line of management of infectious patients, were particularly affected by the pandemic and required modernization of the daily routine [3, 4]. Previous studies showed that Emergency Medical Service (EMS) personnel was exposed to a high level of stress, anxiety, and fear caused by new and difficult working conditions that affected also their family lives [5, 6]. The EMS working conditions were also influenced by the high risk of infection and, as a result, the need to wear personal protective equipment [7]. To manage the COVID-19 related challenges the EMS workers underlined the need to create and follow a comprehensive systematic protocol for providing pre-hospital care [8]. To address this issue European Society For Emergency Medicine published 2020 recommendations on the functioning of EMS systems in Europe [9]. The influence of the COVID-19 pandemic on the EMS system was also observed with regard to patients diagnosed with life-threatening conditions (e.g. cardiac arrest or stroke) [10–27]. The meta-analysis by Bielski et al. showed clearly that the COVID-19 pandemic was related to prolonged time to Emergency Medical Team (EMT) arrival and what is more disturbing decreased survival in patients with out-of-hospital cardiac arrest [28]. The response time could be an indirect measure of the quality and efficiency of the emergency system. The delayed EMT intervention might in some cases lead to fatal consequences, especially in patients with life-threatening conditions.

The aim of the study was to analyze the impact of the COVID-19 pandemic on the EMS in Bydgoszcz with emphasis on response time to emergency calls in comparison to the pre-pandemic period.

Material and methods

The retrospective analysis of the data obtained from the State Emergency Medical Support System was performed. All dispatched cards from the EMS in Bydgoszcz were analyzed within the period between January 1st, 2018, and December 31st, 2020. All EMT interventions were realized within the operational area of the EMS station in Bydgoszcz covering an area of 1395 km^2. Bydgoszcz district is located in the north-central part of Poland and was inhabited by approximately 470,000 citizens during the study period [29]. The district includes 1219 km^2 of suburban areas inhabited by 24.5% of the population.

During the study period, all EMT departures were analyzed regardless of the emergency call reason. The study period was divided into the pre-pandemic period (covering years 2018–2019) and the pandemic period (the year 2020). The response of EMS to the emergency call was assessed in three time-points: from dispatcher's call to EMT departure (T1), from EMT departure to arrival at the scene (T2), and from the arrival to reaching the hospital (T3) and handover of the patient to the emergency department (ED). The differences regarding time intervals between the pre-pandemic period and the year 2020 were analyzed.

Statistical analysis was performed with Statistica 13.0 software (TIBCO Software Inc., California, USA). The Shapiro-Wilk test demonstrated the non-normal distribution of the investigated continuous variables however, it was decided to present these variables as means with standard deviation (SD). The categorical variables were presented as percentages. The significance of the difference between the variables was checked using the Mann-Whitney test. The two-sided p-value < 0.05 was considered statistically significant.

The purpose and design of the study required no patients informed consent as well as the approval of the bioethical committee.

Results

During the study period, there were 47 783 EMT departures in 2018, 47 113 in 2019 and 40 835 in 2020. The majority of patients were men (51.5%) and the mean (SD) age of the group was 59.0 (23.3) years. The interventions occurred in 79.2% of the urban area. The mean time interval between the dispatcher's call and the EMT departure (T1) was 0.71 (1.25) min, the mean time between EMT departure and arrival at the scene (T2) was 8.75 (5.53) min and the time between the arrival at the scene and reaching the ED (T3) was 37.71 (16.45) min for the total analyzed period.

During the pandemic period, patients were less likely to be men (50.2% *vs*. 51.0%, $p = 0.01$) and their mean age was higher [61.2 (22.3) *vs*. 58.0 (23.7) years, $p < 0.001$] in comparison to the pre-pandemic period. In 2020 mean monthly number of interventions was significantly lower [3403 (349) *vs*. 3954 (182), $p < 0.001$]. Figure 1. shows the monthly distribution of EMT departures. The lowest number of departures in 2020 was observed in April ($n = 2673$) and May ($n = 2977$). During the year 2020 the number of EMT interventions was lower in all months but January in comparison to the years 2018–2019. All response times were significantly longer during the pandemic period (Fig. 2.). The monthly distribution of the T1 interval is presented in Figure 3. In all months the mean EMT response time to the dispatcher's call was significantly longer in the year 2020. The observed differences were the highest in October [1.01 (1.75) *vs*. 0.68 (1.03) min, $p < 0.001$], November [1.02 (1.68) *vs*. 0.6 (0.95) min,

