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# Analysis of the Intervention of Emergency Medical Teams in Lodz in 2020

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**Natalia Skorzycka**[1]
https://orcid.org/0009-0004-5647-6427

**Agata Kunert**[1]
https://orcid.org/0000-0002-5392-9548

**Jan Krakowiak**[1]
https://orcid.org/0000-0002-3435-9658

**Dominika Cichońska-Rzeźnicka**[1]
https://orcid.org/0000-0001-8623-4307

[1] Department of Social Medicine, Medical University of Lodz, Poland

**Address for correspondence**

Natalia Skorzycka
Department of Social Medicine
Medical University of Lodz
4 Tadeusza Kościuszki St.
90-419 Lodz, Poland
natalia.skorzycka@gmail.com

## *Abstract*

***Background:*** *The main task of the State Medical Rescue System is to provide assistance to every person who faces a sudden health emergency or threat to life. This is provided through Medical Rescue Teams, the analysis of which will allow us to take a closer look at their characteristics and indicate possible areas for improvement.*

***Objectives:*** *The purpose of this study is to research the functioning of Medical Rescue Teams in Łódź in 2020, including determining the number, type, reasons and legitimacy of interventions, and detailing the characteristics of patients, place of events, time of departure, time of arrival at the scene and the number and type of trips.*

***Material and methods:*** *The material consists of 72,749 trips carried out by Medical Rescue Teams in Łódź in 2020. The obtained results were statistically analyzed using the Statistica v. 13.3 program, where the $\chi 2$ test was used to determine the relationship between the variables. A significance level of $p<0.05$ was assumed. The statistical analysis shows that 72,749 trips were carried out by Medical Rescue Teams in Łódź in 2020, 89% of which were "P" type, and 11% "S" type.*

***Results:*** *Most of the interventions (emergency callouts) were visits to women and to the elderly (those in the 60+ age category). Teams were usually dispatched in the departure urgency code "1". The most common places to which emergency teams were sent were patients' homes and public places. Ambulances were more often called for patients who were not in a state of emergency than for those who were. The most common reasons for requesting help were symptoms, disease features, cardiovascular diseases, injuries and poisonings.*

***Conclusions:*** *Noting the high percentage of calls to patients who did not have a sudden threat to life or health – educational activities should be carried out to promote and increase awareness of the reasons for calling emergency medical teams.*

## Introduction

One of the most important tasks of the state is to care for people facing a sudden health emergency or threat to life. The entity responsible for this is the State Medical Rescue System (PRM). Quickly providing assistance in the case of a sudden health threat increases the patient's chances of survival. The patient is transported with qualified professionals who maintain and stabilize basic life functions and implement adequate rescue procedures (e.g. fluid therapy, anti-shock treatment, pharmacological treatment) until the patient reaches the hospital emergency department (ER), at which point the patient is provided with further medical services. In order to determine the indications for admission of a patient to a specialist center, emergency medical teams also use telemedicine solutions for teletransmission of data (e.g. ECG or ultrasound) to the destination hospital, where the results are sent to the doctor on duty, who immediately decides whether the patient has to undergo a life-saving procedure [1, 2, 3, 4].

The development of the State Medical Rescue system was a multi-stage process. Ideas for its implementation were based on the experiences of other countries. A milestone was the adoption on July 25, 2001, of the first law on State Medical Rescue. After analyzing many ideas, the President signed the current Act of 8 September 2006 on the State Medical Rescue Service, which defines the composition of the system:

- medical rescue teams (ZRM) – land (ambulances), air (Polish Medical Air Rescue) and water,
- hospital emergency departments [5, 6, 7, 8, 9].

There is also a second division of the PRM system, which includes government administration bodies, i.e., the Ministry of Health and voivodes. These bodies are responsible for organizing, coordinating, planning and supervising the performance of the system's tasks, and partly for financing the system's units [9, 10].

