ELECTRONIC VERSION

# EMERGENCY MEDICAL SERVICE

## RATOWNICTWO MEDYCZNE

UTILIZATION OF POLISH HEMS FOR PATIENTS WITH OHCA

THE USE OF TRACTION SPLINTS IN THE EMTS IN POLAND

RESPIRATORY TRACT BURNS IN EMERGENCY MEDICAL CARE

PREHOSPITAL MANAGEMENT OF ACCIDENTAL HYPOTHERMIA

Vol. 7 | No 4 | 2020 October – December ISSN 2391-7822

Czasopismo jest beneficjentem programu
Ministra Nauki i Szkolnictwa Wyższego
„Wsparcie dla czasopism naukowych”

# EMERGENCY MEDICAL SERVICE

RATOWNICTWO MEDYCZNE

THE JOURNAL IS AFILIATED TO THE FACULTY OF HEALTH SCIENCES OF THE MEDICAL UNIVERSITY OF WARSAW

# PATRONAGES

Ministry of Science and Higher Education
Republic of Poland

*The Journal has been included in the register of journals published by The Polish Ministry of Science and Higher Education on July 31st, 2019 with 20 points awarded.*

*The journal Emergency Medical Service is financed under Contract No. 31/WCN/2019/1 by the funds of The Minister of Science and Higher Education.*

Copyright: **ALUNA PUBLISHING**
Z.M. Przesmyckiego 29
05-510 Konstancin-Jeziorna, Poland
tel. +48 604 776 311
a.luczynska@wydawnictwo-aluna.pl

**www.ems.edu.pl**

**Managing Editor**
Agnieszka Rosa
tel. +48 600 600 938
a.rosa@wydawnictwo-aluna.pl

# CONTENTS

Emerg Med Serv, 2020; VII, 4: 247-255

**DOI:** 10.36740/EmeMS202004101 **ORIGINAL ARTICLE**

# UTILIZATION OF AIR SUPPORT IN THE POLISH EMERGENCY MEDICAL SYSTEM FOR PATIENTS WITH OUT-OF-HOSPITAL CARDIAC ARREST

Stanisław Paweł Świeżewski[1,2], Daniel Rabczenko[3,4], Arkadiusz Wejnarski[5,2], Piotr Konrad Leszczyński[5], Patryk Rzońca[6,7], Marta Jarzębowska[4], Grzegorz Michalak[1,4], Adam Fronczak[8], Robert Gałązkowski[1,4]

1 DEPARTMENT OF EMERGENCY MEDICAL SERVICES, FACULTY OF HEALTH SCIENCE, MEDICAL UNIVERSITY OF WARSAW, WARSAW, POLAND
2 OPERATIONS CENTER, POLISH MEDICAL AIR RESCUE, POLAND
3 HEADQUARTERS, NATIONAL INSTITUTE OF PUBLIC HEALTH – NATIONAL INSTITUTE OF HYGIENE, WARSAW, POLAND
4 HEADQUARTERS, POLISH MEDICAL AIR RESCUE, WARSAW, POLAND
5 INSTITUTE OF HEALTH SCIENCES, FACULTY OF MEDICAL AND HEALTH SCIENCES, SIEDLCE UNIVERSITY OF NATURAL SCIENCES AND HUMANITIES, SIEDLCE, POLAND
6 DEPARTMENT OF EMERGENCY MEDICINE, FACULTY OF HEALTH SCIENCES, MEDICAL UNIVERSITY OF LUBLIN, LUBLIN, POLAND
7 HEMS CREW, HEADQUARTERS, POLISH MEDICAL AIR RESCUE, WARSAW, POLAND
8 DEPARTMENT OF PUBLIC HEALTH, FACULTY OF HEALTH SCIENCE, MEDICAL UNIVERSITY OF WARSAW, WARSAW, POLAND

**Abstract**

**The aim:** This study aimed to evaluate the utilization of air support in cases of OHCA in the Polish emergency medical system, in particular to assess the prevalence of return of spontaneous circulation (ROSC) and to determine the 30-day survival of patients.

**Material and methods:** A retrospective cohort study based on the analysis of aviation and medical records of all HEMS missions in 2014 was conducted. Patients' follow-up was traced using information from nationwide databases. The inclusion criterion for the study was both the disposal of HEMS to OHCA and the appearance of OHCA during the intervention.

**Results:** During the research period PMAR aircraft performed 8366 missions. The criteria for inclusion were met for 574 missions. Most often HEMS crews intervened in cases of OHCA in men and patients over 60 years old. In 58% of all cases OHCA has a cardiological background and the most common first rhythm was asystole. ROSC was obtained in 237 (41.2%) cases and 30-day survival was observed in 10.4% of patients in the study population.

**Conclusions:** The utilization of air support in the Polish emergency medical system has a positive impact on the pre-hospital phase of the therapeutic process of OHCA patients. The cooperation between GEMS and HEMS in OHCA cases in Poland allows obtaining ROSC and 30-day survival of patients at the level of countries with the well-developed emergency medical systems in the world.

**Key words**

out-of-hospital cardiac arrest, resuscitation, return of spontaneous circulation, Helicopter Emergency Medical Service

## INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) cases are a challenge for health care systems around the world, with high mortality rates and serious socio-economic consequences.

In Europe approximately 350.000 people suffer from out-of-hospital cardiac arrest every year. The survival rate for patients to discharge from hospitals globally is 6% and in Europe 10.7%. [1, 2]. In Poland the estimated number of OHCA is from 15.000 to 52.000 cases per year [3-5]. According to the data from the POL-OHCA register 26.783 cases of OHCA with cardiopulmonary resuscitation attempts by emergency services were reported in 2018 [6].

Factors that improve the prognosis for Sudden Cardiac Arrest (SCA) patients include early diagnosis of SCA, the earliest possible start of action by witnesses, early defibrillation, implementation of advanced resuscitation, and professional post-resuscitation care [7]. The first step in helping patients with OHCA is to try and get ROSC. The greatest impact on patient survival is primarily due to high-

quality chest compressions and early defibrillation for defibrillation rhythms (VF/pVT). The optimal way and extent of implementation of advanced resuscitation procedures are still under study [8, 9].

Despite the differences in the structure and organization of health care systems around the world, a common challenge and goal are to improve the quality and effectiveness of the therapeutic process for OHCA patients [3, 10, 11].

In many developed health care systems around the world helicopters are used as a backup and alternative to ground-based medical rescue teams [12]. The utilization of air support for the most severely affected patients brings measurable benefits in terms of increased survival, especially in rural and hard-to-reach areas [13].

In the Polish medical emergency system the key life-saving procedures are undertaken by two types of rescue teams: the basic one - P (consisting of paramedics) and the specialist one - S (with a doctor). The range of medical rescue procedures that can be undertaken by paramedics from P teams is wide and during the study period included cardiopulmonary resuscitation using advanced methods of airway management, defibrillation, and pharmacotherapy excluding the use of muscle relaxants and most catecholamines. All the activities mentioned above could be fully undertaken by S team members.

On the territory of Poland during the period of the research there were 17 permanent bases and 1 temporary base of the Polish Medical Air Rescue. One helicopter was stationed at each base. Its crew consisted of a pilot, a physician specializing in anaesthesiology or emergency medicine, and a paramedic (paramedic or a rescue nurse).

The decision to dispatch the HEMS is made by the medical dispatcher based primarily on the criterion of time of arrival at the scene of the incident or shortened time of transporting the patient to the proper hospital.

In the Polish medical emergency system in the case of OHCA the time of ambulances' readiness for departure is up to 60 seconds. The mean time of GEMS arrival of OHCA should not exceed 8 min in large cities and 15 min in small towns and rural areas [14]. Depending on the location of the base, air ambulances are ready for departure up to 3 or 6 minutes after being called by a dispatcher. The area of activity of PMAR is 16 voivodeships with a total population of about 38 million inhabitants. HEMS crews can reach almost any place in the country within 35 min of deployment.

## THE AIM

The study aimed to analyze the utilization of air support in cases of OHCA in the Polish medical emergency system, in particular to assess the prevalence of ROSC and to determine the 30-day survival of patients based on available nationwide databases.

This is the first Polish research on the utilization of HEMS in OHCA cases in which information on patients' follow-up was obtained.

## MATERIAL AND METHODS

A retrospective analysis of the medical and aeronautical records of all 8366 missions performed by PMAR aircraft between 1 January and 31 December 2014 was conducted. The criteria for inclusion in the study were the call to OHCA and the occurrence of OHCA in patients during interventions undertaken by HEMS crews on the scene and/or during transport to the hospital. Cases of OHCA caused both by trauma and by sudden illness were considered. The exclusion criteria were situations of cancellation of the HEMS by the dispatcher and missions where OHCA did not occur. Further analysis also excluded OHCA cases that occurred during inter-hospital transport.

Aerial data concerning HEMS missions were grouped in a database using Microsoft Excel (Microsoft Inc.). Information on patients' vital signs and medical emergency procedures was collected based on Utstein protocol recommendations and grouped in a Microsoft Excel database (Microsoft Inc.).

Statistical analysis of the collected data was carried out using STATISTICA version 13.2 software (StatSoft, Cracow, Poland). For quantitative data measures of central tendency were determined, including median, mean (M), standard deviation (SD), and interquartile range (IQR). Quantity (n) and percentage (%) were used to describe qualitative data. The Shapiro-Wilk normality test was used to verify the normality of variable distribution. Chi2 test was used to assess differences between qualitative variables, while nonparametric Mann-Whitney's U test was used to investigate differences between two independent groups. The significance level $P < 0.05$ was assumed.

An unsuccessful attempt was made to obtain information about the survival of the examined group of patients to be discharged from the hospitals based on the data from the Research on General Hospital Diseases conducted by the Institute–Center for Monitoring and Analyses of the Population's Health at the National Institute of Public Health – National Institute of Hygiene (NIPH – NIH). NIPH – NIH data do not contain information that would make it possible to identify individuals (such as the PESEL identity

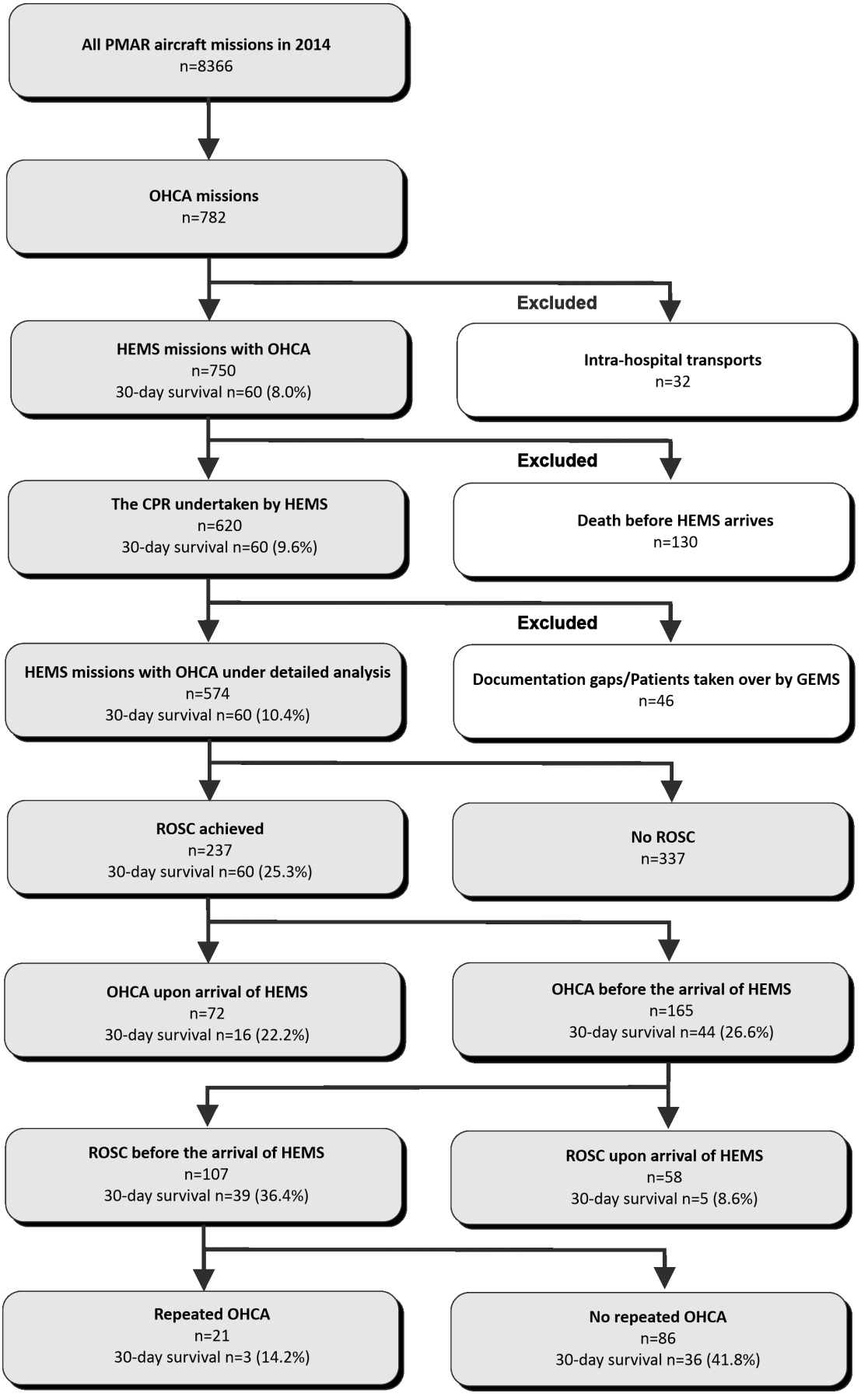


Fig. 1. Summary of HEMS missions to OHCA patients with 30-day survival for each group. Abbreviations: CPR – cardiopulmonary resuscitation, GEMS – ground emergency medical services, HEMS – helicopter emergency medical services, OHCA – out-of-hospital cardiac arrest, PMAR – Polish Medical Air Rescue, ROSC – return of spontaneous circulation.

number). The records were used jointly using the information on the region of the hospital location, the diagnosis, the patient's gender, and date of birth.

Further fate of patients after transfer to hospitals was verified using data from the national PESEL database containing information about the date of death or time of finding the body. With the date of OHCA a 30-day survival in the study population was determined. The data were made available by the Ministry of Digital Affairs on the request of the authors.

Due to the retrospective nature of our research, the approval of the bioethics committee was not required.

## RESULTS

### MISSIONS

During the study period the PMAR aircraft performed 8366 missions. OHCA occurred in 782 (9.3%) patients. 481 missions were carried out as a result of emergency calls, 269 were flights to accidents, and 32 times SCA occurred during inter-hospital transports. In 135 cases the HEMS team was the first to assist at the scene.

The criteria for inclusion in the study were met by 574 patients in whom OHCA occurred during the HEMS mission (Fig. 1).

In the analyzed population the majority were men (77.0%), and the average age of all respondents was 55.4 years. The most frequent causes of OHCA occurred in the group of patients aged 60-69 years (22.4%) and under 40 years (22.2%). HEMS crews in the vast majority of cases were available to assist GEMS (86.9%). More than half of all analyzed patients suffered from cardiac OHCA (58.0%) and the most common initial rhythm was asystole (44.9%) (Table 1).

### RESPONSE TIME

During the described period the median time of arrival of the HEMS team at the scene of the event

| **Gender** | **n (%)** | **ROSC (%)** | **Statistical analysis** |
|---|---|---|---|
| Female | 132 (23.0) | 45.4 | $\chi2 = 1.2269$<br>$P = 0.26$ |
| Male | 442 (77.0) | 40.0 | |
| **Age (years)** | **M (SD)** | **ROSC (%)** | $Z = 2.9243$<br>$P = 0.003$ |
| Mean | 55.48 (20.8) | 41.2 | |
| **Age (years)** | **n (%)** | **ROSC (%)** | |
| <40 | 118 (22.2) | 45.7 | |
| 40 – 49 | 54 (10.1) | 42.5 | |
| 50 – 59 | 98 (18.4) | 50.0 | $\chi2 = 13.9338$<br>$P = 0.01$ |
| 60 – 69 | 119 (22.4) | 40.3 | |
| 70 – 79 | 78 (14.7) | 24.3 | |
| 80+ | 63 (11.8) | 36.5 | |
| **First on scene** | **n (%)** | **ROSC (%)** | |
| HEMS | 75 (13.0) | 21.3 | $\chi2 = 14.1729$<br>$P < 0.001$ |
| GEMS | 499 (86.9) | 44.2 | |
| **Etiology** | **n (%)** | **ROSC (%)** | |
| Cardiac | 333 (58.0) | 57.0 | $\chi2 = 103.4803$<br>$P < 0.001$ |
| Trauma | 134 (23.3) | 32.8 | |
| Other | 107 (18.6) | 2.8 | |
| **First ECG rhythm** | **n (%)** | **ROSC (%)** | |
| Asystolia | 258 (44.9) | 12.7 | |
| PEA | 79 (13.7) | 31.6 | |
| VT/VF | 40 (6.9) | 32.5 | $\chi2 = 248.1800$<br>$P < 0.001$ |
| Bradycardia/Block AV | 8 (1.3) | 87.5 | |
| Sinus rhythm | 134 (23.3) | 85.8 | |
| Tachyarithms | 44 (7.6) | 88.6 | |
| Unknown | 11 (1.9) | 45.4 | |

Table 1. Characteristics and return of spontaneous circulation in the studied population.
Abbreviations: AV – atrioventricular, ECG – electrocardiographic, PEA – pulseless electrical activity, VF – ventricular fibrillation, VT – ventricular tachycardia, others, see Figure 1.

was 21 minutes (IQR 18-26 min). The median time of medical emergency procedures (from arrival to handover in hospital) was 50 minutes (IQR 41-64 min). The median time for the entire HEMS team intervention from dispatch to referral to the appropriate therapeutic facility was 74 minutes (IQR 62-89 min).

### EMERGENCY MEDICAL PROCEDURES

Sedation and relaxants were used by HEMS crews in 42 (17.7%) patients, the sedation itself was carried out in 50 (21.0%) cases, and 5 (2.1%) victims only required relaxation after previous sedation by GEMS crews.

HEMS crews performed intubation in 94 (39.6%) cases, of which 9 (3.7%) times in helicopter. Out of 143 (60.3%) patients in whom the airways were instrumentally secured by GEMS, in 24 (10.1%) cases the airway protection had to be changed. The HEMS crews then performed reintubation (14 patients), reintubation with a change in the tube diameter (9 patients), intubation after previous laryngeal mask placement (1 patient).

Mechanical ventilation was performed by HEMS crews in 166 (70.0%) patients.

In 30 (12.6%) cases the PMAR staff performed defibrillation, 7 (2.9%) of them were on board a helicopter.

Among other emergency medical procedures that may be crucial for the survival of the patients the HEMS crews performed: pneumothorax decompression in 8 cases, an intraosseous puncture in 4 cases, percutaneous electrostimulation in 4 cases, hemorrhaging containment using haemostatic dressings in 3 cases, electric cardioversion in 1 case and introduction to therapeutic hypothermia in 1 case (during the study period only one helicopter had the necessary equipment to perform the above procedure).

| Variables | | | 30-day survival (%) | Statistical analysis |
|---|---|---|---|---|
| **Gender n (%)** | | | | |
| | Female | 59 (24.8) | 27.1 | $\chi2 = 0.1349$<br>$P = 0.71$ |
| | Male | 178 (75.1) | 24.7 | |
| **Age (years) n (%)** | | | | |
| | <40 | 54 (22.7) | 22.2 | |
| | 40 – 49 | 23 (9.7) | 34.7 | |
| | 50 – 59 | 70 (29.5) | 21.4 | $\chi2 = 9.1451$<br>$P = 0.10$ |
| | 60 – 69 | 48 (20.2) | 22.9 | |
| | 70 – 79 | 19 (8.0) | 15.7 | |
| | 80+ | 23 (9.7) | 47.8 | |
| **First on scene n (%)** | | | | |
| | HEMS | 16 (6.7) | 25.0 | $\chi2 = 0.0009$<br>$P = 0.97$ |
| | GEMS | 221 (93.2) | 25.3 | |
| **Etiology n (%)** | | | | |
| | Cardiac | 192 (81.0) | 22.9 | $\chi2 = 3.0800$<br>$P = 0.07$ |
| | Trauma | 45 (18.9) | 35.5 | |
| **First ECG rhythm n (%)** | | | | |
| | Asystolia | 33 (14.2) | 33.3 | |
| | PEA | 28 (12.0) | 21.6 | |
| | VT/VF | 15 (6.4) | 26.2 | $\chi2 = 1.9289$<br>$P = 0.85$ |
| | Bradycardia/Block AV | 7 (3.0) | 14.2 | |
| | Sinus rhythm | 115(49.5) | 24.3 | |
| | Tachyarithms | 34 (14.6) | 23.5 | |
| **ROSC before the arrival of HEMS n (%)** | | | | |
| | Yes | 107 (45.1) | 36.4 | $\chi2 = 12.7855$<br>$P < 0.001$ |
| | No | 130 (54.8) | 16.1 | |

Table 2. 30-day survival analysis for selected variables.
Abbreviations: see Figure 1 and Table 1.

### ROSC AND 30-DAY SURVIVAL

Statistical analysis showed the relationship between the return of spontaneous circulation and the age of patients, the type of the first team at the scene, etiology of cardiac arrest and initial heart rhythm ($p < 0.05$). ROSC in the studied group of patients was more often achieved when the HEMS team was called to help GEMS (44.2%), in cases of cardiac origin of OHCA (57.0%) and when the initial rhythm of OHCA was defibrillation rhythm (32.5%). Moreover, the analysis showed that the younger the patient was, the higher percentage of ROSC was achieved (Table 1).

An attempt to correlate the data from the PMAR database with those from the NIH-PZH database resulted in matching only 54/237 (22.8%) records, which made reliable statistical conclusions impossible.

The at least 30-day survival of patients in the studied population was calculated based on data from the PESEL database of the Ministry of Digital Affairs. The results were 158/237 (66.7%) of compatible records. For further statistical analysis it was assumed that the remaining 79 (33.3%) patients did not survive 30 days after primary OHCA.

The statistical analysis did not show the relationship between 30-day survival and gender, age of patients, type of the first team on site, etiology of cardiac arrest and initial heart rhythm ($p > 0.05$).

However, a correlation was found between the 30-day survival of patients and the time of ROSC occurrence. Patients who received ROSC before the arrival of HEMS were more likely to survive 30 days after the onset of OHCA (36.4% vs 16.1%) than patients who received ROSC after the arrival of air support (Table 2).

## DISCUSSION

In our study we found that:

1. HEMS in Poland is mainly used as a support for GEMS teams;
2. medical emergency procedures performed by HEMS crews fall within and often go beyond the scope of medical emergency procedures provided by paramedic GEMS, which may be crucial for the survival of patients;
3. HEMS missions to OHCA represent a much higher percentage of all missions than GEMS;
4. the presence of primary and secondary OHCA on board a helicopter justifies equipping the HEMS with mechanical chest compression devices;
5. the effective collaboration of GEMS and HEMS in the Polish emergency medical system results in a high percentage of ROSC on the scene and a high percentage of 30-day survival of patients with OHCA.

Studies carried out in Norway and the UK indicated that the greatest benefit from air support was obtained by patients who achieved ROSC before the arrival of HEMS at the scene of the incident [15, 16]. Our study confirms this trend.

In the studied population 30-day survival was most often observed in patients who received ROSC before the arrival of HEMS. However, in the Polish medical emergency system there are situations when the HEMS team is the first team to provide medical emergency procedures in patients with OHCA. In the studies cited above such a situation occurred very rarely (Skogval) or not at all (Lyon and Nelson). It should also be noted that in the study of Skogvoll et al. and Lyon and Nelson the patients who first had OHCA in the presence of HEMS crews were excluded from the study population [15, 16]. In our study we observed that a large number of critically ill patients received the life-saving procedures at the scene and were transported to hospitals despite OHCA after the arrival of the HEMS team.

Although the majority of OHCA patients have been secured by GEMS that perform emergency medical procedures at the Advanced Life Support level, HEMS crews have performed numerous early critical care interventions that may be critical for patient survival. The most important activities carried out by HEMS personnel included intubation and mechanical ventilation, sedation, relaxants, cardioversion, electrostimulation, intraosseous puncture, decompression of pneumothorax, and haemorrhage control using haemostatic dressings (not available during the study period in the GEMS). The influence of the above mentioned early critical care intervention on patients' survival requires further research.

Publications by Taylor et al. and Gerritse et al. on the utilization of air support indicate a significant and, in pediatric patient situations, the key role of HEMS crews as support for GEMS teams [17, 18].

The conclusions of the large prospective Sunde team study are similar to our observations on instrumental airway management in patients with OHCA [19]. In difficult intubations the presence of high experienced HEMS medical crews enables proper airway management and effective ventilation of patients with OHCA. Our study showed that HEMS teams frequently corrected the airway control in patients already treated by GEMS.

Research by Freshwater et al. points to another important aspect of using air support. HEMS crews can transport patients in critical condition to remote specialist hospitals bypassing small regional facili-

ties, which is of great importance for patients after OHCA [20].

Rzońca et al. demonstrated that HEMS calls to OHCA represented 5.4% of all missions [21]. In the Lyon and Nelson research this type of mission constituted 11% of all rescue flights performed [16]. Our study showed that such interventions of HEMS crews concerned 8.9% of all missions performed. GEMS interventions in patients with OHCA represented a much smaller percentage of all interventions. A study by Nadolny et al. and Gach et al. showed that only 0.6% and 1.1% of the calls were related to GEMS crews undertaking CPR [5, 6]. The relatively frequent CPR and the continuous training process of HEMS crews allow us to be ready to provide the highest quality of early critical care interventions for OHCA patients.

The publication of Havel et al. did not show significant differences in CPR on board ambulance and rescue helicopter [22]. On the other hand, Putzer's and Fortie's studies demonstrate the effectiveness of mechanical chest compressions in cases of prolonged OHCA on board helicopters [23, 24]. Our study showed that the first and second OHCA on board PMAR helicopters took place in over 12% of patients in the research population. During the study HEMS crews were not equipped with mechanical chest compression devices. Preliminary results of our study were used in the decision-making process and in June 2018 all PMAR helicopters were equipped with such devices.

A large nationwide study by Rzońcy et al. showed that during 6 years of the HEMS mission to patients with OHCA in Poland, ROSC was achieved at 54.8% of the studied population [21]. The results of a 10-year study by Skogvoll et al. concerning the utilization of air support in OHCA, ROSC was obtained in 21.9% of cases and 8.5% of patients survived to discharge from the hospital [15]. In the study by Lyon and Nelson, ROSC was obtained in 39.0% of resuscitated patients and 6.3% of the studied population survived to discharge [16]. Our study showed that during the mission to OHCA patients ROSC was obtained in 41.2% of patients, and 30 days after OHCA 10.4% of patients survived.

The presented results confirming the high effectiveness of cooperation between GEMS and HEMS in OHCA cases in the Polish emergency medical system are comparable with national (ROSC 36.3% and 30.4%) [6, 25], European (ROSC 33%, survival to hospital discharge 8.0%) [26] and global reports (survival to hospital discharge/30-day survival: USA 10.5%, Australia 11.0%, New Zealand 13.8%, Canada 9.4%) [27].

## STUDY LIMITATIONS

The presented study has several limitations. First of all, it was not possible to follow the whole therapeutic process of the majority of the studied population. The retrospective nature of the study requires high-quality medical documentation, and in the absence of a publicly accessible national OHCA database, it proved impossible to access much of the information.

The issue of optimal utilization of HEMS in the therapeutic process of OHCA patients requires further research. This should be a prospective study with high-quality medical records.

## CONCLUSIONS

The vast majority of PMAR helicopters are dispatched in support of the GEMS teams present on the scene. In cases where there is no ambulance or OHCA patients is in a difficult to reach location, the utilization of HEMS shortens the arrival time of medical services and accelerates the implementation of medical emergency procedures. HEMS crews perform numerous early critical care interventions within and beyond the scope of paramedic GEMS teams, which can have a key impact on the survival of OHCA patients. Due to the occurrence of first and second OHCA in patients on board helicopters, mechanical chest compression devices are an important piece of medical equipment. By using air support as one of the elements of the therapeutic process of OHCA patients, 10.4% of them survived more than 30 days after the occurrence of OHCA. The percentage of 30-day survival is higher among patients who achieved ROSC before the arrival of HEMS.

To better understand and research OHCA cases, not only in terms of utilising air support in the therapeutic process, it seems necessary to create a nationwide OHCA registry covering both the pre-hospital and hospital phases of the diagnostic and therapeutic process.

## REFERENCES

1. Grasner JT, Bossaert L. Epidemiology and management of cardiac arrest: what registries are revealing. Best Pract Res Clin Anaesthesiol. 2013;27:293-306.
2. Atwood C, Eisenberg MS, Herlitz J, Rea TD. Incidence of EMS-treated out-of-hospital cardiac arrest in Europe. Resuscitation. 2005;67:75-80.

3. Gräsner JT, Lefering R, Koster RW, et al. EuReCa ONE-27 Nations, ONE Europe, ONE Registry: A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe. Resuscitation. 2016;105:188-195.
4. Nadolny K, Gotlib J, Panczyk M, et al. The epidemiology of sudden cardiac arrest in prehospital care in the area of the silesian voivodeship. Wiad Lek. 2018;71:193-200. [in Polish]
5. Gach D, Nowak JU, Krzych ŁJ. Epidemiology of out-of-hospital cardiac arrest in the Bielsko-Biala district: a 12-month analysis. Kardiol Pol. 2016;74:1180-1187.
6. Nadolny K, Zyśko D, Obremska M, et al. Analysis of out-of-hospital cardiac arrest in Poland in a 12-month period: data from the Polish POL-OHCA registry. Kardiol Pol. 2020; 78:404-411.
7. Soar J, Nolan JP, Böttiger BW, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 3. Adult advanced life support. Resuscitation. 2015;95:100-147.
8. Callaway CW, Soar J, Aibiki M, et al. Part 4: Advanced life support: 2015 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Circulation. 2015; 132: 84-145.
9. Nolan JP. Optimizing outcome after cardiac arrest. Curr Opin Crit Care. 2011;17: 520-526.
10. von Vopelius-Feldt J, Powell J, Morris R, Benger J. Prehospital critical care for out-of-hospital cardiac arrest: An observational study examining survival and a stakeholder-focused cost analysis. BMC Emerg Med. 2016;16:47.
11. Monsieurs KG, Nolan JP, Bossaert LL, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 1. Executive summary. Resuscitation. 2015;95:1-80.
12. Taylor CB, Stevenson M, Jan S, et al. A systematic review of the costs and benefits of helicopter emergency medical services. Injury. 2010;41:10-20.
13. Ringburg AN, Thomas SH, Steyerberg EW, et al. Lives saved by helicopter emergency medical services: an overview of literature. Air Med J. 2009;28:298-302.
14. The Act of September 8, 2006 on the State Emergency Medical Services. Journal of Laws of 2006: nr 191, Item 1410, as amended. [in Polish]
15. Skogvoll E, Bjelland E, Thorarinsson B. Helicopter emergency medical service in out-of-hospital cardiac arrest, a 10-year population-based study. Acta Anaesthesiol Scand. 2000;44: 972-979.
16. Lyon RM, Nelson MJ. Helicopter emergency medical services (HEMS) response to out-of-hospital cardiac arrest. Scand J Trauma Resusc Emerg Med. 2013;21:1.
17. Taylor CB, Liu B, Bruce E, et al. Primary scene responses by Helicopter Emergency Medical Services in New South Wales Australia 2008-2009. BMC Health Serv Res. 2012;12:402.
18. Gerritse BM, Schalkwijk A, Pelzer BJ, et al. Advanced medical life support procedures in vitally compromised children by a helicopter emergency medical service. BMC Emerg Med. 2010;10:6.
19. Sunde GA, Heltne JK, Lockey D, et al. Airway management by physician-staffed Helicopter Emergency Medical Services - a prospective, multicentre, observational study of 2,327 patients. Scand J Trauma Resusc Emerg Med. 2015;23:57.
20. Freshwater ES, Dickinson P, Crouch R, et al. Extending access to specialist services: the impact of an onsite helipad and analysis of the first 100 flights. Emerg Med J. 2014;31:121-125.
21. Rzońca P, Gałązkowski R, Panczyk M, Gotlib J. Polish Helicopter Emergency Medical Service (HEMS) Response to Out-of-Hospital Cardiac Arrest (OHCA): A Retrospective Study. Med Sci Monit. 2018;24:6053-6058.
22. Havel C, Schreiber W, Riedmuller E, et al. Quality of closed chest compression in ambulance vehicles, flying helicopters and at the scene. Resuscitation. 2007;73:264-270.
23. Putzer G, Braun P, Zimmermann A, et al. LUCAS compared to manual cardiopulmonary resuscitation is more effective during helicopter rescue-a prospective, randomized, cross-over manikin study. Am J Emerg Med. 2013;31:384-389.
24. Forti A, Zilio G, Zanatta P, et al. Full recovery after prolonged cardiac arrest and resuscitation with mechanical chest compression device during helicopter transportation and percutaneous coronary intervention. J Emerg Med. 2014;47:632-634.
25. Cebula GM, Osadnik S, Wysocki M, et al. Comparison of the early effects of out-of- hospital resuscitation in selected urban and rural areas in Poland. A preliminary report from the Polish Cardiac Arrest Registry by the Polish Resuscitation Council. Kardiol Pol. 2016;74:356-361.

26. Gräsner JT, Wnent J, Herlitz J, et al. Survival after out-of-hospital cardiac arrest in Europe - Results of the EuReCa TWO study. Resuscitation. 2020;148:218-226.
27. Kiguchi T, Okubo M, Nishiyama C, et al. Out-of-hospital Cardiac Arrest across the World: First Report from the International Liaison Committee on Resuscitation (ILCOR). Resuscitation. 2020;152:39-49.

**ORCID AND CONTRIBUTIONSHIP** *

Stanisław Paweł Świeżewski – 0000-0001-9665-2182 A, B, C, D, F
Daniel Rabczenko – 0000-0002-9746-2003 C, F
Arkadiusz Wejnarski – 0000-0003-1454-6664 B, F
Piotr Konrad Leszczyński – 0000-0002-3408-3591 D, F
Patryk Rzońca – 0000-0001-7008-1721 C, F
Marta Jarzębowska – 0000-0001-9872-4012 E, F
Grzegorz Michalak –0000-0002-4402-3824 E, F
Adam Fronczak – 0000-0002-2950-286X E, F
Robert Gałązkowski – 0000-0002-7205-2219 A, E, F

**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

**FUNDING**

This research was co-financed as part of a competition for research projects and development projects aimed at the development of young scientists and Ph.D. students, financed as part of the scientific activities of WUM faculties – NZB/PM2/17/17.