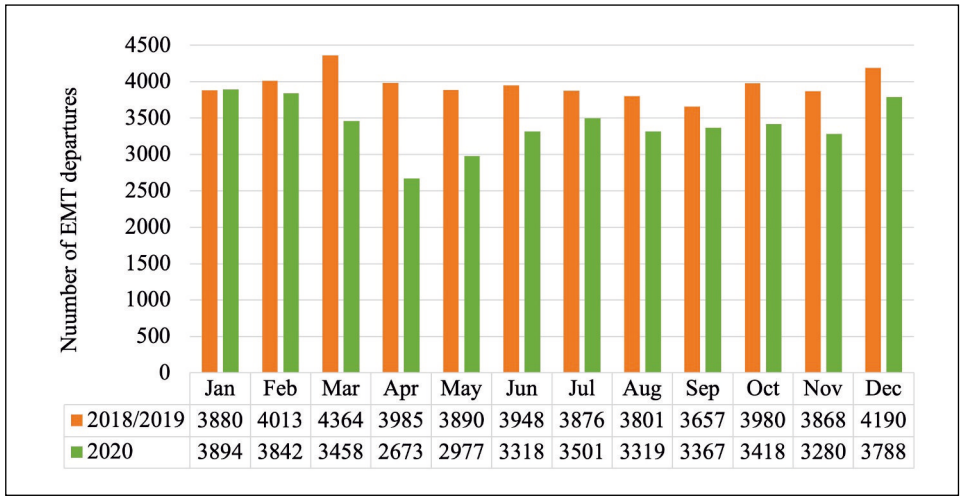
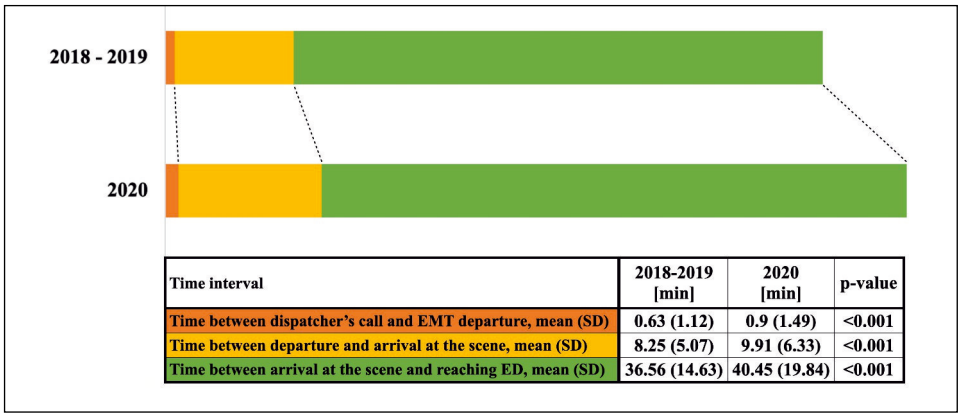


Figure 1. The number of EMT departures during the pre-pandemic (2018–2019) and the pandemic (2020) periods



Time interval	2018-2019 [min]	2020 [min]	p-value
Time between dispatcher's call and EMT departure, mean (SD)	0.63 (1.12)	0.9 (1.49)	<0.001
Time between departure and arrival at the scene, mean (SD)	8.25 (5.07)	9.91 (6.33)	<0.001
Time between arrival at the scene and reaching ED, mean (SD)	36.56 (14.63)	40.45 (19.84)	<0.001

Figure 2. Time intervals of EMS response during the pre-pandemic (2018–2019) and the pandemic (2020) periods