Basic and specialist emergency medical teams, when providing medical assistance to a patient with very poor health, are only able to maintain his or her basic life functions. In this case, the patient must be taken to a hospital

emergency department or trauma center as soon as possible. The time frame in which the appropriate unit of the system should be delivered to the patient is set out in the Act on State Medical Rescue. The main assumption regarding the time of arrival at the scene of the incident are the following criteria: in a city with up to 10,000 inhabitants, the time of arrival should not exceed 15 minutes, and outside the city, it should not exceed 20 minutes. The factor that has the greatest impact on extending the time is the topography of the area – mountains, large cities or water reservoirs can complicate the access of the emergency medical team to the patient. In such a situation, the Helicopter Emergency Medical Service (HEMS) is called [10, 11, 12, 13, 14, 15].

There are clearly defined indications for calling the Air Rescue Service as a State Medical Rescue unit, e.g., cardiac arrest, acute coronary incident, stroke or cardiogenic shock. The service is available for incidents that require the urgent intervention of emergency medical teams, but it is also used due to logistical reasons, taking into account any circumstances which might delay the arrival of the ambulance, an insufficient number of medical personnel and the estimated time of the patient's arrival to hospital if facing a sudden threat to life [16, 17, 18, 19].

The medical rescue teams include:

- a basic team consisting of two persons with the right to provide medical rescue activities,
- a specialist team with at least three persons authorized to perform medical rescue activities, i.e., a system doctor, a system nurse or a paramedic [20].

The team must have an appropriate mode of transport, but the regulations do not specify the requirements for the driver. This person may be an additional member of the team with a license to drive an emergency vehicle, or it may be one of the rescuers [4, 20].

## Material and methods

The tests were carried out at the Provincial Medical Rescue Station in Łódź from October 4, 2021, to May 31, 2022. A report was created containing data

from medical rescue team departure order cards and medical rescue activity cards. The obtained results were statistically analyzed using the Statistica v. 13.3 program, where the $\chi 2$ test was used to determine the relationship between the variables. A significance level of $p<0.05$ was assumed. Access to the Reporting Module and the Analyst Module of the Command Support System of the State Medical Rescue System was used for the research, from which the "ZRM-5" Report was generated. Further analyses were carried out on the basis of the report. The material consisted of 72,749 trips carried out by Medical Rescue Teams in Łódź in 2020.

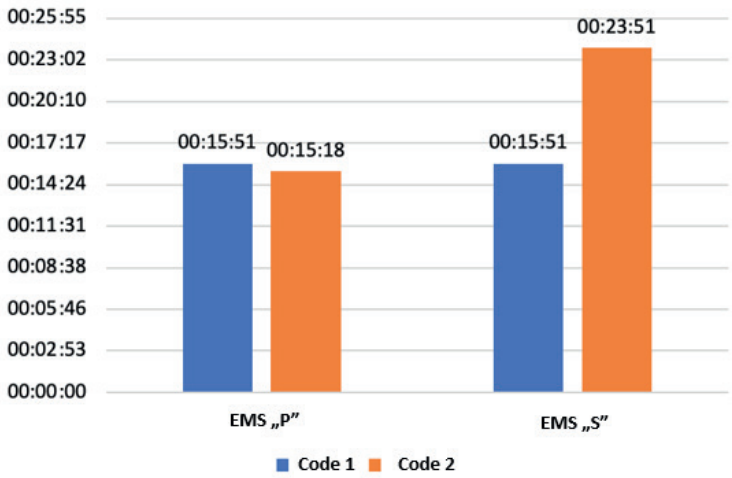
## Results

In 2020, 72,749 trips were carried out by Medical Rescue Teams in Łódź, 89% (64,408) by basic EMS and 11% (8,341) by specialized EMS. Among the interventions of Medical Rescue Teams, 91% were orders in code "2", while the remaining 9% were orders in code "1". Basic Medical Rescue Teams traveled more often in code "2" (89%), while Specialized Medical Rescue Teams traveled more often in code "1" (63%). A statistically significant relationship was found between the type of EMS and the assigned departure urgency code ($\chi 2= 13942.6$, $p=0.0000$). Most interventions were called, firstly, for incidents at patients' homes (71%), secondly, for those in public places (16%), and thirdly for incidents in street and road traffic (3%). On the other hand, the least common interventions were for incidents in agriculture (0.3%). Seven percent % of all interventions did not contain information about the place of the event. EMS interventions were more often made in code "2" for 6 out of 7 categories of place, most commonly those at school (90%); however, in incidents in street and road traffic, interventions in code "1" were more prevalent (66%).Statistical analysis showed that the departure urgency code depended on the place of the event ($\chi 2=3480.576$, $p=0.0000$). The largest number of trips made by Specialized Medical Rescue Teams were for incidents in street and road traffic (22%), and the least for incidents in agriculture (4%) and school (6%). In the case of Basic Medical Rescue Teams, most interventions were carried out for events in agriculture (96%), and the least for incidents in