**ADDRESS FOR CORRESPONDENCE**

Stanisław Paweł Świeżewski
Zakład Ratownictwa Medycznego,
Wydział Nauk o Zdrowiu,
Medyczny Uniwersytet Warszawski
ul. Litewska 14/16, 00 576, Warszawa, Poland
e-mail: stanislaw.swiezewski@gmail.com

| RECEIVED | ACCEPTED |
|---|---|
| 25.06.2020 | 29.10.2020 |

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

ORIGINAL ARTICLE DOI: 10.36740/EmeMS202004102

# IMPACT OF TELEPHONE CARDIOPULMONARY RESUSCITATION ON THE RETURN OF SPONTANEOUS CIRCULATION IN PATIENTS WITH OUT-OF-HOSPITAL CARDIAC ARREST

Jerzy Jaskuła[1], Karolina Niemczyk[2]

[1] DEPARTMENT OF MEDICAL DIDACTICS, CENTER FOR INNOVATIVE MEDICAL EDUCATION, JAGIELLONIAN UNIVERSITY MEDICAL COLLEGE, CRACOW, POLAND

[2] QUALITY MONITORING DEPARTMENT, CRACOW AMBULANCE SERVICE, CRACOW, POLAND

**Abstract**

**The aim:** Research aim is the evaluation of return of spontaneous circulation (ROSC) ratio among the individuals with out-of-hospital sudden cardiac arrest (SCA), depending on the so-called Telephone Cardiopulmonary Resuscitation (T-CPR). T-CPR is based on live instruction given by the dispatcher to incident witness, who is performing CPR efforts until the EMS team arrives on scene.

**Material and method**s: Research was based on the analysis of 782 entries (from EMS documentation) which recorded SCA and CPR. Emergency call voice recording has been rehearsed for each case, in order to confirm the capability of recognizing SCA and providing T-CPR instructions. Data was divided into two groups and the results have been compared. The ROSC ratio for both groups ("T-CPR" and "No T-CPR") were analyzed along with the type of incident location.

**Results:** The research has shown that 26,4% of all SCA cases researched ended up with the ROSC. In 94% of cases the dispatcher had succeeded in encouraging the witness to perform CPR with telephone instruction (T-CPR) until the EMS team has arrived. In the "T-CPR" group, 28,7% of cases have ended with ROSC. In the "No T-CPR" group, 19,7% of cases have ended with ROSC (28,7% vs. 19,7%).

**Conclusions:** The T-CPR should be utilized by dispatcher in the form of uniform protocol. In the process of training dispatchers there should be special emphasis on the skill of recognizing SCA upon receiving a call. The evaluation of SCA recognition, T-CPR undertaken and ROSC ratio may be an effective indicator of quality monitoring within the State Emergency Medical System.

**Key words**

telephone cardiopulmonary resuscitation (T-CPR), out-of-hospital cardiac arrest, Emergency Medical Services, ambulance quality indicators, medical dispatch, chest compressions

## INTRODUCTION

Chances of survival for sudden cardiac arrest victim are directly dependent on undertaking several critical interventions. The eventual result of cardiopulmonary resuscitation depends on the weakest link in the chain of survival [1, p.83]. Immediate initiation of cardiopulmonary resuscitation (CPR) may increase sudden cardiac arrest survival rate by up to four times. The role of medical dispatcher is to recognize cardiac arrest while gathering information via the phone, giving instruction to the witness – the so-called Telephone Cardiopulmonary Resuscitation (T-CPR), followed by dispatching emergency medical team and, if possible, giving the information about the nearest publically accessible Automated External Defibrillator (AED) [1, p.84]. The introduction of formalized call-handling protocols, containing properly prepared questions, makes it easier to recognize cardiac arrest. The use of such protocols may result in the increase of cardiac arrest recognition effectiveness. This may increase the number of cases in which the medical dispatcher initiates live instruction for the witnesses on how to perform resuscitation until the emergency medical team arrives [1, p.85]. The first formal protocol of telephone-assisted resuscitation has been introduced in 1979 in the USA, as a part of Medical Priority Dispatch System. In the US, emergency call centers employ adequately trained emergency number operators. In Poland receiving medical distress calls is the duty of medical dispatchers, who are required to be emergency nurses or paramedics with over 5 years of professional experience [2].

## THE AIM

Research aim is comparison of the ROSC ratio between a group of patients who have been resuscitated with the assistance of Telephone Cardiopulmonary Resuscitation (T-CPR) before ambulance arrival, and the other group where telephone assistance did not take place.

## MATERIAL AND METHODS

The subject matter analysis considered cases of out-of-hospital SCA which occurred between April 1st, 2017 and October 18th, 2017 in the area covered by Kraków Medical Dispatch Center. This center receives distress calls from 13 regions, including the city of Kraków, which cover 7161 square kilometers inhabited by 2,1 million people [3]. The research material has been obtained from the Kraków ambulance dispatch system software, used by medical dispatchers to handle distress calls and dispatch emergency medical teams.

The analysis covered emergency medical teams' documentation containing recognizing SCA and initiating CPR by the EMS team, in the abovementioned time period. In this manner 782 records (both created by the dispatcher and by the EMS team) have been selected and qualified for further detailed analysis in terms of content. For each case, the call voice recording has been also rehearsed in order to determine if medical dispatcher was capable of recognizing SCA symptoms followed by instructing the witness on how to perform resuscitation (T-CPR).

271 cases were excluded from research for one of the following reasons: calling person not being in the same location as the victim, sudden call termination, SCA occurring between the call and EMS team arrival, not initiating CPR by the EMS team, SCA with EMS team on scene, mistake in filling in documentation concerning SCA, or revealing doubled documentation (when two ambulances have responded the same emergency).

This research defines the return of spontaneous circulation (ROSC) indicator as the percentage of patients, who suffered sudden cardiac arrest but as a result of initiation or continuation of cardiopulmonary resuscitation by the emergency medical team have regained vital signs and were transported to hospital emergency department. The ROSC indicator value difference observed between "T-CPR" and "No T-CPR" groups was researched with the use of structure indicator test, with the established significance level $\alpha$=0,05. STATISTICA 13 software (StatSoft Inc., Kraków, Poland) was used for statistical analyse. Additionally, the odds ratio (OR) for the group and the confidence interval were calculated.

## RESULTS

In the researched time period most sudden cardiac arrest cases occurred at home (78,8%) and in public places (17,1%). Remaining SCA cases took place within traffic, agriculture or at workplace. Detailed division of cases in relation to incident location is shown in Table 1.

Out of 249 analyzed cases of sudden cardiac arrest recorded between August and October 2017, 66 cases ended with ROSC and the patients were transported to hospital – this constitutes 26,4% of all sudden cardiac arrest cases in the researched group. Medical dispatcher managed to encourage witness to perform T-CPR before the arrival of emergency medical team in 188 of 199 recognized SCA cases, which is 94% of all cases analyzed (Fig. 1).

Among the „T-CPR" group ROSC occurred in 28,7% of patients, and in the „No T-CPR" group ROSC occurred in 19,7% of patients (Figure 2). In the T-CPR group, patients with SCA in shockable rhythms (VF/pVT) accounted for 27% (51/188). In the "No T-CPR" group, patients with SCA in shockable rhythms (VF/pVT) accounted for 8% (5/61).

The p-value calculated using the structure indicator test was 0,083. At the adopted significance level $\alpha = 0,05$, no statistically significant result was obtained. A score of $0,083 > \alpha$ means that there is no relationship between the occurrence of ROSC and the T-CPR. The calculated odds ratio for the group was 1,7, which means that the chance of ROSC occurring in the T-CPR group is 1,7 times greater than in the No T-CPR group. The obtained value of the odds ratio for the population in the form of a 95% (CI) confidence interval (0,81-3,33) did not obtain statistical significance.

## DISCUSSION

The pilot research has shown that after the emergency medical team has reached the scene, patients

Table 1. Sudden cardiac arrest cases number in relation to incident location. Data for August-October 2017.

| Incident scene | T-CPR group | No T-CPR group | Number of sudden cardiac arrest (SCA) cases | Percentage of total SCA in relation to incident scene |
|---|---|---|---|---|
| Home | 360 | 50 | 410 | 78,8% |
| Public place | 75 | 14 | 89 | 17,2% |
| Workplace | 6 | 1 | 7 | 1,3% |
| Traffic | 8 | 3 | 11 | 2,1% |
| Agriculture | 3 | 0 | 3 | 0,6% |
| Total | 452 | 68 | 520 | 100% |

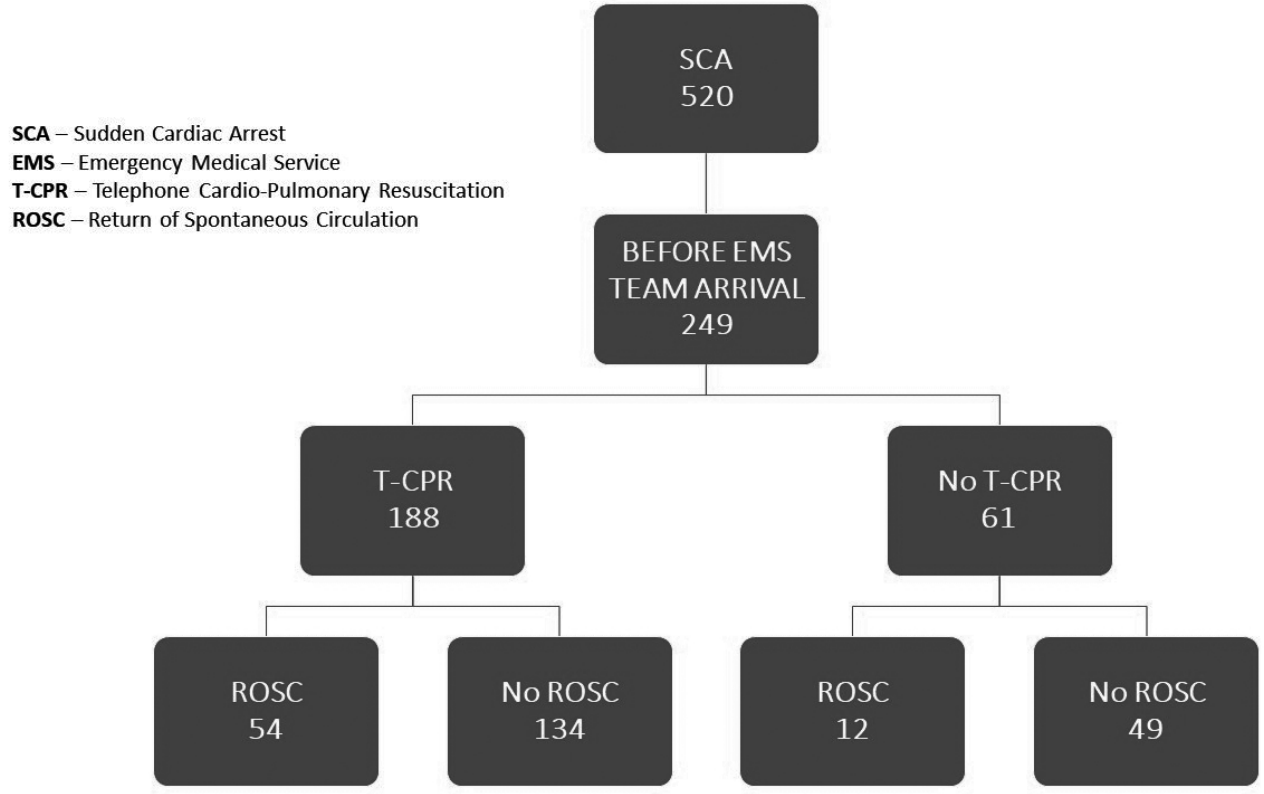


Fig. 1. Dispersion of sudden cardiac arrest cases in relation to undertaking resuscitation by the witness and achieving the return of spontaneous circulation.

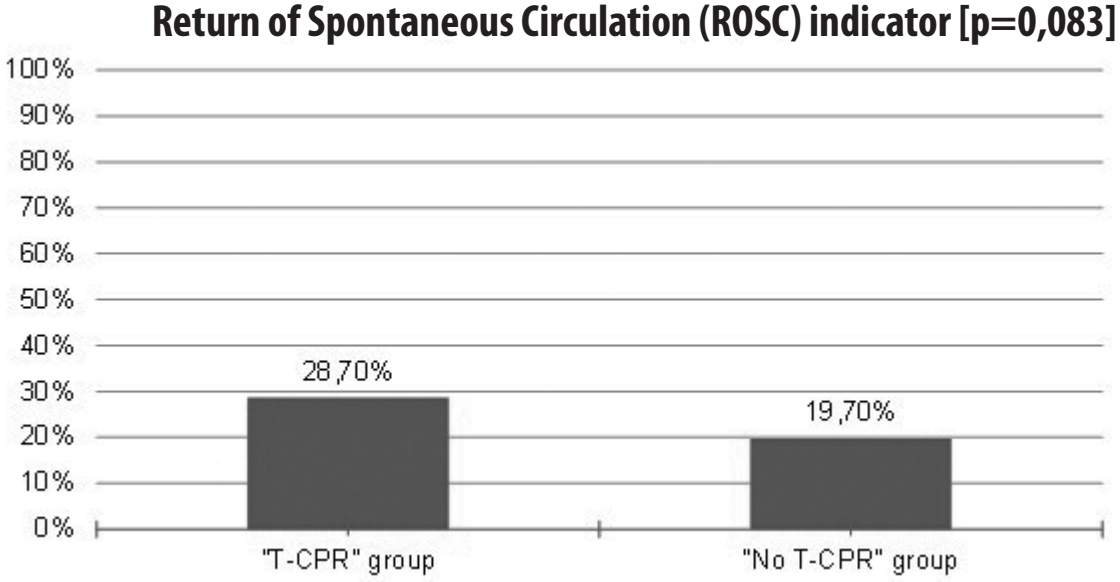


Fig. 2. Chart showing percentage of ROSC-ended (Return of Spontaneous Circulation-ended) interventions among groups of patients where Telephone Cardiopulmonary Resuscitation was, and was not initiated.

from "T-CPR" group presented ROSC rate higher by 9 percentage points than in case of group where the witness had failed to initiate resuscitation (28,7% vs. 19,7%).

The p-value = 0,083 exceeds the assumed α only slightly, which may indicate that utilizing larger research sample would lead to obtaining statistically important result. It has to be noticed, that there is significant difference in the number of patients in groups considered (with one being over three times larger than the other). This may also lessen discriminatory strength of the test and diminish its significance. The results obtained suggest that further subject matter research is required. Confirming statistical importance of differences shown would allow for estimating an increase by 3400 cases of return of spontaneous circulation nationwide thanks to use of T-CPR, compared to the situation without such procedure.

In many countries the ROSC ratio is one of clinical Ambulance Quality Indicators [4]. On its basis it is possible to monitor the emergency medical system quality in various time periods and regions. Currently measuring the ROSC ratio (depending on recognizing SCA by the dispatcher and initiating T-CPR) is neither routinely measured within the nationwide state ambulance dispatch system software (System Wspomagania Dowodzenia Państwowego Ratownictwa Medycznego – SWD PRM). Such data is also not linked to the information concerning survival rate upon dismissal from hospital. Elements concerning "telephone resuscitation" are a part of medical dispatcher training, however with no imposed format [5, 6]. Protocols in current use have a local character; there is lack of uniform T-CPR dispatcher procedure for nationwide use.

American Heart Association guidelines (concerning T-CPR program) indicate the need of annual medical dispatcher training in the field, analyzing and supervising each call considering cardiac arrest as well as constant monitoring of quality indicators regarding the effectiveness of recognizing cardiac arrest via the phone. The latter is possible due to analyzing data gathered by the emergency medical team on the incident scene. This standard further underlines that making a distress call, answering it in the medical dispatch center, confirming the incident address and recognizing cardiac arrest should not exceed 60 seconds. Initiating chest compressions should take place no later than 120 seconds since dialling the emergency number [7]. Detailed recommendations contain particular questions and phrases which should be used by the medical dispatcher in order to enhance recognizing cardiac arrest via the phone, and in order to introduce (in cooperation with witness) the most effective form of helping the victim until the EMS team arrives [8].

Development of State Emergency Rescue System in Poland creates technological and organizational possibilities for introducing validated protocols concerning medical action and monitoring clinical and systemic quality indicators. Survival rate in sudden cardiac arrest depends on the effectiveness of particular links in the chain of survival. Medical dispatcher is the first of these links, therefore there should be special emphasis on educating these professionals and on the evaluation of procedures introduced.

## CONCLUSIONS

Telephone cardiopulmonary resuscitation (T-CPR) as a tool for medical dispatcher is effective in saving lives (28,7% vs. 19,7% ROSC cases) and should be implemented and improved as a protocol in all dispatch centers nationwide. During medical dispatcher training, special emphasis should be put on teaching the skill of recognizing sudden cardiac arrest while answering the call. T-CPR protocol should contain detailed instruction, which is to be fulfilled in the exact same way each time. Evaluation of SCA cases recognized via the phone, T-CPRs undertaken and ROSCs achieved may constitute an effective indicator of quality monitoring both in medical dispatch centers, and in the emergency medical system as a whole. Undertaking such action may significantly increase the functioning effectiveness of medical dispatch centers, emergency medical teams and other units contributing to Polish medical rescue system. The subject of telephone-assisted resuscitation requires further research on a larger sample of calls. This would lead to creation of the most effective procedures possible, concerning action while calling for help before the emergency medical team arrives on the incident scene.

## REFERENCES

1. Perkins GD, Handley AJ, Koster RW et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 2. Adult basic life support and automated external defibrillation. Resuscitation 95:81-99
2. Ustawa z dnia 8 września 2006 r. o Państwowym Ratownictwie Medycznym Dz.U. 2006 nr 191 poz. 1410, [http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU20061911410/U/D20061410Lj.pdf. Accessed: 04.03.2020].
3. Website of the Kraków Ambulance Service, http://kpr.med.pl/o-nas/dyspozytornia-medyczna/, access on 04.03.2020
4. https://www.england.nhs.uk/statistics/statistical-work-areas/ambulance-quality-indicators/ambulance-quality-indicators-data-2018-19/. Accessed 04.03.2020
5. Rozporządzenie Ministra Zdrowia z dnia 11 sierpnia 2017 r. w sprawie doskonalenia zawodowego dyspozytorów medycznych Dz.U. 2017 poz. 1620 http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU20170001620/O/D20171620.pdf. Accessed: 04.03.2020

6. Rozporządzenie Ministra Zdrowia z dnia 10 stycznia 2014 r. w sprawie ramowych procedur przyjmowania wezwań przez dyspozytora medycznego i dysponowania zespołami ratownictwa medycznego, Dz.U. 2014 poz. 66 [http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU20140000066/O/D20140066.pdf Accessed: 04.03.2020]
7. Telephone CPR (T-CPR) Program Recommendations and Performance Measures [https://cpr.heart.org/en/resuscitation-science/telecommunicator-cpr/telecommunicator-cpr-recommendations-and-performance-measures. Accessed: 04.03.2020]
8. Lerner EB, Rea TD, Bobrow BJ, et al. Emergency Medical Service Dispatch Cardiopulmonary Resuscitation Prearrival Instructions to Improve Survival From Out-of-Hospital Cardiac Arrest, A Scientific Statement From the American Heart Association, 9.01.2012 Circulation 2012;125(4):648-655.

**ORCID AND CONTRIBUTIONSHIP** *
Jerzy Jaskuła – 0000-0001-9160-3955 A, B, C, D, E, F
Karolina Niemczyk – 0000-0002-2830-3025 A, B, E

**CONFLICT OF INTEREST**
Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**
Jerzy Jaskuła
Zakład Dydaktyki Medycznej, Collegium Medicum, Uniwersytet Jagielloński
ul. Medyczna 7, 30-688 Kraków, Poland
e-mail: jerzy.jaskula@uj.edu.pl

**RECEIVED** 21.03.2020 **ACCEPTED** 17.09.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 261-266

**DOI:** 10.36740/EmeMS202004103 **ORIGINAL ARTICLE**

# IMPACT OF EARLY TRACHEOTOMY FOR SUCCESSFUL PROGNOSIS OF PATIENTS

Mateusz Lech[1], Paulina Bakier[1], Sylwia Jabłońska[1], Rafał Milewski[2], Emilia Duchnowska[3], Klaudiusz Nadolny[4,5], Jerzy Robert Ładny[1]

1 EMERGENCY MEDICINE CLINIC, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND
2 DEPARTMENT OF INTEGRATED MEDICAL CARE, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND
3 DEPARTMENT OF CLINICAL PHONOAUDIOLOGY AND SPEECH THERAPY, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND
4 DEPARTMENT OF EMERGENCY MEDICAL SERVICE, STRATEGIC PLANNING UNIVERSITY OF DABROWA GORNICZA, DABROWA GORNICZA, POLAND
5 FACULTY OF MEDICINE, KATOWICE SCHOOL OF TECHNOLOGY, KATOWICE, POLAND

**Abstract**

**Introduction:** Complications associated with intra-hospital infections are an important clinical issue determining the further condition of hospitalized patients. One of the most invasive and of high risk of complications in ICU conditions is the otolaryngological procedure of opening the anterior wall of the trachea, aimed at introducing the tube into the lumen of the respiratory tract, enabling subsequent ventilation. Epidemiological data indicate that in Poland the percentage of patients admitted to the ICU annually, due to respiratory failure, who require the implementation of mechanical ventilation reaches 74%, where 41% is qualified for prolonged ventilation and requires a tracheostomy.

**The aim:** The epidemiological analysis of patients under the care of the Department of Anaesthesiology and Intensive Care of University Hospital in Bialystok. Particular attention was paid to patients who underwent tracheostomy.

**Material and methods:** The study material was collected based on the analysis of the patient's individual treatment process cards, the results of microbiological tests functioning in the Department of Anaesthesiology and Intensive Therapy of the University Hospital in Bialystok. 115 patients were qualified for the study, including 48 women and 67 men.

**Results:** Retrospective studies were based on medical records of 115 patients treated in the Intensive Care Unit of the Department of Anaesthesiology and Intensive Care, University Hospital in Bialystok in 2017-2018. The analysis involved patients after tracheostomy tube implementation, 48 were women and 67 men. Among the analyzed cases, 53 deaths (46.1%) occurred, and 62 subjects were discharged from the ICU (53.9%).

**Conclusions:** Early tracheostomy significantly improved patients' prognosis and reduced the risk of death. Cardio-respiratory failure with respiratory arrest may often be associated with the need for prolonged mechanical ventilation applied in patients with the aforementioned disease. Therefore, prevention in the form of early tracheostomy is important.

**Key words**

Tracheostomy, Intensive Care Unit, Active oxygen therapy, Passive oxygen therapy

## INTRODUCTION

Complications associated with intra-hospital infections are an important clinical issue determining the further condition of hospitalized patients. Early estimation of risk factors related to patient colonization with foreign bacterial flora is an important factor determining further treatment and final prognosis. Number of studies conducted in clinical conditions indicate the important role of medical and support staff participating in the process of treatment and care of patients. The therapeutic team may contribute to the development of infection due to the possibility of transfer from another patient or misjudgment of risk factors. Epidemiological studies have shown that approximately 25% of all hospital infections have been reported in Intensive Care Units [1]. Many factors affect the incidence and specifics of infections, for example, the nature of work in the ICU or patient predispositions.

The most common risk factors include:

- large number of invasive medical procedures – central, venous and arterial catheterization,
- enteral and parenteral nutrition representing a high risk of developing pathological flora due to the multitude of procedures related to the inclusion of this type of nutrition,
- drainage of body cavities,
- catheters to help control diuresis,
- nephrostomy,
- bronchofiberoscopy,
- mechanical ventilation requiring intubation or tracheostomy and regular assessment of bronchial tree for secretion of secretions and its hygiene.

3600 BC in Ancient Egypt, tracheostomy was thought to be the primary method to open the airways in people with sudden cardiac arrest. Only 100 years BC Asklepiades from Persia has researched and developed the aforementioned method of opening the airways. Then, for the next centuries, tracheotomy was considered a "scandalum chirurgicum", the procedure was abandoned, and it was not even mentioned [2]. Tracheotomy involves cutting the tracheal wall and inserting a tracheostomy tube into it.

The patient with hypoxia may be divided into:

1. sudden – the patient suffers from shortness of breath in such a way that he cannot breathe,
2. urgent – the patient is breathing relatively well.

In emergency tracheotomy, it will be a progressive state of laryngeal dyspnoea, which occurred suddenly, e.g. due to anaphylactic shock; or if the foreign body is stuck in the larynx and removal is impossible with a laryngoscope. In addition, spinal cord paralysis during the development of Heine-Medina disease, poisoning with sedation drugs which may cause respiratory arrest, and it is impossible to perform intubation are also an indication for tracheotomy. The patient is prepared for non-urgent tracheotomy by anesthesiologist. It is performed before major surgical procedures, where there is a risk of prolonged mechanical ventilation, or for face and neck operations, as well as long neurosurgical procedures. In addition, non-urgent tracheostomy includes procedures performed within the Intensive Care Unit. When the patient's condition requires prolonged mechanical ventilation, a decision is made to perform the procedure. In intensive care patients, most tracheotomies is performed rather as planned procedures. Before the procedure, the patient should be premedicated and ventilation with 100% oxygen should be introduced. It involves the administration of anesthetic drugs to ameliorate pain and also to cause muscle relaxation. Patients under intensive care are subjected to numerous procedures aimed at saving or supporting life. Tracheotomy is currently one of the most frequently performed procedures in patients in critical condition. It is an operative method of opening the airway, which involves cutting the tracheal wall, then inserting a tube into its lumen, which is necessary to ensure the patency of the airway and to allow prolonged mechanical ventilation [3].

The aim of the procedure is to replace the intubation tube, thereby preventing complications of prolonged intubation. According to the development of various methods of airway patency, such as endotracheal intubation, introduction of larynx masks that allow respiratory therapy, as well as the development of bronchofiberoscopic techniques, tracheotomy in the ICU conditions may be performed as a planned procedure. Sudden tracheotomy is performed only when patient develops unexpected obstruction of the upper respiratory tract, when endotracheal intubation is impossible, and as a result patient's gas exchange is blocked and hypoxia may occur [3].

Contraindications for performing a tracheotomy in clinical conditions:

- unusual anatomical structure of neck and respiratory tract;
- obesity;
- lack of the possibility to determine puncture points;
- unstable back injury;
- suspected tracheomalacia;

In aforementioned cases surgical tracheotomy should be considered. Replacing the endotracheal tube with a tracheostomy tube has a number of benefits. Patients toleration level to tracheostomy is higher due to reduction of effort during breathing – anatomical useless space is limited and the resistance of the endotracheal tube is reduced. In addition, it is possible to reduce the sedation of the patient remaining in Intensive Care Unit. Therefore, ventilator resignation becomes easier [4].

Tracheostomy as an artificial respiratory tract enables more accurate care of the patient. Compared to the endotracheal tube, it is more stable and may be attached easier. In addition, nursing staff has the opportunity to perform an accurate oral hygiene, thereby reducing the source of infection, which is associated with increased possibility of discharge from Intensive Care Unit. The literature also indicates the benefit from introducing oral feeding of ICU patients and creating conditions for activating the speech organ, which has positive effect on patients general comfort. Early tracheostomy is also widely discussed in the literature. Numerous studies analyze its benefits and risks that affect patient's condition. Positive factors are indicated, such as: improvement of the final result of treatment of ICU patients, reduction of mortality and reduction of mechanical ventilation duration. In addition, the literature mentions that previous tracheostomy prevents the development of VAP.

There is a distinction between intraoperative and postoperative complications. At the time of surgery, bleeding may occur, the tracheal position may be incorrectly identified, the trachea perforation or cardiac arrest may occur [5]. As a postoperative complication, the literature documents early bleeding, which is associated with inaccurate supply of blood vessels during

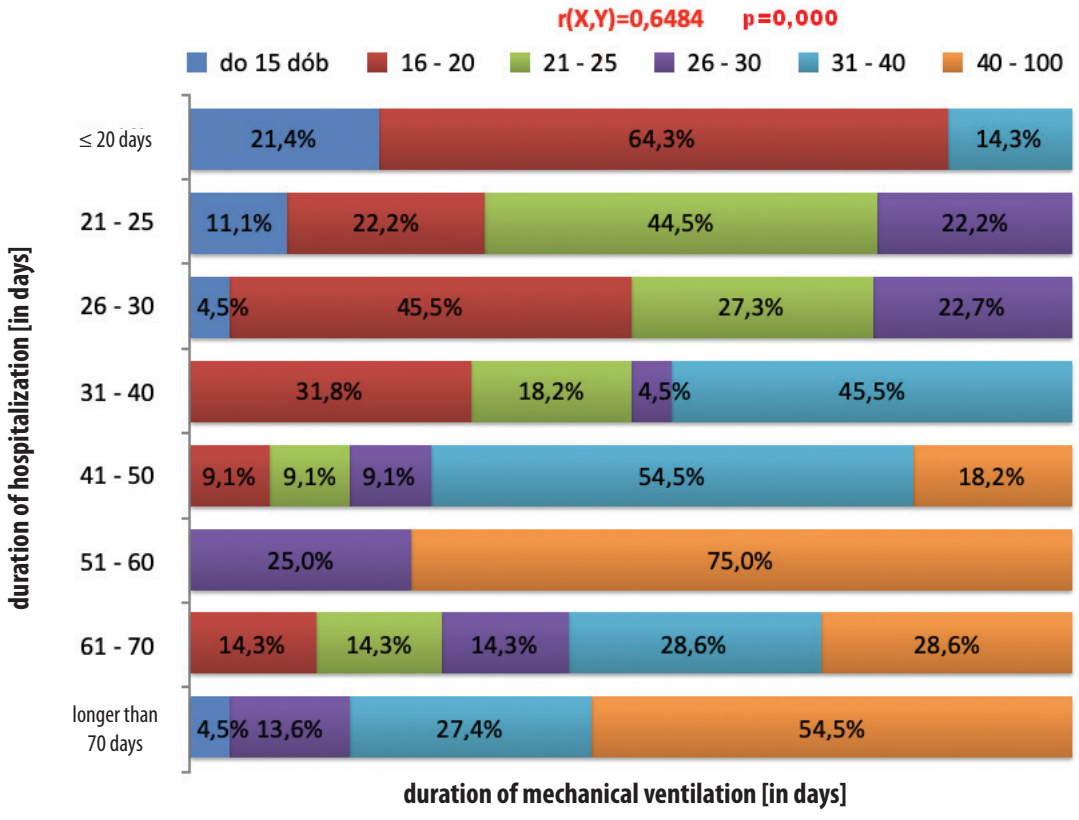


Fig. 1. Duration of mechanical ventilation and successful prognosis of patients.
*Source: own material.*

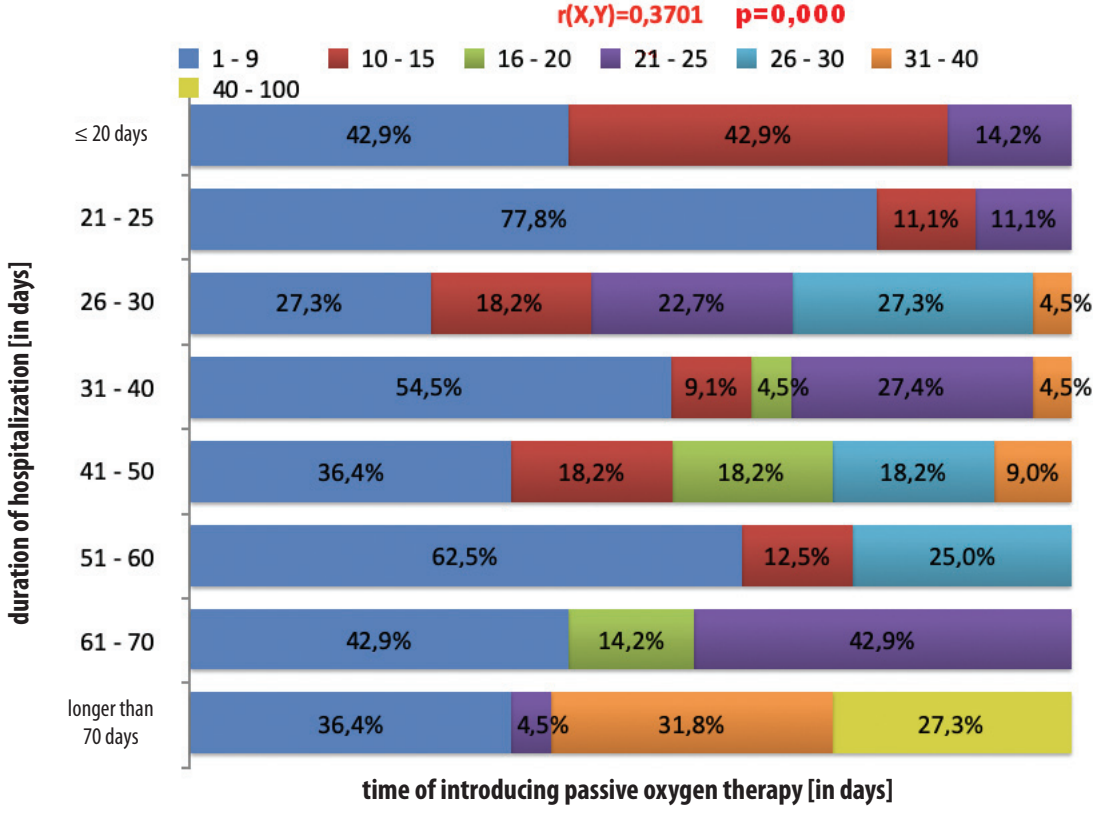


Fig. 2. Time of hospitalization of patients and the time of implementation of passive oxygen therapy.
*Source: own material.*

the procedure. The infection of the wound around the tracheostomy tube is possible or the formation of subcutaneous or pleural pneumothorax. Improper location of the tube between the tracheal wall and the mucosa forms the so-called "false channel". The formation of the tracheo-esophageal fistula and bleeding occurring at the 6th day after surgery are among the late complications. This also includes pressure ulcers from the tracheostomy tube. Prolonged pressure of the tube balloon on the mucous membrane of the trachea leads to narrowing of the trachea, which arises as a result of ischemia, which causes ulceration of the tracheal wall, where later granulation and fibrosis are formed [6].

### EPIDEMIOLOGY

Epidemiological data indicate that in Poland the percentage of patients admitted to the ICU due to respiratory failure who require mechanical ventilation is 74% every year, where 41% is qualified for prolonged ventilationand requires tracheostomy [7].

## THE AIM

The aim of the study is epidemiological analysis of patients hospitalized at the Department Anaesthesiology and Intensive Care, University Hospitalin Bialystok. Particular attention was paid to patients after tracheotomy.

## MATERIAL AND METHODS

The study material was collected based on analysis of the ICU patient's individual treatment process, the results of microbiological tests at the Department of Anaesthesiologyand Intensive Care, University Hospital in Bialystok. 115 patients were qualified for the study, including 48 women and 67 men.