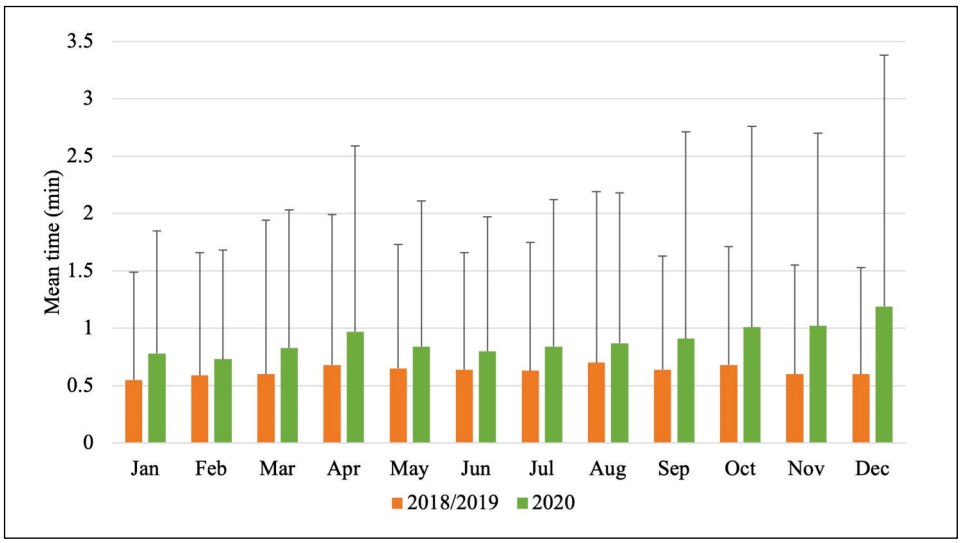


Figure 3. The mean time between dispatcher's call and EMT departure (T1) in a particular month of the year during the pre-pandemic (2018–2019) and the pandemic (2020) periods. The difference between analyzed periods was statistically significant ($p < 0.001$) in all months. Whiskers show a positive value of standard deviation

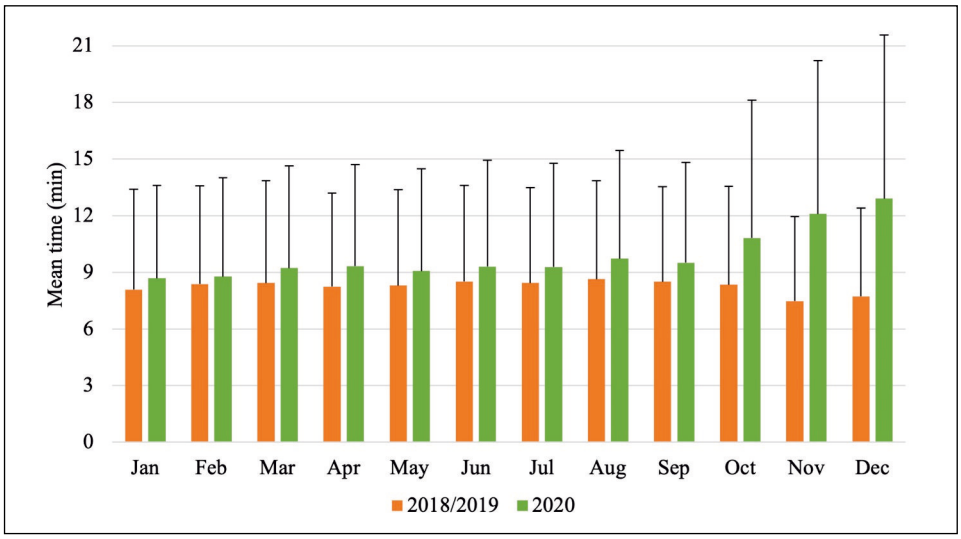


Figure 4. The mean time between EMT departure and arrival at the scene (T2) in a particular month of the year during the pre-pandemic (2018–2019) and the pandemic (2020) periods. The difference between analyzed periods was statistically significant ($p < 0.001$) in all months. Whiskers show a positive value of standard deviation