street and road traffic (78%). The examined variables – the place of the event and the type of EMS – are statistically dependent ($\chi 2=261.2001$, $p=0.0000$). The division of patients by gender was as follows: women predominated, accounting for 65%, while men accounted for 35%. The distribution of patients by age group was as follows: most interventions were for patients aged 70–79 (17.6%), 60–69 (17.3%) and 80–89 (16.4%). The fewest interventions were for patients in the age group 0–9 years (1.9%), 10–19 years (2.5%) and 90–99 years (5.6%). Among all interventions, there were also those where the patient's age was not specified (1.4%). The largest number of interventions occurred in January, February and December, and the fewest in April and May. Most departures were on Saturdays (16.6%), with the fewest on Sundays (13.2%). On other days of the week, the number of trips was at a similar level. The time of EMS trips, taking into account the urgency code, was as follows: the statutory time was exceeded 71.57% in the case of trips in code "1", and 52.26% in code "2". Meanwhile, 25.74% of trips in code "1" and 44.61% in code "2" were completed on time. A statistically significant relationship was also found between the departure code and the time of departure of the ambulance to the patient ($\chi 2=1560.20$, $p=0.0000$).

The maximum time to reach the event site in a city with more than 10,000 inhabitants should not be longer than 15 minutes. The average time of arrival of the Basic Medical Rescue Teams in code "1" was 15 minutes and 51 seconds, and in code "2", 15 minutes and 18 seconds, while the average time of the "S" type EMS team in code "1" was 15 minutes and 51 seconds, and in code "2", 23 minutes and 51 seconds. The results are shown in graph 1.

Graph 1. Average time of arrival at the event site, broken down by departure urgency code and EMS type




Source: own elaboration.

During the EMS intervention, teletransmission was used for emergency patients in 83.06% of cases, and in the absence of an emergency in 16.94%. The use of data transmission is statistically significant with the occurrence of a state of emergency in patients ($\chi 2=138.3874$, $p=0.0000$). Basic Medical Rescue Teams used transmission more often than Specialist EMS. Out of 72,749 EMS trips, only 183 interventions were teletransmitted, while the remaining 72,566 trips took place without it. The most common reasons for patients calling the EMS were symptoms, disease features and abnormal results of clinical and laboratory tests not classified elsewhere (34.49%), cardiovascular diseases (13.92%), and injuries, poisoning and other specific effects of external factors (12.55 %). The exact distribution of diagnoses according to the International Statistical Classification of Diseases and Health Problems ICD-10 is presented in the table below.

Table 1. General diagnoses in EMS patients by ICD-10 category

| Categorization according to ICD-10 | N | % |
|---|---|---|
| Selected infectious and parasitic diseases | 200 | 0.27% |
| Cancers | 568 | 0.78% |
| Diseases of the blood and hematopoietic organs and selected diseases involving immunological mechanisms | 42 | 0.06% |
| Disorders of internal secretion, nutritional status and metabolic changes | 1061 | 1.46% |
| Mental and behavioral disorders | 3532 | 4.86% |
| Diseases of the nervous system | 1572 | 2.16% |
| Diseases of the eye and eye appendages | 26 | 0.04% |
| Ear and mastoid diseases | 76 | 0.10% |
| Cardiovascular disease | 10128 | 13.92% |
| Respiratory system diseases | 2071 | 2.85% |
| Diseases of the digestive system | 1023 | 1.41% |
| Diseases of the skin and subcutaneous tissue | 108 | 0.15% |
| Diseases of the musculoskeletal system and connective tissue | 818 | 1.12% |
| Diseases of the genitourinary system | 752 | 1.03% |
| Pregnancy, childbirth and postpartum period | 245 | 0.34% |
| Selected states beginning in the perinatal period | 18 | 0.02% |
| Congenital malformations, distortions and chromosomal aberrations | 2 | 0.00% |
| Symptoms, features and abnormal clinical and laboratory findings not otherwise classified | 25092 | 34.49% |
| Injuries, poisonings and other specific effects of external factors | 9127 | 12.55% |
| External causes of illness and death | 5120 | 7.04% |
| Factors affecting health and contact with health services | 5405 | 7.43% |
| Codes for special purposes | 450 | 0.62% |
| No data | 5313 | 7.30% |