Statistical analysis was performed using the STATISTICA 7.0 software from StatSoft Poland. Nominal data were described by creating distribution series, in which variants of features were specified, giving their number and frequency in the entire studied population. The obtained results were presented in the form of figures

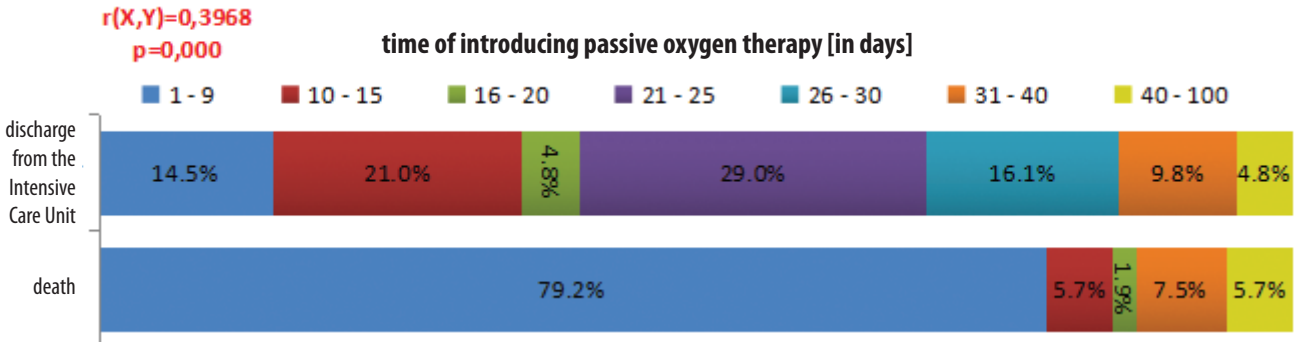


Fig. 3. Time to implement passive oxygen therapy and the number of deaths (n = 115).
*Source: own material.*

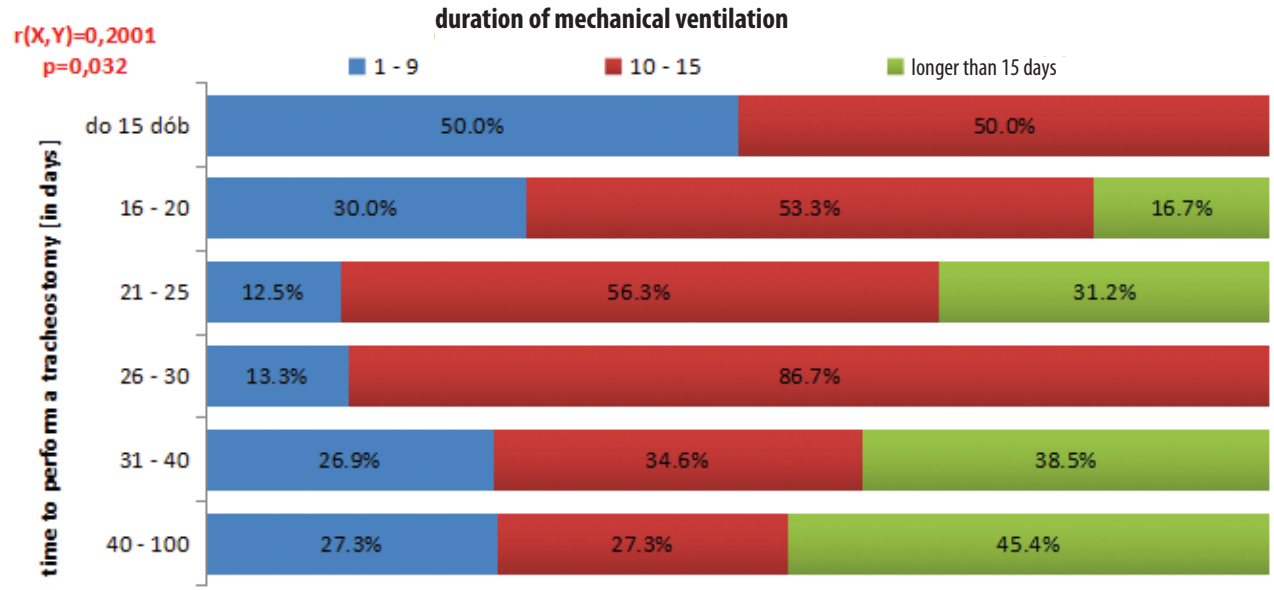


Fig. 4. Time of hospitalization of patients and time of tracheostomy.
*Source: own material.*

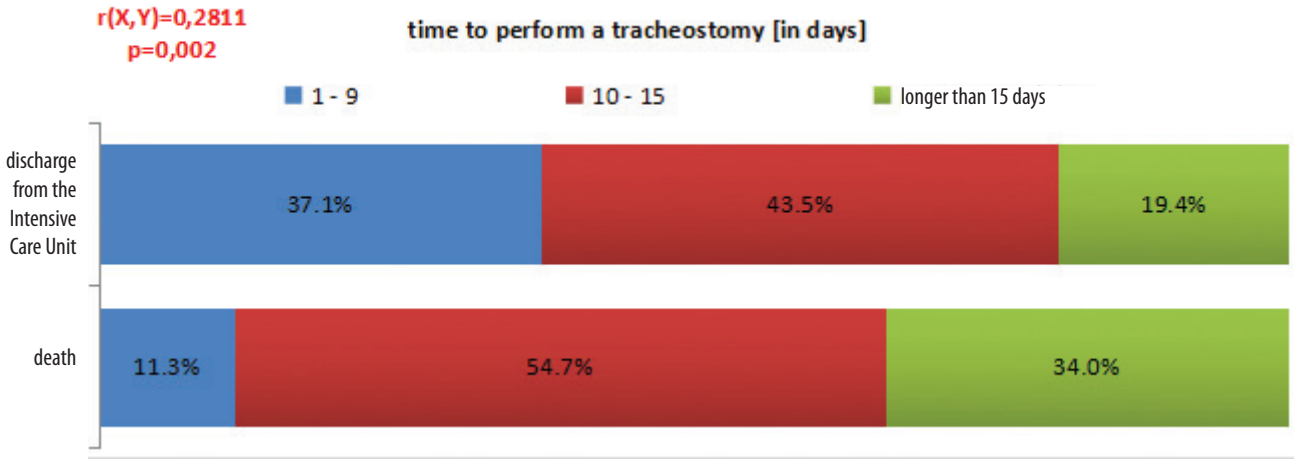


Fig. 5. Duration of mechanical ventilation and time of tracheostomy (n = 115).
*Source: own material.*

## RESULTS

Retrospective studies were based on medical records of 115 patients treated in the Intensive Care Unit of the Department of Anaesthesiology and Intensive Care of the University Hospital in Bialystok in 2017-2018. The analysis involved patients undergoing tracheotomy, among the examined persons 48 were women and 67 men. Among the analyzed cases, 53 deaths (46.1%) occurred, and 62 subjects were discharged from the ICU (53.9%).

The most common reason for admitting a patient to the unit was breathing cessation,which constituted 85.2% and cardiopulmonary failure – approximately 75%. Other cases include out-of-hospital sudden cardiac arrest with effective cardiopulmonary resuscitation, sepsis, multi-organ trauma, pneumonia of unknown origin and other.

According to the study, patients staying in the Intensive Care Unit for more than 40 days constituted approximately 42% of the study group, for the other results, as follows: 12% of subjects were hospitalized for less than 20 days, between 20-40 days – 38%; hospitalization for more than 70 days – 19%, and approximately 15% of patients were treated in the ICU for over 100 days.

Basing on conducted analysis, it was found that 68.7% of patients were mechanically ventilated for more than 20 days, 26.1% of patients underwent respiratory therapy between 16-20 days, a small group of patients was mechanically ventilated for less than 15 days.

It was proved that in the case where respiratory therapy was prolonged, the prognosis was much less favorable and more often death occurred (Fig. 1).

The implementation of passive oxygen therapy was used in approximately 44% of patients within the first 9 days after tracheotomy, the remaining patients resigned from the respirator later after surgery. Delayed introduction of passive oxygen therapy was associated with worse prognosis and often fatal result (Fig. 2, 3).

Studies have shown that delayed implementation of passive oxygen therapy was associated with extended stay in the ICU (Fig. 4).

The study proved that in half of the patients, a tracheostomy was performed between 10 and 15 days of hospitalization; in comparison to other cases, the treatment time after which the procedure was performed was: 1-9 days – 25.2% and over 15 days – 26.1%. In addition, it was proved that early surgery significantly reduced the patient's stay in the ICU and earlier resignation from the respirator, thus improved the prognosis and decreased the risk of death (Fig. 5).

## DISCUSSION

The analysis of the results obtained in the study showed a significant impact of early tracheotomy on the successful prognosis of patients. It was proved, that in 80% of patients after early tracheotomy, between 1 and 15 days, the process of introducing passive oxygen therapy was significantly accelerated and the risk of death was reduced. In the study by Rodriguez, tracheostomy was performed within 7 days of admission to the ICU, in patients who were at risk of prolonged mechanical ventilation [8]. Rodriguez obtained similar results to those presented in own material. In case of patients whose duration of respiratory therapy through the endotra-

cheal tube was extended to 32 days and more, it was much more difficult to resign from mechanical ventilation than in those who developed a tracheostomy within 12 days of admission. It has been shown that prolonged active oxygen therapy significantly extends the patient's stay in the ICU. Patients with prolonged intubation were hospitalized in the unit for on average 37 days, where after an early tracheotomy they remained in the unit for 16 days and less [9]. Rumbak's research has shown that early tracheotomy reduces mortality and reduces mechanical ventilation by approximately 30% [10].

## CONCLUSIONS

It was demonstrated that the main reason for admission of patients to the Intensive Care Unit was cardiopulmonary failure resulting in respiratory arrest. Early tracheotomy reduced the hospitalization in ICU and accelerated resignation form mechanical ventilation. No influence of gender and age of the patient on the success of resignation from the respirator was demonstrated. The essence of early tracheotomy should be considered in order to improve the quality of care and treatment of patient with respiratory failure requiring active oxygen therapy.

## REFERENCES


1. Maciejewski D, Misiewska- Kaczur A. Zakażenia w oddziałach intensywnej terapii. In: Zakażenia Szpitalne. Ed. D. Dzierżanowska. Media press, Bielsko-Biała 2008, pp. 249-265.
2. Andres J, Nestorowicz A. Zarys historii anestezjologii i jej przyszłość. In: Kamiński B, Kubler A (eds). Anestezjologia i intensywna terapia. Wydawnictwo Lekarskie PZWL, Warszawa, 2002.
3. Ferrario M, Cambiaghi A, Brunelli Let al. Mortality prediction in patients with severe septic shock: a pilot study using a target metabolomics approach. Sci Rep 2016;6: doi: 10.1038/ srep20391.
4. Pietkiewicz P, Machała W, Kuśmierczyk K, Miłoński J, Wiśniewski P, Urbaniak J. Wczesne powikłania tracheotomii przezskórnej metodą Griggsa w materiale własnym. Otolaryngol Pol 2012;66:196-2000.
5. Veelo DP, Binnekade JM, Buddeke AW, Dongelmans A, Schultz MJ. Early predictability of the need for tracheotomy a er admission to ICU: an observational study. Acta Anaesth Scand 2010;54:1083-8.
6. Chastre J, Fagon JY. Ventilator-associated pneumonia. Am J Respir Crit. Care Med. 2002;165:867-903.
7. Tyczkowska-Sieroń E, Bartoszko-Tyczkowska A, Gaszyński W. Analiza zakażeń bakteryjnych u pacjentów Oddziału Intensywnej Terapii Uniwersyteckiego Szpitala Klinicznego Nr 1 w Łodzi w latach 2002-2015. Med Dośw Mikrobiol. 2016;68:39-46.
8. Rodriguez JL, Steinberg SM, Luchetti FA, Gibbons KJ, TaheriPA,Flint LM. Early tracheostomy for primaty airway management in the surgical critical care setting. Surgery 1990; 108(4):655-659.
9. Arabi Y, Haddad S, Shirawi N, Al Shimemeri A. Early tracheostomy in intensive care trauma patients improves resource utilization: a cohort study and literature review. Crit Care 2004;8:R347-R352.
10. Rumbak MJ, Newton M, Truncale T, Schwartz SW, Adams JW, Hazard PB. Aprospective, randomized,study comparing early percutaneous dilational tracheotomy to prolonged translaryngeal intubation (delayed tracheotomy) in critically ill medical patients. Crit Care Med 2004;32:1689-1694.



### ORCID AND CONTRIBUTIONSHIP *

Mateusz Lech – 0000-0002-3401-6479 A, D
Paulina Bakier – 0000-0001-6425-6943 C D
Sylwia Jabłońska – 0000-0001-9972-5260 D
Rafał Milewski – 0000-0002-2331-6759 D
Emilia Duchnowska – 0000-0002-9213-1416 D
Klaudiusz Nadolny – 0000-0003-0355-241X E
Jerzy Robert Ładny – 0000-0003-4167-1962 F


### CONFLICT OF INTEREST

Authors declare no conflict of interest.


### ADDRESS FOR CORRESPONDENCE

Mateusz Lech
Klinika Medycyny Ratunkowej
Uniwersytet Medyczny w Białymstoku
ul. Szpitalna 37, 15-295 Białystok, Poland
tel: +48 798-697-717
e-mail: lech.mateusz10@gmail.com



### ACKNOWLEDGEMENT

The article was created as part of the Master's thesis within Public Health at the Faculty of Health Sciences of the Medical University of Bialystok.

| RECEIVED | ACCEPTED |
|---|---|
| 15.06.2020 | 16.09.2020 |


* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 267-271

**DOI:** 10.36740/EmeMS202004104 **ORIGINAL ARTICLE**

# GENDER AND AGE AS VARIABLES IMPACTING STRESS LEVEL AND STRATEGIES OF DEALING WITH IT BY PARAMEDICS

Sebastian Kowalski[1], Adrian Moskal[2], Magdalena Prylińska[1], Mariusz Goniewicz[1]

[1] DEPARTMENT OF EMERGENCY MEDICINE, MEDICAL UNIVERSITY OF LUBLIN, LUBLIN, POLAND
[2] EMERGENCY DEPARTMENT, HOSPITAL KROSNO, KROSNO, POLAND

**Abstract**

**Introduction:** Stress is present in every part of human life. It can be encountered especially among people, who due to the nature of their jobs, have to make quick and adequate decisions. The profession that can be included in this group is paramedic.

**The aim:** To analyse the level of stress and strategies of dealing with it among paramedics taking into account gender and age of the sample group.

**Material and methods:** The sample size consisted of 120 paramedics working for Emergency Medical Service. The survey was carried out from May to October 2017. The participation was voluntary and anonymous. As an estimate of tested parameters PSS-10 test was used to assess level of stress and mini-COPE test to assess strategies of dealing with stress. The analysis was carried out using STATISTICA 12 software.

**Results:** 49 women took part in the survey, who consisted of 40.83% of the whole sample size. Statistical analysis showed significant correlation between the level of stress and gender. Women were more impacted by stress in their job. The most popular strategy of dealing with stress for both genders were undertaking actions and planning. Statistically significant difference was shown for 5 strategies: seeking emotional and instrumental support, denial, stopping actions as well as blaming yourself and all of them were more frequently chosen by women. Age was not a significant factor in terms of level of stress encountered, however played important role in strategies undertaken to deal with stress which was blaming yourself.

**Conclusions:** Stress in paramedics' job is a key issue. Choosing appropriate strategy of dealing with stress by paramedics can help them to keep optimal level of stress at work and it should be used in motivating and effective way.

**Key words**

stress level, occupational risk, coping style, Emergency Medical Service

## INTRODUCTION

Stress is unavoidable in human's life. Defining stress is not possible using only one, concise and universal definition. It results from different perception of stress by various researches depending on the area of science which is used to define it [1-3]. As a result many definitions and understandings of stress have evolved. According to Lazarus and Folkman, stress is defined as "determined relationship between a person and environment, which is seen by the person as nerve-wracking or exceeding their abilities and enderging their well-being" [4]. Nowadays stress is present in every sphere of our lives. We can encounter it at home, school, doing shopping and at work. People who as a part of their job are required to make fast and adequate decisions regarding other people are particularly exposed to stressful situations [5-7]. Paramedics job is included among these professions. People who work in this area are responsible for applying first aid to people whose life is in danger [8]. There are many causes of stress for paramedics. The most common are plenty of duties, aggression and patient's claims, possibility of health damage or losing life, enormous responsibility for undertaken actions [9-11]. It does impact psychophysical condition of paramedics and their personal life. According to Binczycka-Anholcer and Lepiesza's research [12] 46% of paramedics suffer from traumatic consequences of events that happened at work, which impact their life outside work. Cumulative, chronic stress can influence paramedics' actions and as a result quality of services delivered by paramedics can be also deteriorated.

## THE AIM

The purpose of this research was to analyse stress level and strategies of managing it among paramedics using gender and age as explanatory variables.

## MATERIAL AND METHODS

120 paramedics took part in the research surveyed who are employed at National Emergency Services. Survey took place from May to October 2017. To evaluate stress level PSS-10 test was used and to

evaluate strategies of managing stress Mini-COPE test was applied. Statistical analysis was done in STATISTICA 12 software.

## RESULTS

There were 120 paramedics in the analysed group. 49 of them were women who constituted to 40.83% of the whole sample size. People in the sample were between 22 and 56 years old, average age was 31.31 years and standard deviation was 7.78. Points results obtained in PSS-10 test were recalculated into Sten fscores.

Based on them, results between 1-4 Stens were classified as 'low', 5-6 Stens as 'average' and 7-10 Stens as 'high'. Stress level classified as high was represented by 53.06% (n=26) women and 33.8% (n=24) in the sample size. Stress level classified as 'low' was represented by 8.16% (n=4) women and 27% (26.76%, n=19) men. Differences were statistically significant (p=0.020) (Table1).

Similar general results of PSS-10 were obtained, where women experienced higher level of stress than men and the difference was statistically significant (Table 2).

Analysed group was divided into 3 age groups: up to 25 years old, 25-34 years old and 35 and more years old. Age variable turned out not to be statistically significant (p=0.222) (Table 3).

There is also no statistically significant relationship between stress level and age when using PSS-10 (p=0.740) (Table 4).

It was possible to determine strategies of managing stress by using mini-COPE test, which differentiates between 14 strategies when dealing with stressful situations. Women as well as men have most frequently chosen to actively manage stress, planning was on the second place. The most rare strategies among women were taking psychoactive substances and among men were stopping undertaken actions as well as taking psychoactive substances. The analysis showed statistical significance for five strategies of managing stress between genders. They were: looking for emotional support (p=0.004), looking for instrumental support (p=0.024), denial (p=0.000), quitting actions (p=0.020) and blaming yourself (p=0.021). All aforementioned strategies were more frequently chosen by women (Table 5).

Table 1. Stress level and paramedics gender in the analysed group.

| Score level | Gender | |
|---|---|---|
| | Women | Men |
| **Low** | 4 | 19 |
| | 8.16% | 26.76 % |
| **Average** | 19 | 28 |
| | 38.78% | 39.44 % |
| **High** | 26 | 24 |
| | 53.06% | 33.80 % |
| **Totality** | **49** | **71** |

$Chi^2 = 7.815$, df = 2, p = 0.020

Table 2. General results of PSS-10 test and paramedics gender in the analysed group.

| Analyzed variable | Women | | Men | | t | p |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | | |
| PSS-10 | 6.76 | 1.56 | 5.73 | 1.58 | 3.507 | 0.001 |

Table 3. Stress level and age of analysed group.

| Score level | Age | | |
|---|---|---|---|
| | up to 25 years | 26–34 years old | 35 years and more |
| **low** | 10 | 7 | 6 |
| | 25.64% | 16.67% | 15.38% |
| **average** | 10 | 17 | 20 |
| | 25.64% | 40.48% | 51.28% |
| **high** | 19 | 18 | 13 |
| | 48.72% | 42.86% | 33.33% |
| **Totality** | **39** | **42** | **39** |

$Chi^2 = 5.712$ , df = 4, p = 0.222

Among the youngest paramedics up to 25 years old, the most frequently used strategies of managing stress were active dealing with the situation, planning and looking for emotional support. Similar results were obtained in 2 other age groups, which also most frequently actively dealt with situation, planned and looked for emotional support. The oldest age group has also used positive reevaluating strategy. The most rare strategies used by paramedics regardless of age were taking psychoactive strategies and quitting actions.

The analysis between groups has showed statistically significant difference regarding 14th strategy of managing stress which was blaming yourself

Table 4. General result of PSS-10 and age of analysed group.

| Analyzed variable | I. Up to 25 years | | II. 26–34 years old | | III. 35 years and more | | Statistical analysis | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | F | p |
| PSS-10 | 6.15 | 1.95 | 6.29 | 1.53 | 6.00 | 1.43 | 0.302 | 0.740 |

Table 5. Strategies of managing stress (mini-COPE) used by paramedics and their gender.

| Coping strategies | Women | | Men | | t | p |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | | |
| M-COPE.1. Active coping | 2.24 | 0.58 | 2.31 | 0.58 | -0.607 | 0.545 |
| M-COPE.2. Planning | 2.18 | 0.70 | 2.21 | 0.52 | -0.249 | 0.804 |
| M-COPE.3. Positive reframing | 1.62 | 0.68 | 1.70 | 0.58 | -0.709 | 0.480 |
| M-COPE.4. Acceptance | 1.63 | 0.65 | 1.68 | 0.69 | -0.403 | 0.687 |
| M-COPE.5. Sense of humor | 0.86 | 0.82 | 1.03 | 0.68 | -1.251 | 0.213 |
| M-COPE.6. Turning to religion | 1.09 | 0.82 | 1.07 | 1.01 | 0.123 | 0.902 |
| M-COPE.7. Seeking emotional support | 2.07 | 0.64 | 1.67 | 0.80 | 2.943 | 0.004 |
| M-COPE.8. Seeking instumental support | 1.98 | 0.69 | 1.66 | 0.79 | 2.280 | 0.024 |
| M-COPE.9. Self-distraction | 1.86 | 0.68 | 1.63 | 0.65 | 1.812 | 0.073 |
| M-COPE.10. Denial | 1.02 | 0.82 | 0.53 | 0.64 | 3.689 | 0.000 |
| M-COPE.11. Venting | 1.42 | 0.64 | 1.19 | 0.61 | 1.971 | 0.051 |
| M-COPE.12. Substance use | 0.41 | 0.66 | 0.51 | 0.69 | -0.783 | 0.435 |
| M-COPE.13. Quitting actions | 0.78 | 0.76 | 0.49 | 0.55 | 2.354 | 0.020 |
| M-COPE.14. Self-blame | 1.23 | 0.81 | 0.92 | 0.68 | 2.342 | 0.021 |

Table 6. Strategies of managing stress (mini-COPE) used by paramedics and their age.

| Coping strategies | I. Up to 25 lat | | II. 26–34years old | | III. 35 years and more | | Statistical analysis | | |
|---|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | F | p | inter-group differences |
| M-COPE.1. Active coping | 2.22 | 0.56 | 2.23 | 0.65 | 2.41 | 0.50 | 1.419 | 0.246 | – |
| M-COPE.2. Planning | 2.17 | 0.61 | 2.12 | 0.63 | 2.32 | 0.53 | 1.253 | 0.289 | – |
| M-COPE.3. Positive reframing | 1.63 | 0.67 | 1.61 | 0.62 | 1.78 | 0.57 | 0.940 | 0.393 | – |
| M-COPE.4. Acceptance | 1.72 | 0.63 | 1.75 | 0.66 | 1.51 | 0.71 | 1.472 | 0.234 | – |
| M-COPE.5. Sense of humor | 0.96 | 0.67 | 0.99 | 0.69 | 0.92 | 0.86 | 0.078 | 0.925 | – |
| M-COPE.6. Turning to religion | 1.14 | 0.99 | 1.05 | 0.91 | 1.05 | 0.92 | 0.125 | 0.882 | – |
| M-COPE.7. Seeking emotional support | 1.85 | 0.69 | 1.87 | 0.73 | 1.78 | 0.86 | 0.139 | 0.871 | – |
| M-COPE.8. Seeking instumental support | 1.78 | 0.78 | 1.83 | 0.77 | 1.76 | 0.76 | 0.106 | 0.900 | – |
| M-COPE.9. Self-distraction | 1.72 | 0.76 | 1.82 | 0.65 | 1.63 | 0.59 | 0.842 | 0.434 | – |
| M-COPE.10 Denial | 0.73 | 0.76 | 0.82 | 0.77 | 0.63 | 0.74 | 0.657 | 0.520 | – |
| M-COPE.11. Venting | 1.32 | 0.60 | 1.37 | 0.68 | 1.15 | 0.60 | 1.283 | 0.281 | – |
| M-COPE.12. Substance use | 0.50 | 0.77 | 0.49 | 0.69 | 0.41 | 0.58 | 0.200 | 0.819 | – |
| M-COPE.13. Quitting actions | 0.64 | 0.71 | 0.62 | 0.61 | 0.56 | 0.67 | 0.140 | 0.870 | – |
| M-COPE.14. Self-blame | 1.26 | 0.81 | 1.06 | 0.74 | 0.82 | 0.63 | 3.464 | 0.035 | I-III |

(p=0.035). This difference appeared between the youngest group (up to 25 years old) and the oldest group (35 years old and more). Blaming yourself was more common in the youngest group (M=1.26 SD=0.81) compared to oldest group (M=0.82 SD=0.63). The rest of the groups and strategies did not show any statistical significance (Table 6).

## DISCUSSION

Stress is constantly present in paramedics' life. In the carried out research only 8.33% of people report low level of stress at work. The rest of the respondents surveyed report average level of stress (49.17%) or high (42.5%). Bienczycka-Anholcer and Lepiesza [12] showed in their research that almost 60% of asked paramedics encounter stress at work. According to the respondents surveyed, 24% of them experience stress during every shift, and every third person experiences it once a week. Nowicki et al [13] in the research presents results of 98 paramedics. According to the study, 92% of them experiences stress at work and only 8% of them do not.

Kulczycka et al. [10] analysed mental strain among 100 paramedics aged between 23 and 52 employed at different medical centers. Among paramedics working for emergency medical services, 60% of them believe that mental effort is inseparable part of their work. Similar opinion was shared among paramedics employed at clinic and emergency department / room – 57% and 53% respectively. Rasmus et al [14] shows that stress is present in paramedics' job. According to 140 paramedics surveyed, 82.14% of them experience high stress level due to their profession.

Analyzing own studies, statistical significance is shown between gender and level of stress. Results of PSS-10 test show that women are more prone to stress at work (M=6.76) than men (M=5.73). Dependence between declared level of stress among genders was also proved by Nowicki et al [13]. According to the study, women more frequently respond that stress is present at work whereas men claim that stress level is low ($p<0.05$). Kaflik-Pierog and Oginska-Bulik [15] researched 152 members of medical staff – paramedics, doctors as well as nurses. The results did not show statistical significance between level of stress and gender. This study has also researched strategies of managing stress at work. The most frequently used strategies were planning, positive revaluation and development as well as active dealing with the situation. Women were most frequently looking for emotional support and prayed whereas men most commonly used alcohol and drugs. Another study of Oginska-Bulik [16] with 80 paramedics who experienced traumatic events at work showed that active dealing with the situation and planning is the most frequently used strategy of managing stress.

Variable age turned out not to be statistically significant in explaining level of stress at work.

Strategy of blaming yourself showed statistically significant difference between the youngest group (M=1.26) and the oldest group (M=0.82) of paramedics This dependence shows that this strategy is the less used the older the paramedics. Nowick et al [13] showed no statistical significance between age, stress level and strategy choice of managing it.

Amount of stress, its intensity and organisation of work of paramedics impact their well-being [17]. Papiernik et al [18] prove that when traumatic events happen, mental support for people applying first aid is also crucial as they often cumulate stress from many events and this can lead to post-traumatic stress. Paramedic who was trained on giving mental support can help injured people who also experience post-traumatic stress due to their health condition, injuries or stay at emergency department [18−20]

## CONCLUSIONS

1. Stress level experienced by paramedics on duty is high. Paramedic's gender variable shows statistical significance in explaining level of stress encountered at work. Women are prone to higher stress at work.
2. Results show necessity of ongoing research on stress experienced by paramedics and looking for support as well as optimal strategies of managing it.
3. Actions need to be taken to maintain optimal stress level in paramedics job.
4. Using appropriate strategies of managing stress by paramedics can be effective and motivating for them as well as improve the quality of service they provide.

## REFERENCES

1. Grygorczuk A. Pojęcie stresu w medycynie i psychologii. Psychiatria. 2008;5(3):111-115.
2. Dugiel G, Tustanowska B, Kęcka K, Jasińska M. Przegląd teorii stresu. Acta Scient Acad Ostrov. 2012;1(Sectio B):47-70.
3. Potocka A. Stres – natura zjawiska. In: Waszkowska M, Potocka A, Wojtaszczyk P (eds). Miejsce pracy na miarę oczekiwań. Poradnika dla pracowników socjalnych. Instytut Medycyny Pracy im. prof. J. Nofera. Łódź 2010, pp. 9-43.

4. Lazarus R.S, Folkman S. Stress, appraisal and coping. Springer Verlag. New York, 1984.
5. Pomiankiewicz J. Stres i wypalenie zawodowe funkcjonariuszy Służby Więziennej – uwarunkowania, przejawy, konsekwencje – zarys problemu. Przegl Wiezien Pol. 2010:(67-68):47-60.
6. Oskwarek P, Tokarska-Rodak M. Stres w środowisku pracy strażaków. Rozpr Spol. 2017;11(2):57-61.
7. Dziedzic A. Problemy funkcjonariusza Policji związane z codzienną służbą – badania ankietowe. Bezp Pr Nauka Prakt. 2013;7:16-18.
8. Kosydar-Bochenek J, Ozga D, Woźniak K, Migut M, Lewandowski B, Burdzy D. Traumatic stress in the work of paramedics. Przegl Epidemiol. 2017;71(4):639-645.
9. Frydrysiak K, Góraj D, Trendak W, Grześkowiak M. Analiza czynników wywołujących stres w pracy personelu Zespołów Ratownictwa Medycznego. Anest Rat. 2016;10:53-59.
10. Kulczycka K, Kuśmierz Ł, Stychno E, et al. Obciążenie psychiczne na stanowisku pracy ratownika medycznego. Przedsieb Zarz. 2014;15(12, 3):261-273.
11. Goniewicz M, Skitek-Adamczak I, Witt M, Goniewicz K. Stosowanie przymusu bezpośredniego w praktyce zespołów ratownictwa medycznego. Hyg Public Health. 2015;50(1):70-74.
12. Binczycka-Anholcer M, Lepiesza P. Stres na stanowisku pracy ratownika medycznego. Hyg Publ Health. 2011;46(4):455-461.
13. Nowicki G, Ślusarska B, Jędrzejewicz D. Sposoby radzenia sobie ze stresem w pracy ratowników medycznych. Bezp Pr Nauka Prakt. 2015;8:14-17.
14. Rasmus P, Kozłowska E, Sudra S, Machała W, Sobów T. Czy poziom doświadczanego stresu wpływa na wystąpienie zachowań ryzykownych w grupie pracowników zespołów ratownictwa medycznego?. Anest Rat. 2015;9:448-456.
15. Kaflik-Pieróg M, Ogińska-Bulik N. Wyznaczniki stanu zdrowia personelu ratownictwa medycznego. Acta Univers Lodz Folia Psychol. 2004;8:79-89.
16. Ogińska-Bulik N. Rola strategii radzenia sobie ze stresem w rozwoju po traumie u ratowników medycznych. Med Pr. 2014;65(2):209-217.
17. Kulczycka K, Grzegorczyk-Puzio E, Stychno E, Piasecki J, Strach K. Wpływ pracy na samopoczucie ratowników medycznych. Med Ogol Nauki Zdr. 2016;22 (1):66-71, doi: https://doi.org/10.5604/20834543.1198726.
18. Papiernik B, Holajn P, Żak-Jasińska K, Basiński A. Zespół stresu pourazowego w pracy zawodowej ratowników medycznych. Anest Rat. 2012;6:339-342.
19. Krzyszycha R, Goniewicz M, Goniewicz K, Pawłowski W, Wańkowicz P. Meta-analysis of pain and stress in emergency department patients. Pol J Public Health. 2016;126(4):165-169, doi: https://doi.org/10.1515/pjph-2016-0034.
20. Goniewicz K, Misztal-Okońska P, Pawłowski W, et al. Evacuation from Healthcare Facilities in Poland: Legal Preparedness and Preparation. Int J Environ Res Public Health. 2020; 17: 1779, doi: 10.3390/ijerph17051779.

**ORCID AND CONTRIBUTIONSHIP** *

Sebastian Kowalski – 0000-0003-0826-6025 A, B, D, F
Adrian Moskal – 0000-0002-4061-5275 A, B, C, D
Magdalena Prylińska – 0000-0002-4045-6913 C, D, E
Mariusz Goniewicz – 0000-0002-3004-6195 A, E, F

**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**

Sebastian Kowalski
Zakład Ratownictwa Medycznego
Uniwersytet Medyczny w Lublinie
ul. Staszica 4-6, 20-081 Lublin
(Collegium Maximum), Poland;
e-mail: skowalski.medicine@iclo

**RECEIVED** 08.09.2020
**ACCEPTED** 04.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 272-277


ORIGINAL ARTICLE DOI: 10.36740/EmeMS202004105

# HEALTH CONSEQUENCES OF ALCOHOL ABUSE ON THE EXAMPLE OF PATIENTS OF THE EMERGENCY DEPARTMENT AT THE UNIVERSITY HOSPITAL IN BIALYSTOK

Sylwia Jabłońska[1], Paulina Bakier[1], Mateusz Lech[1], Rafał Milewski[2], Jerzy Robert Ładny[1], Klaudiusz Nadolny[3,4], Emilia Duchnowska[5]

1 DEPARTMENT OF EMERGENCY MEDICINE, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND
2 DEPARTMENT OF INTEGRATED MEDICAL CARE, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND
3 DEPARTMENT OF EMERGENCY MEDICAL SERVICE, STRATEGIC PLANNING UNIVERSITY OF DABROWA GORNICZA, DABROWA GORNICZA, POLAND
4 FACULTY OF MEDICINE, KATOWICE SCHOOL OF TECHNOLOGY, KATOWICE, POLAND
5 DEPARTMENT OF CLINICAL PHONOAUDIOLOGY AND SPEECH THERAPY, MEDICAL UNIVERSITY OF BIALYSTOK, BIALYSTOK, POLAND

**Abstract**

**The aim:** To assess patients admitted to the Emergency Department requiring hospitalization in whom the presence of alcohol has been stated in laboratory tests.

**Material and methods:** The study was conducted on the basis of medical documentation analysis of 134 patients treated in Emergency Department in whom blood alcohol has been stated. The study included: sociodemographic data, blood alcohol concentration, the reason for hospitalization, the average duration of hospitalization and the patient's future.

**Results:** Retrospective study was based on medical records of134patients treated in the Emergency Department of the University Hospital in Bialystok from 01/01/2016 to 01/06/2016.The analysis took into account patients whose laboratory tests results showed an alcohol concentration above 0.004 ‰.The most common reason for hospitalization for examined patients was alcohol intoxicationa 26%.For 25% of examined patients, the cause of hospitalization was alcohol addiction syndrome, 19%drug poisoning,13% gastrointestinal bleeding. Almost 20% of patients was hospitalized in the Emergency Department with multiple injuries.

**Conclusions:** The majority of patients hospitalized in Emergency Departments are patients under the influence of alcohol. Such patients are a cause of Emergency Departments overload, which are not efficient due to the number of patients who use the services of EDs instead primary healthcare facilities. Other causes of hospitalization of alcoholic patients are associated with constant exposure to alcohol. Such situation suggests changes in the health care system which would relieve EDs and involve other units of the health care system. The system should focus on education and treatment of patients by non-invasive methods, i.e. psychotherapy or other psychological help.