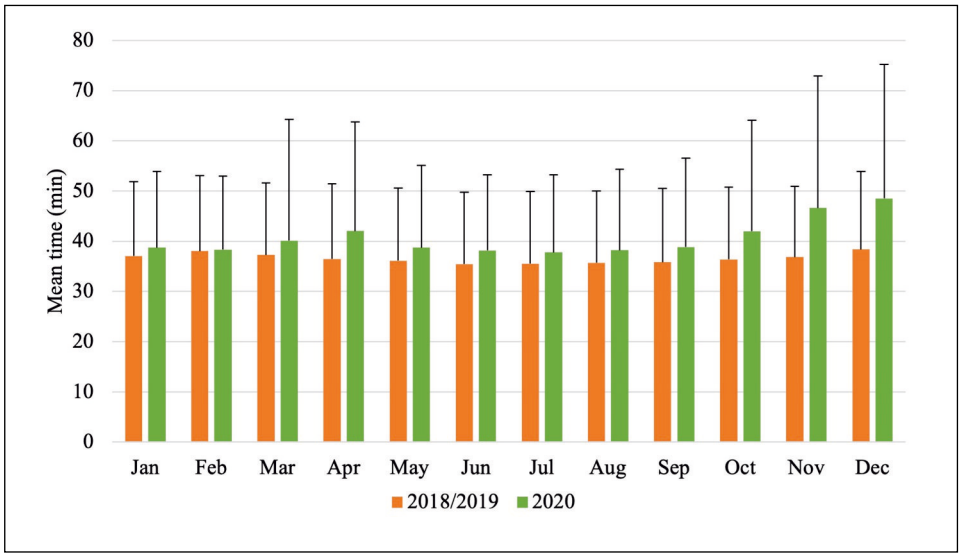


Figure 5. The mean time between the arrival at the scene and reaching the ED (T3) in a particular month of the year during the pre-pandemic (2018–2019) and the pandemic (2020) periods. The difference between analyzed periods was statistically significant ($p < 0.001$) in all months but February ($p = 0.12$). Whiskers show a positive value of standard deviation

$p < 0.001$], and December [1.19 (2.19) *vs*. 0.6 (0.93) min, $p < 0.001$] (Fig. 4). shows the monthly distribution of the T2 interval. The arrival at the scene in 2020 was significantly delayed in all months, particularly at the end of the year. The average delay in arrival to the patient was almost 2,5 minutes in October [10.82 (7.29) *vs*. 8.35 (5.21) min, $p < 0.001$], over 4.5 minutes in November [12.1 (8.13) *vs*. 7.48 (4.48) min, $p < 0.001$] and reached over 5 minutes in December [12.91 (8.67) *vs*. 7.72 (4.68), $p < 0.001$]. The distribution of mean T3 interval in particular months of the year is presented in Figure 5. The mean time of reaching the ED was stable in the pre-pandemic period and stayed within 35–38 minutes. In 2020 the mean T3 interval was greater in every month but February [38.23 (14.65) *vs*. 37.72 (15.0) min, $p = 0.12$], however, the observed difference of means increased in the following months between pre-pandemic and pandemic period reaching over 10 minutes in December [48.51 (26.73) *vs*. 38.35 (15.56) min, $p < 0.001$].

Discussion

Presented results showed a decreased number of EMT interventions and delay in EMS response time during the COVID-19 pandemic in comparison to the pre-pandemic period. The prolonged response time was observed in all months regarding the time interval between dispatcher's call and the EMT departure as well as between EMT departure and arrival at the scene. The time between arrival to the patient and reaching the ED was also prolonged during the pandemic period in all months but February in comparison to the pre-pandemic period.

The pandemic was related to the increased number of emergency calls worldwide however, some studies in fact reported decreased volume of patients admitted to the EDs [5, 30, 31]. Nadolny et al. showed a decreased number of EMT interventions during the first three months of the pandemic in Poland, which is in line with our results [32]. The lowest number of EMT interventions was observed in April and May 2020. It should be noticed that in these months the total number of COVID-19 infections was very low, but still, very strict lockdown restrictions were introduced in Poland. Decreased volume of patients in this period might potentially be explained by social fear of contagion and therefore not seeking help. On the other hand, numerous studies reported that during the pandemic period the incidence of specific conditions, like out-of-hospital cardiac arrest increased [16–18, 20, 32].