Source: own elaboration.

Among all patients who were helped by Medical Rescue Teams, 40.44% were in a state of emergency, while the remaining 59.56% were not in such a state. Most often, a state of emergency occurred in the following age groups: 70–79 years (19.92%), 60–69 years (19.60%) and 80–89 years (18.04%).

The groups least often in a state of emergency were people aged 0–9 (1.98%) and 10–19 (2.13%). Among all interventions made by Medical Rescue Teams, 2.03% of patients died, most often among the age groups 60–69 (23.12%), 80–89 (22.24%) and 70–79 (21.83%). The most common causes of death among patients in the age group 60–69 were the following diagnoses: symptoms, signs and abnormal results of clinical and laboratory tests (72.61%), cardiovascular diseases (21.69%) and neoplasms (2.37%). The most common diagnoses among overall patients who died included: other sudden death of unknown cause (30.64%), unexpected death (23.05%), cardiac arrest (9.08%, cardiac arrest, unspecified (9.02%). COVID-19 accounted for 0.14% of all deaths. Among all EMS interventions in Łódź in 2020, 99.64% (72,486) ended with hospitalization of the patient, while in the case of 0.36% (263) trips the patient was refused admission to the hospital.

## Conclusions

1. Most interventions of the Medical Rescue Teams in Łódź in 2020 were carried out by EMS type "P".

   Eighty-nine percent of trips were carried out by the "P" type EMS (64,408 trips), while 11% of trips were carried out by the "S" type EMS (8,341 trips). In total, in 2020, there were 72,749 interventions by Medical Rescue Teams in Łódź. The difference in dispatching particular types of EMS resulted from the higher number of the "P" type EMS compared to the "S" type EMS.
2. Most trips to patients were carried out in urgency code "2".

   When analyzing the number of trips in urgency codes "1" and "2", it was found that interventions in code "2" were more prevalent, accounting for as many as 91% of trips, while the remaining 9% were carried out in urgency code "1".
3. Interventions of Specialized Medical Rescue Teams were characterized by calls in code "1".

   The results show that 63% of all trips of the "S" type EMS were in code "1", while only 11% of the "P" type EMS were in code "1".

4. Ambulances were most often called to events in public places and to patients' homes.

   The most common places where an intervention was requested were a patient's home (71%) and a public place (16%). On the other hand, incidents in street and road traffic accounted for only 3% of all EMS interventions.
5. Incidents in street and road traffic were more often assigned urgency code "1" than incidents in other locations.

   Street and road traffic is the only place where interventions in code "1" were more prevalent (66% of trips). EMS teams traveled to other places more often in code "2".
6. Specialist Medical Rescue Teams most often went to incidents in street and road traffic.
7. The results show that among all trips of the "S" type EMS, 22% were trips to incidents in street and road traffic. Among the patients who were helped, women predominated.

   The breakdown of EMS interventions by gender was as follows: 65% of trips were made to women and 35% to men.
8. The elderly constituted the largest group of patients.

   There was a regularity in the age of patients and the number of interventions, i.e., the largest number of interventions occurred in the age groups 70–79 years (17.6%), 60–69 years (17.3%) and 80–89 years old (16.4%); thus, age has an impact on the frequency of EMS visits.
9. In winter, the frequency of trips was higher.