**Key words**

alcoholism, alcohol, health consequences, Emergency Department

## INTRODUCTION

According to the World Health Organization (WHO), the definition of health is total mental, physical and social well-being, not just a lack of illness or disability. However, numerous external factors which negatively influence health, such as: stimulants, including alcohol, which is the most commonly used stimulant. Abuse of this substance may cause harm to the body regarding physical, but also psychological symptoms. The toxic effects of ethyl alcohol and its metabolites on organs and systems, improper nutrition, as well as deficiencies and disorders of vitamin absorption cause various types of somatic complications [1].

More frequently, injuries, traffic accidents and suicide attempts are observed in persons who consume alcohol intensively. Abusive alcoholics are more susceptible to infectious diseases. All aforementioned factors reduce the life expectancy of both, those who abuse or are addicted to alcohol [2].

According to the State Agency for Solving Alcohol Problems (PARPA), the number of persons drinking or drinking dangerously is 2.5-3 million. What is more, statistics show that over 30 thousand male deaths annually are associated with alcohol abuse. Studies also prove that persons who start drinking before the age of 15 are five times more likely to develop health problems than those whose alcohol

initiation took place after the age of 21 [3]. It is estimated that 6% of deaths among persons under 75 years old and 20% of serious cases treated in hospitals are related to alcohol. According to the Royal Medical Association, alcohol is involved in 15-40% of violent deaths in Great Britain. A report for the US Congress shows that at least 3% of all deaths in this country are caused by alcohol [4].

## HEALTH CONSEQUENCES OF ALCOHOL ABUSE

**1. Nervous system.** The nervous system is particularly sensitive to the influence of ethyl alcohol and its metabolites. In this system, the neurotoxic effects of alcohol may be observed earliest and most clearly. The pathological changes in this system is additionally affected by vitamin deficiencies caused by alcohol (mainly from the B group – thiamine, biotin, pantothenic acid and pyridoxine). The most common disease entities resulting from alcohol abuse:

a. dementia,
b. non-amnestic impairment of cognitive functions and memory,
c. alcoholic epilepsy,
d. polineuropatia,
e. Wernicke encephalopathy (Wernicke-Korsakov syndrome) [5]

**2. Digestive system.** The most common digestive system disorders associated with alcohol abuse:

a. chronic inflammation of the mucous membranes of the mouth, esophagus, stomach, duodenum, b. esophageal and intestinal peristalsis disorders,
c. impaired absorption resulting in malnutrition,
d. petechiae, erosions, bleeding due to ruptures in the mucosa,
e. weakness of the esophageal sphincter,
f. gastroesophageal reflux disease – Barrett's esophagus,
g. traumatic esophageal rupture,
h. Mallory-Weiss syndrome (rupture of the esophageal mucosa located in the area of the gastric cardia).

The liver is an organ that is gradually damaged as a result of excessive alcohol consumption which leads to:

a. steatosis (in 90% of heavy drinkers) – reversible when patients ceases to drink alcohol,
b. inflammation – if alcohol is constatntly consumed, fibrosis develops in approximately 80% of cases,
c. fibrosis,
d. cirrhosis.

Another organ that is sensitive to the toxic effects of alcohol is the pancreas. About 65% of OZT and PZT occur in persons who consume alcohol excessively [6, 7].

**3. Circulatory system.** Intensive drinking of high-percentage beverages causes numerous dysfunctions of the cardiovascular system, which may include the following diseases:

a. hypertension
b. cardiomyopathies
c. arrhythmias,
d. cerebral stroke [8].

**4. Respiratory system.** As a result of prolonged alcohol consumption, the respiratory protective barrier, which is the cilia and mucous glands, is destroyed. As a result, the body loses its ability to eliminate pollen and bacteria from the respiratory tract. The result is an increased susceptibility to respiratory diseases, including chronic tracheitis and bronchitis, most frequent in alcoholics [9]

**5. Endocrine system.** Hormonal disorders associated with alcohol abuse include, but are not limited to: adverse effects on thyroid hormones – decreased levels of triiodothyronine and adrenal cortex – increased levels of cortisol, misalignment of the hypothalamic-pituitary-adrenal axis and abnormal secretion of hormones -testosterone and luteotropin, damage to sperm cells structure and motility. Low testosterone in men causes hypogonadism and feminization. Hormonal changes in women are manifested by ovarian atrophy and masculinization [10].

**6. Skin changes and sexually transmitted diseases.** Persons who abuse alcohol are at increased risk of venereal disease and HIV-alcohol may accelerate the occurrence of symptoms of HIV infection. Five times more cases of sexually transmitted infections are recorded in alcoholics, and women who consume alcohol excessively have an incidence rate of up to 29 times [11].

**7. Pregnancy and fetus.** Alcohol causes toxic effects especially in the young body. Therefore, a significant number of premature births and spontaneous miscarriages are reported in women who consumed alcohol during pregnancy. In a newborn's mother drinking during pregnancy, the fetal blood alcohol concentration is the same as that of the mother 40-60 minutes after drinking alcohol. After birth, such child has a withdrawal syndrome. Late symptoms in such children include: slower reactions, delayed growth, and reduced attention and concentration. The most serious complication is Fetal Alcohol Syndrome (FAS). FAS occurs in 7-10% of children of addicted women, some studies say that as many as 50% of births in such women end in FAS syndrome [12].

**8. Mental disorders.** Mental disorders that occur in persons consuming alcohol are divided into those

associated with the state of alcohol intoxication, i.e. acute poisoning of different severity and the effects of long and intense consumption of high-percentage alcoholic beverages. The most common complications are:

a. withdrawal syndrome that may turn into acute or chronic alcohol psychosis,
b. alcohol delirium (delirium tremens, white fever, delirium),
c. acute alcohol hallucinosis (acute hallucinations),
d. chronic alcohol hallucinosis (Wernicke hallucinosis),
e. alcohol paranoia (alcoholic madness of jealousy, drunken madness, Othello syndrome),
f. Korsakov's psychosis [13].

## THE AIM

The aim of the study was the epidemiological analysis of patients under the influence of alcohol in the Emergency Department of the University Hospital in Bialystok as well as presentation of the scale of the social problem of alcoholism and health effects related to this disease, based on statistics developed on the ground of medical documentation of patients hospitalized in Emergency Department of University Hospital in Bialystok.

## MATERIAL AND METHODS

The study included medical records of patients hospitalized in the Emergency Department of the University Hospital in Bialystok who have been admitted to this department during the period of the study, i.e. from 01/01/2016 to 01/06/2016. The study group consisted of 134 adult patients. The conducted research was based primarily on retrospective medical documentation.

## RESULTS

In the period 01.01-1.06.2016, 1260 patients were admitted to the Emergency Department of the University Hospital in Bialystok, 621 of them were women and 639 – men. 134 patients were admitted under the influence of alcohol, including 109 men and 25 women. This shows that nearly 11% of admissions to the Emergency Department were persons under the influence of alcohol. A larger group were men – they constituted 81% (109) of patients, while the remaining 19% (25) were women (Fig. 1).

The age of the patients ranged from 19 to 84 years old. The average age among women was M ± SD = 46.72 ± 12.69 years, while among men M ± SD = 42.49 ± 15.02 years (Table 1). Persons under the age of 25 constitute 11% (16) of all patients, the next

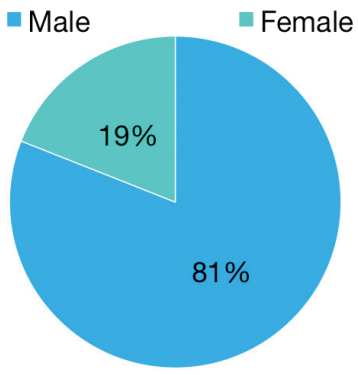


Fig. 1. Gender of respondents.

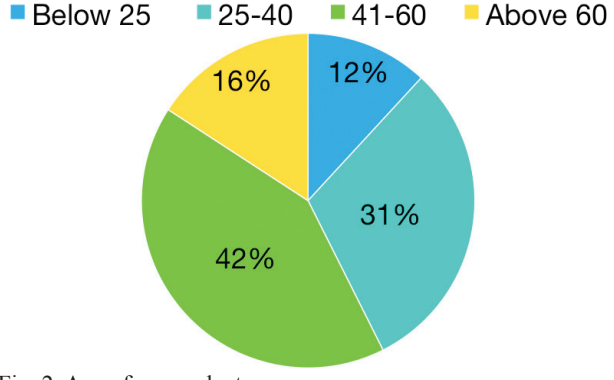


Fig. 2. Age of respondents.

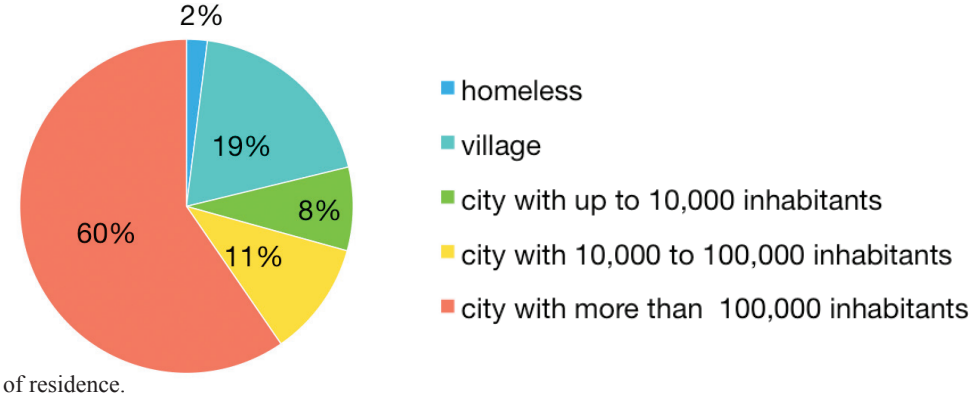


Fig. 3. Place of residence.

group consists of patients between 25 and 40 years old – they constitute 30% (41) of the total examined patients. Persons between 41 and 60 years of age constitute 42% of all examined patients. Subjects over 60 years of age constitute 16% (21) (Fig. 2).

The study involved persons living in various economic structures, and the largest group of respondents lived in cities with more than 100,000 inhabitants, they constituted 59% (79). 11% (15) of patients lived in agglomerations with 10,000 to 100,000 inhabitants. 8% of patients (11) lived in cities with up to 10,000 inhabitants and 19% (26) of the examined group live in the countryside. The remaining 2% of the population was homeless (3 subjects) (Fig. 3).

Subjects had 0.0049 ‰ to 7.49 ‰ blood alcohol. The average alcohol concentration level was M ± SD = 2.22 ± 1.66 ‰ (Table 2).

The most common reason for hospitalization of patients was alcohol intoxication, 26% of the patients was admitted to the Emergency Department due to this condition. For 25% of patients, the cause of hospitalization was alcohol addiction syndrome, while 19% of patients was admitted to the Emergency Department due to drug poisoning. For 13% of subjects, the reason for starting treatment in the hospital was gastrointestinal bleeding. 10% of patients was admitted to Emergency Department with multiple trauma suffered as a result of a traffic accident, 4% with multiple trauma suffered in the household, 3% with multiple trauma in the workplace , 1% with multiple trauma as a result of an assault. 10% of patients had spinal injury, 8% upper limb injury, 7% lower limb injury, 4% chest injury, 3% head injury, and 1% hip injury. A detailed percentage and quantitative distribution of the reasons for hospitalization are presented in Table 3 (Table 3).

The average duration of hospitalization was M ± SD = 14.08 ± 24.85 hours, the minimum time spent in the Emergency Department was 1 hour and the maximum time was 216 hours (Table 4).

## DISCUSSION

Examined patients had 0.0049 ‰ to 7.49 ‰ blood alcohol. The average alcohol level was M ± SD = 2.22 ± 1.66 ‰, and thus most of them presented the following symptoms of alcohol intoxication: irritability, aggression, disturbance of consciousness, disorders of balance and coordination, increase in blood pressure and pulse. Klimkiewicz and many other authors of the publication claim that the lethal dose of blood alcohol is close to 5‰ [36]. My research shows that these statements are misleading because only one death was recorded and a significant proportion of the examined patients had more than 5 ‰ of alcohol in their blood. However, it is difficult to consider because there are few diagnoses in death certificates – alcoholism. It is usually a somatic symptom of alcoholism, e.g. cirrhosis, etc. It should be remembered that alcoholism is a fatal disease and if untreated, it inevitably leads to death.

## CONCLUSIONS

It was presented that the main reason for hospitalization of patients was alcohol intoxication, 26% of the patients was admitted to Emergency Department in Bialystok due to this condition. A large group were patients injured while under the influence of alcohol. These data are worrying and show how huge the issue of alcohol abuse is. Those patients are a burden for the Emergency Departments. EDs, which due to large number of patients are inefficient, also have to deal with patients who in fact, should not be hospitalized in these units. The conducted research shows that the introduction of preventive methods could bring benefits to the health care system. The focus should be on education and treatment of patients by non-invasive methods, i.e. psychotherapy or other type of psychological help. Access to centers dealing with alcoholism should be facilitated for such persons.

Table 1. Descriptive statistics for the age of respondents.

| Age | N | M | SD | Mini | Max |
|---|---|---|---|---|---|
| **Women** | 25 | 46.72 | 12.69 | 25 | 64 |
| **Men** | 109 | 42.49 | 15.02 | 19 | 84 |
| **Total** | 134 | 43.28 | 14.66 | 19 | 84 |

min – minimum, max – maximum, M – mean, SD – standard deviation

Table 2. Descriptive statistics for patients' blood alcohol level.

| Descriptive statistics | N | Mini | Max | M | Sd |
|---|---|---|---|---|---|
| Blood alcohol level | 134 | 0,0049 | 7,49 | 2,2197 | 1,66055 |

min – minimum, max – maximum, M – mean, SD – standard deviation

Table 3. Reasons for hospitalization of patients.

| Reasons for hospitalization | n | [%] | Reasons for hospitalization | n | [%] | Reasons for hospitalization | n | [%] |
|---|---|---|---|---|---|---|---|---|
| **Traumas caused by:** | | | Respiratory failure | 5 | 4% | Pulmonary edema | 1 | 1% |
| Multiple trauma at work | 4 | 3% | fainting | 4 | 3% | Epilepsy | 1 | 1% |
| Multiple trauma as a result of an assault | 2 | 1% | Suden cardiac arrest | 4 | 3% | Temporal bone rupture | 1 | 1% |
| Multiple trauma at household | 5 | 4% | Diabetes | 4 | 3% | Kidney rupture | 1 | 1% |
| Multiorgan injury as a result of traffic accident | 4 | 3% | Heart arythmia | 3 | 2% | Liver rupture | 1 | 1% |
| Multiple trauma as a result of traffic accident | 13 | 10% | Adaptive disorders | 3 | 2% | Postalcoholic liver damage | 1 | 1% |
| **Body injuries:** | | | Acute pancreatitis | 3 | 2% | Lung cancer | 1 | 1% |
| Thoracic injury | 6 | 4% | Schizophrenia | 3 | 2% | Gunshot wound of the abdomen | 1 | 1% |
| Spine injury | 13 | 10% | Sternum fracture | 3 | 2% | Cut wounds of the wrist | 1 | 1% |
| Upper limp injury | 11 | 8% | Diffused tumor | 3 | 2% | Cut wounds of the face | 1 | 1% |
| Lower limb injury | 10 | 7% | cardiorespitarory failure | 6 | 4% | Tongue cut | 1 | 1% |
| Hip injury | 2 | 1% | Coma | 3 | 2% | Conditio after lost consciousness | 1 | 1% |
| Head injury | 4 | 3% | Alcohol abuse | 2 | 1% | Conditio after seizure | 1 | 1% |
| **Suicide attempts:** | | | Deselectorlitemia | 2 | 1% | Brain contusion/fracture | 1 | 1% |
| Drug intoxication | 17 | 13% | Dyspnoea | 2 | 1% | Liver contusion | 1 | 1% |
| Suspention | 4 | 3% | Abdominal pain | 2 | 1% | Trombocythopenia | 1 | 1% |
| Self-mutilation | 1 | 1% | Depressive disorders | 2 | 1% | Traumatic dissection of the abdominal aorta | 1 | 1% |
| **Other:** | | | Foreign body in the digestive tract | 2 | 1% | Liver damage | 1 | 1% |
| Alcohol inebriation | 35 | 26% | Alcoholic epilepsy | 2 | 1% | Hypodynamic shock | 1 | 1% |
| Alcohol addiction syndrome | 34 | 25% | Suspected stroke | 2 | 1% | Upper respiratory tract inflammation | 1 | 1% |
| Drug intoxication | 26 | 19% | Conditio after alcohol abuse | 2 | 1% | Pneumonia | 1 | 1% |
| Digestive tract bleeding | 18 | 13% | Intracerebral hematoma | 2 | 1% | Pancreatitis | 1 | 1% |
| Brain contusion | 9 | 7% | Spleen rupture | 2 | 1% | Marijuana intoxication | 1 | 1% |
| Traumatic shock | 8 | 6% | Retroperitoneal hematoma | 1 | 1% | Withdrawal syndrome | 1 | 1% |
| Rib fracture | 7 | 5% | Heart tamponade | 1 | 1% | Systemic inflammatory response syndrome | 1 | 1% |
| Alcohol intoxication | 6 | 4% | Hypothermia | 1 | 1% | Skull fracture | 1 | 1% |
| Consciousness disorders | 6 | 4% | Multiple cut wounds | 1 | 1% | Fracture of the vertebrae and sacrum | 1 | 1% |
| emphysema | 6 | 4% | Multiple skull fracture | 1 | 1% | Vertebra fracture | 1 | 1% |
| Lung contusion | 6 | 4% | Renal insufficiency | 1 | 1% | Basal skull fracture | 1 | 1% |
| Drug abuse | 5 | 4% | Scalp injury | 1 | 1% | Mandible fracture | 1 | 1% |
| Hypertension | 5 | 4% | Scalp trauma | 1 | 1% | | | |
| Thoracic pain | 5 | 4% | Brain edema | 1 | 1% | | | |

n – number, % – percent, * percentages do not sum up 100%, due to the fact that respondents may suffer from more than one condition

Table 4. Duration of the patient's stay at the Emergency Department.

| Hospitalization | n | [%] | Hospitalization | n | [%] | Hospitalization | n | [%] |
|---|---|---|---|---|---|---|---|---|
| 1 h | 11 | 8% | 6,5 h | 2 | 1% | 14 h | 1 | 1% |
| 1,5 h | 2 | 1% | 7 h | 6 | 4% | 22 h | 2 | 1% |
| 2 h | 9 | 7% | 8 h | 5 | 4% | 23 h | 2 | 1% |
| 2,5 h | 3 | 2% | 8,5 h | 3 | 2% | 29 h | 1 | 1% |
| 3 h | 7 | 5% | 9 h | 4 | 3% | 1 doba | 24 | 18% |
| 3,5 h | 5 | 4% | 9,5 h | 2 | 1% | 2 doby | 3 | 2% |
| 4 h | 7 | 5% | 10 h | 6 | 4% | 3 doby | 1 | 1% |
| 5 h | 7 | 5% | 11 h | 3 | 2% | 4 doby | 1 | 1% |
| 5,5 h | 2 | 1% | 12 h | 3 | 2% | 6 dób | 1 | 1% |
| 6 h | 7 | 5% | 13 h | 3 | 2% | 9 dób | 1 | 1% |

n – number; % – percent

## REFERENCES


1. [hhttp://stat.gov.pl/obszary-tematyczne/zdrowie/zdrowie/zdrowie-i-zachowania-zdrowotne-mieszkancow-polski-w-swietle-badania-ehis-2014,10,1.html. Accessed: 02.02.2020].
2. [http://www.alkoholizm.medserwis.pl. Accessed: 28.02.2020]
3. [www.mz.pl. Accessed: 16.12.2019].
4. Cierpiałkowska L. Alkoholizm: przyczyny, leczenie, profilaktyka. Wydawnictwo Naukowe UAM, Poznań 2000, pp. 135-152.
5. Cierpiałkowska L. Psychologia uzależnień – alkoholizm. Wydawnictwa Akademickie i Profesjonalne, Warszawa 2010, pp. 49-61.
6. Szczeklik A. Choroby wewnętrzne. Wydawnictwo Medycyna Praktyczna, Kraków 2005, pp. 1178-1199.
7. Kurdziej M. Alkoholizm: przewodnik po terapii. Wydawnictwo Projekt-Kom, Sosnowiec 2007, pp. 22-26.
8. Osiatyński W. Alkoholizm: i grzech, i choroba, i... Wydawnictwo Iskry, Warszawa 2007, pp. 89-96.
9. Klimkiewicz A. Alkohol a twój organizm. Wydawnictwo Edukacyjne PARPAMEDIA, Warszawa 2010, pp. 30-32.
10. Soyka M. Alcohol-induced psychotic disorder – a diagnostic entity of its own?. Der Nervenarzt 2014, 85/9, pp. 1093-1098.
11. Jędrzejko M, Netczuk-Gwoździewicz M. Człowiek wobec uzależnień: alkohol – narkotyki – dopalacze. Oficyna Wydawnicza ASPRA-JR, Zielona Góra 2013, pp. 181-197.
12. Bielan J, Ziębińska M. Alkohol. Lissner Studio, Warszawa 2013, pp. 18-48.
13. Weiss E, Singewald EM, Ruepp B, Marksteiner J. Alcohol induced disorders. Wiener MedizinischeWochenschrift 2014;164(1-2):9-14.



### ORCID AND CONTRIBUTIONSHIP *

Sylwia Jabłońska – 0000-0001-9972-5260 A, B, C, D
Paulina Bakier – 0000-0001-6425-6943 C, B, D
Mateusz Lech – 0000-0002-3401-6479 C, D
Rafal Milewski – 0000-0002-2331-6759 C, D
Jerzy Robert Ładny – 0000-0003-4167-1962 E, F
Klaudiusz Nadolny – 0000-0003-0355-241X E, F
Emilia Duchnowska – 0000-0002-9213-1416 D


### CONFLICT OF INTEREST

Authors declare no conflict of interest.


### ACKNOWLEDGEMENT

The article was created as part of the MA thesis on Public Health at the Faculty of Health Sciences of the Medical University of Bialystok.



### ADDRESS FOR CORRESPONDENCE

Sylwia Jabłońska
Klinika Medycyny Ratunkowej
Uniwersytet Medyczny w Białymstoku
ul. Szpitalna 37, 15-295 Białystok, Poland
tel.: +48 575255733
e-miał: sylwiajablonska@icloud.com



| RECEIVED | ACCEPTED |
|---|---|
| 20.07.2020 | 04.11.2020 |


* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 278-283


ORIGINAL ARTICLE

DOI: 10.36740/EmeMS202004106

# THE USE OF TRACTION SPLINTS IN THE EMERGENCY MEDICAL TEAMS IN POLAND

Jan Stachurski[1], Andrzej Sionek[2], Robert Gałązkowski[3]

1 DEPARTMENT OF PEDIATRIC EMERGENCY MEDICINE, MEDICAL UNIVERSITY OF WARSAW, WARSAW, POLAND
2 DEPARTMENT OF ORTHOPEDICS, PEDIATRIC ORTHOPEDICS AND TRAUMATOLOGY, MEDICAL CENTRE OF POSTGRADUATE EDUCATION, WARSAW, POLAND
3 DEPARTMENT OF EMERGENCY MEDICAL SERVICES, MEDICAL UNIVERSITY OF WARSAW, WARSAW, POLAND

**Abstract**

**The aim:** Traction splints are part of the procedure recommended in the femoral shaft fractures and in many countries they are equipped with ambulances. The aim was to determine the availability of traction splints in the emergency medical teams in Poland.
**Material and methods:** The survey was conducted using a survey method, obtaining answers from 29% of administrators of emergency medical teams in Poland, representing 36% of all emergency medical teams.
**Results:** Traction splints are found only in 11% of examined emergency medical teams in Poland, more often in specialized teams (17%) than basic ones (less than 10%). There has been wide variation between models of traction splints. Only in two cases organized cooperation between emergency departments and emergency medical teams was found in the matter of replacing traction splints in the piece-by-piece mode.
**Conclusions:** There is low availability of traction splints at the pre-hospital stage in Poland. There is no organized cooperation between emergency departments and emergency medical teams in the matter of replacing the traction splints with the use of the piece-for-piece method.

**Key words**

ambulances,
Emergency Medical Service,
traction,
splints,
femur fracture

## INTRODUCTION

Traction splints are a known element of pre-hospital rescue used mainly in femoral shaft fractures, recommended in course manuals of International Trauma Life Support [1] or Prehospital Trauma Life Support [2]. Recommendations for the use of traction splints can also be found in the American emergency medicine handbook „Tintinalli's Emergency Medicine" [3], or handbook of American Collage of Orthopedic Surgeons [4], as well as in the Israeli consensus of orthopedic trauma surgeons [5].

In Poland, ambulances with traction splints are not required by either Polish Standard PN-EN 1789+A2:2015-01 [6], either by National Health Fund requirements for contracted emergency medical teams [7].

There are two types of emergency medical teams in Poland, basic and specialist. In basic teams (73% of ambulances), work at least two paramedics or rescue nurses and in specialized teams (27% of ambulances) there is a doctor in addition to two paramedics or rescue nurses [8]. In the summer season in some water reservoirs, such as lakes or sea, are organized water basic or specialized ambulances on special boats.

## THE AIM

The aim of the study was to determine the availability of traction splints in the emergency medical teams in Poland and to analyze the relationship of administrators of emergency medical teams to use the traction splints at the State Emergency Medical Services.

## MATERIAL AND METHODS

The study was designed as a study using a response questionnaire, which was sent to all administrators of emergency medical teams in Poland. The questionnaire was prepared according to the author's project. Its distribution took place in a significant part through the system of electronic platform of public administration services, called ePUAP, and letters to the entities not receiving electronic correspondence were sent by post. The questionnaire itself consisted of two metric questions defining the voivodship in which the administator of emergency medical teams operates and the number of emergency medical teams contracted by the National Health Fund in a given entity, along with a division into team type (specialized, basic, water specialized, water basic). Then, five substantive questions were asked, first of all regarding equipping emer-

gency medical teams with traction splints, procedures for replacing the traction splint in the 'piece-by-piece' mode, and sentences on the mandatory equipment of ambulances and emergency departments with traction splints. The questionnaire of answers did not contain questions enabling direct identification of the respondent, neither personally nor institutionally. However, in some cases, the answers to the metric questions could make it possible to determine the answer. At the same time, the form of answering, via e-mail, ePUAP platform or mailing list, has repeatedly allowed the unequivocal identification of the institution or responder. For this reason, every effort has been made in the process of statistical procedures to reduce the likelihood of readers determining which entities have answered and which have not.

On November 1, 2019, a list of all administrators of emergency medical teams – healthcare entities, comprising emergency medical teams, placed in voivodship plans of the State Emergency Medical System was prepared, according to data provided by all 16 voivodship offices. On this basis, the addresses of 208 administrators of units were determined, thanks to which, from 1 to 2 November, they were sent electronically survey questionnaires to 170 administrators of emergency medical teams via the electronic platform of public administration services, called ePUAP, and to the remaining 38 entities that do not have an electronic inbox, by November 8, letters with questionnaires were sent via Polish Post.

The final results were developed statistically together with charts using Microsoft Excel 2016 software and Statistica 13 package (StatSoft Polska licensed for the Medical University of Warsaw).

## RESULTS

Answers were received from November 4 to the end of December 2019. In total, information was received from 63 facilities, receiving 30% feedback from questionnaires. Of all the answers received, 61 questionnaires were qualified for the study (N = 61), which constitutes 29% of all administrators of emergency medical teams in Poland. Incomplete or illegible answers were obtained from two administrators, preventing further analysis. Very diverse administrators took part in the study. The smallest administrator had 1 basic team in its structure, and the largest 77 teams, including 18 specialized and 59 basic ones. In total, administrators with 556 emergency medical teams were qualified for the study, including 114 specialized teams, over 440 basic teams and 2 basic water teams. According to the Central Statistical Office of Poland, there are 1541 emergency medical teams contracted, which means that 36% of all Emergency Medical Teams participated in the study and this is presented in Table 1.

The obtained answers and qualified forms for the study were also divided according to the voivodship to obtain the geographical scope of the study. Answers were obtained from fifteen voivodships, because from the Świętokrzyskie voivodship not a single response was received from any of the two administrators of emergency medical teams. Among the remaining voivodships, the percentage of administrators included in the survey ranged from 12% for the Wielkopolskie voivodship to 62% in the Podkarpackie voivodship. The detailed geographical distribution is presented in Table 2.

The most important substantive issue raised in the questionnaire was the question of whether the emergency teams in the surveyed administrators of emergency medical teams were equipped with traction splints. Only 14 administrators, constituting 23% of all surveyed, answered that at least one emergency medical team had an traction splint. Nine administrators (15%) reported that each emergency medical team had a traction splint, and five administrators (8%) indicated that some emergency medical team had in ambulance traction splint. As many as 47 administrators, or 77% of all respondents, indicated that none of the emergency medical teams had a traction splint (Fig. 1).

Administrators were also asked in detail, how many emergency medical team were equipped with traction splint, along with the division into ambulance types. It turns out that only 11% of emergency medical teams are equipped with traction splints, with specialized teams predominantly, of which 19 out of 114 (17%) had a traction splint. In the case of basic teams,

Table 1. Numbers of included emergency medical teams.

| Emergency Medical Team | All Together | Specialized | Basic | Water Specialized | Water Basic |
|---|---|---|---|---|---|
| Included Emergency Medical Teams | 556,16 | 114 | 440,16 | 0 | 2 |
| All Emergency Medical Teams | 1541 | 413 | 1128 | no data | no data |
| **Percent** | **36%** | **28%** | **39%** | - | - |

it was 42 emergency medical team out of 440, and it's less than 10% of the teams. None of the water emergency teams had a traction splint (Table 3).

The most commonly indicated traction splints by the administrators were FernoTrac and Davis splints – in both cases there were three administrators, and in two cases the Kendrick Traction Devices. Other splints, such as Medotti, REEL or CT-6 got one indication.

In the matter of cooperation with emergency departments, administrators of emergency medical teams were asked about their knowledge about the availability traction splints to be exchanged in 'piece-by-piece' mode from the emergency department. Only two administrators out of sixty-one (3%) reported that an exchange splints was available in their operating area in some emergency departments. Twenty-five administrators (41%) have held that in any emergency department is not possible to exchange traction splint, and thirty-four (56%) had no knowledge of this possibility.

The last two questions to the administrators of emergency medical teams concerns their opinion about the obligation to have traction splints on the equipment of emergency departments and emergency medical teams. Most answers to yes, because as many as 27 (44%), received the opinion that emergency departments should be obligatorily equipped with traction splints. Not much less – 26 disposers (43%) have no opinion on this issue, and only 13% of respondents (8 answers) disagree with the opinion that it is mandatory to equip emergency departments with traction splints (Fig. 2).

Table 2. Division by voivodships of administrators of emergency medical teams included in the study.

| Voivodship | Administrators of emergency medical teams included in the study | All of administrators of emergency medical teams | Percent |
|---|---|---|---|
| dolnośląskie | 4 | 12 | 33% |
| kujawsko-pomorskie | 7 | 18 | 39% |
| lubelskie | 4 | 13 | 31% |
| lubuskie | 3 | 10 | 30% |
| łódzkie | 3 | 12 | 25% |
| małopolskie | 6 | 19 | 32% |
| mazowieckie | 2 | 5 | 40% |
| opolskie | 1 | 10 | 10% |
| podkarpackie | 8 | 13 | 62% |
| podlaskie | 1 | 4 | 25% |
| pomorskie | 5 | 19 | 26% |
| śląskie | 3 | 12 | 25% |
| świętokrzyskie | 0 | 2 | 0% |
| warmińsko-mazurskie | 9 | 22 | 41% |
| wielkopolskie | 4 | 33 | 12% |
| zachodniopomorskie | 1 | 4 | 25% |
| **All together** | **61** | **208** | **29%** |

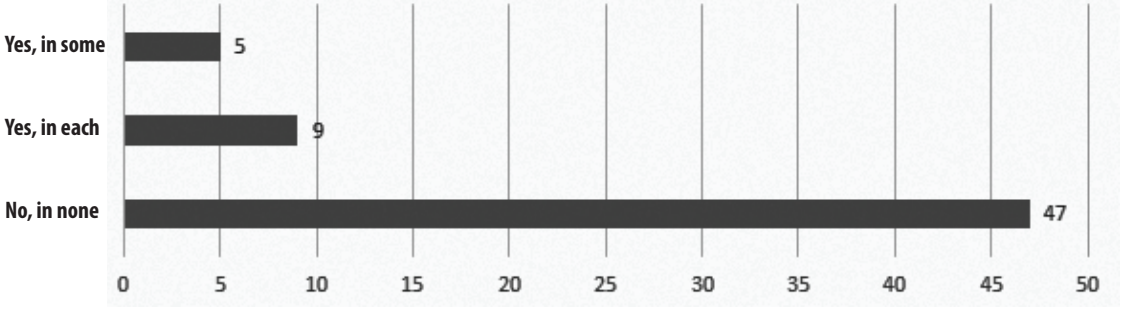


Fig. 1. Answers of administrators of emergency medical teams to the question about the presence of traction splints in emergency medical teams.

| Emergency Medical Team | All | Specialized | Basic | Water Specialized | Water Basic |
|---|---|---|---|---|---|
| Emergency Medical Team with traction splint | 61 | 19 | 42 | 0 | 0 |
| Surveyed Emergency Medical Team | 556,16 | 114 | 440,16 | 0 | 2 |
| **Percent** | **11%** | **17%** | **10%** | **0%** | **0%** |

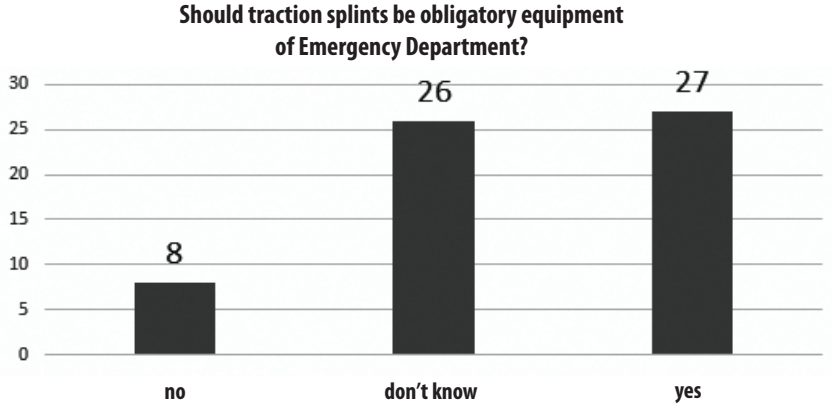


Fig. 2. Opinion of administrators of emergency medical teams on the mandatory equipment of emergency departments with traction splints.

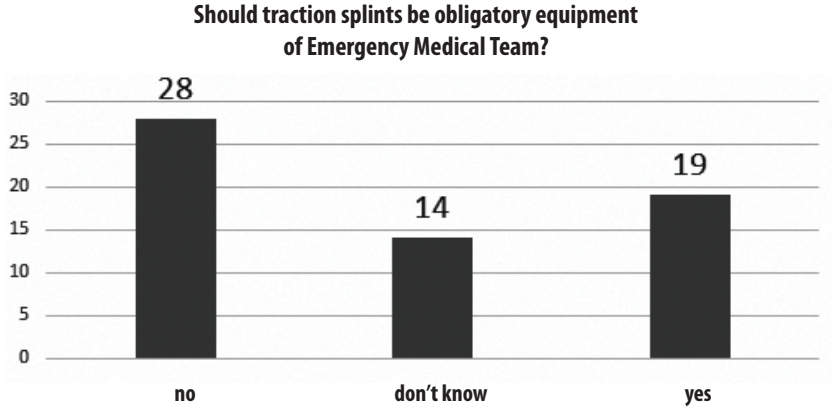


Fig. 3. Opinion of administrators of emergency medical teams on the mandatory equipment of emergency medical teams with traction splints.