All analyzed time intervals were significantly prolonged during the first year of the COVID-19 pandemic. Previous studies reported pandemic-related differences in time intervals mainly regarding conditions that particularly require time-depended EMS interventions e.g. cardiac arrest [10–23, 25, 26] or acute stroke [27]. Out-of-hospital cardiac arrest is related to low survival and requires high-quality cardiopulmonary resuscitation and intensive treatment as soon as possible to improve the outcome [33–36]. Ball et al. showed that every minute increase in the call-to-patient time was associated with a 13% lower chance of survival to hospital discharge in patients with out-of-hospital cardiac arrest [13]. The EMS response time, most frequently defined as the time interval between the emergency call and EMT arrival at the scene, was increased during the pandemic outbreak in the majority of studies regarding out-of-hospital cardiac arrest [10, 11, 13, 15–18, 20, 22, 25]. This observation could potentially be explained by an increased number of emergency calls, the need for more detailed dispatcher's interviews and gathering additional information about potential COVID-19 symptoms, and the need for EMT personnel to wear personal protective equipment [19, 28]. On contrary, data from the CARES registry [14], registry from Switzerland [12], and Bologna, Italy [23] showed no differences in time to EMT arrival between the pandemic and the pre-pandemic period. Interestingly, Nishiyama et al. reported even shorter median response time [6 min (5–8) *vs*. 7 min (6–9), $p < 0.001$] during the COVID-19 outbreak in the group of 1687 cardiac arrest patients [21]. The authors suggested traffic reduction due to lockdown as a potential explanation for this observation. Nevertheless, the meta-analysis of 18 studies performed by Bielski et al. showed that the COVID-19 pandemic was related to about a minute delay in EMS response in patients with out-of-hospital cardiac arrest (mean difference = –1.05; 95%CI: –1.54 to –0.56; $p < 0.001$) [28]. Our results showed not only that the time to the arrival at the patient was increased but also the time between EMT arrival and reaching the ED at the hospital. This time interval coveres medical procedures performed by the EMT at the scene as well as the time needed for transportation to the hospital. Prolonged time at the scene related to the pandemic was reported by Yu et al. [756.1 (289.7) seconds *vs*. 675.1 (245.5) seconds, $p < 0.001$] and Ahn et al. (19.0 min, IQR 17.0–23.0 *vs*. 17.0 min, IQR 14.0–20.5, $p < 0.001$), however in both studies the time interval of transportation to the hospital was similar to the pre-pandemic period [10, 26]. In the study by Fothergill et al. time between the emergency call and EMT arrival at the hospital with a patient who suffered from out-of-hospital cardiac arrest was significantly increased in 2020 (86.4 min *vs*. 74.4 min, $p < 0.001$). Wearing personal protective equipment and the need for more cautious actions due to contagion risk could potentially be related to observed delay after the arrival at the scene.

The increased EMS response time was observed in all months of the year 2020 in comparison to the corresponding months during the pre-pandemic period. The highest differences in mean time intervals were observed at the end of the year (October–December), which overlapped with the peak of the second wave of the COVID-19 pandemic in Poland [37]. A similar observation was made regarding cardiac arrest patients in the United States. Glober et al. showed prolonged EMS response time during 2020 in all months but June in comparison to 2019 [17].

Prolonged EMS response time might be an indirect determinant of system efficiency. Increased stress and anxiety level among EMS personnel could also be related to observed delays. Despite the demonstrated resilience in difficult working conditions during the first year of the COVID-19 pandemic, major concerns about future challenges remained among the EMS personnel [38].

Presented analysis has some limitations that require remarks. The major limitation of the study is the retrospective character of the analysis. Secondly, no information regarding the reason for EMT intervention

was provided. However, the analysis focused on the EMS response time, which should be reduced to the necessary minimum regardless of the emergency call reason to provide the highest quality of care. Thirdly, the study period was relatively short and limited to one EMS station. Therefore, further research is required to investigate the impact of COVID-19 on the functioning of the EMS system.

Conclusions

During the first year of the COVID-19 pandemic, the number of EMT interventions decreased with the lowest number observed in April and May. The EMS response was prolonged in 2020 in comparison to the two-year pre-pandemic period. The highest differences regarding time intervals were observed at the end of the year (October–December), which overlapped with the peak of the second wave of COVID-19 infections in Poland.

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