   More trips were made in the winter months. Looking at the results, January, February and December can be considered as the period of the most frequent EMS interventions.
10. There were more EMS trips on Saturdays than on other days of the week.
11. The research results show a greater number of incidents on Saturdays (16.6%) than on other days of the week, but there was a similar number of incidents on each of those other days, with only minor differences. Trips in code "1" more often exceeded the statutory time.

12. The statutory time of departure (the time from accepting the call to the time of departure), should not be longer than 60 seconds in the case of code "1", and no more than 180 seconds in the case of code "2". However, 71.57% of trips in code "1" exceeded this time. Both the EMS type and the departure urgency code have a significant impact on the average time of EMS arrival at the event site.

    The average time to reach a patient in Łódź should not be longer than 15 minutes. In the case of Basic Medical Rescue Teams, the average time in code "1" was 15 minutes and 51 seconds, in code "2", 15 minutes and 18 seconds. For Specialized EMS in code "1" it was also 15 minutes and 51 seconds, but in code "2" it took much longer – 23 minutes and 51 seconds.
13. 1EMS members used the teletransmission of data more often when the patient was in a state of emergency.

    EMS uses teletransmission more often if it was an intervention for a patient in a state of immediate danger. During such interventions, data teletransmission was used in 83.06% of trips. When there was no emergency, teletransmission was not used in most of the interventions (59.67%).
14. Teletransmission was rarely used during interventions.

    Regarding the number of teletransmissions made, it can be concluded that 99.75% of trips did not use this option, whilst the remaining 0.25% of trips used this option.
15. The most common reasons for calling EMS were related to diagnoses concerning symptoms, disease features and abnormal test results, cardiovascular diseases, injuries and poisoning.

    Among EMS interventions, most were related to diagnoses concerning symptoms, disease features and abnormal clinical test results and laboratory tests (34.49%), cardiovascular diseases (13.92%), and injuries, poisoning and other specific effects of external factors (12.55%).
16. Ambulances were sent to non-emergency patients more often.

    A state of emergency was present in 40.44% of patients for whom help was called. On the other hand, trips to patients who did not have such a condition amounted to 59.56%.

17. Most deaths among patients occurred among the elderly.

    Most deaths occurred in patients aged 60–69 years, 80–89 years and 70–79 years, respectively. The most common diagnoses were those related to the categories of symptoms, disease features and abnormal results of clinical and laboratory tests, cardiovascular diseases, and cancer.

18. Trips to patients with COVID-19 accounted for 0.62% of all EMS trips in 2020 in Łódź.

    Among all 72,749 EMS trips, 420 interventions were carried out for patients diagnosed with COVID-19, which accounted for 0.62%.

## Discussion

As part of the State Medical Rescue System, in 2020 there were 1,581 emergency medical teams in Poland, of which 1,238 were basic and 343 specialized [21]. As in previous years, there was a decrease in the number of specialist teams with a simultaneous increase in the number of basic teams; this is evident in the results of the study which show the disproportion between the number of interventions of various types of ambulances. There were many more basic teams, a feature which was present in every voivodeship; this directly influenced the difference in the number of interventions of basic and specialist teams. In Łódź it was broken down as follows: trips carried out by the "P" team (89%) and by the "S" team (11%).

With regard to statistical data, in 2020, in Poland, on average, there were 71.9 ambulance trips per 1,000 inhabitants, while in Łódź, 107 interventions of Medical Rescue Teams were carried out per 1,000 inhabitants. The number of trips per 1,000 inhabitants of Łódź was higher than the average number of interventions in the Łódź Voivodeship, where assistance was provided to 70.1–80.1 persons per 1,000 inhabitants [21].

In the analyzed material, ambulances were most often called for incidents at the patients' home (71%), and in a public place (16%). According to data from the Central Statistical Office, Medical Rescue Teams in Poland carried out interventions at the following type of places: 77.9% at the patient's home,

15.6% in a public place. On the other hand, the share of calls to incidents in road and street traffic in Łódź was lower by 1.1% than the number of interventions in comparable places throughout the country. A large percentage of trips to patients' homes was certainly influenced by the COVID-19 pandemic, which imposed restrictions on movement in public places and isolated patients by the obligation to stay at home for the duration of the disease, as well as imposing home quarantine on their relatives [21].

According to the law, individuals entitled to use the help of Medical Rescue Teams are those facing a sudden threat to health or life. In 2020, the percentage of non-life-threatening EMS trips in Poland amounted to as much as 55.9%, while in Łódź it was 59.6% [21].

The population of Łódź as of December 31, 2020, was 679,941 inhabitants, of which over 370,000 were women. In 2020, 29.3% of deaths in the Łódź Voivodeship were caused by cardiovascular diseases, 18.5% of deaths were caused by cancer, and 6.3% of deaths were caused by respiratory diseases. There were 15.66 deaths per 1000 population. This is much higher than the average for Poland [21].

The high rate of hospitalization of patients (99.6%) indicates very effective work of the dispatchers, whose task is to manage EMS trips and approve the appropriateness of possible interventions. It also means that the condition of the patients to whom the ambulances were directed clearly indicated the need for hospitalization.

An important element that is responsible for the efficiency of the system's operation is the time of arrival of the team at the scene of an incident. The dispatcher can assign two urgency codes for the departure of the Medical Rescue Team:

- code 1, which means that the visit to the patient should take place immediately in the shortest time possible,
- code 2, where EMS departure is necessary.

Individual EMS urgency codes have specific maximum times of ambulance departure from the receipt of the notification: in the case of code 1, the time cannot be longer than 60 seconds, while in code 2, the time of departure cannot be longer than 180 seconds [22, 23]. In the analyzed material, only

25.74% of trips in code "1" and 44.61% in code "2" occurred within the required time. However, the average time it took for the Basic Medical Rescue Teams to arrive at the scene was 15 minutes and 51 seconds in code "1", and 15 minutes and 18 seconds in code "2", while EMS type "S" trips (for which the maximum time should be no longer than 15 minutes) took on average 15 minutes and 51 seconds in code "1", and 23 minutes and 51 seconds in code "2". This requires attention, but the times of departure and arrival depend on many variables – in 2020 this may have been due to the start of the COVID-19 pandemic, which involved the maintenance of many additional procedures.

Analyzing the gender of patients, a significant difference can be seen; in Łódź, women were more often provided with help (65%), whilst in the whole of the country, help was slightly more often given to men (50.8%). From the presented data, we can observe that patients over 60 years of age account for almost 57% of all EMS trips. To a large extent, this is related to the multimorbidity typical of elderly patients. Patients aged 70–79 (17.6%) account for the largest number of trips. These patients also have a high risk of polypharmacy and related adverse drug interactions. Comparing the age of patients who were provided services by emergency medical teams in Poland and Łódź, it can be observed that it did not differ significantly. In Poland, 4.5% EMS trips were to children and young people up to the age of 18, 48.5% were to people aged 18–64, and 47% were to people aged 65 or over. In Łódź, the age distribution of patients was similar. Another important reason for the large number of EMS trips to the 60–99 age group may have been due to emotional loneliness. Piotr Czekanowski's research has shown that 59.3% of the elderly aged 65–74 often feel lonely, and 22.1% aged 75 and older [21, 24]. Although it is not directly related to the health of patients, it is not an isolated case that elderly people call EMS because they feel lonely and want to get a little attention from ambulance workers. In addition, from the collected data, it can be observed that the largest number of EMS trips took place in the winter months – December – February. This is due to many different reasons. Firstly, it is a period of increased morbidity of patients, especially in the elderly, as more frequent infections contribute to the exacerbation of existing disease states of patients. It is also a period in which people suffer an increased

number of injuries and injuries caused by weather conditions. Regardless of the season, for several years the most common cause of ambulance calls has been cardiological diseases and heart problems. These concern hypertension, chest pain and myocardial infarction. Holidays occur during this period, when additional stress related to preparing for the festivities, fatigue, family meetings and travel exacerbate the cardiac symptoms in chronically ill people and others. With this information, we can better manage the busiest periods when the system is overloaded and fails to meet the statutory travel time. This will allow us to make the necessary personnel and logistical changes to make the rescue system more efficient and able to meet the requirements of an aging society that will present new challenges.

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