As regards the obligation to equip emergency medical teams with traction splints, the administrators were definitely more negative. 28 administrators, representing almost half (46%) of all respondents, provided the negative assessment of the potential to equip emergency medical teams in traction splints. At the same time 19 administrators (31%) would support such an obligation, and only 14 (23%) had no opinion (Fig. 3). It is immediately noticeable that only 15% of the administrators had traction splints in all the emergency medical teams in their equipment, but 31% see such a need, because they agree with the proposal to introduce mandatory ambulance equipment with the traction splints.

## DISCUSSION

Traction splints have been used in emergency medical services for many years. Most probably historically Thomas splints were first introduced in ambulances by Meurice Sinclair in 1916 [9]. Since its introduction in the late 1960s, Hare splints have been successively displacing not handy Thomas splints in ambulances in the US [10]. With the development of numerous models and solutions for the use of the traction splints, the traction splints have become routine equipment for ambulances in the western world. For many years, traction splints have been recommended in pre-hospital recommendations [11]. Today, the guidelines of

American scientific communities dealing in emergency medical services (including the American College of Emergency Physicians, the National Association of EMS Physicians or the National Association of State EMS Officials) in optional equipment recommend an introduction of a traction splints for adults and children at the level of BLS ambulances [12]. A study from 2003 from the United Kingdom indicated that 74% of ambulances there were equipped with traction splints [13].

It should be recognized that in Poland at the prehospital stage the use of traction splints is much lower than abroad. In the Polish version of European standards, the traction splint does not appear as mandatory equipment, it is optional and is not required by the National Health Fund. As the results in Table 3 show, in Poland only 11% of emergency medical teams are equipped with traction splints, which means that this percentage is almost 7 times lower than in the United Kingdom. Differentiation between teams is also visible, specialized emergency medical teams are more often equipped (17%) compared to basic emergency medical teams (10%). A possible explanation for this disproportion may be the conviction of administrators of emergency medical teams of the more frequent cases of serious injuries encountered in the practice of specialized emergency medical teams. However, the results of the analysis of 21,896 interventions of emergency medical teams indicate that almost three times more often to emergency states associated with traffic accidents went to basic (73.6%) than specialized (26.4%) emergency medical teams [14].

Similar problems with equipping emergency medical teams and emergency departments with any lift rails is not a Polish problem only, it was raised in 2015 in South Africa, where a low percentage of immobilized femoral shaft fractures was observed, both at the pre-hospital level and among low reference hospitals, which was explained by the poor availability of equipment [15].

## CONCLUSIONS

1. Most emergency medical teams in Poland do not use traction splints.
2. There is no organized cooperation between emergency medical teams and emergency departments regarding traction splints.
3. Some of the administrators see the need to equip ambulances and emergency department with traction splints.

## REFERENCES


1. Campbell JE, Alson RL. International Trauma Life Support. Ratownictwo przedszpitalne w urazach. Kraków: Medycyna Praktyczna, 2017
2. Committee of the National Association of Emergency Medical Technicians in cooperation with the Committee on Trauma of the American College of Surgeons. Prehospital Trauma Life Support. Burlington: Jones & Bartlett Learning; 2018
3. Boggust B, Boggust A. Prehospital Equipment. In: Tintinalli JE, et al. (ed.). Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 8th edition. New York: McGraw-Hill; 2015
4. Pollak AN (ed.). Emergency: Care and Transportation of the Sick and Injured. Burlington: Jones & Bartlett Learning; 2016
5. Melamed E, Blumenfeld A, Kalmovich B, et al. Prehospital care of orthopedic injuries. In: Prehospital and disaster medicine. 2007; 22: 22–25. DOI:10.1017/S1049023X00004295.
6. Norma Europejska numer PN-EN 1789+A2:2015-01 – wersja polska
7. Załącznik numer 3 do zarządzenia Prezesa Narodowego Funduszu Zdrowia numer 64/2016/DSM
8. Borowicz A, Nadolny K, Kucap M, et al. The role and operation of emergency medical teams in patients with ST-segment elevation myocardial infarction. Post Nauk Med. 2008;2:92–96; DOI:10.25121/PNM.2018.31.2.92.
9. Austin RT. Meurice Sinclair CMG: A great benefactor of the wounded of the First World War. Injury. 2009;40(5):567–570; DOI:10.1016/j.injury.2007.05.002.
10. Owens JC. Ambulance equipment: Standards neccesary for ideal emergency care and communication. Emergency Medical Services: Recommendations for an approach to an urgent national problem: Proceedings of the Airlie Conference on Emergency Medical Services. 1969; Airlie House, Warrenton, Virginia, May 5-6,
11. Davies G, Anast G. The Fractured Femur: Acute Emergency Care Treatment. In: The Journal of orthopaedic and sports physical therapy. 1979;1:53–58. DOI:10.2519/jospt.1979.1.1.53.
12. American Academy of Pediatrics, American College of Emergency Physicians, American College of Surgeons Committee on Trauma, Emergency Medical Services for Children, Emergency Nurses Association, National Association of EMS Physicians & National Association of State EMS Officials. Equipment for Ground Ambulances. In: Prehospital Emergency Care. 2014;18(1):92–97. DOI:10.3109/10903127.2013.851312.

13. Roberts K, Allison KP, Porter KM, et al. A review of emergency equipment carried and procedures performed by UK front line paramedics. Resuscitation. 2003;58(2):153–158, DOI:10.1016/S0300-9572(03)00150-3.
14. Guła P, Wejnarski A, Moryto R, et al. Analiza działań zespołów ratownictwa medycznego w polskim systemie Państwowego Ratownictwa Medycznego. Czy model podziału na zespoły specjalistyczne i podstawowe znajduje uzasadnienie? Wiad Lek. 2014;67(4):468–475
15. Maqungo S, Allen J, Carrara H, et al. Early application of the thomas splint for femoral shaft fractures in a level 1 trauma unit. SA Orthopaedic J. 2015; 14(3):75–79, DOI:10.17159/2309-8309/2015/V14N3A9.

**ORCID AND CONTRIBUTIONSHIP** *
Jan Stachurski – 0000-0001-7097-4466 A, B, C, D, E, F
Andrzej Sionek – 0000-0003-1403-5709 A, E, F
Robert Gałązkowski – 0000-0002-7205-2219 A, F

**CONFLICT OF INTEREST**
Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**
Jan Stachurski
Zakład Medycyny Ratunkowej Dzieci
ul. Żwirki i Wigury 63a, 02-091, Warszawa, Poland
tel: +48 605172114
e-mail: jan.stachurski@wum.edu.pl

**RECEIVED** 23.06.2020
**ACCEPTED** 04.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 284-290


**ORIGINAL ARTICLE** **DOI:** 10.36740/EmeMS202004107

# PREHOSPITAL PROCEDURE IN INJURIES – INJURY ANALYSIS IN THE ŚLĄSKIE VOIVODESHIP IN KATOWICE

Anna Chowaniec[1,2], Olimpia Karczewska[3,4], Piotr Szwedziński[5]

1 STUDENT SCIENTIFIC SOCIETY AT THE DEPARTMENT OF ANAESTHESIOLOGY AND INTENSIVE NURSING CARE, DEPARTMENT OF ANAESTHESIOLOGY AND INTENSIVE CARE, FACULTY OF HEALTH SCIENCES, MEDICAL UNIVERSITY OF SILESIA IN KATOWICE, KATOWICE, POLAND
2 DEPARTMENT OF ANAESTHESIOLOGY AND INTENSIVE CARE, PROF. LESZEK GIEC UPPER-SILESIAN MEDICAL CENTRE OF THE SILESIAN MEDICAL UNIVERSITY IN KATOWICE, KATOWICE, POLAND
3 DEPARTMENT OF ANAESTHESIOLOGY AND INTENSIVE NURSING CARE, DEPARTMENT OF ANAESTHESIOLOGY AND INTENSIVE CARE, FACULTY OF HEALTH SCIENCES, MEDICAL UNIVERSITY OF SILESIA IN KATOWICE, KATOWICE, POLAND
4 DEPARTMENT OF GERONTOLOGY AND GERIATRIC NURSING, FACULTY OF HEALTH SCIENCES IN KATOWICE, MEDICAL UNIVERSITY OF SILESIA IN KATOWICE, KATOWICE, POLAND
5 DEPARTMENT OF EMERGENCY MEDICAL SERVICE, STRATEGIC PLANNING UNIVERSITY OF DABROWA GORNICZA, DABROWA GORNICZA, POLAND

**Abstract**

**The aim:** Analysis of injuries suffered in street and road traffic and in public places in the Śląskie Voivodeship in the city of Katowice from January 1, 2017 to October 10, 2017.
**Material and methods:** The study was based on a retrospective data analysis covering 248 Medical Rescue Activity Cards of the Voivodship Ambulance Service in Katowice – Katowice station from January 1 to October 10 2017.
**Results:** Among 248 victims were 120 men and 128 women. 8 women who were injured were pregnant. In the analyzed material, 234 people (94%) were sober, while 14 people (6%) were found to be under the influence of alcohol. Among 248 victims, 83 people suffered multi-organ trauma, while 62 people were injured. 14 patients (5.6%) assessed pain using the NRS scale, while analgesic treatment was initiated in 22 people (8.9%).
**Conclusions:** The most common type of injuries among victims of street and road traffic and in public places in Katowice from January 1 to October 10 2017 were bruises. Most often injuries occurred on Wednesday and Saturday, the least often on Sunday. None of the persons injured in prehospital procedures had a vacuum mattress, some had an orthopedic board (18.1%) and a cervical collar (32.3%). The personnel of the Emergency Medical Teams do not routinely use tools to assess the intensity of pain (only 5.6% of victims have documented pain assessment using the NRS scale on the MCR card). Consider changing the format of the medical records used by emergency teams to include a separate heading to assess pain intensity.

**Key words**

injuries,
prehospital proceedings,
medical emergency operations

## INTRODUCTION

The effects of action in bodily injuries is a multistage process that begins at the scene of the incident, ends with rehabilitation and the return to work of the victim. In Małopolska, the treatment of injuries is the most expensive field of medicine, but despite the best costs, mortality and morbidity among hits with serious injuries remains higher than it should be. The consequences of bodily injuries are in fourth place in the statistics of deaths and their causes after cardiological, oncological and neurological causes. Road accidents cause injuries in Poland [1-3].

The World Health Organization (WHO) believed that about 1.24 million people, 20-50 million people are exposed to disabling injuries each year as a result of road accidents. According to the annual report of the Police Headquarters, 32,760 road accidents were reported in 2017, as a result of which 2,831 people were killed and 39,466 people were injured (including 11,103 seriously). The statistics show that due to the accident, 68.2% died at the scene, and the remaining (31.8%) were deaths within 30 days from the date of the accident. There were 3,502 accidents in the Śląskie Voivodeship, in which 246 people were killed and 4,307 were injured [4, 5].

Huge progress in the field of rescue operations and evacuation of the wounded from the battlefields took place at the turn of the 18th and 19th centuries. Thanks to an outstanding surgeon, Dominique Jean Larrey, the first study was organized, a well-known

and functioning system for supplying, evacuating the wounded and staged surgical treatment, known as the "Trauma System" [6, 7].

Tragic events had a great influence on the creation of the rescue system in Europe. In 1882, the Vienna Ambulance Service was established, prompted by the fire of Vienna. In Poland, in 1891, the Krakow Volunteer Rescue Society was established, and in 1909 Tatrzańskie Ochotnicze Pogotowie Ratunkowe.

In 1973, the USA issued a regulation describing the "Trauma System" organization, to which three years later standardization of Trauma Centers was introduced and a three-stage system of trauma care was established. In 1980, the first significant standard for dealing with trauma victims was introduced – Advenced Trauma Life Support (ATLS). As a consequence, later the International Trauma Life Support (ITLS) and Pre-Hospital Trauma Life Support (PHTLS) were established. The introduction of the above-mentioned systems allowed to systematize and disseminate the treatment of victims with injuries not only at the prehospital level, but also at the "trauma room" level, where it is important to act in a coherent team. For over a dozen years, these systems have formed the basis of training for paramedics, nurses and doctors. Prehospital management of bodily injuries in different countries differs in the area of professional qualifications of personnel, equipment, geographical conditions and broadly understood operational problems. "To quote the creator of modern CPR, Peter Safar: Excellence is not just one option, it is a duty in emergency care, so you should always start from the top and go higher" [2,7].

Injury (trauma) is damage to the tissues of the body or human organs as a result of an external factor. Trauma factors can be:

- mechanical;
- thermal;
- electric;
- chemical;
- acoustic;
- lighting;
- ionizing.

There are two terms in common language: trauma or personal injury, which are synonymous but not in line with their actual meaning. Injury should not be confused with injuries resulting from trauma [7, 8].

## PREHOSPITAL MANAGEMENT IN INJURIES

Prehospital management of body injuries depends on several important elements. The first element is the injury mechanism, its severity and possible secondary or accompanying injuries (e.g. poisoning, burns). The next step is to assess the patient's baseline status, including his / her circulatory and respiratory fitness, state of consciousness, and age. The presence of life-threatening conditions that require immediate intervention, such as external hemorrhage, tension pneumothorax, or airway obstruction, will be an important element of the management. Then, consider whether there is a need for urgent damage control surgery and determine the place where the casualty will be transported. The decision to choose the place of patient transport will depend on factors such as: distance from the nearest Trauma Center (CU), Hospital Emergency Department (HED); the type of emergency medical team at the scene; the possibility of ordering the HEMS (Helicopter Emergency Medical Service) team and whether the event is a mass event When deciding whether to transfer the casualty to the ICU, it is important to remember that at least two anatomical and two physiological criteria must be met.

Anatomical criteria:

- amputation above the elbow or knee level,
- spinal cord injury,
- penetrating injuries to the head or torso and blunt injuries with suspected damage to internal organs,
- fracture of the pelvis or at least two proximal long bones,
- bone fracture complicated by nerve and vessel damage.

Criteria for physiological parameters:

- heart rate over 120 beats per minute,
- systolic blood pressure equal to or below 80 mmHg,
- respiratory rate below 10 or above 29,
- Glasgow City Consciousness Score (GCS) of 8 points or less;
- arterial saturation ($SpO_2$) of 90% or less.

In trauma care, the term "golden period" introduced by Dr. R. Adams will be commonly used. It is an effort to ensure that patients with severe bodily injuries receive specialist assistance at the center as soon as possible after the injury is sustained [1, 2, 10].

Additional activities in prehospital treatment of injuries include performing FAST ultrasound and transferring the patient to the HED / CU according to the AT-MIST scheme. A portable ultrasound machine is used to diagnose, among others, bleeding into the abdominal cavity, to diagnose tension pneumothorax or cardiac tamponade. FAST ultrasound is non-invasive and usually takes 1-3 minutes. Introducing FAST ultrasound as a mandatory examination performed by an emergency medical team would significantly

improve the identification of patients who would require direct transport to a trauma center (e.g. due to massive internal bleeding visible in ultrasound). However, there are several medical articles that draw attention to a different problem when introducing portable ultrasound to EMS in Poland. Namely, it concerns, among other things, the shortages of staff that should create the "Trauma Team" and the lack of financing of training for medical personnel. The next additional activity is the transfer of the patient to the HED / CU according to the AT-MIST protocol. It aims to improve communication between the EMS team and the trauma team [1, 9, 11].

AT-MIST scheme:

- A (age) – age, gender,
- T (time of trauma) – time from injury,
- M (mechanism of trauma) – the mechanism of trauma,
- I (injuries) – type of injury,
- S (symptoms) – symptoms and vital signs,
- T (treatment) – treatment applied and scope of activities.

## THE AIM

Analysis of injuries suffered in road and street traffic and in public places in the Śląskie Voivodeship in the city of Katowice from 1 January 2017 to 10 October 2017.

## MATERIAL AND METHODS

The study was based on a retrospective data analysis covering 248 Medical Emergency Cards of the Provincial Ambulance Service in Katowice – Katowice station from January 1 to October 10, 2017.

## RESULTS

The results of the research are presented in Figures 1-6 and in Tables 1-3.

Among the 248 injured, there were 120 men and 128 women. 8 women who were injured were pregnant. 27 people were under 18 years of age, 96 people aged 19-35, 46 people aged 36-44, 60 people aged 45-64 and 19 people aged 65 and over. 21 people were injured in January, 18 people in February, 35 people in March, 30 people in April, 12 people in

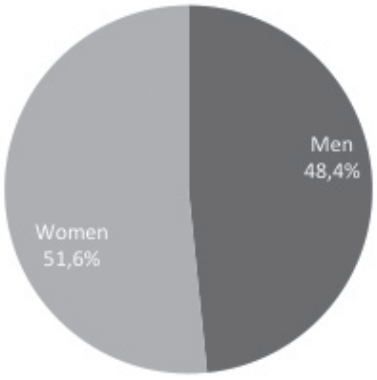


Fig. 1. Graph showing the percentage distribution of injured people in the period from January 1, 2017 to October 10, 2017, by gender.

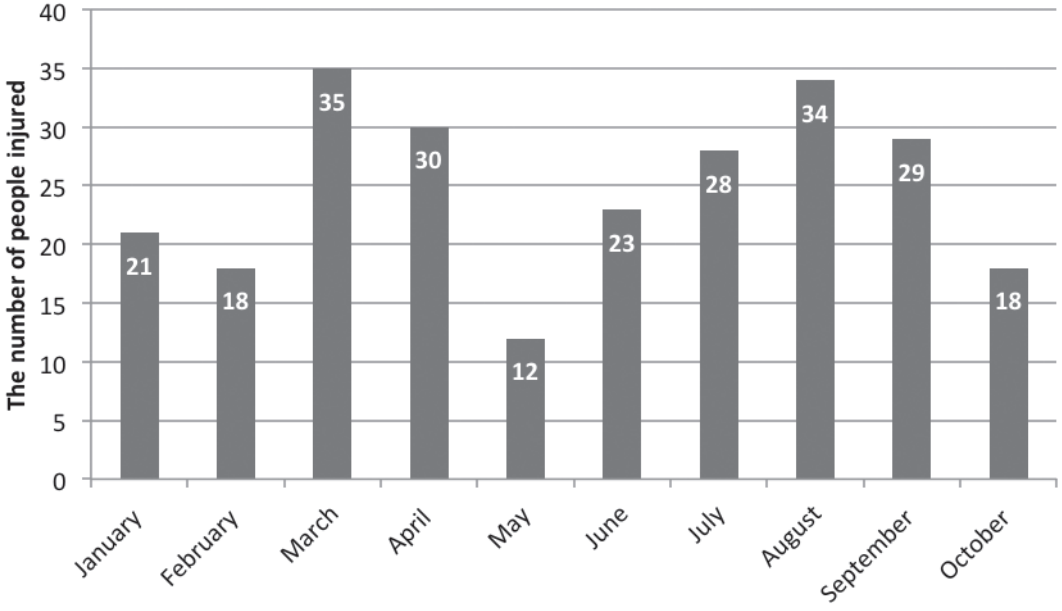


Fig. 2. Chart showing the number of injured people broken down by month.

May, 23 people in June, 28 people in July, 34 people in August, 29 people in September and 18 people in October. In the analyzed material, 234 people (94%) were sober, while in 14 people (6%) it was found that they were under the influence of alcohol. The analysis included the year of birth, gender, place of the event, day of the week, month, type of injury, recommendation of the team leader, pain assessment using the NRS scale, analgesic treatment used, use of a spine board, cervical collar, vacuum mattress and assessment of pupil response to light.

The classification of a person as intoxicated in the material was mainly based on the subjective assessment of the person filling out the Medical Emergency Procedure sheet. Only in 4 cases (out of 14) the presence of alcohol in the body was confirmed by testing the exhaled air with a breathalyzer. Among the people under the influence of alcohol, 8 were hit, while 6 people were involved in a road accident as a driver, 1 person was under the influence of psychoactive substances.

Among 248 injured persons, 83 persons suffered multi-organ trauma, 43 persons suffered limb injuries, 31 persons suffered head injuries, 20 persons spine injuries, 2 persons abdominal injuries. However, no injuries were found in 62 people.

Pain was assessed in 14 patients (5.6%) using the NRS scale, and analgesic treatment was initiated in 22 (8.9%). 2 people did not consent to the administration of painkillers. Of the painkillers used: 10 people

Tab. 1. Number and percentage of casualties, taking into account sex and individual months.

| Month | Victims | | | | | |
|---|---|---|---|---|---|---|
| | Women | | Men | | Total | |
| | number | [%] | number | [%] | number | [%] |
| January | 9 | 3,8 | 12 | 4,8 | 21 | 8,6 |
| February | 11 | 4,4 | 7 | 3 | 18 | 7,4 |
| March | 22 | 8,9 | 13 | 5,2 | 35 | 14,1 |
| April | 18 | 7,3 | 12 | 4,8 | 30 | 12,1 |
| May | 6 | 2,4 | 6 | 2,4 | 12 | 4,8 |
| June | 8 | 3,2 | 15 | 6 | 23 | 9,2 |
| July | 15 | 6 | 13 | 5,2 | 28 | 11,2 |
| August | 16 | 6,4 | 18 | 7,3 | 34 | 13,7 |
| September | 11 | 4,4 | 18 | 7,3 | 29 | 11,7 |
| October | 12 | 4,8 | 6 | 2,4 | 18 | 7,2 |
| **In all** | **128** | **51,6** | **120** | **48,4** | **248** | **100** |

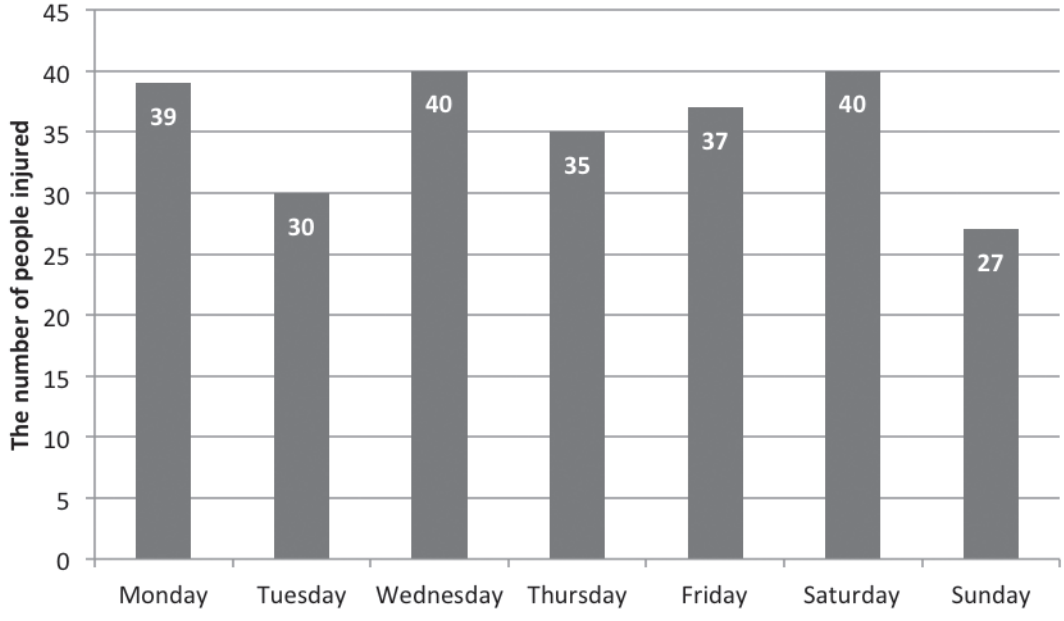


Fig. 3. Diagram presenting the number of injured people, broken down by days of the week.

were given morphine, 9 people were given ketonal, 1 person was given dolcontral, 1 person was fentanyl and 1 person was pyralgine.

Among 248 casualties in the prehospital procedure, 45 people (18.1%) used a spine board, and 80 people (32.3%) had a cervical collar. No one has a vacuum mattress. 2 people (0.8%) did not agree to put on a cervical collar, while 1 person was unable to put on a collar.

220 people were injured in road and street traffic, 26 people in a public place. Two exit cards did not provide information about the place of the event. 104 injured persons (41.9%) who sustained injuries took part in a road collision as a driver, 51 persons (20.6%) as a passenger, while in the case of 26 persons (10.5%) it was impossible to identify the seat in the vehicle, due to the lack of information in the teams' departure cards. 48 people (19.3%) were hit,

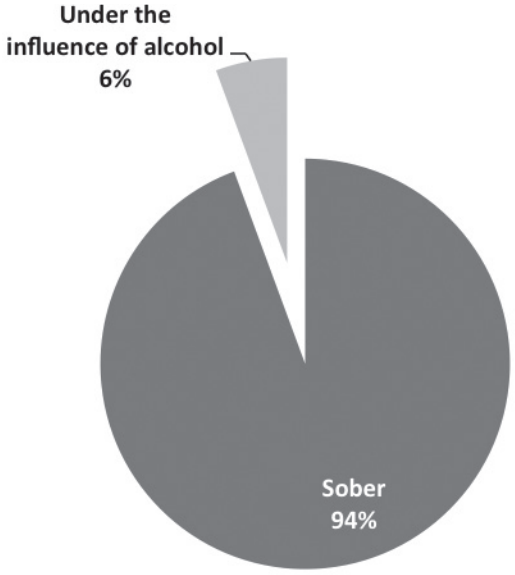


Fig. 4. Graph showing the percentage distribution of injured persons, taking into account the state of sobriety.

Tab. 2. Number and percentage of casualties, taking into account sex and age.

| Age (in years) | Victims | | | | | |
|---|---|---|---|---|---|---|
| | Women | | Men | | Total | |
| | number | [%] | number | [%] | number | [%] |
| 0-18 | 12 | 4,9 | 15 | 6 | 27 | 10,9 |
| 19-35 | 43 | 17,3 | 53 | 21,4 | 96 | 38,7 |
| 36-44 | 28 | 11,2 | 18 | 7,3 | 46 | 18,5 |
| 45-64 | 31 | 12,5 | 29 | 11,7 | 60 | 24,2 |
| 65+ | 14 | 5,6 | 5 | 2,1 | 19 | 7,7 |
| In all | 128 | 51,6 | 120 | 48,4 | 248 | 100 |

Tab. 3. Number and percentage of casualties, taking into account the location of injuries.

| Injuries | Victims | | | | | |
|---|---|---|---|---|---|---|
| | Women | | Men | | Total | |
| | number | [%] | number | [%] | number | [%] |
| Head | 13 | 5,2 | 18 | 7,3 | 31 | 12,5 |
| Spine | 11 | 4,4 | 9 | 3,6 | 20 | 8 |
| Chest | 4 | 1,6 | 3 | 1,2 | 7 | 2,8 |
| Limbs | 20 | 8,1 | 23 | 9,3 | 43 | 17,4 |
| Abdomen | 1 | 0,4 | 1 | 0,4 | 2 | 0,8 |
| Multi-organ | 43 | 17,3 | 40 | 16,1 | 83 | 33,4 |
| No damage | 36 | 14,5 | 26 | 10,5 | 62 | 25 |
| In all | 128 | 51,6 | 120 | 48,4 | 248 | 100 |

while 15 people (6%) were injured as a result of a fall from a bicycle or motorcycle.

When assessing the pupil's reaction to light, it was normal in 238 patients, slow in 2, and no right pupil reacting to light in 1 person. Assessment of the reaction to light was not performed in 7 people.

When assessing pupil width, 237 people had normal pupil size, 1 person had anisokoria, 1 person had both pupils, and 9 people had no such information in the MCR chart.

## CONCLUSIONS

1. Contusions were the most common type of injuries among injured in road and road traffic and in public places in Katowice from 1 January to 10 October 2017.
2. The highest number of injuries was recorded in March, the lowest in May.
3. The most common injuries were on Wednesday and Saturday, and the least frequent on Sunday.
4. Some of the injured persons (6%) were under the influence of alcohol.
5. As many as 1/4 of the injured suffered multiple organ injuries.
6. The most frequently injured were people aged 19-35.
7. None of the injured in the prehospital procedure had a vacuum mattress, some of them had an orthopedic board (18.1%) and a cervical collar (32.3%).
8. The staff of Emergency Medical Services Teams do not routinely use tools to assess pain intensity (only 5.6% of casualties have a pain assessment documented on the MCR chart using the NRS scale).
9. The use of a pain intensity rating scale has a positive effect on the use of analgesic treatment.
10. The NRS scale appears to be a more useful tool than the VRS scale in prehospital care.
11. Consider changing the model of medical records used by emergency medical teams to include a separate box for pain intensity assessment.

Injuries are a serious problem in modern medicine. According to the World Health Organization, more than 75 million people worldwide are injured each year in the world, and the effects of bodily injury rank fourth in the death statistics. Since the Middle Ages, efforts were made to obtain the most professional prehospital assistance. The motivation for these aspirations were patients who could have a second chance at life. Nowadays, the change in the organization of the rescue system in Poland, regulated by the Act on the State Medical Rescue of 2006, has significantly changed the concept of providing emergency care in the prehospital area, where efficiency, experience and cooperation of teams are of great importance. The dynamics of the work of emergency medical teams in the case of a traumatized patient, limited by human resources and sometimes, is extremely hard and extremely responsible work that requires constant improvement of qualifications and updating of knowledge. Matthew Woodring Stover's thought: "Hope for the best, prepare for the worst, should always be accompanied by the thought of Matthew Woodring Stover in prehospital trauma management."

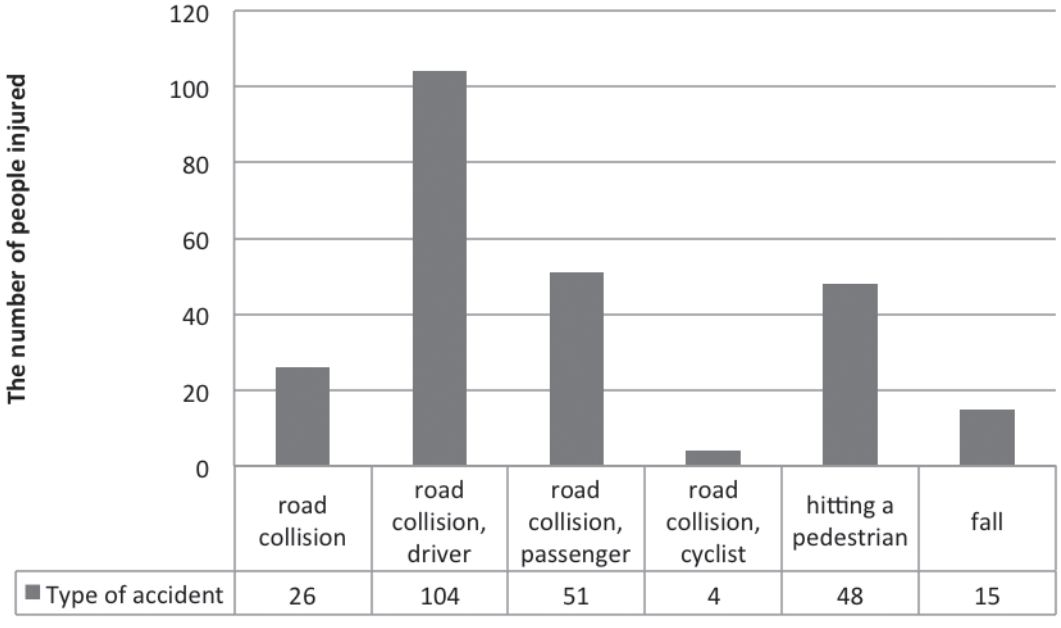


Fig. 5. Graph showing the number of casualties, taking into account the type of event during which the injury occurred.

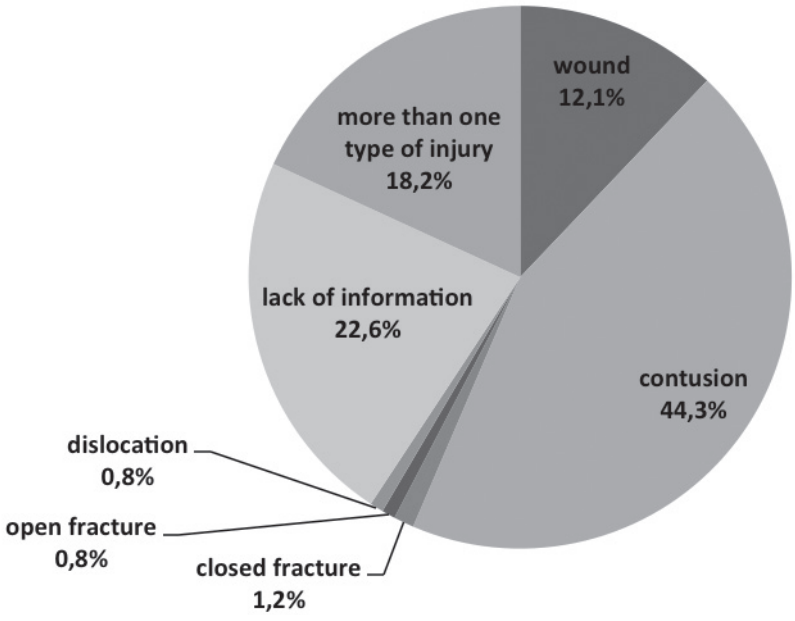


Fig. 6. Graph showing the percentage of casualties by type of injury.

## REFERENCES

1. Campbell JE, Alson RL (eds). International Trauma Life Support – ratownictwo przedszpitalne w urazach. Medycyna Praktyczna, Kraków, 2017, 3rd edn.
2. Guła P, Machała W (eds). Postępowanie przedszpitalne w obrażeniach ciała. PZWL, Warszawa, 2015, 1st edn.
3. Jurecki R, Jaskiewicz M. Analysis of road accidents in Poland over the last ten years, Scient J Marit Univers Szcz 2012;32(104).
4. Wydział Opiniodawczo-Analityczny Biura Ruchu Drogowego Komendy Głównej Policji. Wypadki drogowe w Polsce w 2017 roku. Warszawa, 2018 (online). [http://statystyka.policja.pl/].
5. Shrivastava SR, Shrivastava PS, Ramasamy J. Mid-term assessment of the decade of action for road safety: Progress made, yet at a slow rate. Ind J Critical Care Med. 2016;20(5):312.
6. Brown J, Sajankila N, Claridge J. Prehospital Assessment of Trauma. 2017; Surg Clin North Am 97(5):961-983.
7. Guła P, Machała W (eds) Postępowanie w obrażeniach ciała w praktyce SOR. PZWL, Warszawa, 2017, 1st edn
8. Stępiński A, Guzik P. Skale urazowe w chirurgii urazowej i traumatologii – przegląd, analiza przydatności klinicznej. Anest Rat 2015;9:400-409.
9. Kasica D, Ozga D, Lichota-Mach E, Wojtaszek M, Bochenek-Kosydar J. Wykorzystanie USG FAST w polskim Emergency Medical System (EMS) w opinii personelu medycznego – doniesienia wstępne. Anest Rat 2016;10:286-295.
10. Anand LK, Singh M, Kapoor D. Prehospital trauma care services in developing countries. Anaest Pain Intens Care 2013;17(1):65-70.
11. Machała W. USG w pomocy przedszpitalnej. Czy dzisiaj tego właśnie brakuje nam do szczęścia? Anest Rat 2016;10:296-298.

**ORCID AND CONTRIBUTIONSHIP** *

Piotr Szwedziński – 0000-0003-2010-2541 A, C, E, F,
Anna Chowaniec – 0000-0001-9297-8564 A, B, C, D
Olimpia Karczewska – 0000-0002-1235-1663 A, D, E, F

**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**

Piotr Szwedziński
Department of Emergency Medical Service,
Strategic Planning University of Dabrowa Gornicza,
Kościelna 6, 41-303, Dąbrowa Górnicza, Poland
tel.: 504794439
e-mail: pszwedzinski@gmail.com

**RECEIVED** 19.10.2020 **ACCEPTED** 30.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 291-295

**DOI:** 10.36740/EmeMS202004108 **REVIEW ARTICLE**

# RESPIRATORY TRACT BURNS IN EMERGENCY MEDICAL CARE

Piotr Białoń[1,2], Rafał Bobiński[3], Monika Mikulska[1], Robert Kijanka[1], Michał Szlagor[2,4], Michał Ćwiertnia[1,4], Tomasz Ilczak[1,4], Małgorzata Rak[1,5], Arkadiusz Stasicki[1,4], Marek Kawecki[1]

1 DEPARTMENT OF EMERGENCY MEDICINE, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF BIELSKO-BIALA, BIELSKO-BIALA, POLAND
2 DEPARTMENT OF EMERGENCY MEDICAL AID OF THE HEALTH CARE CENTER, EMERGENCY MEDICAL SERVICES IN ZYWIEC, ZYWIEC, POLAND
3 DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF BIELSKO-BIAŁA, BIELSKO-BIALA, POLAND
4 EMERGENCY MEDICAL SERVICES IN BIELSKO-BIALA, BIELSKO-BIALA, POLAND
5 NOFER INSTITUTE OF OCCUPATIONAL MEDICINE, TOXICOLOGY CLINIC, LODZ, POLAND

**Abstract**

Respiratory tract burns are among the most serious injuries. Complications include rapid swelling of the respiratory tract, which is the cause of high mortality rates. Such injuries require appropriate specialist treatment. The priority in emergency medical care is to ensure the airways remain unobstructed. If symptoms appear that suggest rapidly increasing swelling of the respiratory tract, intubation becomes essential to ensure the airways remain open.

**The aim of this article** is to discuss the issue of the necessity to develop guidelines for emergency medical personnel attending patients with respiratory tract burns. Currently, according to the State Emergency Medical Care statute, paramedics may carry out intubation on patients suffering from sudden cardiac arrest. According to the Regulation of the Minister of Health of the 20th April 2016, the list of actions that a paramedic may freely undertake does not include intubation of patients with rapidly increasing swelling of the respiratory tract caused by burns. Taking into consideration the decrease in the number of specialist teams, recommendations should be developed as quickly as possible on indications for prompt intubation of patients with inhalation injuries. The scope of emergency medical treatment carried out independently by paramedics should also be expanded.

**Key words**

burns, respiratory system, intubation

## INTRODUCTION

Respiratory tract burns, otherwise known as inhalation injuries, are among the most serious injuries and are characterized by high mortality. Most frequently they are accompanied by serious skin burns, but can also occur as isolated injuries. The high mortality is usually either the result of obstructions of the airways resulting from swelling caused by high temperatures, or rapidly developing respiratory failure. Such injuries require appropriate specialist treatment with particular care paid to keeping the victim's airways unobstructed.

## EPIDEMIOLOGY

According to the available medical literature, respiratory tract burns make up 20% to 30% of all burn injuries [1]. In the USA, inhalation injuries are the cause of 5,000 to 10,000 deaths per annum. According to World Health Organization data, 265,000 people around the world die of burn injuries every year. Research has shown that mortality rates among patients with inhalation injuries are as high as 30% [2, 3]. There is no precise statistical data available in Poland on this issue.

## CAUSES

Respiratory tract burns can be caused either by high temperatures or by chemical agents. Injuries usually occur as a result of inhaling air or fire gases at high temperatures. Heat burns usually affect the upper airways (the nasal cavity, the oral cavity, the throat and the epiglottis) and are the direct result of heat. The high temperature causes damage to the mucous membranes of the mouth, nose and throat and the release of inflammatory mediators. As the hot air is breathed in by the patient, it enters the nasal cavity and passes through the throat to the larynx, cooling to such a degree as not to cause heat burns to the trachea. The ample blood supply to this area and the rapid blood flow in the upper airways lowers the tem-

Fig. 1. Patient with suspected respiratory tract burns being treated by a Medical Response Team during transportation to the burns unit in Siemianowice Śląskie (photo Robert Kijanka).

perature of the burn injury as the heat is absorbed by surrounding structures [1, 11].

Chemical burns result from the effects of water vapor and the substances dissolved within it. Water vapor burns are extremely dangerous as the heat carrying properties of such air are 4000 times higher than dry air. The toxic substances most commonly present in smoke are: carbon monoxide, hydrogen cyanide, phosgene, ammonia and hydrogen sulfide. Hot particles of these substances can cause heat burns to the mucous membrane of the upper airways. The size of the particles affects how deeply they can penetrate into the respiratory tract. Particles of 10 μm are retained in the nasal cavity, while smaller particles of 1-2 μm can penetrate into the alveoli [4]. The chlorides and sulfides contained in fire smoke mix with water in the lower airways to form chloric and sulfuric acid, which can cause serious chemical injuries.

Inhalation injuries lead to damage to the mucous membrane and the respiratory epithelium. In the bronchial lumen, thick discharge accumulates, the evacuation of which is disturbed as a result of damage to the ciliary epithelium and impaired cough reflex. The damaged mucous membrane separates from healthy tissues, and together with the discharge forms blockages that close off the bronchial lumen. In the damaged lungs, the blood flow to the swollen airway increases and more exudative fluid and inflammatory mediators are released, causing a further increase in flow through the bronchial blood vessels [1, 4-6]. Current research has shown that the blood flow through the lungs may increase by as much as tenfold. The toxic substances present in the smoke stimulate the sensory nerve endings of the tracheobronchial tree causing the release of substances called neuropeptides, which cause the bronchial tubes to narrow. The above factors combined lead to impaired exchange of gases and an increase in hypoxia in the body.

## IDENTIFICATION OF RESPIRATORY TRACT BURNS BY EMERGENCY MEDICAL RESPONSE TEAMS

Treatment of patients with respiratory tract burns must begin with a thorough physical examination. Inhalation injuries should be suspected if a fire has broken out in an enclosed space and the victim has breathed in air containing toxic substances released by the high temperature [6-8]. Respiratory tract burns can be indicated by burns to the face as well as reddening of the lips. Particular attention should be paid to any burnt hairs around the nose and eyebrows or on the head as these may suggest exposure to high temperatures. During assessment of the patient's condition using a general test procedure, attention should be paid to symptoms indicating a blocked airway. The oral cavity should be inspected visually for any indication of burns. If the victim begins to show shortness of breath, or if additional sounds are heard such as inspiratory or inspiratory-expiratory stridor or blennorrhoea, this suggests serious damage to the airways with rapidly developing swelling of the upper airways. Lapses in consciousness caused by developing hypoxia can be compounded by symptoms resulting from poisoning by carbon monoxide or other toxic substances [1, 7-10, 12].

## EMERGENCY MEDICAL RESPONSE PROCEDURES IN CASES OF RESPIRATORY TRACT BURNS

As the first step, the victim should be evacuated from any place of danger. At incidents sites, paramedics work in cooperation with Fire Department personnel. Fire officers operate in the zone of immediate danger, applying first aid to stabilize the patient, and then hand over the victim to the Medical Response Team for further emergency medical care. Dirty clothing and jewelry should be removed as quickly as possible. Hot elements can transfer heat and if swelling occurs they can cause the so-called

band effect. The increasing swelling can cut off the blood supply to the peripheral parts of the body. Victims with inhalation injuries require systematic subjective and physical examinations in order to determine as quickly as possible whether they are displaying symptoms indicating a life-threatening condition. It is extremely important to discover for how long they were exposed to high temperatures, as well as obtain information on any pre-existing conditions the victim suffers from. The patient should be examined using to the ABCDE approach, or if the patient is injured, an examination according to ITLS standards (International Trauma Life Support – procedure for patients under pre-hospital care) should be used (Fig. 1). Crucial symptoms that can be confirmed by listening to the chest are diffuse rasping and wheezing with a prolonged exhalation phase.

Examination of the patient should begin with an overall general impression. Attention should be paid to the victim's overall appearance. While checking that there is no blockage to the airways, we should look for symptoms that may indicate respiratory tract burns. The priority is to keep the airways open in order to ensure proper exchange of gases. The battle against hypoxia requires the use of high flow oxygen therapy. Advanced clearing of the airways may be difficult to predict and complicated to carry out. It must be emphasized that there are no clear standards, recommendations or guidance for treatment by paramedics in emergency medical teams of patients with respiratory tract burns. The scientific literature recommends carrying out intubation in order to free the airways and ensure clear passage of air before sudden swelling occurs. The decision to intubate must be preceded by a thorough physical examination and a precise clinical assessment of the victim. The question to ask oneself is whether a patient with inhalation injuries requires intubation.

In the opinion of many authors, indications for ad hoc intubation of inhalation injury patients are often overestimated [17]. Research was conducted by Romanowski et al. in 2015 on 416 patients with skin burns and accompanying inhalation injuries. The authors found that over 40% of patients were extubated in under two days, and expressed the opinion that one third of the patients had not required intubation [18]. Intubation is vital if there are symptoms that indicate rapid development of blockage to the airways, rapidly increasing respiratory failure, burns over a considerable surface area of the body, or burns to the face, neck or oral cavity. Intubation should be carried out using the largest size intubation tube possible. A low-pressure cuff should also be used. The diameter of the intubation tube affects the possible occurrence of resistance in the airways, and is also of key importance during the removal of discharges collecting in the airways. The person carrying out the procedure must have a great deal of experience as repeated unsuccessful attempts at intubation may damage the upper airways, and cause an increase in swelling or complete blockage of the airways [1, 13-16]. Intubation inevitably involves sedating the patient, which halts the natural system that cleans out the airways, thus depreciating the function of the ciliary epithelium. This leads to the collection of discharge in the airways and complicates treatment of the inhalation injury. For these reasons, paramedics should carefully weigh up the use of ad hoc intubation.

An alternative to intubation is the LMA laryngeal mask airway, however LT laryngeal tubes are not recommended as ventilation using such devices is not effective if swelling is present in the glottis and the structures below it. Fitting such devices is difficult if there is considerable swelling, and inflating the cuff is simply impossible. Intravenous access should be used to start early fluid resuscitation at the scene of the incident. Thorough physical and neurological examinations are recommended.

Inhalation of irritants in smoke can cause powerful bronchial spasms, which can be treated by Emergency Medical Team using salbutamol. This relaxes the smooth bronchial muscles and reduces resistance in the airways [21, 22]. Proper treatment with analgesic opioid drugs such as morphine and fentanyl must be also be remembered, and if there are accompanying skin burns, the wound must be cooled and a local antiseptic and an appropriate dressing must be applied.

## INTUBATION BY A PARAMEDIC OF PATIENTS WITH RESPIRATORY TRACT BURNS

According to the Public Emergency Medical Care bill of the 6th September 2006 and the Regulation of the Minister of Health of the 20th April 2016 on emergency medical interventions and other healthcare treatment other than emergency medical treatment that can be provided by paramedics, a paramedic may only carry out unblocking of the airways using intubation in cases of sudden cardiac arrest. For cases of respiratory tract burns and symptoms of rapid blockage of the airways, the legislator did not define an appropriate procedure. Guidelines issued by many scientific associations emphasize the necessity of prompt intubation with the use of medication, which paramedics cannot employ if the patient's vital bodily functions are intact. At the site of an incident,

a paramedic must take the difficult decision whether to act outside the law in cases of ultimate necessity. Delaying intubation until sudden cardiac arrest occurs is out of the question.

If a standard Emergency Medical Team consisting of 2 paramedics is dispatched to a patient with suspected inhalation injuries, the medical dispatcher should, on the basis of the patient interview, immediately send a specialist team with a doctor, if available, or dispatch the Emergency Air Rescue in order to ensure the full range of equipment is on hand to prevent blockage of the airways. We must remember that patients with respiratory tract burns meet the criteria for referral to a specialist burns unit.

According to American Advanced Burn Life Support guidelines, the indicators for early intubation are:

- symptoms indicating rapid increase in blockage of the airways: wheezing, stridor,
- observed action of additional breathing muscles indicating increasing respiratory failure,
- degree of burns (TBSA) > 40-50% total surface area of burns,
- extensive deep burns to the face, oral cavity burns,
- considerable swelling or the risk that it may develop,
- increasing difficulty in swallowing,
- signs of impaired breathing, inability to remove discharge, increasing lapses in consciousness [20]

The guidelines recommend that if there is no direct indication of the need for intubation, the oral cavity and throat should be examined in all patients with burns to the face and neck in order to proceed to further actions relating to observation and monitoring of airway patency. From the point of view of emergency medical teams, implementation of the guidelines in Poland would make it possible to use vital life signs to identify patients who require urgent intubation. According to 2019 data from the Central Statistical Office and the Ministry of Health, Poland had 1206 standard medical teams comprising at least 2 paramedics, and 375 specialist teams with doctors [23, 24]. For many years there has been a significant reduction in the number of specialist teams. In this situation, it is vital that additional legislative regulations are implemented and the scope of emergency medical interventions carried out by paramedics is further expanded.

## CONCLUSIONS

Paramedics should operate on the basis of clear guidelines and algorithms for intervention in the case of inhalation burns, especially if symptoms begin to appear that indicate a rapid increase in swelling of the airways.

Paramedics cannot avoid difficult interventions with burns patients in the course of their work, especially with inhalation burns, and should be supported by appropriate legal regulations for implementing optimal procedures for ensuring airway patency. Adequate standards of intervention should be developed and implemented in emergency medical care with immediate effect.

## REFERENCES


1. Wróblewski P, Knefel G, Trzask M et al. Respiratory tract burn injuries. Pneumonol.Alergol. Pol.2011;79(4):298-304.
2. Smith DL, Cairns BA, Ramadan F et al. Effect of inhalation injury, burn size, and age on mortality: a study of 1447 consecutive burn patients. J Trauma. 1994;37:655-659.
3. Mlcak RP, Suman OE, Herndon DN. Respiratory management of inhalation injury. Burns. 2007;33:2-13.
4. Gupta K, Mehrotra M, Kumar P et al. Smoke Inhalation Injury: Etiopathogenesis, Diagnosis, and Management. Indian J Crit Care Med. 2018 Mar;22(3):180-188.
5. Hamahata A, Enkhbaatar P, Sakurai H et al. Effect of ablated bronchial blood flow on survival rate and pulmonary function after burn and smoke inhalation in sheep. Burns. 2009;35:802–10.
6. Kimla J, Glik A., Nowak-Wróżyna M et al. Physiotherapy in patients with inhalation injury in burns. J Orthop. Trauma Surg Rel Res. 2008; 1: 68-77.
7. Mlcak RP, Suman OE, Herndon DN. Respiratory management of inhalation injury. Burns.2007;33:2-13.
8. Cha SI, Kim CH, Lee JH. Isolated smoke inhalation injuries: acute respiratory dysfunction, clinical outcomes, and short-term evolution of pulmonary functions with the effects of steroids. Burns 2007; 33:200-208.
9. Ogura H, Sumi Y, Matsushima A et al. Smoke inhalation injury: Diagnosis and respiratory management. Nihon Geka Gakkai Zasshi. 2005;106:740-744.

10. Sheridan RL. Airway management and respiratory care of the burn patient. Int Anesthesiol Clin. 2000;38:129-45.
11. Toon MH, Maybauer MO, Greenwood JE et al. Management of acute smoke inhalation injury. Crit Care Resusc. 2010;12:53-61.
12. Enkhbaatar P, Pruitt BA, Suman O et al. Pathophysiology, research challenges, and clinical management of smoke inhalation injury. Lancet. 2016;388:1437-46.
13. Madnani DD, Steele NP, de Vries E. Factors that predict the need for intubation in patients with smoke inhalation injury. Ear Nose Throat J. 2006;85:278-80.
14. Güldoğan CE, Kendirci M, Gündoğdu E et al. Analysis of factors associated with mortality in major burn patients. Turk J Surg. 2018 Nov;20:1-8.
15. Burn and Trauma Branch of Chinese Geriatrics Society, Ming J, Lei P, Duan JL, Tan JH, Lou HP, Di DY, Wang DY. [National expert consensus on tracheotomy and intubation for burn patients (2018 version)]. Zhonghua Shao Shang Za Zhi. 2018 Nov 09;34(11):E006.
16. Badulak JH, Schurr M, Sauaia A et al.Defining the criteria for intubation of the patient with thermal burns. Burns. 2018 May;44(3):531-538.
17. Deutsch CJ, Tan A, Smailes S et al. The diagnosis and management of inhalation injury: An evidence-based approach. Burns. 2018 Aug;44(5):1040-1051.
18. Romanowski KS, Palmieri TL, Sen S et al. More than one third of intubations in patients transferred to burn centers are unnecessary: proposed guidelines for appropriate intubation of the burn patient. J Burn Care Res, 2016);37:409-414.
19. Matsumura K, Yamamoto R, Kamagata T et al. A novel scale for predicting delayed intubation in patients with inhalation injury. Burns. 2020;46:1201-1207.
20. Wachtel TL. Major burns. What to do at the scene and en route to the hospital. Postgrad Med. 1989;85:178
21. Advanced Burn Life Support [http://ameriburn.org/wp-content/uploads/2020/02/aba117_abls-brochure_022620.pdf. Accessed: 21.03.2020].
22. Palmieri TL, Enkhbaatar P, Bayliss R et al. Continuous nebulized albuterol attenuates acute lung injury in an ovine model of combined burn and smoke inhalation. Crit Care Med 2006;34:1719-24.
23. Palmieri TL, Enkhbaatar P, Sheridan R et al. Studies of inhaled agents in inhalation injury. J Burn Care Res 2009;30:169-71.
24. [https://www.gov.pl/web/zdrowie/zespoly-ratownictwa-medycznego. Accessed: 22.03.2020].
25. [https://stat.gov.pl/obszary-tematyczne/zdrowie/zdrowie/pomoc-dorazna-i-ratownictwo-medyczne-w-2018-roku. Accessed: 22.03.2020].
26. Sikora L, Misołek M, Krzywiecki A et al. Long-term results of airway's injury after a methane explosion. Otolaryngol Pol 2011;65(1):33-39.

**ORCID AND CONTRIBUTIONSHIP** *

Piotr Białoń – 0000-0002-9744-2678 A, B, D
Rafał Bobiński – 0000-0002-3649-5653 A, E, F
Monika Mikulska – 0000-0002-5412-010X A, E, F
Robert Kijanka – 0000-0003-1303-6734 B, D
Michał Szlagor – 0000-0002-9020-3252 A, D
Michał Ćwiertnia – 0000-0001-9576-8095 B, D
Tomasz Ilczak – 0000-0003-2478-9045 A, E, F
Małgorzata Rak – 0000-0003-0911-5309 A, E
Arkadiusz Stasicki – 0000-0002-4754-7308 B
Marek Kawecki – 0000-0001-9925-5297 A, E, F

**ADDRESS FOR CORRESPONDENCE**

Piotr Białoń
Katedra Ratownictwa Medycznego,
Wydział Nauk o Zdrowiu,
Akademia Techniczno-Humanistyczna
ul. Willowa 2, 43-309, Bielsko-Biała, Poland
e-mail: pbialon@ath.bielsko.pl

**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

**RECEIVED** 01.06.2020

**ACCEPTED** 05.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 296-305


REVIEW ARTICLE DOI: 10.36740/EmeMS202004109

# VARIOUS DIMENSIONS OF TRUST IN THE HEALTH CARE SYSTEM

Maciej Bartłomiej Rogala[1], Ewa Donesch-Jeżo[2]

[1] DEPARTMENT OF HEALTH POLICY AND MANAGEMENT, INSTITUTE OF PUBLIC HEALTH, FACULTY OF HEALTH SCIENCES, JAGIELLONIAN UNIVERSITY, MEDICAL COLLEGE, CRACOW, POLAND
[2] FACULTY OF PSYCHOLOGY AND HUMANITIES "ANDRZEJ FRYCZ MODRZEWSKI" CRACOW UNIVERSITY, CRACOW, POLAND

**Abstract**

Trust is one of the most important factors in building effective and long-lasting relationships in the entire healthcare sector. Trust becomes a valuable ally in situations of high risk and uncertainty as well as the increasing complexity of tasks that accompany the daily work of all medical professionals, especially paramedics, due to the nature of their work in the medical rescue system. Mutual trust is the basis of social capital thanks to which it is possible to achieve mutual benefits, easier to coordinate activities, create new quality and solutions through cooperation or strong ties. It is a kind of glue that binds various organizational and system links, thanks to which it is easier to plan and introduce necessary improvements and changes within individual medical units or the entire health care system. The high degree of trust increases the quality of clinical communication with the patient and the effectiveness of medical care and strengthens the employees' motivation and willingness to cooperate. Creating social capital based on trust is in the interest of all internal and external stakeholders of the entire health care system, thanks to which joint, cross-sectoral projects for health in the public dimension are possible.

**The aim of the article** was, on the one hand, to systematize the theoretical and practical knowledge related to the multidimensionality of trust in the health care system, but on the other, to identify and analyse the factors building trust that should be discussed and, above all, applied in everyday professional practice and social space of all employees of the health care system. with particular emphasis on paramedics.

**Key words**

health care system trust, interpersonal and impersonal trust, social capital, cooperation based on trust, medical professionals

## INTRODUCTION

Trust has a very complex nature and is considered in various dimensions, which results in difficulties in the elaboration of one unambiguous conceptualization. A concept of trust is usually analysed on different levels: interpersonal or impersonal/social and micro- or macro-levels [1, 2].

Trust is a subject of theoretical and empirical research in many scientific disciplines and areas of social activities. Its role is widely presented in both social and health sciences and medicine. Trust has been defined by many authors and its importance has been investigated in many contexts associated with individual subjects and public health. Among terms that are attributed to trust as having similar or close meaning are hope, confidence, trustworthiness, and faith. Different scientific interpretations of the concept of trust do not allow for one universal explanation, underlying interdisciplinary approach, and wide application of trust in simple individual interactions and all kinds of complex social relationships, which is especially important in all groups of health care professionals in their relations with patients and contacts both with individual organizations and the whole health sector [2-5].

Theoretical approaches, conceptual analyses, and empirical data concerning trust emphasize a broad understanding of this concept which requires different criteria for its classification. The significance of trust in social life is manifested in various dimensions and in many scientific disciplines such as sociology, management, economics, ethics, psychology, public health, and medicine. Numerous definitions of trust in both general and medical context stress its feature of "optimistic acceptance of the vulnerable situation in which the truster believes that the trustee will care the truster's interests," and in a broader sense, trust is described as "the lubricant of the social system". Moreover, studies confirm the importance of mutual trust as a factor in improving cooperation and reducing the need for monitoring [6-8].

Research also suggests a significant contribution of trust to the development of cooperative or collaborative relationships in many aspects of social interactions [9]. These features seem to play a significant role in an everyday work of paramedics where relations

based on interpersonal and systemic trust build positive relations and social networks, shape collaboration, which usually results in higher motivation. Conversely, the lack of trust or its low level may hinder or prevent effectiveness, collaboration, and even not lead to planned organizational or systemic change.

For many years practical implications of trust in the health care system have been widely studied and discussed. Results of research and clinical practice revealed a positive role and influence of trust in all health care relationships and settings and a strong link between patient's trust in health care professionals and health outcomes [10-12]. What is more, trust in health care is regarded as one of the key factors which may support effective treatment and create a foundation for patient-centred care [13, 14]. Research findings require not only their implementation but also the dissemination of the knowledge and benchmarking of good practices on how to build trust-based relationships among all health care professionals including paramedics working in the emergency system.

## REVIEW AND DISCUSSION

### DIFFICULTIES WITH UNAMBIGUOUS TRUST EXPLANATION

Among known and common views on trust cited in literature which emerged from theoretical analyses are definitions proposed by modern and influential representatives of social sciences such as Erik H. Erikson, Anthony Giddens, Michel Foucault, Francis Fukuyama, Niklas Luhmann, James Coleman, Martin Hartmann, Russell Hardin, Diego Gambetta, and Piotr Sztompka. All of them have made a significant contribution to the knowledge about trust and understanding of this concept, which in consequence created an area for studies for many contemporary researchers analysing the influence of trust on different levels of relationships in the whole health care system. The conceptualizations of trust offered by the above-mentioned authors often contained terms related to it such as "leap of faith", "willingness to be vulnerable or to take a risk", "a key component of social capital", "a component of power-knowledge and true-telling" or "belief in the responsibility for others". The results of many studies suggest that it is difficult to elaborate one general definition of this concept because trust has been investigated from many perspectives and in many disciplines. This resulted in many theoretical approaches derived from different backgrounds. Among these approaches, an especially interesting and important for the goals of this paper seems to be the one treating trust as a basic component of social capital as a kind of glue that bonds and bridges distinctions, strengths weak ties, creates a sense of community between disconnected networks and forms a kind of social fabric of connection and collaboration [15].

Although there are many differences in conceptualisations and theories dealing with trust, they all have one common element – all of them emphasize the distinct role of trust in the functioning of societies including health care systems. Looking for similarities in the definitions, it needs to be pointed that trust can develop from three main factors: experience, information/knowledge, or an expected outcome, all of which are based on the trusting relationship. Trust is usually built on some uncertainty and is associated with risk because the outcome of a trusting relationship cannot is unpredictable [2, 16].

In this place, it is worthy to present the approach to this concept proposed by researchers engaged in studies on trust in medical institutions and health care systems. On the one hand, this approach emphasizes the general and multidimensional nature of trust and on the other hand, the important role of trust in health care. The approach has been named the "optimistic acceptance of a vulnerable situation" which indicates that the trustee believes that the trustor will take care of the trustee's interests or will act in his/her best interests at heart [1, 7, 8].

Other known classical trust conceptualization depicts "the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" [17] and "a state involving confident positive expectations about another's motives with respect to oneself in situations entailing risk" [18, 19].

A common situation associated with trust is a kind of relationship between minimum two individuals which is described as "A trusts B to do – or not to do – X". A trusting relationship is also described between groups as "A – group, B – group" of people, organisations, institutions, companies. Trust is based on relations and is developed by the exchange of "truthful" information without which trust cannot be built. It is emphasized that truthful information is especially important in health care, as it allows, for example, to make an informed decision in the patient consent process [16]. The studies on trust show that it applies to people, social or organizational systems, that is, to individual persons, groups, social entities, relations between people and groups [20].

Assuming that trust is regarded as a kind of optimistic acceptance of a vulnerable situation that focuses on the positive intentions of the trusted individual or organisation, it should be taken into attention that this concept is always associated with some uncertainty regarding activities, behaviours, and attitudes that may or may not occur. Trust allows people to undertake present or future decisions based on previous experience and the knowledge of the past, which minimizes the risk associated with undertaking actions. A part of researchers suggest that trust occurs only in risky situations. In situations without risk, we can speak about confidence or expectation rather than trust [1, 21, 22]. The outcomes of studies indicate that:

1. trust is associated with uncertainty;
2. trust is accompanied by fear of losing something valuable;
3. trust concerns a partner whose attitudes and actions cannot be fully controlled [23].

Some researchers distinguish 5 categories of trust which make a continuum − from distrust (deterrence-trust), low trust (calculus-based trust), confident-trust (knowledge-based trust), high/strong trust (relational-based trust) to complete trust (identification-based trust). This classification includes five fundamental types of experiencing trust based on its intensity [19].

The very act of trusting someone elicits a reciprocal reaction, which favours building relationships on both sides – that of a truster and a trustee. Although trust is a consequence of the assessment of the reliability of the relationship between partners, it is not an objective phenomenon, as it is established on individual perception. As a rule, trust may result from the evaluation, direct or indirect, of the data reflecting the trusted person's attitudes, behaviour, characteristics, and qualities. Trust is dynamic and is conditioned by the dynamics of relations between the two parties participating in interactions. The tendency to trust others is individual. In interpersonal trust, the credibility of the other person is the basis of trust, and because it is connected with the perception of another person, it can be subjected to evaluation. Establishing credibility occurs through certain determinants which depict someone credible and someone unreliable based on specific features, characteristics, or behaviours. Researchers of the problem of trust have put forward many determinants of credibility, and it is impossible to create a closed list of them, since they include a variety of concepts such as motivation, personality traits, competencies, honesty, predictability, intentions, abilities, consistency, openness, keeping promises and reliability [19, 24, 25].

In the debates about trust conceptualizations, the distinction has been made between two opposites on one continuum – trust and distrust (a lack of trust). Later this distinction between trust and distrust has been changed and currently, trust and distrust are regarded as two separate constructs that differ from each other by contrasting characteristics and determinants. One of the approaches describes trust and distrust in terms of disposition. Distrust is not only the absence of trust but is also seen as "an actor's assured expectation of intended harm from the other" while "disposition to trust means the extent to which one displays a consistent tendency to be willing to depend in general on others across a broad spectrum of situations and persons" [26, 27]. Trust is based on "confident positive expectations regarding another's conduct" whereas distrust is based on "confident negative expectations regarding another's conduct" [28]. Researchers of this problem also distinguish a culture of trust and culture of distrust. In this perspective culture of distrust is characterised by "a pervasive, generalized climate of suspicion" that in consequence can lead to alienation and passivism [29].

Empirical studies on trust indicate a relationship between trust, and monitoring, and controlling. Investigations have provided evidence that there is an inverse association between trust and monitoring and controlling. On the one hand, the primary value of trust is linked to the reduction in monitoring and controlling, which means that there is no need to monitor and control the activities and behaviour of a fully trusted partner. On the second hand, reduction in monitoring and control is associated with the increase of trust and may positively influence joint working, open communication, problem solving, and gradual improvement that can be used in project management. The pointed out role and effects of trust will be presented in the next parts of this paper [9].

## MULTIDIMENSIONALITY OF TRUST IN ORGANISATIONS

The multidimensional theory of trust does not facilitate the resolution of problems on how to explain its wide application and importance. Trust is described as a complex phenomenon associated with many theories and approaches. As a construct, trust has a strong background in sociology but its role is also deeply discussed in psychology, economics, management, and philosophy. Its role in individuals, organisations and other social processes is widely discussed. Researchers from many disciplines treat trust as a factor contributing to many benefits in interpersonal and social interactions and emphasize its role in health care organizations [21]. These findings

are a subject of many analyses and scientific studies on how to use the knowledge and the gained interdisciplinary experience in organizational processes in the everyday work of professionals in health care systems [7].

Described in this paper difficulties in generalising trust as a concept are strongly associated with its function in societies. Human future-oriented actions are accompanied by uncertainty or risk. Uncertainty is connected with contingent actions of others – we never know how the partners in our interactions and social relationship will react. Based on their rational calculations, people estimate the amount of risk they can take or, in other words, to what extent they can trust others [21, 30].

Regardless of the differences in approaches to trust, problems in agreeing on an unambiguous definition of this concept or the scientific discipline which should examine the effects of trust, it is assumed, and seems to be a common point of view, that trust plays an important role in every organization, including health care institutions in which health professionals work, including rescuers performing their professional functions across the entire medical rescue system. Trust is an indispensable condition for building and continuity of various relationships and is particularly important in the professional sphere of man, as it effectively determines the activity and co-operation between people, institutions, or entire systems, which is particularly important in the sphere of health protection [3, 4, 6, 16, 24].

Three levels of trust emerge: interpersonal trust in a given organization, a person's trust in the organization, and trust between organizations. Each of these levels plays a significant role in the health care system [7, 24].

Many studies show an important role of trust in organizations in the context of interpersonal behaviour and management. As a rule, trust arises in risky situations and is therefore assumed to be related to the management of uncertainty or risk. It has been proven that a high degree of trust is necessary to engage employees effectively in co-operation and enhance the effectiveness of the organization. Besides, trust at the interpersonal level allows us to increase trust at the organizational level [23].

As it seems, the results of studies on trust should be taken into account by all health care organizations, especially those that operate in an acute mode and admit patients in emergences performing their tasks in the face of high risk and crises, where trust is or should be one of the cornerstones of their professional business.

Studies indicate the importance of trust as an integral factor of creating a business or professional relationship and affecting the effectiveness of the strategic management process in the context of communication with external partners, with employees and as a factor that can decrease the costs of transactions. Moreover, trust may turn valuable in exchange relationships. [4, 23].

The research results indicate the crucial role of leaders and managers as people who should build a long-term partnership with external and internal stakeholders and systematically participate in building a dialogue with them. Trust strengthens cooperation and is one of the key elements of the assessment of internal relations between managers and employees. A high level of trust in an organization translates into better information exchange between people, better engagement of co-workers, greater loyalty and innovation as well as willingness to cooperate [9, 23, 31].

It is also assumed that trust is a critical factor influencing three important areas in organizations such as coordination of activities, risk-taking, and facilitates mobilization of resources for productive activities. Trust is important in all institutions and essential in the context of organizational change because it is usually connected with increased complexity, uncertainty, and risk. In situations of change, people always need at least a minimum of trust in their leaders who are responsible for planning, implementation, and evaluation of change in the organization. Additionally, trust strongly influences employees' compliance with managers' decisions, which is important not only in everyday activities but also at the stage of formulation and development of strategies and change initiatives. In this meaning, trust between managers and employees may create a kind of interface between the development and realization of strategic initiatives. Empirical findings also suggest that some highly successful organizations acting in high turbulence environment were able to make better and faster decisions because of effective and multimodal communication channels based on trust [9, 17, 20, 23, 24, 31].

While trust shapes the initiation and development of organizational relationship in a workplace, distrust works in the opposite direction having an impact on the dissolution of these relations. Structures in organizations based on personal networks and friendships are more vulnerable to the detection of relevant environmental stimuli and the mobilization of resources that can be used during change strategies. Conversely, weak ties in organizations may result in the

inability to identify serious signals from the environment and obstruction of the mobilization of resources necessary to plan, organize, and implement some organizational change [32, 33].

Theoreticians and researchers of this problem alike indicate that among many benefits to organizations, trust supports the development of important initiatives and helps solve problems connected with an open exchange of information and knowledge, process of inter-organizational learning, conflicts between organizations, coordinating economic activities, organizational changes, and adaptation. Moreover, trust is regarded as a factor positively influencing a significant reduction of transaction costs, creation of joint strategies, facilitation of investments in a long-term perspective, and limitation of opportunism [23, 24, 32, 33]. The dependencies described in this part of the article apply to organizations both in a private and public sector, they are cross-sectoral and can be successfully used in all health care institutions which employ paramedics.

## ROLE OF TRUST IN THE HEALTH CARE SYSTEM

Trust in healthcare is generally defined as a set of patient's expectations from the healthcare system to help them cure their medical problem. These expectations include appropriate diagnosis, correct treatment, non-exploitation, interest in the patient's welfare and transparent disclosure of information. Collected data about trust indicate that it plays a substantial role in improving the performance of the healthcare system which is defined by the WHO "as comprising all the organizations, institutions and resources that are devoted to producing health actions. A health action is defined as any effort, whether in personal health care, public health services or through intersectoral initiatives, whose primary purpose is to improve health" [34-37].

The fundamental function of trust in health care system derives from the fact that the health care provision is based on uncertainty and unpredictability and its erosion may lead to the breakdown of cooperation in the area of health [3, 35].

Practical application of trust is widely analysed in health care sectors which results in numerous scientific research in the field of medicine and public health examining the importance of this concept in various areas and explaining its significant role in all health care relationships. Importance of trust in health sector refers to two basic aspects of trust: interpersonal trust between individuals and social trust between institutions which are the subject of many analyses and empirical studies. Results of theoretical and practical research indicate that trust can be treated as one of the important factors in the improvement of performance in the health care system. Moreover, trust is regarded as one of the main ingredients of effective, high-quality health care. The findings also recognize the influence of trust on health outcomes [7, 8, 38, 39].

Trust between different actors in the healthcare triangle (between insured and insurers, healthcare insurers and providers, healthcare providers and patients) in the healthcare system facilitates the cooperation that is necessary to reach the goals of healthcare systems. Although a majority of research on trust is focused on interpersonal trust between patients and healthcare providers, it should be mentioned that interpersonal trust may also affect the functioning of healthcare systems and their components. The institutional trust may be observed in health care providers in general, the medical professionals, hospitals and other medical institutions. Trust between the actors in the healthcare triangle may affect the effectiveness, efficiency and the longevity of these relationships, quality of care, and overall success of policies [1, 40, 41].

As has been mentioned earlier, trust is distinguished into interpersonal trust including the day-to-day interactions between individuals, and social trust which may build through the collective actions of social institutions. In this meaning, trust is categorised according to the object of trust and may be analysed as trust in individual healthcare professionals and trust in healthcare institutions [7, 8, 34].

Trust in the healthcare system is understood as a combination of trust in the healthcare providers (called as an individual trust) and trust in the healthcare institutions (called as institution trust) which create a conceptual model named as health care system trust. The main elements of this system which influence trust include sociodemographic factors, previous experience with providers and institutions, cultural factors and media influence. Among the benefits of health care system trust are: better adherence, improved health-seeking pattern, increased health care utilisation and improved communication. Researchers analysing the influence of trust in health care emphasize that the health care system trust should be characterized by transparency in the transactions between healthcare professionals and individuals, effective communication between them necessary to build trust, delivery of quality services by public healthcare institutions. Health care providers should be competent to correctly prevent, diagnose and treat diseases. Collected data suggest that trust in the healthcare provider (individual trust) and trust

in the healthcare institution (institutional trust) may be regarded as one of the key factors contributing to trust in the public healthcare system [8, 16, 34, 42].

Researchers indicate that personal experience is substantial in the process of trust-building and point out the following correlation: if people have personal experience of medical staff, they trust more. Moreover, personal experience with health care system representatives encourages the transfer of trust in these representatives to trust in the wider health care system [16].

Trust in health care can be measured and is an area of many studies and analyses. Among common used scales are Public Healthcare System Trust, Multidimensional Trust in Health Care System Scale, Trust in Primary Care Physician Scale, Primary Care Assessment Survey, Trust in Physician Scale, Physician Trust Scale, Health Care Relationship Trust Scale and developed Health Care Relationship Trust Scale Revised, Health Insurance Organization Trust Scale, Whole Health System Trust Scale and the Medical Professions Trust Scale. They generally refer to individual and institutional trust and include indicators such as quality, communication, transparency, reliability, fidelity, honesty, openness, advocacy and administrative and clinical competence [2, 8, 16, 43]

Trust as a multidimensional construct cannot be measured directly and it is difficult to measure it due to its complexity. The majority of used scales measure trust in different components of the healthcare system and only a few asses this system as a whole. According to recommendations, measuring trust in the healthcare system facilitates building a system which may be more trustworthy and based on better health outcomes [8].

Studies show an influence of trust on health outcomes is connected with patient's satisfaction, adherence to treatment and continuity of care with a health care provider. Moreover, trust encourages patients to access health care as well as results in a higher quality of interaction, and lower transaction costs in the health system. Additionally, trust enables health care providers to encourage necessary behavioural changes and may grant patients more autonomy in decision-making about treatment. It is worthy to emphasize that patients having trust in health care professionals reported more beneficial health behaviours, fewer symptoms and higher quality of life and were more satisfied with treatment. Collected data suggest that relationships based on trust are especially important in chronic disease management as a factor contributing to adherence with medical advice and is perceived as a crucial component of effective therapeutic procedures [1, 2, 37, 44-47].

Research data show that there is a kind of connection between trust and satisfaction. On the one hand, trust has the same functional attributes as satisfaction and on the other hand, satisfaction is based on an assessment of past events, while trust is based on a forward-looking evaluation of an on-going relationship [1, 39, 48]. Some empirical research also present a specific problem of the relation between trust and dependence especially in emergencies when patients have no choice (dependence) and "have to trust" in the medical system and their medical members. Responses of participants taking part in the research suggest the dependence of these patients on the medical emergency system rather than a trust which is based on choice. The problem of a clear distinction between trust and dependence remains unresolved because any emergency circumstances are characterized by immediate risk and an urgent need for medical attention which can be provided only by medical professionals. In these situations, patients who were participants of the research despite earlier negative experiences with the medical system and health professionals, indicated that they had no other choice but to trust in medical professionals in emergency situations because they were dependent on them. They passively accepted performed actions in situations of health or life risk and patients' compliance or submission resulted not from the trust but rather dependence [21].

Degree of competence presented by medical professionals is regarded as a key factor affecting trust. Studies indicate that patient's experience can be associated with the expectation of care and appropriate cure and with the nature of the relationship with a particular health care provider including concern and empathy. On the other hand, some findings suggest that trust may arise when patients are convinced about medical professionals' competencies which include [3, 49]:

- carrying out appropriate tests to confirm the diagnosis before treatment;
- consistent diagnoses between colleagues;
- calling a senior colleague promptly when the case requires it;
- ability to identify a serious case through triage and prioritise treatment accordingly;
- consistent follow-up of patients to check progress.

The importance of trustworthiness of individual health professionals and healthcare institutions (hospitals, health centres, emergency system) and forms of professionalised knowledge which are crucial for health systems to function in the interest of society have been emphasized [47].

Continuing the theme of professional competences, it is worthy to note an example of research measuring trust among health care professionals in Poland − a study comparing the level of trust in physicians, nurses and paramedics which indicated in patients' opinion important advantages and disadvantages of each of these occupational groups. The questionnaires included four areas of questions such as contact with the patient (good/wrong), manual skills (possessing/lack), diagnosis/therapy (accurate/wrong) and level of knowledge (high/low). In respondent's assessment, the best advantages of physicians were the accuracy of the diagnosis and therapy and high level of knowledge and the best advantages of nurses were good contact with a patient and manual skills and in case of paramedics − manual skills and high level of knowledge. The respondents pointed that among the biggest disadvantages of physicians were wrong diagnosis/therapy and bad contact with patients, the biggest disadvantages of nurses were bad contact with a patient and low level of knowledge and of paramedics low level of knowledge and bad contact with a patient [50].

Although some researchers analysing the importance of trust in health care system have primarily focused on the relationship between physicians and patients, over time, the issue of trust also began to be raised in relationships between patients and health care teams, particular health care providers and organizations as whole systems and also managers supervising health care units [3, 46]. In this meaning, research indicate also benefits of trust between managers and medical professionals which reduces the need for monitoring and may result in bigger job satisfaction and staff retention as well as higher efficiency of organisational performance.

In the face of uncertainty and risk at various levels (low, medium or high), there is usually uncertainty related to the motives, intentions or future actions of other people. These circumstances strengthen the need for trust, and in health care − as suggested by the results of various studies − it manifests itself through embracing confidence in competence understood as skills and knowledge and whether the trustee will work in the best interests of the trustor [17, 46, 51].

Collected and interpreted data about trust emphasize the fact that successful and sustainable cooperation results in a foundation of trust and reciprocity as well as the reduction of complexity and risk [52]. These values seem to be invaluable and it is worth considering how to put them into practice or improve their functioning in the face of the challenges encountered by modern medicine, health care systems in various countries, as well as people who shape it daily, being its integral part as medical professionals.

## CONCLUSIONS

The article shows the multidimensionality of trust and the role it plays in the entire health care system. The collected cross-sectional data on the importance of the concept research proves that mutual trust improves long-term and effective cooperation, reduces the need for monitoring, and triggers reciprocity. Moreover, it is the basic factor that builds social capital and a kind of glue that binds various organizational and system links, thanks to which they can efficiently implement their goals and tasks.

Trust is especially important in situations where the degree of risk, uncertainty, and complexity increases, as it allows us to reduce them and deal with them better. The fact that people can trust each other in situations requiring effort, cooperation, stress, and challenges has a positive effect on their relationships, which in such situations can strengthen and further develop positively. Research shows that a high degree of interpersonal trust translates into increased trust in the activities of health care units and the entire health care system, which seems to be a positive effect of shaping a culture based on trust ties, not only in the interpersonal but also in the wider context − general society.

It should be noted here that the professional duties of paramedics working in the medical rescue system are particularly burdened with risk and the occurrence of uncertainty as well as complexity. That is why building a climate of trust is so important both concerning patients who need emergency medical care, as well as members of the medical rescue team with whom they work daily, as well as other employees and superiors in the organization and the entire medical rescue system.

Trust in health care can be assessed at the three mentioned levels: interpersonal, organizational, and systemic. Thanks to trust at the interpersonal level, especially concerning the relationship between patients and medical professionals, a better level of adherence and compliance to treatment is observed, as well as a higher level of satisfaction with medical care, greater willingness to use health care services, including the continuation of care with a specific health care provider, as well as the perceived higher health-related quality of life.

Thanks to trust at the organizational level, it is possible to create joint plans aimed, on the one hand, at the improvement of a medical institution or effective change management, and on the other hand, at

its efficient functioning. A high degree of trust in the organization is reflected in the willingness to cooperate and exchange information, greater commitment to work, loyalty of employees and innovation, and allows the mobilization of human resources in the situation of organizational change.

Thanks to trust at the system level, it is possible to establish relationships with various stakeholders and joint implementation of projects, including cross-sectoral projects, and to implement innovative strategic solutions for development in both the public and private spheres in the healthcare sector.

Trust is born out of previous experiences, information, or expected results, where there is always some element of risk and uncertainty as to whether the person, organization, or system will behave and perform as expected. This unpredictability is inherent in social interactions and is unlikely to ever go away. Trust in the area of health is something special since it is one of the most important life values for people, and a successful fight for health protection can undoubtedly build a huge credit of trust.

However, it is worth remembering that in addition to the so-called hard competencies, which constitute the core of trust in health care, interpersonal skills also seem to be important. Establishing and maintaining relationships through open communication based on facts and reliable analysis of the situation may provide a chance to create a platform which, if it results in mutual trust − and taking into account the results of previous research on this subject − may be beneficial for all sides of this relation. Trust breeds trust, which, especially in the times of the coronavirus pandemic and many other threats to health in the individual and public dimension, seems to be an invaluable value.

## REFERENCES


1. Gilson L. Trust and the development of health care as a social institution. Soc Sci Med. 2003;56(7):1453-1468.
2. Pearson SD, Raeke LH. Patients' trust in physicians: many theories, few measures, and little data. J Gen Intern Med. 2000;15(7):509-13.
3. Calnan M, Rowe RJ. Researching trust relations in health care: conceptual and methodological challenges-introduction. Health Organ Manag. 2006;20(5):349-5.8
4. Tschannen-Moran M, Hoy WK. A Multidisciplinary Analysis of the Nature, Meaning, and Measurement of Trust. Rev Edu Res. 2000;70(4):547-93.
5. Croker JE, Swancutt DR, Roberts MJ, Abel GA, Roland M, Campbell JL. Factors affecting patients' trust and confidence in GPs: evidence from the English national GP patient survey. BMJ open. 2013:3(5).
6. Hall M, Camacho F, Dugan E, Balkrishnan R. Trust in the Medical Profession: Conceptual and Measurement Issues. Health Serv Res. 2002;37(5):1419-439.
7. Hall MA, Dugan E, Zheng B, Mishra AK. Trust in physicians and medical institutions: what is it, can it be measured, and does it matter? Milbank Q. 2002;79(4):613-39.
8. Egede LE, Ellis C. Development and testing of the Multidimensional Trust in Health Care Systems Scale. J Gen Intern Med. 2008;23(6):808-15.
9. Meng X. The role of trust in relationship development and performance improvement. J Civ Eng Manag. 2015;21(7):845-853.
10. Lee YY, Lin JL. Linking patients' trust in physicians to health outcomes. Br J Hosp Med. 2008;69(1):42-6.
11. Safran DG, Taira DA, Rogers WH, Kosinski M, Ware JE, Tarlov AR. Linking primary care performance to outcomes of care. J Fam Pract. 1998;47(3):213-20.
12. David AS. Communicating in times of uncertainty: the need for trust. J Health Commun 2003;8(S1):13-14.
13. Barry MJ, Edgman-Levitan S. Shared decision making – pinnacle of patient-centered care. New Engl J Med. 2012; 366(9):780-1.
14. Hughes JC, Bamford C, May C. Types of centeredness in health care: themes and concepts. Med Health Care Philos. 2008;11(4):455-63.
15. Leith D. Representations of the concept of trust in the literature of Library and Information Studies. Cosmopolitan Civil Societies: Interdiscipl J. 2013;5:3.
16. Gille F. Theory and conceptualisation of public trust in the health care system: Three English case studies: care.data, biobanks and 100,000 Genomes Project. PhD thesis, London School of Hygiene & Tropical Medicine; 2017.
17. Mayer RC, Davis JH, Schoorman FD. An integrative model of organizational trust. The Academy of Management Review. 1995;20(3):709-34.

18. Boon SD, Holmes JG. The dynamics of interpersonal trust: resolving uncertainty in the face of risk, In: Hinde RA, Groebel J (eds). Cooperation and prosocial behaviour. Cambridge: Cambridge University Press.1991, pp. 190-211
19. Dietz G, Hartog D. Measuring trust inside organisations. Person Rev. 2006;35(5):557-588.
20. Wekselberg V. Reduced "Social" in a New Model of Organizational Trust. Acad Manag Rev. 1996;21(2):333-35.
21. Meyer S, Ward PR. Reworking the sociology of trust: making a semantic distinction between trust and dependence. The Future of Sociology. Proceedings of the Australian Sociological Association conference. 2009, pp. 1-16. [https://dspace2.flinders.edu.au/xmlui/bitstream/handle/2328/26057/Meyer%20Reworking.pdf?sequence=1. Accessed: 20.08.2020]
22. Dugan E, Trachtenberg F, Hall MA. Development of abbreviated measures to assess patient trust in a physician, a health insurer, and the medical profession. BMC Health Serv Res. 2005;5:64.
23. Sołoducho-Pelc L. The Importance of Trust in the Implementation of the Strategic Management Process. Inter J of Contemp Manag Vol. 2017;16(4):237-261.
24. Jaklik A, Łaguna M. Zaufanie w organizacji. Analiza sposobów ujęcia i modeli teoretycznych. Psychol Spol. 2015;10/4(35):369-382.
25. Sztompka P. Zaufanie. Fundament społeczeństwa. Kraków: Znak, 2007.
26. van de Walle S, Six F. Trust and distrust as distinct concepts: Why studying distrust in institutions is important. J Comparat Pol Anal Res Pract. 2013:158-174.
27. McKnight HD, Chervany NL. Trust and distrust definitions: One bite at a time. Trust Cyber Soc. 2001:27-54.
28. Lewicki RJ, McAllister DJ, Bies, RJ. Trust and distrust: New relationships and realities. Acad Manag Rev. 1998;23(3):438-458.
29. Sztompka P. Trust, Distrust and Two Paradoxes of Democracy. Eur J Soc Theory. 1998:1(1):19-32.
30. Sztompka P. Trust and emerging democracy: lessons from Poland. Inter Soc. 1996:11(1):37-62.
31. Holland P, Cooper BK, Pyman A. Trust in Management: The Role of Employee Voice Arrangements and Perceived Managerial Opposition to Unions. Hum Res Manag J. 2012;22(4):377-391.
32. Johansen ST, Selart M. Expanding the role of trust in the management of organizational change. Expanding the Role of Trust in the Management of Organizational Change. In: Lines R, Stensaker I, Langley A (eds). New Perspectives on Organizational Change and Learning. Bergen: Fagbokforlaget. 2014:259-280.
33. Dirks KT, Ferrin DL. The Role of Trust in Organizational Settings. Organ Sci. 2001;12(4):450-467.
34. Anand TN, Kutty VR. Development and testing of a scale to measure trust in the public healthcare system. Indian J Med Ethics. 2015;12(3):149-57.
35. Maynard A, Bloor K. Trust and performance management in the medical marketplace. J R Soc Med. 2003;96(11):532-539.
36. WHO. The world health report 2000 – Health systems: improving performance. Geneva: World Health Organization; 2000.[https://www.who.int/whr/2000/en/. Accessed: 08.09.2020]
37. Attar GE. Trust in the Health System: The Case of Cardiology Patients in Turkey. Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi Haziran 2018;22(2):961-976.
38. Campos-Castillo C, Woodson BW, Theiss-Morse E et al. Examining the Relationship Between Interpersonal and Institutional Trust in Political and Health Care Contexts. In: Shockley E, Neal TMS, PytlikZillig LM et al (eds.) Interdisciplinary Perspectives on Trust. Towards Theoretical and Methodological Integration. 2016, pp. 99-115.
39. Robinson CA. Trust, Health Care Relationships, and Chronic Illness: A Theoretical Coalescence. Glob Qual Nurs Res. 2016;3:1-11.
40. Groenewegen P, Hansen J, de Jong JD. Trust in times of health reform. Health Policy. 2019;123(3):281-287.
41. Wilk AS, Platt JE. Measuring physicians' trust: a scoping review with implications for public policy. Soc Scien Med. 2016;165:75-81.
42. Van der Schee E, Braun B, Calnan M et al. Public Trust in Health Care: A Comparison of Germany, the Netherlands, and England and Wales. Health Policy. 2007;81(1):56-67.
43. Gopichandran V, Wouters E, Chetlapalli SK. Development and validation of a socioculturally competent trust in physician scale for a developing country setting. BMJ open. 2015;5(4):e007305.

44. Birkhäuer J, Gaab J, Kossowsky J. Trust in the health care professional and health outcome: A meta-analysis. PLoS One 2017;7/12(2):e0170988.
45. Jin J, Sklar G, Sen Oh VM. Factors affecting therapeutic compliance: A review from the patient's perspective. Ther Clin Risk Manag. 2008;4(1):269-286.
46. Rowe R, Calnan M. Trust relations in health care: Developing a theoretical framework for the "new" NHS. J Health Organisat Manag.2006;20(5):376-96.
47. Meyer S, Ward PR, Coveney J. Trust in the health system: An analysis and extension of the social theories of Giddens and Luhmann. Health Soc Rev. 2014;17(2):177-186.
48. Hall MA, Zheng B, Dugan E et al. Measuring patients' trust in their primary care providers. Med Care Res Rev.2002;59:293-318.
49. Rachel A. What causes patients to trust medical professionals? Insights from mothers in Juba. South Sudan Med J. 2017;10(2):33-36.
50. Klepacka M, Bakalarski P. Trust of society towards selected medical professions – doctors, nurses, paramedics. Critic Care Innov. 2018;1(2):1-10.
51. Borum R. The Science of Interpersonal Trust. Ment Health Law Policy Fac Public. 2010;1.
52. Calnan M, Rowe R, Entwistle VA. Trust relations in health care: An agenda for future research. J Health Organ Manag. 2006;20(5):477-84.

**ORCID AND CONTRIBUTIONSHIP** *
Maciej Bartłomiej Rogala – 0000-0001-8104-7617 A,B,D,E,F
Ewa Donesch-Jeżo – 0000-0002-4655-8822 D,F

**CONFLICT OF INTEREST**
Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**
Maciej Rogala
Zakład Polityki Zdrowotnej i Zarządzania,
Instytut Zdrowia Publicznego,
Wydział Nauk o Zdrowiu,
Uniwersytet Jagielloński Collegium Medicum
ul. Grzegórzecka 20, Kraków
e-mail: maciej.rogala@uj.edu.pl

**RECEIVED** 19.09.2020
**ACCEPTED** 04.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 306-312


REVIEW ARTICLE DOI: 10.36740/EmeMS202004110

# PREHOSPITAL MANAGEMENT OF ACCIDENTAL HYPOTHERMIA

Maciej Otworowski[1], Krzysztof Sośnicki[1], Elżbieta Cipora[1], Andrzej Kotela[1,2]

[1] MEDICAL INSTITUTE, THE JAN GRODEK STATE UNIVERSITY IN SANOK, SANOK,POLAND
[2] INSTITUTE OF MEDICAL SCIENCES, FACULTY OF MEDICAL SCIENCE, COLLEGIUM MEDICUM, CARDINAL STEFAN WYSZYŃSKI UNIVERSITY IN WARSAW, WARSAWA, POLAND

**Abstract**

The accidental hypothermia can be diagnosed if a body temperature fall below the 35°C. It is frequently encountered in Poland. It was the cause of death of 1836 people between 2009 and 2012.

**The aim of our paper** was to present the current state of the art regarding prehospital management of the hypothermic patient.

The gold standard of internal body temperature measurement is by an esophageal probe.

The hypothermic patient should be handled very carefully. The wet clothes should be cut and the patient should be covered with insulation materials. Active rewarming should be initiated in all of the patients in severe and mild hypothermia. After finding an unconscious person who is likely to be in hypothermia, the search for signs of life should take 60 seconds. When CPR is started it should be conducted with standard protocols. Infusion fluids should be heated and the preferred ones are: 0,9% NaCl and crystalloids. No antiarrhythmic or vasoconstrictive drugs should be given in patients with internal body temperature below 30°C.

**Conclusions:** We should encourage providers to equip the rescue teams with the active rewarming devices and insulation materials. The prevention of further heat loss in hypothermic patient is of the greatest importance. The life support should be centered around cardiopulmonary resuscitation with quality chest compressions and adequate ventilation. The definitive treatment of patients suffering from deep hypothermia is most effective in specialist centres dedicated to treating this condition. Air transportation is preferred to land transportation.

**Key words**

hypothermia, resuscitation, prehospital

## INTRODUCTION

Between 2009 and 2012 1836 people had died due to hypothermia in Poland [1]. The most common cause of hypothermia was exposure to cold air (90% of cases) [1]. The occurrence of hypothermia in Poland is strongly associated with poor social circumstances [1].

The accidental hypothermia can be diagnosed if a body temperature fall below the 35°C and we divide it into: mild (35–32°C), moderate (32–28°C) and severe ( <28°C) [2-8].

We should have in mind that all of the patients in a prehospital environment can suffer hypothermia. Amongst patients with severe trauma, the hypothermia occurence ranges between 13,3% and 43% [2].

## THE AIM

The aim of our paper was to present the current state of the art regarding prehospital management of the hypothermic patient.

## REVIEW AND DISCUSSION

### PATHOPHYSIOLOGY

Hypothermia primarily develops if the heat loss is greater than its production. The heat can be lost by conduction, convection, radiation and vaporization. The heat always flows from the warmer to colder object or medium. Conduction is a direct heat transfer between the objects. Convection is a heat transfer from an object to gas or liquid that is in motion. Radiation is a transfer of heat through electromagnetic energy. Vaporization causes the heat loss through an endothermic reaction of water vaporization from skin or while breathing.

The risk of hypothermia increases after alcohol or drugs consumption, during exhaustion, trauma, illness and consciousness impairment [8-10]. In Poland ⅔ of the patients admitted to hospital because of hypothermia is under the influence of alcohol [1].

The first reaction after the exposure to a cold environment is sympathetic nervous system activation. It causes vasoconstriction in the skin limiting the heat loss through the body surface and stimulates shivering. Shivering increases with the body temperature decline and peaks at about 32°C [11, 12]. It reduces below 32°C and stops about 30°C [11].

Shivering is an exceptionally effective heat production method which can increase 6 times compared to

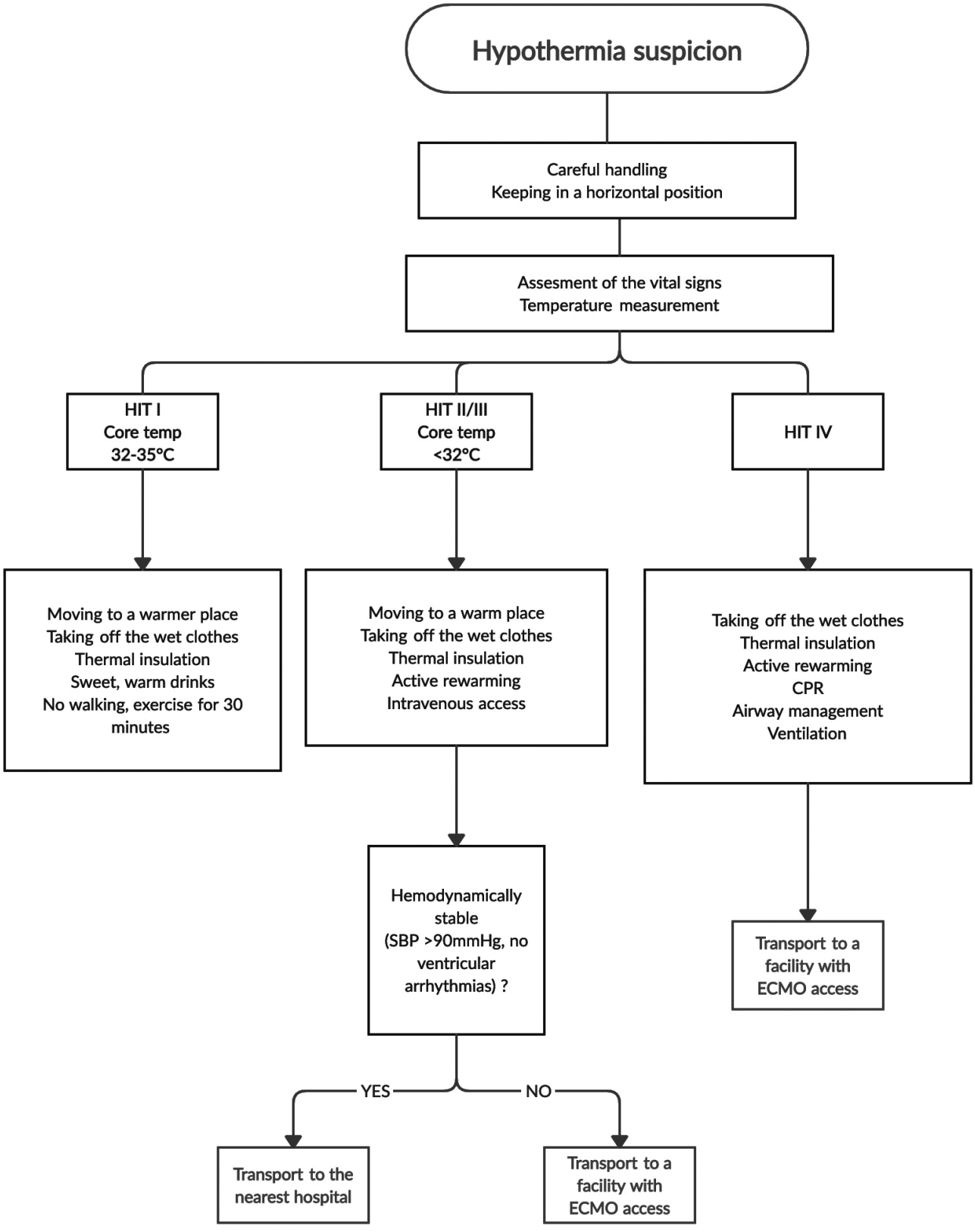


Fig. 1. Algorithm for prehospital management of hypothermic patient.

base metabolic rate [4, 8, 9, 13, 14]. Such effective shivering can last between 4 and 6 hours [4, 13]. In appropriately insulated patients with energy reserves, shivering can increase internal body temperature by up to 3°C per hour [11, 15].

The heat loss steps up when energy reserves depletes [3]. The heat loss rate is influenced by many factors such as age, body weight and proportions, heat insulation, injuries and the body adaptation to low temperatures. Also the heat loss can be greatly

increased by specific environmental circumstances. The conjunction of cold air, wind and rain can reduce the insulation effectiveness provided by clothing by 90% [4, 13].

The initial catecholamines ejection causes the rise of mean arterial pressure and cardiac output [3]. However, as the internal temperature drops, the rate of impulse conduction in the cardiac stimulus-conduction system decreases, leading to bradycardia [3, 5]. Together with vasoconstriction and imparied dissociation of oxygen from hemoglobin it leads to hypoxia. Then this leads to anaerobic metabolism and eventually to metabolic acidosis [2].

When the internal body temperature falls below the <28°C it greatly increases the risk of arrhythmias such as ventricular fibrillation [3].

With the temperature drop the clotting factors are less active and the platelet aggregation is impaired leading to increased bleeding time [2, 8].

Hypothermia along with coagulopathy and acidosis creates the so-called triad of death because of their synergic action leading to vital functions collapse [16].

Hypothermia protects the brain from hypoxia [5, 11, 17]. The temperature decline lowers the oxygen demand by 6% for any 1°C drop [5, 9, 17]. In around 26°C the oxygen consumption falls to 50% and by 22°C to 25% of the baseline [5]. The time of the circulatory arrest after which full recovery can be achieved doubles every 8°C drop. In severe hypothermia the brain can tolerate circulatory arrest for more than 30 minutes [11]. Full neurological in severe hypothermia was reported after over 6 hours of resuscitation [5, 11].

## EVALUATION

The gold standard of internal body temperature measurement in prehospital environment is by an esophageal probe inserted in the lower ⅓ of the esophagus, 24 cm below the larynx on average [3, 5, 8-11, 18]. Placing the sensor too high can result in a falsely higher reading, due to the fact that it is heated by exhaled air [8]. The alternative for this is a tympanic temperature measurement which reflects the brain temperature [3, 18, 19]. For the reading to be correct the device must be designed to be used in a cold environment [3, 8, 18, 19]. The ear canal must be cleaned, properly insulated and the sensor must be placed in an anterior-inferior quadrant of the ear canal [18]. In Poland, according to Darocha et al. study only 1/3 hypothermia cases are diagnosed based on the internal body temperature reading [1].

The apparent neurological symptoms appear when the body temperature falls by 4°C. Those include disorientation, apathy, amnesia, dysarthria, ataxia [3]. When the body temperature drops below 30°C it usually leads to loss of the consciousness [3].

The Swiss System is useful in the initial examination and in the absence of appropriate temperature measurement methods [5, 8, 10, 11, 20].

1st stage hypothermia (HT1) – mild: conscious, shivering. (35-32°C)
2nd stage hypothermia (HT2) – moderate: impaired consciousness, may or not be shivering. (32-28°C)
3rd stage hypothermia (HT3) – severe: unconscious, vital signs present. (<28°C)
4th stage hypothermia (HT4) – severe: apparent death; no vital signs. (Variable)

According to Deslarzes et al. study the assigned category in swiss system correlates with the actual body temperature in only 50% of the cases [21].

## MANAGEMENT

The prehospital management must be guided by three rules: adequate oxygenation, careful handling and full body insulation (Fig. 1) [3, 5].

The conscious hypothermic patient that is found in sitting or horizontal position must not be encouraged to stand up immediately. Walking increases the venous return of cold blood [22, 23]. Patient should be moved to a warm place and properly insulated. He should be given warm sugary drinks (if there is a certainty that he hasn't got any condition needing urgent surgical management) [3]. He should be kept under the observation for at least 30 minutes. After this time he should gradually walk increasing its tempo to tolerable intensivity [11].

The wet clothes should be cut to minimize movement of the patient [3, 5, 6, 14, 24]. Patient should be covered with insulation materials [3, 6, 9, 14, 24, 25]. Full body insulation and active rewarming methods are recommended for all of the patients that cannot move by themselves [3].

The coverings should maintain appropriate insulation and prevent further heat loss due to evaporation and convection. The most important is insulation from the ground [20].

When no special insulating materials are available the patient can be covered in improvised ones: jackets, aluminium foil, bubble wrap, sleeping bags [26].

Lack of insulation will cause further heat loss and increase the risk of arrhythmias [9].

Those actions must be taken quickly and under no circumstances they can't delay the transportation to the medical facility [8, 20].

ECG monitoring should be connected as soon as possible, due to the high risk of arrhythmias in hypothermic patients [3, 5, 10]. All kinds of pathological readings might be encountered: PR and QT intervals prolongement, QRS complex prolongement, elevation or depression of ST [14]. Most of them will correct with the rewarming [14]. The most often recorded initial rhythm in cardiac arrest in hypothermic patients is ventricular fibrillation, but asystole may be recorded in a substantial proportion of patients (30%) [27].

After finding an unconscious person who is likely to be in hypothermia, the search for signs of life should take 60 seconds [3, 5, 4, 8]. The pulse should be palpated on the carotid artery [3]. Stiff, dilated pupils are not contradictions for resuscitation in hypothermic patients [7, 11].

When CPR is started it should be conducted with standard protocols [5, 11, 17]. The mechanical chest compression devices should be used if they are available [9]. In some circumstances in which hypothermic patients are encountered the immediate or continuous CPR might not be possible.

If there is a necessity to pause CPR it should be taken after 5 minutes of continuous CPR and should maximally last:

- if the temperature is unknown or is between 20°C and 28°C – 5 minutes
- if the temperature is below 20°C – 10 minutes [5, 11, 17]

The rescuers should use standard protocols regarding defibrillation when internal temperature is over 30°C [5, 9, 14, 17]. Below that margin they should do maximally three defibrillators [5, 9, 11, 17].

Active rewarming should be initiated in all of the patients in severe and mild hypothermia in whom shivering is diminished [5, 6, 14]. In patients in whom shivering is present, active rewarming reduces shivering proportionally to heat given [2, 5]. However, we should consider it due to reduction of burden to the cardiovascular system and preservation of energy storages [2].

There are several methods of active rewarming. The most popular being electric, chemical and charcoal heaters [8, 25, 28-30]. Heaters can be placed in armpits, on the chest or on the back. Those places guarantee the best heat transfer [2, 9, 20, 29]. However the placement of the heater must not interfere with the CPR [20].

The intravenous access can be challenging to obtain due to vasoconstriction. When the intravenous can't be obtained the intraosseous access should be placed [11].

Infusion fluids should be heated to 38-42°C and administered under pressure (preferably in boluses) using short infusion tubes to limit the cooling of the fluid on its way to the body [1, 8, 14]. If a transfusion is necessary, the blood also should also be warmed to 38-42°C [2]. For warming the fluids the special heaters might be used, if they are not available the fluid bottles might be wrapped in insulation materials and for example placed in the warmest area in a transportation vehicle [2].

In one study warming blood by putting the pack in the armpit of a normothermic person increased the temperature to 17,2°C which shows complete inefficiency of that method [2].

Considering the types of the fluids, the Ringer fluid should not be given to hypothermic patients due to the reduced ability to metabolise lactic acid in the liver in low temperatures [11]. The prefered infusion liquids are: 0,9% NaCl and crystalloids [8][10].

During the treatment of hypothermic patients we should remember about the afterdrop effect. It is a phenomenon in which the body temperature decreases despite the elimination of cooling factor [8][9][23][28]. The effect can be as profound as 5-6°C.

The internal temperature drops as a result of heat loss through its flow from a warm body core to cold peripheries and as a result of convective heat loss during increased flow through cold extremities [11]. Also, moving the patient might increase the venous return [11].

Only sources of high heat such as immersion in warm water or forced air rewarming completely prevent the afterdrop effect. [4, 5, 13, 14, 28, 31, 32]. The biggest afterdrop is caused by early, forceful exercises [13]. It is worth noting that the only proven effective method of heating in warm water is to immerse the arms, forearms, shins and feet in water at a temperature of 42 to 45°C [13, 31]. It causes the opening of arterio-venal anastomoses in digits increasing the return of warmed blood.

Heated oxygen can prevent heat loss while breathing, but does not contain much heat itself [11, 20, 28]. It shouldn't be used as the only rewarming strategy [4, 11, 20, 28].

The adequate oxygenation is pivotal in myocardium protection. Non intubated patients should receive supplemental oxygen. If the patient is uncon-

scious the airways should be managed, including a laryngeal mask or intubation if necessary [6]. The advantage of adequate oxygenation outweighs the risk of ventricular fibrillation induction (which is low anyway) [3, 5, 9, 4, 8]. It is not recommended to use paralytics agents when the internal temperature is below 30°C due to their unpredictable metabolism associated with liver, kidney and blood enzymes function impairment in low temperatures [8].

The medications administration in ALS protocols in hypothermic patients stirs a lot of controversy. No clear beneficial effect of antiarrhythmic or vasoconstrictive drugs during resuscitation in patients with internal body temperature below 30°C has been reported so far [1, 5, 6, 17]. After achieving the temperature over 30°C the drugs should be administered with doubled intervals compared to standard protocols (i.e. adrenaline every 3-6 minutes) [5]. After achieving normothermia the drugs should be administered according to standard protocols [5].

That being said, the best prognosis have the patients without comorbidities in whom cardiac arrest has been witnessed, CPR started immediately and were treated with ECMO in hospital [9].

In the case of circulatory arrest during hypothermia the prognosis is influenced by number of factors. HOPE score integrates six variables available at hospital admission, to predict survival to hospital discharge of hypothermic patients with ECLS rewarming:

- Age
- Sex
- Core temperature
- Serum potassium
- Presence of asphyxia (submersion with the head fully covered by water or snow avalanche accident AND in cardiac arrest at extrication)
- Duration of CPR (since CPR initiation until expected time of ECLSR cannulation [33].

### TRANSPORTATION

In the case of HT1 and HT2 the patient should be transported to the nearest hospital [5]. In the case of HT3 and HT4 and/or circulatory arrest/risk of circulatory arrest (ventricular arrhythmia/systolic arterial pressure <90 mmHg) the patient should be treated in a specialist centre with access to ECMO [5, 6, 8-10]. The temperature in the means of transport should be increased to the maximum temperature at which the rescue team feels comfortable [20].

Full recovery was reported at the internal body temperature as low as 13.7°C in an adult, 11.8°C in a child and resuscitation lasting up to 8h 40 min [34-37].

## CONCLUSIONS

Hypothermia is not an unusual problem. It is frequently encountered in autumn and winter. High consumption of alcohol paralleled with poor social circumstances, which is not unusual, increases the risk of hypothermia dramatically.

The body has its efficient adaptation systems, but they can easily collapse.

The adequate temperature measurement is critical. Assessing the temperature by Swiss System has a profound burden of poor accuracy and placing the patient in a higher category (especially in HT2 instead of HT3) might have dreadful consequences. The use of esophageal probes is far too rare and we rely too much on skin temperature measurement which is inadequate. The solution might be tympanic temperature measurement. It is easy to obtain and its reading is reliable.

Active rewarming in prehospital field depends on rescue team equipment and experience in using such devices. However, the passive strategies which fall into the category of proper insulation must not be overlooked. The prevention of further heat loss is pivotal (Fig.1).

We should encourage providers to equip the rescue teams with the active rewarming devices and infusion liquids heaters. Numerous studies confirmed their efficacy and effectiveness.

The life support should be centered around cardiopulmonary resuscitation with quality chest compressions and adequate ventilation. The use of medications in hypothermic patients is of limited use.

The prehospital management should be as rapid as possible, because the definitive treatment of patients suffering from deep hypothermia is most effective in specialist centres dedicated to treating this condition.

## REFERENCES

1. Darocha T, Kosinski, S, Jarosz A, Gazkowski R, Sadowski J, Drwia R.. Severe accidental hypothermia center. Eur J Emerg Med. 2015;22(4), 288–291. [https://doi.org/10.1097/MEJ.0000000000000213]
2. Haverkamp FJC, Giesbrecht GG, Tan ECTH. The prehospital management of hypothermia — An up-to-date overview. Injury. 2018;49(2):149–164. [https://doi.org/10.1016/j.injury.2017.11.001]

3. Paal P, Brugger H, Strapazzon G. Accidental hypothermia. In: Handbook of Clinical Neurology. 1st edn., vol. 157). Elsevier B.V., 2018 [https://doi.org/10.1016/B978-0-444-64074-1.00033-1]
4. Giesbrecht GG. Emergency treatment of hypothermia. Emerg Med. 2001;13(1), 9–16. [https://doi.org/10.1046/j.1442-2026.2001.00172.x]
5. Truhlar A, Deakin CD, Soar J, et al. European resuscitation council guidelines for resuscitation 2015: section 4. Cardiac arrest in special circumstances. Resuscitation 2015;95:148–201. [https://doi.org/10.1016/j.resuscitation.2015.07.017].
6. Vanden Hoek TL, Morrison LJ, Shuster M, et al. Part 12: cardiac arrest in special situations: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010;122(18 Suppl 3):S829–61.
7. Hilmo J, Naesheim T, Gilbert M. "Nobody is dead until warm and dead": Prolonged resuscitation is warranted in arrested hypothermic victims also in remote areas – A retrospective study from northern Norway. Resuscitation 2014 [https://doi.org/10.1016/j.resuscitation.2014.04.029]
8. Brown DJA, Brugger H, Boyd J, Paal P. Accidental hypothermia. New Eng J Med. 2012;367(20):1930–1938. [https://doi.org/10.1056/NEJMra1114208]
9. Zafren K. Out-of-Hospital Evaluation and Treatment of Accidental Hypothermia. Emerg Med Clin North Am 2017;35(2):261–279. [https://doi.org/10.1016/j.emc.2017.01.003].
10. Paal P, Gordon L, Strapazzon G, et al.. Accidental hypothermia-an update. Scan J Trauma Resusc Emerg Med 2016;24(1), 1–20. [https://doi.org/10.1186/s13049-016-0303-7]
11. Durrer B, Brugger H, Syme D. The Medical On-site Treatment of Hypothermia: ICAR-MEDCOM Recommendation. High Altit Med Biol 2003;4(1):99–103. [https://doi.org/10.1089/152702903321489031].
12. Tikuisis P, Giesbrecht GG. Prediction of shivering heat production from core and mean skin temperatures. Eur J Appl Physiol Occup Physiol 1999;79(3):221–9. doi 10.1007/s004210050499
13. Giesbrecht GG. Prehospital treatment of hypothermia. Wildern Environl Med., 2001;12(1):24–31. [https://doi.org/https://doi.org/10.1580/1080-6032(2001)012[0024:PTOH]2.0.CO;2].
14. McCullough L, Arora S. Diagnosis and treatment of hypothermia. Am Fam Physician. 2004;70:2325–2332.
15. Giesbrecht GG, Goheen MSL, Johnston CE, Kenny GP, Bristow GK, Hayward JS.. Inhibition of shivering increases core temperature afterdrop and attenuates rewarming in hypothermic humans. J Appl Physychol. 1997;83(5):1630-1634. [https://doi.org/10.1152/jappl.1997.83.5.1630]
16. Mitra B, Tullio F, Cameron PA, Fitzgerald M. Trauma patients with the "triad of death". Emerg Med J 2012;29(8):622 LP–625. [https://doi.org/10.1136/emj.2011.113167]
17. Gordon L, Paal P, Ellerton JA, Brugger H, Peek GJ, Zafren K. Delayed and intermittent CPR for severe accidental hypothermia. Resuscitation 2015;90:46–49. [https://doi.org/10.1016/j.resuscitation.2015.02.017]
18. Strapazzon G, Procter E, Putzer G, et al. Influence of low ambient temperature on epitympanic temperature measurement: a prospective randomized clinical study. Scan J Trauma Resusc Emerg Med. 2015;23(1):90. [https://doi.org/10.1186/s13049-015-0172-5].
19. Walpoth BH, Galdikas J, Leupi F, Muehlemann W, Schlaepfer P, Althaus U. Assessment of hypothermia with a new "tympanic" thermometer. J Clin Monit 1994;10:91-96.
20. Willmore R. Cardiac Arrest Secondary to Accidental Hypothermia: Rewarming Strategies in the Field. Air Med J 2020;39(1):64-67. [https://doi.org/10.1016/j.amj.2019.09.012]
21. Deslarzes T, Rousson V, Yersin, B, Durrer B, Pasquier M. An evaluation of the Swiss staging model for hypothermia using case reports from the literature. Scan J Trauma, Resusc Emerg Med. 2016;24(1), 16. [https://doi.org/10.1186/s13049-016-0210-y]
22. Giesbrecht GG, Bristow GK. A second postcooling afterdrop: more evidence for a convective mechanism. J Applied Physiol. 1992;73(4), 1253–1258. [https://doi.org/10.1152/jappl.1992.73.4.1253].
23. Giesbrecht GG, Bristow GK. The convective afterdrop component during hypothermic exercise decreases with delayed exercise onset. Aviat Space Environ Med 1998;69(1):17-22.
24. Henriksson O, Lundgren P, Kuklane K, Holmér I, Naredi P, Bjornstig U. Protection against cold in prehospital care: Evaporative heat loss reduction by wet clothing removal or the addition of a vapor barrier'a thermal manikin study. Prehosp Disast Med 2012;27(1):53-58. [https://doi.org/10.1017/S1049023X12000210].

25. Goheen MSL, Ducharme MB, Kenny GP et al. Efficacy of forced-air and inhalation rewarming by using a human model for severe hypothermia. J Appl Physiol. 1997;83(5):1635-640.
26. Henriksson O, Lundgren JP, Kuklane K, et al. Protection against cold in prehospital care-thermal insulation properties of blankets and rescue bags in different wind conditions. Prehosp Disaster Med 2009;24(5):408-15.
27. Frei C, Darocha T, Debaty G et al. Clinical characteristics and outcomes of witnessed hypothermic cardiac arrest: A systematic review on rescue collapse. Resuscitation, 2019;137:41-48. [https://doi.org/10.1016/j.resuscitation.2019.02.001].
28. Goheen MSL, Ducharme MB, Kenny GP et al. Efficacy of forced-air and inhalation rewarming by using a human model for severe hypothermia. J Appl Physiol 1997;83(5):1635-1640. [https://doi.org/10.1152/jappl.1997.83.5.1635].
29. Lundgren JP, Henriksson O, Pretorius T, Cahill F et al.. Field torso-warming modalities: A comparative study using a human model. Prehosp Emerg Care, 2009;13(3):371-378. [https://doi.org/10.1080/10903120902935348].
30. Giesbrecht GG, Bristow GK, Uin A, Ready AE, Jones RA. Effectiveness of three field treatments for induced mild (33.0 degrees C) hypothermia. J Appl Physiol 1987;63(6):2375-2379. [https://doi.org/10.1152/jappl.1987.63.6.2375].
31. Vanggaard L, Eyolfson D, Xu X et al. Immersion of distal arms and legs in warm water (AVA rewarming) effectively rewarms mildly hypothermic humans. Aviat Space Environ Med. 1999;70(11):1081-8.
32. Steele MT, Nelson MJ, Sessler DI et al. Forced air speeds rewarming in accidental hypothermia. Ann Emerg Med, 1996;27(4):479-484. [https://doi.org/10.1016/S0196-0644(96)70237-8].
33. Pasquier M, Rousson V, Darocha T, et al. Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: An external validation of the HOPE score. Resuscitation. 2019;139:321-328.
34. Meyer M, Pelurson N, Khabiri E, Siegenthaler N, Walpoth BH. Sequela-free long-term survival of a 65-year-old woman after 8 hours and 40 minutes of cardiac arrest from deep accidental hypothermia. J Thor Cardiovas Surg 2014. [https://doi.org/10.1016/j.jtcvs.2013.08.085].
35. Dobson JA, Burgess JJ. Resuscitation of severe hypothermia by extracorporeal rewarming in a child. J Trauma. 1996;40:483-5.
36. Gilbert M, Busund R, Skagseth A, Nilsen PA, Solbo JP. Resuscitation from accidental hypothermia of 13.7 degrees C with circulatory arrest. Lancet. 2000;355:375–376.
37. Darocha T, Podsiadło P, Polak M et al. Prognostic Factors for Nonasphyxia-Related Cardiac Arrest Patients Undergoing Extracorporeal Rewarming – HELP Registry Study. J Cardiothorac Vasc Anesth 2020;34(2):365-371. [https://doi.org/10.1053/j.jvca.2019.07.152].

**ORCID AND CONTRIBUTIONSHIP** *

Maciej Otworowski – 0000-0002-7635-9752 B, D
Krzysztof Sośnicki – 0000-0001-8274-748X B, E
Elżbieta Cipora – 0000-0002-7794-550X E, F
Andrzej Kotela – 0000-0003-3282-7486 A, F

**CONFLICT OF INTEREST**

Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**

Maciej Otworowski
Instytut Medyczny Uczelnia Państwowa
im. Jana Grodka
Mickiewicza 21, 38-500 Sanok, Poland
e-mail: maciek.otworowski@gmail.com

| RECEIVED | ACCEPTED |
|---|---|
| 02.05.2020 | 04.11.2020 |

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.

Emerg Med Serv, 2020; VII, 4: 313-318

**DOI:** 10.36740/EmeMS202004111 **REVIEW ARTICLE**

# REVIEW OF RECOMMENDATIONS FOR EMERGENCY MEDICAL TEAMS DURING THE SARS-COV-2 EPIDEMIC

Przemysław Kożan[1], Daniel Ślęzak[1], Rafał Szczepański[1], Marlena Robakowska[2], Piotr Robakowski[1], Przemysław Żuratyński[1]

[1] DEPARTMENT OF MEDICAL RESCUE, FACULTY OF HEALTH, MEDICAL UNIVERSITY OF GDANSK GDANSK, POLAND
[2] DEPARTMENT OF PUBLIC HEALTH AND SOCIAL MEDICINE, FACULTY OF HEALTH, MEDICAL, UNIVERSITY OF GDANSK, GDANSK, POLAND

**Abstract**

**The aim of this work** was to present the recommendations for emergency medical teams in Poland during the SARS-CoV-2 epidemic.

During the epidemic of the new coronavirus, health care system in the world faced the need to deal with the effects of the virus. The medical staff's behavior has been adapted to the new reality in order to help patient best and prevent the staff from becoming infected. The result of these activities was the creation of new procedures and recommendations. Due to the huge role of pre-hospital care, it has become necessary to create procedures at the national level so that the way of dealing with an infected patient is the same. With the growing knowledge of the virus, the case definition has changed and the Ministry of Health has updated its recommendations. Emergency medical teams and air emergency services have adapted to the changes imposed by the Minister of Health.

The global problem of the SARS-CoV-2 is still a challenge for healthcare systems in Poland and worldwide. It will be necessary to update previously developed guidelines and management schemes, with particular emphasis on emergency medical services. The priority is to secure a sufficient amount of personal protective equipment, disinfectants and to create such procedures that will protect the system during the next crisis. It is important that healthcare professionals adopt a universal set of guidelines that they should follow to minimize SARS-CoV-2 infection.

**Key words**

coronavirus, SARS-CoV-2, COVID-19, epidemic, emergency medical services

## INTRODUCTION

The turn of 2019/20 and year 2020 unexpectedly became a huge challenge for health care systems of most countries in the world. Treatment and prevention of the spread of newly detected coronavirus causing pneumonia with acute respiratory failure has become a priority to protect the population from death.

The first country where a new coronavirus later named (Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2) was detected as the causative agent of several cases of pneumonia was China. On December 31, 2019, the Wuhan Municipal Health Commission in Wuhan City reported 27 cases of pneumonia, including 7 with severe course, of unknown etiology, which was found to be due to coronavirus as a result of further research. Already on January 20, the virus was confirmed in three other countries: Thailand, Japan and South Korea. The cases described are exported from China. The first infected person reported in Europe was a patient from France who had previously stayed in China. On 28 January, four days after the first European incident, some infections were recorded in Germany [1]. On January 30, 2020, the World Health Organization (WHO) announced the outbreak of the new coronavirus as "an international public health emergency" [2]. Week after week, public opinion has learned about the next numerous cases of the virus in different parts of the world with large outbreaks and large numbers of victims in Italy, Spain, the United States and Brazil. On March 11, WHO announced a "pandemic" of the new SARS-CoV-2 coronavirus.

China has changed the case definition of the new coronavirus several times, resulting in uncertainty as to the exact number of cases and the extent of the virus's spread. SARS-CoV-2 belongs to the Coronaviridae family, has a single RNA strand with positive polarization (ssRNA (+)) and causes severe acute respiratory distress syndrome. COVID -19 as an infectious disease caused by a newly discovered virus unknown before the outbreak of China is characterized by: fever, dry cough, and fatigue. Other symptoms observed include myalgia, headaches, nasal congestion, conjunctivitis, loss of taste and smell, rash, skin changes in fingers and toes [3].The severe form of the disease causes breathing difficulties, shortness of breath and subsequent respiratory failure leading to death.

## THE AIM

The aim of this work was to present the recommendations for emergency medical teams in Poland during the SARS-CoV-2 epidemic.

## REVIEW AND DISCUSSION

The first Polish case of SARS-CoV-2 was detected on March 4, 2020 [1]. Along with the increase in the number of confirmed cases, on March 13 the Minister of Health introduced a regulation "regarding the announcement of an epidemic emergency in the territory of the Republic of Poland" [4]. On March 24, an "epidemic status"[5] was announced and then declared relevant ordinances in connection with the epidemic.

Health protection in Poland has faced a huge challenge aimed at preventing and reducing the effects of a rapidly spreading virus. Patient treatment was targeted at helping with infected coronavirus, planned patients' appointments were suspended, specialist clinics were limited, appropriate procedures in primary care and inpatient care were introduced. A network of infectious hospitals was created, and pre-existing infectious wards were placed in full readiness. Particular attention should be given to pre-hospital care activities. Emergency medical teams, including Polish air ambulance, have become a pillar of help for patients infected with SARS-CoV-2.

From the very beginning, the dispatchers of emergency teams had to face basic problems: lack of current procedures, lack of personnel (personnel in quarantine due to ambiguous regulations ) and the availability of personal protective equipment.

The knowledge we have about the virus shows that it is transmitted from person to person by droplet or by inhalation of secretions generated by an infected person. The infection is also possible through mucosal contact and by inhalation of the aerosol. Therefore, the person providing assistance, particularly during high-risk procedures, including those generating aerosols (e.g. nebulization, patient suctioning) should be fully secured. In the initial period, the disposers who had not been prepared for such a scale before had to face the lack of adequate resources to protect personnel against infection and disinfectants. There were no suits, masks, goggles, hand disinfectant, etc. The help of voivods, including material reserves agencies, was often needed. To meet the needs, recommendations began to arise regarding the use of personal protective equipment (PPE):

- ECDC recommendations on putting on and taking off personal protective equipment during patient care with suspected or confirmed SARS-CoV-2 infection (COVID 19);
- recommendations of a national consultant in the field of infectious diseases of 06.04.2020 regarding the use of personal protective equipment and the way of organizing rooms in which medical assistance is provided to patients with suspected COVID-19;
- recommendations on the type of personal protective equipment for medical staff in contact with a patient suspected or diagnosed with SARS-CoV-2 infection" issued on 23.04.2020 by the Ministry of Health.

Personal protective equipment for medical personnel includes [6, 7]:

1. gloves (optimally 2 pairs put on each other inside preferably with an extended cuff;
2. aprons or overalls (barrier / waterproof apron, with long sleeves covering the knees, in the absence of a non-woven apron optimally combined with a foil apron. Overalls with the appropriate EN 14126 standard. The use of special types of footwear, shoe protectors is not required).
3. masks (covering the nose, mouth and chin tightly type FFP2 = N95 or FFP3 = N99. The half-mask should be best fitted the face. In the absence of the above mentioned masks, the use of surgical masks is allowed);
4. goggles and visors (reusable after disinfection);
5. caps or other hair protection (used by people whose hair interferes with the proper use of other personal protective equipment).

These documents also pay attention to how to put on and take off personal protective equipment. The carried out observations indicate that contamination during work in a damaged suit or improper removal may cause the infection of the staff.

The members of emergency medical teams in the initial phase operated without procedures relevant to the situation. In order to meet the expectations, the dispatchers began to create appropriate recommendations aimed at ensuring the safety of crews and assistance to patients by a qualified personnel in dedicated departments. Began to be use:

- putting on personal protective equipment (goggles, masks) for each patient;
- putting on surgical masks for patients;
- limiting the number of team members staying with the patient;
- change in the test method (interview focused on the possibility of SARS CoV-2 infection and temperature measurement).

Baker et al. [8] provides guidance on the minimum necessary protection that physicians, nurses, related healthcare, and facility personnel should pro-

vide against SARS-CoV-2. infection. The document presents in detail issues such as:

- washing personal clothing – personal clothes should have been recently laundered in hot water with detergent, bleach, and dried in an electric or gas dryer,
- personal hygiene – before leaving home or on arriving at the health care facility the staff member should shower from head to toe with soap and warm water,
- nonessential wear – remove all jewelry, watches, and other nonessential wear that is not covered by clothing, cosmetic facial makeup,
- clean identification card (ID),
- hand washing – wash both hands and all fingers with soap and warm water for at least 20 seconds (soap and water or use a concentration of 60% or more alcohol-based, especially before and after each patient contact); use a moisturizer on the skin frequently following washing with soap and water,
- cell phones and cell phone covers should be cleaned at least once daily advisably after a shift,
- protective eye coverings – the role of eye protection is. google, helmets, personal glasses and contact lenses,
- protection of the nose and mouth – the role of face mask, types, removal, cutaneous irritation, adverse physical effects on staff,
- facial hair – beards and facial hair cut short and tightly controlled,
- the role of disposable gloves – gloves must be used when in contact with the patients' blood, stool, or other body fluids such as saliva, sputum, nasal discharge, conjunctival discharge or tears, vomit, or urine,
- contact with blood, stool, or other body fluids,
- coveralls vs. white coats/gowns – no clinical studies have compared white coats, gowns, and coveralls,
- footwear – cleaning, disinfection, bagged,
- postshift hygiene and doffing PPE, postshift clothing,
- privately owned vehicular transportation – clean motor vehicles daily,
- SARS-CoV-2 testing – medical personnel should be tested initially for the antigen of SARS-CoV-2 and subsequently every 3 days throughout the pandemic.

With the passage of time and the increase in the incidence of new coronavirus, the Ministry of Health began to issue recommendations for emergency teams and medical dispatchers. The first document was issued on February 11, 2020. "Recommendations for sanitary / medical transport teams and emergency teams, due to the risk of coronavirus infection from Wuhan nCOV 2019) [9]. The recommendations included a description of the way in which coronavirus was disseminated, how to protect personnel: long sleeved disposable clothing, disposable gloves, goggles, helmets, at least surgical masks. Patient protection measures: protect the patient with a protective mask. Suspicious of getting infected patients were to be transported with extreme caution to a hospital with an infectious disease department. Attention was also paid to disinfection of the ambulance with antiviral agents. The updates of the recommendations were related to the changing epidemic situation in the country and the definition of the case, which is being transformed for the purposes of surveillance of human infections with the new coronavirus. Initially, the patients were divided into two groups, the first one required meeting the epidemiological criterion (maintaining close contact with a person diagnosed with COVID-19; travelling / staying in a region in which widespread COVID-19 transmission was maintained; returning from the area in which local COVID-19 transmission was of low prevalence but the clinical condition required COVID-19 diagnostics). Along with the growing internal transmission of the virus, the epidemiological criterion was limited to the information on contact within the last 14 days with an infected person or a person suspected of SARS-CoV-2 infection. In addition, patients were divided into three groups (criteria) [9-11]:

- Criterion A – an asymptomatic patient meeting the epidemiological criteria
- Criterion B – subfebrile condition, cough, malaise, rhinitis, sore throat, without symptoms such as fever> 38 deg. C, number of breaths> 20 / min, low saturation.
- Criterion C – symptoms of acute respiratory infection of sudden onset meeting at least one of the conditions fever> 38 degrees C, number of breaths> 20 / min, low saturation.

Depending on the symptoms reported, the actions of the members of emergency medical teams included giving advice or transporting the patient to the appropriate hospital. On 23.04.2020, the Ministry of Health issued another update of the procedure where the epidemiological criteria were changed again (a close contact with a person with confirmed or probable incidence of COVID-19 or with a person in isolation; a person from quarantine or home isolation; a person covered by epidemiological surveillance) [12]. This document, unlike the previous ones,

also refers to on-site procedures, where the priority is given to:

- the option of examining the patient without other people;
- putting on a surgical mask for the patient (optimal placement of the mask by the patient himself);
- the measurement of temperature, $SaO_2$, a number of breaths

Patients with symptoms of shortness of breath, high fever, tachypnoe, and low saturation should be carried to a hospital dealing with patients with COVID-19.

Medical dispatchers also play a key role in the emergency medical system, for which the Ministry of Health publishes relevant recommendations along with the procedures envisaged for emergency medical teams. Due to the limitations of primary care, patients requiring help try to get it by calling the emergency medical team even in a non-life threatening situation. Medical dispatchers, in accordance with their competences, acting on the basis of recommendations, inform patients about the appropriate course of action, depending on the state in which the patient is. In a life-threatening situation (patients with criterion C), a medical rescue team is available. The issued recommendations meant that cooperation had to be established between medical dispatch offices and the sanitary inspection [12, 13]. The dispatcher's tasks include reporting to the Poviat Sanitary Inspection about every patient suspected of being infected with SARS-CoV-2.

The air Emergency Medical Service as dispatchers of air medical emergency teams also faced up problems that need to be tackled by medical emergency teams. To meet the expectations, a team of experts creates and updates procedures to serve the safety of crew members and help patients.

"Recommendations for HEMS (helicopter emergency medical service) / SZT (airplane transport team) crews in case of contact with a patient suspected or diagnosed with SARS-CoV-2" contain constantly updated recommendations regarding: information support scheme, case definition according to the recommendations of the Minister of Health, routine use of personal protective equipment, changes in medical standardization ( change of medical equipment), isolation and disinfection methods, preparation for flights, patient handling including during high risk procedures, decontamination of the aircraft after the mission, using special procedures such as transporting a patient from extracorporeal membrane oxygenation (ECMO) [14].

As it turned out initially, the decontamination of the aircraft became the most serious problem. As a result of the procedures imposed by the helicopter manufacturer and the limited possibility of using available disinfectants publicly, the aircraft had to be subjected to 72 hour quarantine and readiness for the mission was limited to assistance only to patients with confirmed SARS-CoV-2 infection [14]. As a result of the work that has been done to update the disinfection procedures, current guidelines allow you to return to full readiness after just 6 hours.

In order to help patients in the most severe condition (subjected to ECMO), a procedure for transporting patients with ECMO was created. Thanks to these guidelines, patients can be safely and quickly transported to specialized centers dealing with extracorporeal techniques supporting organs functions.

The Ambulance Service has used a number of solutions to protect its personnel who have direct contact with the patient against SARS-CoV-2 infection:

- the helicopter cabin was modified by using a special partition separating the cockpit from the medical compartment;
- barrier tents were introduced to protect against direct contact with the patient's head;
- decontamination chambers were purchased to disinfect the personnel after being in contact with the sick;
- isolation chambers were put into use;
- crews provided with reusable half masks.

The LPR Rescue Center operating within the structures of the Aviation Emergency Service has also taken a number of actions thanks to which, based on appropriate procedures, assistance is provided to patients with COVID-19. The priority task is to organize air transport of patients in the most severe condition to higher reference centers, including "single-name" hospitals.

## CONCLUSIONS

The global problem of the new coronavirus is still a challenge for healthcare systems in Poland and worldwide. Along with further research on the virus, it will be necessary to update previously developed guidelines and management schemes, with particular emphasis on emergency medical services. The Medical Rescue System, including medical, air and ground dispatch teams, still needs to be prepared for a sudden increase in the number of cases including severely ill patients. The priority is to secure a sufficient amount of personal protective equipment, disinfectants and

to create such procedures that will protect the system during the next crisis. Physicians, nurses, and allied health care and facility staff in all frontline environments must be provided and utilize necessary personal protective equipment (PPE). It is important that health care staff adopt a universal set of guidelines in which to conduct themselves in order to minimize infection with the SARS-CoV-2 contagion.

## REFERENCES


1. Weekly surveillance report on COVID-19. European Centre for Disease Prevention and Control. [https://www.ecdc.europa.eu/en/covid-19/surveillance/weekly-surveillance-report. Accessed: October 30, 2020].
2. Key considerations for repatriation and quarantine of travellers in relation to the outbreak of novel coronavirus 2019-nCoV. World Health Organization. [https://www.who.int/ith/2020-27-01-outbreak-of-pneumonia-caused-by-new-coronavirus/en/. Accessed: October 30, 2020].
3. Case definition for coronavirus disease 2019 (COVID-19), as of 29 May 2020. European Centre for Disease Prevention and Control. [https://www.ecdc.europa.eu/en/case-definition-and-european-surveillance-human-infection-novel-coronavirus-2019-ncov. Accessed: October 30, 2020]
4. Rozporządzenie Ministra Zdrowia z dnia 13 marca 2020 r. w sprawie ogłoszenia na obszarze Rzeczypospolitej Polskiej stanu zagrożenia epidemicznego (Dz.U. 2020 poz. 433). [http://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200000433. Accessed: October 30, 2020].
5. Rozporządzenie Ministra Zdrowia z dnia 24 marca 2020 r. zmieniające rozporządzenie w sprawie ogłoszenia na obszarze Rzeczypospolitej Polskiej stanu epidemii (Dz.U. 2020 poz. 522). [http://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20200000522. Accessed: October 30, 2020].
6. Zalecenia ECDC dotyczące zakładania i zdejmowania środków ochrony indywidualnej w czasie opieki nad pacjentami z podejrzeniem lub potwierdzonym zakażeniem wirusem SARS-CoV-2 (COVID-19). Medycyna Praktyczna. [https://www.mp.pl/covid19/zalecenia/229175,zalecenia-ecdc-dotyczace-zakladania-i-zdejmowania-srodkow-ochrony-indywidualnej-w-czasie-opieki-nad-pacjentami-z-podejrzeniem-lub-potwierdzonym-zakazeniem-wirusem-sars-cov-2-covid-19. Accessed: October 30, 2020].
7. Zalecenia krajowego konsultanta w dziedzinie chorób zakaźnych z dnia 6.04.2020 dotyczące stosowania środków ochrony osobistej oraz sposób organizacji pomieszczeń, w których udzielana jest pomoc medyczna dla pacjentów z podejrzeniem COVID-19. Ministerstwo Zdrowia. Accessed October 30, 2020 https://www.gov.pl/web/zdrowie/zalecenia-krajowego-konsultanta-w-dziedzinie-chorob-zakaznych-dotyczace-stosowania-srodkow-ochrony-osobistej.
8. Terrance L, Baker JV. Greiner E, Maxwell-Schmidt P, Lamothe H, Vesonder M. Guidelines for Frontline Health Care Staff Safety for COVID-19. J Prim Care Community Health. 2020 Jan-Dec; 11: 2150132720938046. [Published online: 2020 Jul 13. doi: 10.1177/2150132720938046].
9. Zalecenia dla zespołów transportu sanitarnego/ medycznego oraz zespołów ratownictwa medycznego, w związku z ryzykiem wystąpienia zakażeniem koronawirusem z Wuhan (nCOV 2019). Ministerstwo Zdrowia. ROR.520.1.13.2020.MS (Warszawa, 11.02.2020) [https://www.meditrans.ostroleka.pl/images/dokumenty/COVID19/17-04-2020/Zalecenia%20Ministerstwa%20Zdrowia%20z%20dnia%2011%20lutego%20dotyczce%20transportowania%20pacjentw%20przez%20ZRM.pdf. Accessed: October 30, 2020].
10. Wroczyńska A, Rymer W. 2019-nCoV – nowy koronawirus z Chin. Med Prakt. 2020;2:119-133.
11. Informacja Głównego Inspektora Sanitarnego dla szpitali w związku z dynamicznie rozwijającą się sytuacją epidemiologiczną związaną z szerzeniem się nowego koronawirusa SARS-CoV-2. Główny Inspektor Sanitarny. Warszawa, 27.02.2020. [http://www.nfz-szczecin.pl/files/6956__Instrukcja_GIS_02-SZPITALE-procedury_koronawirus.pdf. Accessed: October 30, 2020].
12. Koronawirus SARS-CoV-2. Schemat postępowania dla zespołów ratownictwa medycznego systemu Państwowe Ratownictwo Medyczne z pacjentem spełniającym kryteria epidemiologiczne wersja z 23.04.2020. Ministerstwo Zdrowia. [https://www.gov.pl/attachment/5e09d80c-f2ae-4bd7-8a9b-1c2c17ef5095. Accessed: October 30, 2020].
13. Koronawirus SARS-CoV-2. Schemat postępowania dla dyspozytorów medycznych systemu Państwowe Ratownictwo Medyczne z pacjentem spełniającym kryteria epidemiologiczne. Ministerstwo Zdrowia. [https://www.gov.pl/attachment/70fae1ff-8fb2-4e59-8fa2-9baba15dc55a. Accessed: October 30, 2020].

14. Kowalski M, Derkowski T, Pawlak A. Zalecenia postępowania dla załóg HEMS/SZT w przypadku kontaktu z pacjentem z podejrzeniem lub rozpoznaniem zakażenia wirusem SARS CoV-2. (wersja 5.0 z dnia 30 kwietnia 2020 roku, 1-19).

**ORCID AND CONTRIBUTIONSHIP** *
Przemysław Kożan – 0000-0001-6088-8476 F
Rafał Szczepański – 0000-0002-0993-1675 E
Przemysław Żuratyński – 0000-0003-3498-6229 B
Marlena Robakowska – 0000-0003-4890-2794 B
Piotr Robakowski – 0000-0003-1641-2643 D
Daniel Ślęzak – 0000-0002-0052-5654 A

**CONFLICT OF INTEREST**
Authors declare no conflict of interest.

**ADDRESS FOR CORRESPONDENCE**
Daniel Ślęzak
Zakład Ratownictwa Medycznego
Wydział Nauk o Zdrowiu
z Instytutem Medycyny Morskiej i Tropikalnej
Gdański Uniwersytet Medyczny
Dębinki 7, Gdańsk 80-170, Polska
e-mail: daniel.slezak@gumed.edu.pl

**RECEIVED** 03.07.2020
**ACCEPTED** 09.11.2020

* Contribution: A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval.