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RATOWNICTWO MEDYCZNE

COMPLIANCE WITH HAND HYGIENE REGULATIONS BY PARAMEDICS

PEDIATRIC PATIENT DURING EMERGENCY MEDICAL TEAM INTERVENTION

PAIN TREATMENT IN THE PRACTICE OF PARAMEDICS

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DOI: 10.36740/EmeMS202204102 **ORIGINAL ARTICLE**

SELF-EVALUATION OF THE COMPLIANCE WITH HAND HYGIENE REGULATIONS BY PARAMEDICS IN EMERGENCY RESPONSE TEAMS

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Abstract

Aim: Infection with biological factors is a significant issue which occurs during the undertaking of professional tasks in the daily work of paramedics in Emergency Response Teams. Due to the volatile conditions of the work environment, paramedics as an occupational group are at a higher risk of exposure to biological factors (e.g., hepatotropic viruses (HBV, HCV); human immunodeficiency virus (HIV); *Mycobacterium tuberculosis* bacteria; influenza virus; or contemporarily the SARS-CoV, MERS-CoV and SARS-CoV-2 coronaviruses). The possibility of infection grows in situations where work safety and hygiene regulations are not followed. The aim of the following work is the evaluation of the compliance with hygienic standards and the knowledge regarding the prophylaxis of infection among paramedics.

Material and methods: The study was carried out between May and September of 2019, with the use of diagnostic survey methodology on 238 (223 male, 15 female) paramedics in mobile Emergency Response Teams from the Masovian voivodship. The mean age was 39.03±9.27 years for males, and 31.93±7.76 years for females.

Results: 59.66% of the participants (n = 142) report always following the recommended hygiene procedures. 50.85% (n = 121) of the participants indicated hands playing a significant role in the spread of infection. Co-workers followed hygiene procedures at a satisfactory level for 53.78% (n =128) of the participants.

Conclusions: There is a wide range of factors which limit respecting hygiene procedures, the most important of which being sudden and unforeseeable situations. Issues of the broadly understood hand hygiene practice should be a constant element of prophylaxis in ERTs.

Key words

paramedic, hand hygiene, occupational hazard, work environment, biological factor

INTRODUCTION

Infections are currently one of the main reasons for the occurrence of contemporary infectious diseases, and they concern patients and medical facility personnel alike, including paramedics employed in mobile Emergency Response Teams (ERTs).

Due to the nature of the professional tasks they undertake, paramedics are considered to be the medical professional group coming into direct contact with patients most frequently. Therefore, they are expected to exhibit a responsible attitude regarding the health and life of patients, as well as their own [1]. The environment paramedics work in creates the risk of their infection. Every year they are the most often ill among healthcare professionals, including occupational illnesses related to biological factors [2, 3].

The specifics and nature of the work, especially the volatile working conditions in ERTs, make the unambiguous definition of occupational exposure to biological factors very difficult. The discussion of the aforementioned issue in a complex manner in this paper is impossible. It is due to the fact that there are no limits as to where, location-wise, ERTs extend their aid, and consequently, each intervention involves changes in the factors of the work environment. During their undertaking of professional tasks, ERT paramedics may be exposed to, among others, viruses causing hepatitis (HBV, HCV), HIV, tubercle bacilli, tetanus bacilli, Clostridium perfringens, and Staphylococcus aureus, or currently SARS-CoV, MERS-CoV and SARS-CoV-2 [1, 3, 4].

Numerous studies indicate that hands are in fact the main vector of pathogen transmission in healthcare system facilities. Improper hand washing technique, improper use of disinfectants, or lack thereof altogether, increases the risk of infection spreading,

and is also the cause of the growing resistance against antibacterial products in medical facilities. These factors pose a threat to the health and safety of employees working in medical professions. There are many reasons as to why the employees of healthcare facilities do not sufficiently adhere to the rules of proper hand washing and disinfecting technique. The transitional microbiome acquired in contact with other people, medical equipment, and the contaminated environment is responsible for a majority of the infections. The risk of spreading infection increases in case of negligence in terms of asepsis and antisepsis [1, 4, 9, 11, 12].

The data from the World Health Organization (WHO) point towards the fact that medical facility employees do not sufficiently execute proper hand washing and disinfecting techniques in daily professional practice. Hand hygiene procedures compliant with WHO guidelines are executed fully by as few as 38% to 50% of employees in the healthcare system [11, 12].

THE AIM

The aim of the present study is the evaluation of the compliance with hygienic standards and knowledge regarding the prophylaxis of infection among paramedics in mobile ERTs.

MATERIAL AND METHODS

The study was carried out as part of the joint project between the Health Department of the Mazovian Voivodship Office in Warsaw and the Health and Social Policy Department of the Marshal's Office for the Mazovian Voivodship in Warsaw in the period between May and September of 2019 among professionally active ERT paramedics in the Mazovian Voivodship from 5 operational regions located in Warsaw, Płock, Ostrołęka, Siedlce and Radom.

The sample choice was deliberate given that on the national scale, according to data from Statistics Poland, the Mazovian voivodship had the highest number of functioning mobile ERTs in the country in 2019, amounting to 200 mobile ERTs constituting 12.7% of the overall number of teams [13].

The study was anonymous and voluntary in nature and was carried out following the guidelines outlined in the Helsinki Declaration. All of the participants of the study were informed of its aims and their ability to withdraw participation at any stage, and participation was voluntary, which every patient granted informed consent upon.

The diagnostic survey method was used to perform the research. The applied research tool was a self-developed, anonymous interview questionnaire, consisting of 22 items. The questionnaire was divided into two parts. The first part contained questions related to gender, level of education, and years of work experience, while the second part was based on the criteria outlined in the Centers for Disease Control and Prevention (CDC) guidelines in 2002 and the World Health Organization (WHO) guidelines in 2009 [14] and the items were concerned with: the evaluation of the degree of compliance with hygiene procedures (hand hygiene, using protective gloves) by paramedics, involving their subjective self-evaluation and the evaluation of their co-workers alike, as well as the self-evaluation of the knowledge on the topic of prophylaxis and infection control.

The data analysis used elements of descriptive statistics, and the percentage share of the answers to the questions posed was calculated. The $\chi 2$ test was used to analyze the relationship between the studied qualitative variables. For the quantitative variables (age and years of work experience), the normality of the distribution was verified, and the comparison of these distributions was carried out with the use of the non-parametric Mann-Whitney U test. The study had a set significance level of $\alpha = 0{,}05$. The grouping variable for the entire study was the level of education of the participating paramedics. Due to the size of the group of female participants taking part in the research being too low, the analysis was not carried out, as the result would not be representative in this regard.

Normality of distribution for quantitative variables was checked using the Shapiro-Wilk (SW-W) test . The value of the test statistic in the group of men for the variable seniority: SW-W = 0.9167; $p = 0.00<\alpha$; $\alpha=0.05$, in the group of women for the seniority variable SW-W = 0.6759; $p = 0.01<\alpha$; $\alpha=0.05$. The assumption of normality of distribution is violated. For further analysis non-parametric tests were used. The value of the test statistic in the male group for the variable age: SW-W = 0.9499; $p = 0.00<\alpha$; $\alpha=0.05$, in the group of women for the variable age SW-W =. 0.8906; $p = 0.04<\alpha$; $\alpha=0.05$. The assumption of normality of distribution is violated. Nonparametric tests were used for further analysis.

RESULTS

A vast majority of the participants (93.69%) were males. Among the participants, 58.82% reported having higher education, 25% had secondary or further secondary education, and an equal percentage had a master's degree.

238 participants were included in the final analysis, 223 of which were male and 15 were female. The

mean age of the participants was 39.03±9.27 years for males, and 31.93±7.76 years for females.

The mean years of work experience of the participating paramedics showed a statistically significant difference between the two genders (p=0.000). It amounted to 12.62±9.41 years among men, while it was 5.36±7.04 years among women. In both groups of participating paramedics, the shortest length of work experience was around half a year. These were participants with further secondary education, or higher and professional higher education.

Compliance with hygiene procedures is significantly dependent on the level of education of the participating paramedics (p=0.001). Over half of the participants (142; 59.66%) reported that they follow hygiene procedures in every situation. The majority of the participants in this group has higher or professional higher education. Every fifth participating paramedic did not follow procedures only sometimes (47; 19.75%), with the reports most often coming from participants with secondary or further secondary education. Approximately 21% of the participants (n = 49) indicated that they quite often do not follow hygiene procedures. In this participant group, the people who reported non-compliance with accepted hygiene behaviors most often were those with pro-

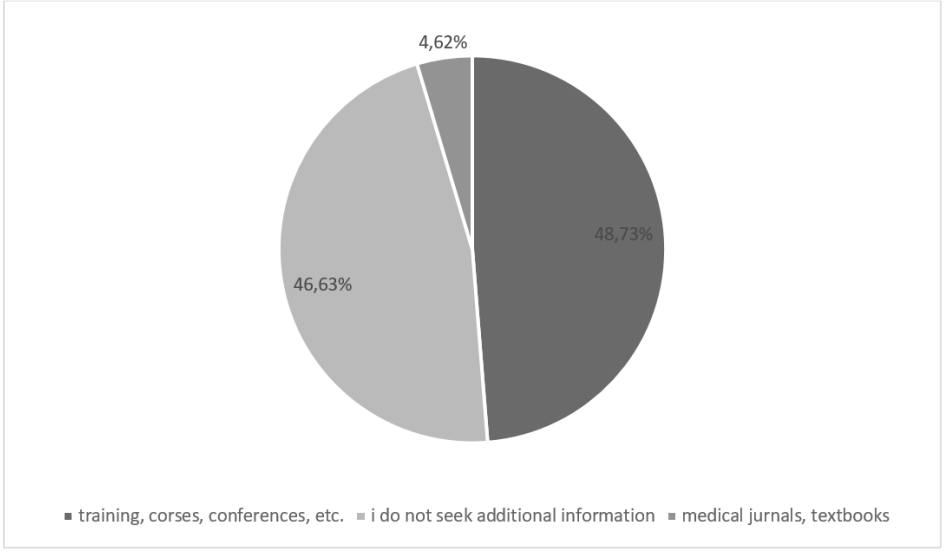

Fig. 1. The role of the hands of ERT personnel in the spread of infection according to participants.

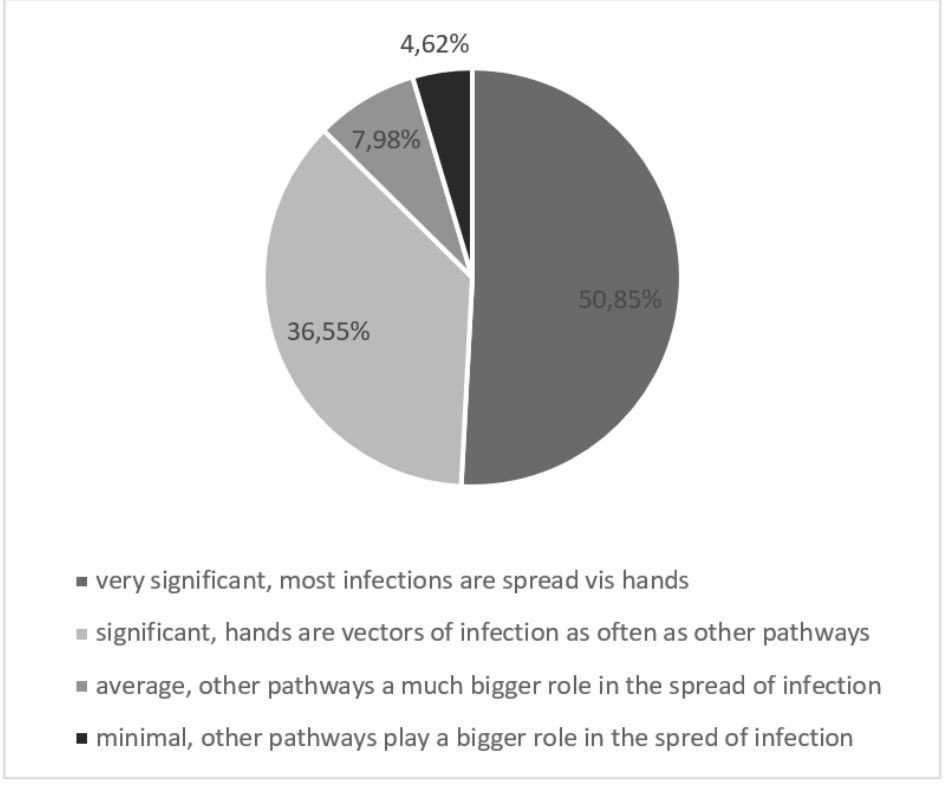

Fig. 2. Sources of information about infections and their prophylaxis among participants.

Table 1. Compliance with hygiene procedures (washing and disinfecting hands, wearing protective gloves) according to the subjective evaluation of the participating paramedics in view of their level of education.

Following hygiene procedures	Secondary/ further secondary education n =49; (%)	Professional higher education n=140; (%)	Master's higher education n=49; (%)	Overall n; (%)	p-value
I always follow procedures	24 (48.98)	87 (62.14)	31 (63.27)	142 (59.66)	
Sometimes I do not follow procedures	18 (36.73)	16 (11.43)	13 (26.53)	47 (19.75)	p=0.001*
I do not follow procedures quite often	7 (14.29)	37 (26.43)	5 (10.20)	49 (20.59)	

**Pearson χ2 Test, p<α; α=0.05, statistical significance*

Table 2. The evaluation of compliance with hygiene procedures by participants according to participating co-workers in view of their level of education.

Evaluation of following hygiene procedures	Secondary /further secondary education n=49; (%)	Professional higher education n=140; (%)	Master's higher education n=49; (%)	Overall n; (%)	p-value
Very good or good	15 (30.61)	36 (25.71)	14 (28.57)	65 (27.31)	
Satisfactory	24 (48.98)	87 (62.14)	21 (42.86)	132 (55.46)	p=0.034*
Bad or very bad	7 (14.29)	6 (4.29)	4 (8.16)	17 (7.14)	
I do not pay attention to it	3 (6.12)	11 (7.86)	10 (20.41)	24 (10.08)	

** χ2 NW, p<α; α=0.05, statistical significance*

Table 3. Self-evaluation of the participant's knowledge regarding the issue of infection and its prophylaxis in view of their level of education.

Participant self-evaluation	Secondary/ further secondary education n =49; (%)	Professional higher education n=140; (%)	Master's higher education n=49; (%)	Overall n; (%)	p-value
Very good	12 (24.49)	18 (12.86)	13 (26.53)	43 (26.53)	
Good	21 (42.86)	96 (68.57)	29 (59.18)	146 (61.34)	p=0.004*
Satisfactory	16 (32.65)	26 (18.57)	7 (14.29)	49 (20.59)	

**Pearson χ2 Test, p<α; α=0.05, statistical significance*

Table 4. Factors influencing the lack of compliance with rules of hand disinfection by patients in view of their level of education.

Factors** influencing lack of compliance with hand hygiene rules	Secondary /further secondary education n=49; (%)	Professional higher education n=140; (%)	Master's higher education n=49; (%)	Overall n; (%)	p-value
Lack of knowledge of hygiene procedures	2 (4.08)	1 (0.71)	1 (2.04)	4 (1.68)	p=0.322
Lack of time	24 (48.98)	113 (80.71)	22 (44.90)	159 (66.81)	p=0.000*
Sudden situations	31 (63.27)	115 (82.14)	27 (55.10)	173 (72.69)	p=0.001*
Lack of or small number of antiseptic agents	14 (28.57)	23 (16.43)	11 (22.45)	48 (20.17)	p=0.172
Lack of ability	33 (67.35)	125 (89.29)	26 (53.06)	184 (77.31)	p=0.000*
Allergies, skin irritation	7 (14.29)	5 (3.57)	4 (8.16)	16 (6.72)	p=0.044*

**Pearson χ2 Test, p<α; α=0.05, statistical significance*
***Participants could select more than one answer*

fessional higher education (26.43%; n=37). None of the participants reported not following hand hygiene-related procedures at all (Table 1).

When answering the question: "What role do hands of ERT members have in the spread of infections?", 50.85% of the participants (n=121) answered that it was a significant one. The spread of the other answers is illustrated in Figure 1.

Co-worker evaluation of the compliance with hygiene procedures is a very valuable phenomenon and it is statistically related to the level of education of the participants (p=0.034). It is due to the fact that it allows to estimate the degree of trustworthiness of the self-evaluation presented above. Only 27.31% (n=65) of ERT members were assessed very well, while 55.46% (n=132) were assessed well by their co-workers. The confrontation of the self-evaluation results and the evaluation given by the co-workers indicates that the results of the research carried out in this professional group with the use of the questionnaire method reflect the actual degree of hygiene procedure compliance. Simultaneously, approximately 10.08% (n=24) of the participants reported that at work they do not pay attention to the hygiene behaviors of co-workers (Table 2).

The self-evaluation of the knowledge regarding infections and their prophylaxis possessed by the participants is dependent on their level of education (p=0.008). ERT medical personnel evaluated their own knowledge regarding infection prophylaxis rather tentatively. 61.34 % (n=146) of the participants reported that their level of knowledge was good. In the participating cohort, 20.58% (n = 49) of ERT members assessed their knowledge to be at a satisfactory level (Table 3).

Almost every second ERT paramedic (48.73%, n = 116) gains their knowledge regarding infections from trainings and courses. A similar percentage of participants (46.63%, n = 111) pointed towards medical journals and textbooks as the main source they use to broaden their information. Almost 5% (n =12) of the participants do not try to learn more about this issue at all and base their knowledge solely on the information acquired in school/university (Fig. 2).

A phenomenon as complex as the compliance/non-compliance with hygiene procedures signifies there being a multitude of co-contributing factors of the organizational, technical, economic, awareness, and physiological kind, as well as the occurrence of situations which are very difficult to classify as routine procedure algorithms of ERT members. Among barriers limiting the respect for hand washing and disinfection, the one that was reported most commonly was definitely the lack of ability to do so (184; 77.31%, p=0.000). This state of things needs to be understood as relating to the conditions under which the aid provided by ERTs takes place (open space, lack of technological conditions, lack of access to running water). Subsequently reported obstacles included sudden situations (173, 72.69%, p=0.001), and lack of time (159; 66.01%, p=0.000) in the case where immediate aid needs to be provided. Every fifth participant reported an insufficient amount or lack of antiseptic agents in the workplace (48; 20.17%, p=0.172). Another obstacle in following hand washing and disinfecting procedures by participants was the occurrence of skin irritation and allergies related to the use of hygiene products (16; 6.72%, p=0.044). A small percentage of the participants (4, 1.69%, p=0.322) noted a lack of knowledge regarding the current procedures (Table 4).

DISCUSSION

Medical first aid provided to patients by ERT paramedics taking place without regard for the sanitary regime, including hand hygiene, before their transport to the hospital may increase the risk of infections spreading [22]. During their shifts, paramedics and the ambulance alike come in frequent contact with many patients each with a different vulnerability to infections [23]. Microorganisms from the patients' homes can be easily transported to the Emergency Department (ED) and the entire hospital, if proper sanitary practice, including the issue of hand hygiene among ERT personnel, is not in place. The environment itself may also be vulnerable to infections. The equipment used by ERTs can get dirty, which poses a potential risk of microorganisms spreading. Studies show that the largest areas of infection as far as medical equipment used by ERTs is concerned are blood pressure cuffs, stethoscopes, and stretchers [24, 25].

The results of the present study showed that according to the self-evaluation, a majority of ERT paramedics follow basic rules of hand hygiene. However, keeping in mind that a majority of the participants want to demonstrate a better score/level of behavior and knowledge, distance and caution need to be kept as far as assuming this state of things as fact is concerned [26, 27].

The research project carried out by Ho et al. involved a prospective, blind observation of a random sample of crews working in emergency medical service ambulances, the latter employing 115 paramedics during the 6-month period of data collection. During the research, events were observed in real-time, including every single situation related to hand hygiene

during contact with the patient. Contact with the patient was defined as each and every situation wherein a paramedic was obliged to evaluate a patient. The observation was carried out continuously over the duration of an 8 or 12-hour shift, during the day, evening, and night alike, as well as during weekdays and weekends, involving 53 paramedics during 258 situations of contact with patients. It was observed that in 62.8% of the cases (162 cases of contact with patients), paramedics would disinfect their hands. Hands were disinfected directly before contact with patients only thrice (1.1%) and nine times while contact with the patient was taking place (3.5%). Protective gloves were not used in 32 cases of contact with patients (12.4%) [28]. The results of the present study, which point towards a compliance with hygiene procedures (washing and disinfecting hands, wearing protective gloves) by paramedics, are consistent with the cited research.

The results of the present study indicating a constant use of protective gloves by paramedics at a level of 59.66% do not stray far from the results obtained in the research by Och et al., which showed that the most commonly used item of personal protective equipment were disposable gloves (68.9%) [29].

The present study's results regarding the factors related to non-compliance with hand disinfection rules and not using protective gloves by participants show that work in an environment characterized by high workload and time constraints combined with emergency situations increases the likelihood of noncompliance with hand hygiene rules, which finds confirmation in other pieces of research [30].

As the present research has shown, ERT paramedics recognize the importance of following hand hygiene procedures regarding the issue of spreading infections, and possess a basic knowledge in this area, which has been confirmed in other studies [1, 17, 23].

The findings of other authors show that medical personnel report a significantly higher opinion regarding their own knowledge in subjective assessments in comparison with what is indicated in objective studies [16, 34-36].

The results of the present study relating to the compliance with hygiene procedures in the realm of washing and disinfecting the hands (79.4%) are consistent with the results obtained in Barr et al.'s research on the scope of hand hygiene through the use of handwash agents or soap – 74.8%. The paramedics who participated in Barr et al.'s research stated that their practice of hand hygiene during sudden accidents was limited due to the pressure to act (47.5%, n = 85), which is consistent with the results obtained in the present research relating to the factors which influence the non-compliance with hand disinfection rules in sudden situations (72.68%, n = 173) [23].

The results of the present study as indicated by the paramedics related to the factors influencing the lack of use of protective gloves in sudden situations (62.6%), and factors, which could influence change in behavior regarding hand hygiene, including lower workload (81.09%), and better work organization (72.68%), ever so slightly vary from those obtained in Garus-Pakowska's research. This study showed that the barriers limiting the use of gloves are sudden situations preventing the immediate use of gloves (59.6%), while 74.8% of the employees reported that better work organization can result in lower workload, which in turn can increase the degree of compliance with hygiene recommendations [36].

The present study shows that work overload affects the noncompliance with hand disinfection rules and not using protective gloves by ERT paramedics. These findings were supported by research carried out by other authors [20, 36, 37].

Our research showed that the participants' sources of information regarding infections and their prophylaxis are trainings and courses (48.73%, n=116), while 46.63% (n = 111) of the participants pointed towards medical journals and textbooks, and almost 5% (n =12) of the participants do not gain additional knowledge in this area through any means, basing their knowledge solely on the information acquired in school/university. Garus-Pakowska et al. reached vastly different conclusions, showing that a majority of the answers paramedics gave when tested on their knowledge (46.75%) was based on the knowledge acquired in school, and only every fifth paramedic (18.3%) acquired additional information through different kinds of supplementary courses, and an equal number of respondents (18.3%) broadened their knowledge through reading the newest scientific journals [38]. The discrepancy between the answers obtained in the two studies may be the result of the way the questions regarding the issue of infections and their prophylaxis were formulated for the participants.

As studies have shown [20, 39], the location of sinks and dispensers, as well as the sufficient number of such, can definitely improve the frequency, and thus the effectiveness, of hand hygiene. The aforementioned findings are congruent with the results of the present study.

CONCLUSIONS

1. While completing the self-evaluation, ERT paramedics were trying to minimize their negative behaviors, and yet despite that, a relatively high

percentage of participants admitted to having made mistakes regarding following hygiene behavior standards.

2. Among the many barriers limiting the ability to respect hygiene procedures, ERT paramedics reported there being a lack of time in case of hand disinfection, and work overload, as well as lack of time, in the case of not using protective gloves.
3. A vast majority of ERT paramedics is of the belief that a lower workload and better work organization would contribute to the improvement of hygiene behaviors in this professional group.
4. In the opinion of ERT paramedics, there is a necessity to introduce lifelong learning measures in the broadly understood area of hygiene, using antiseptic agents, and the accessibility to personal protective equipment, while hand hygiene practice should be a priority in order to improve safety.

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KNOWLEDGE OF IN-HOSPITAL CARDIOPULMONARY RESUSCITATION AMONG NURSING STAFF

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Abstract

Aim: To assess the knowledge of medical personnel about in-hospital cardiopulmonary resuscitation and to compare it with the current European Resuscitation Council Guidelines. Furthermore, the study intended to investigate the respondents' preferences and experiences associated with performing cardiopulmonary resuscitation.

Material and methods: The study included 248 nurses working in conservative and surgical wards. The research used an author-designed survey questionnaire, which was made available in electronic form. It consisted of 20 closed single-choice questions. Participation in the study was anonymous and voluntary.

Results: A high level of knowledge of in-hospital CPR was found in 30.6%, average in 50.4% and low in 19%. Respondents with work experience of ≤2 years (43.2%) and 3-10 years (36%) were significantly more likely to have a high level of knowledge of in-hospital CPR than those with longer work experience, especially 11-25 years (13.6%), $p<0.0001$. Most of respondents reported that the type of equipment used for defibrillation did not matter to them (42.3%), while 27.8% preferred the use of a defibrillator spoon, and 29.8% preferred the use of self-adhesive electrodes for defibrillation. The majority of respondents (70.2%) used 1 mg undiluted epinephrine during CPR. A dose of 1 mg epinephrine after 10-fold dilution in 0.9% NaCl solution was used by 20.2% of respondents.

Conclusions: The study showed an average level of knowledge on in-hospital cardiopulmonary resuscitation. A significantly higher level of knowledge was found in younger respondents, those with shorter work experience and higher education, and among men. The type of equipment used during defibrillation did not matter for most respondents. It was also found that the vast majority of respondents had participated in or witnessed cardiopulmonary resuscitation at least once, and more than half knew the professional qualifications gained after a qualification course and specialisation in anaesthesia and intensive care nursing.

Key words

in-hospital cardiac arrest, resuscitation, nursing, knowledge

INTRODUCTION

Sudden cardiac arrest (SCA) is one of the most common causes of death both worldwide and in Europe. It accounts for approximately 60% of adult deaths due to ischaemic heart disease. The incidence of in-hospital SCA is estimated between 1 and 5 per 1,000 hospital admissions, and the global survival rate is 17.6%. Pulseless ventricular fibrillation (VF) and ventricular tachycardia (VT) are cited as the main causes of SCA [1].

Knowledge and appropriate use of the basic life support (BLS) algorithm significantly increases the chances of survival and successful cardiopulmonary resuscitation (CPR). It is based on non-instrumental airway management, maintenance of breathing and circulation, and the use of an automated external defibrillator (AED). BLS plays a vital role in in-hospital CPR, as it forms the basis for the implementation of advanced life support (ALS). ALS, in turn, involves establishing intravenous access, appropriate pharmacotherapy and fluid therapy, the use of equipment for airway management and the treatment of rhythms for defibrillation. Since the European Resuscitation Council updates its CPR guidelines every few years, it is important to familiarise with and verify the introduced modifications [2-5].

Sudden cardiac arrest is a major challenge for the personnel involved in CPR, even those well trained in their field of expertise. Therefore, it is crucial to acquire practical CPR skills and to practice them frequently and regularly, because it is in the hands of these people that human life rests.

Cardiopulmonary resuscitation in the hospital setting combines both elements of BLS and ALS. Division of these two, which results from the nature of the site, is conventional and based on experience and common sense. Respiratory and cardiac arrest is very quickly identified. CPR is performed immediately, using airway management equipment, oxygen administration and, if indicated, defibrillation as soon as possible. If assistance is needed, a resuscitation team is available on call. The sequence of life-saving

measures will depend on a number of factors including the scene of event, the experience and training of medical personnel, the number of people performing CPR, the equipment and the system in place for emergencies [5-7].

THE AIM

The aim of the study was to assess the knowledge of medical personnel about in-hospital CPR and to compare this knowledge with the current European Resuscitation Council Guidelines. Furthermore, the study intended to investigate the respondents' preferences and experiences associated with performing cardiopulmonary resuscitation.

MATERIAL AND METHODS

This nationwide study was conducted between December 2019 and February 2020. The respondents included the analysis were nurses working in internal medicine, cardiology, surgery, intensive care, and paediatric wards, operating theatres, primary health care (PHC) units, nursing homes and private medical facilities.

The research used an author-designed questionnaire, which consisted of 20 closed-ended, single-choice questions. Using the Google Forms application, the electronic form of the questionnaire was sent via e-mail to medical staff. We received 248 responses. The survey was anonymous and voluntary.

Part one included questions on socio-demographic background such as gender, age, education, place of work and length of service. Respondents then answered questions about their preferences and knowledge of in-hospital CPR.

The survey questionnaire contained 10 questions to asses knowledge. In each question, the respondent could indicate either the correct or incorrect answer, obtaining a maximum score of 10 (Table 1). The correct answers were summed, and the respondents were assigned to groups reflecting their level of knowledge (based on the percentage of correct answers in the knowledge test). The results were also presented quantitatively as percentages of correct answers (0-100%).

The results are presented as qualitative data by means of counts and percentages, and quantitative data by mean, standard deviation, median and minimum and maximum values. In order to check for statistically significant relationships between the variables, an analysis using non-parametric Pearson's Chi-Square for qualitative data was performed. The distribution of quantitative data was tested using the Shapiro-Wilk Test. Once the distribution was determined (non-normal), we used the Mann-Whitney U Test (UMW, Z) for two groups and the Kruskal-Wallis Test (KW, H) for three and more groups. Spearman correlations (R) were also used. It was assumed that a p-value of less than 0.05 does not indicate a statistically significant relationship. StatSoft Statistica 13.1 PL statistical package and Microsoft Office were used for the analysis.

RESULTS

CHARACTERISTICS OF THE STUDY GROUP

A total of 248 medical staff practising as nurses participated in the survey. There were 13.3% (N= 33) of male nurses and 86.7% (N= 215) of female nurses. The respondents were classified into the following age groups: 18-25 years (29%), 26-35 years (29%), 36-45 years (25.8%), and > 45 years (16.1%). Lower than tertiary education was reported by 8.4% of the respondents, including a completed medical high school in 5.6% and vocational college in 2.8% of respondents. Bachelor's degree was held by 47.6% and master's degree by 44%. The largest number of respondents participating in the survey worked in conservative treatment wards (26.2%), surgical wards (25.8%) and intensive care units (22.6%). A total of 8.1% of respondents were employed in hospital emergency departments, 3.6% in PHC and 2.4% in long-term or palliative care. Respondents working elsewhere were included in the 'other' group (11.3%), with the majority working in operating theatres (4%), single respondents employed in private and dental practices, psychiatric units, emergency rooms, social care homes and paediatric wards. Due to the small number of respondents with high school and vocational college education, they were com-

Table 1. Respondents' level of knowledge of in-hospital cardiopulmonary resuscitation, criteria for knowledge assessment.

General level of knowledge	The test score	Percentage of correct answers [%]
Low	0-4	0-30
Average	5-7	41-70
High	8-10	71-100

bined into one group – respondents with secondary medical education (8.5%). Undergraduate education was declared by 48% of the nurses.

GENERAL LEVEL OF KNOWLEDGE ON IN-HOSPITAL CARDIOPULMONARY RESUSCITATION AMONG MEDICAL PERSONNEL (BASED ON KNOWLEDGE TEST)

The respondents answered correctly an average of 57.6% of the questions in the knowledge test, which allows for a conclusion that they had an average level of knowledge of in-hospital cardiopulmonary resuscitation. The respondents mostly answered correctly 60-70% of the questions testing their knowledge in the questionnaire. Male nurses had a statistically significantly higher level of knowledge of in-hospital CPR than their female counterparts (64.5% *vs.* 46.6% of correct answers in the knowledge test), $p<0.02$. The older the respondents, the significantly lower their knowledge on in-hospital CPR, as evidenced by the negative correlation coefficient (R= -0.22), $p<0.0001$. Respondents aged 26-35 years answered correctly 61.7% of the questions on average, and those aged over 45 years had 50% of correct answers on average. The higher the respondents' level of nursing education, the significantly higher their knowledge on in-hospital CPR, as evidenced by the correlation coefficient (R= 0.15), $p<0.02$. The longer the service in the profession, the significantly lower the level of knowledge on in-hospital CPR, as evidenced by the negative correlation coefficient (R= – 0.22), $p<0.001$ (Table 2).

The qualitative analysis confirmed significant correlations between the respondents' level of knowledge of in-hospital CPR and their age, education, length of service, but not with their gender or workplace. A high level of knowledge of in-hospital CPR was found in 30.6%, average in 50.4% and low in 19% of the medical staff surveyed (Fig. 1). Respondents aged 18-35 years and 26-35 years (44.4% and 37.5%) were statistically significantly more likely to have a high level of knowledge of in-hospital CPR than older respondents, especially those aged 36-45 years (10.9%), $p<0.0001$.

Low levels of knowledge of in-hospital CPR were significantly more common among respondents

Table 2. Overall knowledge of medical staff on in-hospital CPR, in total and by variables (a descriptive analysis).

General level of knowledge		M	SD	Me	Min	Max	Statistics	
Total		**57.6**	**19.1**	**63.6**	**0.0**	**100.0**	**Test**	**P**
Gender	Female	56.6	18.5	54.5	9.1	100.0	Z=-2.42	0.015
	Male	64.5	21.6	63.6	0.0	100.0		
Age	18-25 years	61.2	18.9	63.6	9.1	100.0	R= -0.22	0.000
	26-35 years	61.7	17.7	63.6	0.0	90.9		
	36-45 years	53.7	15.0	54.5	27.3	100.0		
	>45 years	50.0	24.1	59.1	9.1	100.0		
Education	Medium	49.8	27.2	45.5	9.1	100.0	R=0.15	0.018
	Bachelor's degree	56.1	18.9	54.5	9.1	90.9		
	Master's degree	60.8	16.9	63.6	0.0	100.0		
Workplace	Interventional department	56.1	20.7	63.6	9.1	100.0	H=10.10	0.120
	Conservative department	56.9	19.3	54.5	9.1	90.9		
	Long-term/palliative care	51.5	9.4	54.5	36.4	63.6		
	ED	58.6	20.3	63.6	0.0	81.8		
	ICU	63.1	17.1	63.6	18.2	100.0		
	PHC	46.5	16.0	45.5	27.3	72.7		
	Other	55.8	18.6	54.5	27.3	90.9		
Length of service	0-2 years	61.1	18.3	63.6	9.1	90.9	R= -0.22	0.001
	3-10 years	60.7	18.5	63.6	0.0	100.0		
	11-25 years	55.5	14.6	54.5	27.3	100.0		
	>25 years	47.1	25.6	45.5	9.1	100.0		

*M – mean, SD – standard deviation, Me – median, Min-Max – minimum-maximum

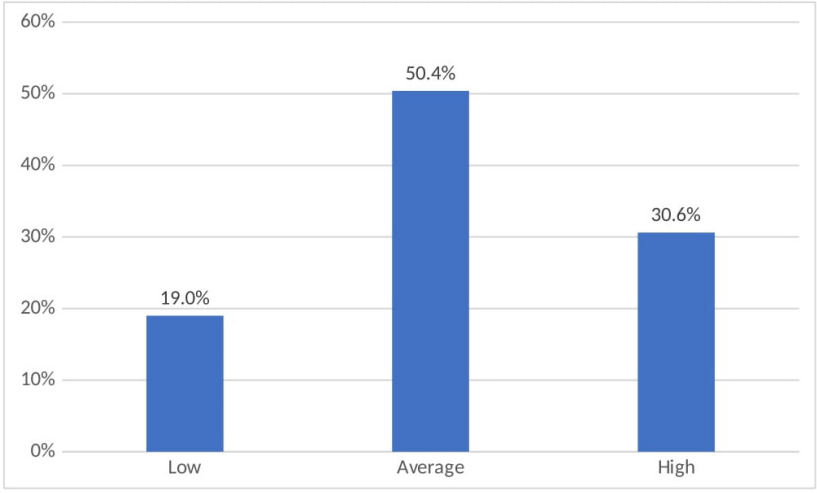

Fig. 1. Overall level of knowledge on in-hospital CPR among the surveyed medical staff.

with secondary and vocational college education than among those with tertiary education (47.6% vs. 21.2% and 11%), p<0.001. Respondents with work experience of ≤2 years (43.2%) and 3-10 years (36%) were significantly more likely to have a high level of knowledge of in-hospital CPR than those with longer work experience, especially 11-25 years (13.6%), p<0.0001. Men were more likely to have a high level of knowledge of in-hospital cardiopulmonary resuscitation than women (48.5% vs. 27.9%): a non-statistically significant relationship with a trend towards significance (p=0.054). A high level of knowledge of in-hospital CPR was more often shown by respondents working in the ICU (41.1%) and ED (35%), while a low level was most often found in respondents working in primary care (44.4%), relationship not statistically significant, p>0.05.

DETAILED ANALYSIS OF MEDICAL STAFF KNOWLEDGE OF IN-HOSPITAL CPR

The majority of respondents (85.1%) believed that the non-instrumental airway management technique included the head tilt–chin lift, followed by the insertion of an oropharyngeal tube (7.3%), pressing the head against the chest (4.4%) and opening the patient's mouth wide (3.2%). The analysed variables were not significantly correlated with the respondents' knowledge of the non-instrumental airway management technique, p>0.05. More than half of the respondents (56.5%) were convinced that it was the centre of the sternum that should be compressed during CPR, 40.7% were convinced that it was the centre of the chest, 2.4% pointed to the upper part of the sternum (n=6), while 0.4% indicated the left-sided ribs (n=1). The variables analysed were not significantly correlated with the knowledge of the location of chest compressions during CPR, p>0.05.

Almost two-thirds of the respondents (73.4%) believed that the correct depth of chest compressions during CPR was 5-6 cm. A compression depth of 3-4 cm was considered appropriate by 13.7%, 7-8 cm by 10.9% and 3 cm by 2% (n=5) of respondents. Respondents aged 18-25 years and 26-35 years (81.9% and 76.4%) were significantly more likely to report that the correct depth of CPR chest compressions was 5-6 cm than older respondents (64.1-67.5%), p<0.04. Respondents with a bachelor's or master's degree (77.1% and 71.6% *vs.* 61.9%, p<0.002) as well as those with shorter work experience (0-2 years: 83.8%, 3-10 years: 77.3%, 11-25 years: 63.6%, >25 years: 60.6%, p<0.001) were significantly more likely to report that the correct depth of CPR chest compressions is 5-6 cm than those with secondary education.

The majority of respondents (78.2%) believed that the correct rate of CPR chest compressions was 100-120 compressions per minute. The remaining respondents reported a rate of 70-80 compressions per minute (11.3%), and 80-90 compressions per minute (8.5%), while five respondents (2%) reported that the rate of chest compression did not matter. The higher the level of education (secondary education: 57.1%, bachelor's degree: 76.3%, master's degree: 84.4%, p<0.02) and shorter the length of service as a nurse (0-2 years: 58.1%, 3-10 years: 82.7%, 11-25 years: 75.8%, >25 years: 57.6%, p<0.02), the significantly more common conviction that the correct rate of CPR chest compressions was 100-120 compressions per minute.

The vast majority of respondents (94.4%) believed that the ratio of chest compressions to breaths when performing CPR in an adult was 30:2. Some of respondents were convinced that the ratio was 15:2 (n=4), 30:1 (n=4) or 15:1 (n=6). Respondents with secondary education were significantly less likely

than those with a tertiary education to report that the ratio of CPR chest compressions to breaths in an adult was 30:2 (81% *vs.* 97.5% and 93.6%), p<0.03.

The study showed that 62.5% of respondents believed that pulseless ventricular fibrillation and ventricular tachycardia require defibrillation. The remaining respondents indicated other cardiac abnormalities as requiring defibrillation, including pulseless electrical activity and ventricular fibrillation (15.3%), atrial fibrillation and ventricular fibrillation (14.5%), as well as asystole and ventricular tachycardia with pulse (7.7%). Pulseless ventricular fibrillation and tachycardia were significantly more frequently mentioned as indications for defibrillation by ICU workers (83.9%) and least frequently by PHC personnel (33.3%), p<0.02.

As for the timing of epinephrine administration, almost half of the respondents (45.6%) believed that the first dose should be administered after the second resuscitation cycle, 34.7% suggested that it should be administered immediately after the onset of resuscitation, 18.5% that it should be administered after the third resuscitation cycle, and three respondents that it should be administered after the fourth resuscitation cycle (1.2%). The variables analysed were not significantly correlated with respondents' knowledge of when to administer the first dose of epinephrine to a patient during CPR, p>0.05.

More than half of the respondents (55.2%) believed that the interval needed to administer successive doses of epinephrine to a patient during CPR was 3-5 minutes, i.e. usually 2 cycles of CPR. Less frequently, respondents believed that this interval should be 7-8 minutes, i.e. every three CPR cycles (7.7%), or every 2-3 minutes, i.e. every one cycle (13.7%). Almost one in four respondents (23.4%) thought that the interval needed to administer successive doses of epinephrine depended on the patient's clinical status. Respondents aged 26-35 years were statistically significantly more likely to report that the interval needed for subsequent epinephrine administration was 3-5 minutes, i.e. typically 2 cycles of CPR compared to others (69.4% vs. others: 40.6-59.7%, p<0.02) and respondents employed in long-term care and other workplaces (66.7% and 71.4% vs. others: 33.3-60.7%, p<0.03).

Almost half of the respondents (48.4%) believed that having completed a qualification course in anaesthesia and intensive care nursing, they could independently perform endotracheal intubation in sudden cardiac arrest by mouth or through the nose without the use of muscle relaxants. A similar opinion, but including the use of muscle relaxants, was expressed by 9.7% of respondents. There were 29.8% of respondents convinced that a nurse could only use an oropharyngeal tube to establish the airway, and 12.1% believed that endotracheal intubation could only be performed by a doctor. The analysed variables were not significantly correlated with the respondents' knowledge of nurses' competence to independently perform endotracheal intubation in sudden cardiac arrest, p>0.05.

The majority of nurses surveyed (57.3%) were convinced that a nurse, having completed specialty training in anaesthesia and intensive care nursing, can undertake and perform basic and advanced cardiopulmonary resuscitation techniques by themselves in an adult, as set out in the current guidelines of the Polish Resuscitation Council. On the other hand, 28.2% of respondents were convinced that a nurse could undertake and perform only basic resuscitation techniques on their own. Some respondents believed that a nurse without completed courses or training could perform both basic and advanced resuscitation techniques (10.5%), and 4% believed that the decision to undertake and perform resuscitation is solely at the discretion of a physician. Respondents with a master's degree were statistically significantly more likely to report that a nurse practitioner could perform basic and advanced resuscitation techniques independently than those with a bachelor's degree and secondary education (67.9% *vs.* 49.2% and 47.6%), p<0.001.

CPR EXPERIENCES OF THE SURVEYED MEDICAL PERSONNEL

Almost half of the study participants (46.4%) had extensive experience of participating in or witnessing adult CPR (more than 10 times). Less extensive experience (4-10 episodes) was reported by 19.4% of the respondents, 1-3 episodes by 14.2% of respondents, while 10.1% of the surveyed nurses had never participated in a similar event in their life. The older the respondents were and the longer their service in the profession, the more frequent their involvement in and/or witnessing adult CPR attempts, p<0.0001. Respondents working in ITUs (67.9%) and EDs (60%) were more likely to witness or involve in >10 adult CPR attempts than others, p<0.03. Particularly, the respondents working in surgical wards (17.2%) had no CPR experience as a team member.

Most of respondents reported that the type of equipment used for defibrillation did not matter to them (42.3%), while 27.8% preferred the use of a defibrillator spoon, and 29.8% preferred the use of self-adhesive electrodes for defibrillation. The majority of respondents (70.2%) used 1 mg undiluted epinephrine during CPR. A dose of 1 mg epinephrine after 10-fold dilution in 0.9% NaCl solution was used by 20.2% of respondents.

The majority of respondents (58.9%) stated that they had performed endotracheal intubation at least once in the past, including 4.4% on the patient, 42.7% on a phantom,

and 11.7% both on a patient and a phantom. The older the respondents were ($p<0.0001$) and the longer their work experience ($p<0.002$), the significantly more likely they were to have experience of endotracheal tube placement both on a patient and a phantom. Respondents with undergraduate education were significantly least likely to perform endotracheal intubation, $p<0.03$.

The majority of respondents (68.1%) had experience of airway management on a patient with alternative devices such as a laryngeal mask or laryngeal tube. Experience involving airway management on the patient was reported by 19.4% of respondents, on the phantom by 30.6%, and on both a phantom and a patient by 18.1%. One in three respondents (31.9%) did not have the experience described above. Airway management on the patient using alternative devices was performed by 37.5% of respondents. Respondents older than 45 years of age (42.5% vs. others: 20.8-36.1%, $p<0.002$) and respondents with 11-25 years of service were significantly more likely to have experience in patient airway management with alternative devices, such as a laryngeal mask or laryngeal tube (25.8% vs. 33.3-36.4%, $p<0.003$).

DISCUSSION

The present study attempted to assess nursing staff knowledge of in-hospital cardiopulmonary resuscitation, as well as their experience of performing life-saving procedures and their preferences for the equipment used. Special attention was paid to the knowledge of basic and advanced resuscitation procedures, such as airway management technique; location, depth and frequency of chest compressions; the ratio of chest compressions to breaths; heart rhythms requiring defibrillation; method, dose and frequency of epinephrine administration during CPR attempts [5].

The study showed that the respondents had an average level of knowledge, with 57.6% of correct answers. The level of knowledge decreased with longer seniority ($R= -0.22$, $p<0.001$). On the other hand, education did not significantly contribute to the increase in knowledge ($R=0.15$, $p<0.02$). Men showed greater knowledge of the principles and guidelines related to in-hospital CPR than women ($p<0.02$). The place of work did not significantly affect the level of knowledge. ICU medical staff had the highest level of expertise, while the poorest knowledge was found among PHC workers.

In a study in 100 respondents, Tomaszek et al. [8] showed that the level of expertise among medical personnel on in-hospital CPR decreased with age and length of service, which corresponds to our findings. Referring to the conclusions by Tomaszek et al. it can be concluded that such a relationship is related to the time elapsed since refresher courses and their regular and cyclical repetition. Analysing the issues in detail, the largest number of respondents gave correct answers to questions related to basic resuscitation procedures, such as placing the hand in the centre of the chest, the ratio of chest compressions to rescue breaths, and the use of a defibrillator to treat pulseless ventricular fibrillation and ventricular tachycardia. In our study, a slight majority of respondents also correctly answered the BLS-related questions, which may indicate an average level of knowledge on the basic principles of in-hospital CPR.

Szpunar et al. [9] conducted a study to assess the knowledge of medical personnel of basic resuscitation procedures, concluding that the knowledge of BLS principles was insufficient. The majority of respondents provided a wrong answer to the question referring to the correct non-instrumental airway management technique, i.e. the head tilt–chin lift, and the place of chest compression (the centre of the chest). Issues related to the frequency and depth of life-saving compressions were also problematic. In our study, the medical professionals surveyed gave similar answers to similar questions, with only slight variations.

Zientarska et al. [10], who included 100 nurses working in an intensive care unit in their study, with a predominance of staff with up to 5 years' seniority, higher education and frequent experience of providing CPR during and after cardiac arrest, reported a satisfactory level of knowledge of in-hospital cardiopulmonary resuscitation. Both basic and advanced resuscitation issues caused no major difficulties for the respondents. This was related to their extensive professional experience and place of work, i.e. the intensive care unit. It is noteworthy that the respondents showed willingness to expand and acquire new skills. Compared to our study, less than half of the respondents had involved in or witnessed >10 CPR attempts, and more than 68% had no experience in airway management with alternative devices.

A literature review by Mazur et al. [11], which included 101 clinical ward staff, found a significant relationship between the length of service and decreasing knowledge of how to perform the CPR algorithm. As in our study, a varying and insufficient level of CPR knowledge was shown. It can be concluded that the above studies by the authors in their review of source

materials encounter a similar problem, namely the need to update the CPR knowledge of medical personnel.

Summarising the results obtained in our research and comparing them with studies by other authors, it can be concluded that they coincide. Medical personnel have average and insufficient knowledge of in-hospital CPR.

CONCLUSIONS

1. The surveyed nursing staff representatives had an average level of knowledge of in-hospital CPR. A statistically significantly higher level of knowledge was shown by respondents who were younger and had shorter seniority, higher education and among males.
2. The majority of respondents (90%) participated in or witnessed an adult CPR attempt at least once in their career, almost half of them more than ten times.
3. The majority of respondents (59%) performed endotracheal intubation at least once, including 4% on the patient, 43% on the phantom and 12% both on the patient and the phantom. Airway management on the patient using alternative devices was performed by 38% of respondents.
4. For the nurses surveyed, the type of equipment used for defibrillation usually did not matter (42%), while 28% preferred the use of a defibrillator spoon and 30% preferred self-adhesive defibrillation electrodes.
5. Approximately half of the nurses surveyed were aware of the professional qualifications obtained in courses and specialisation training in anaesthesia and intensive care nursing.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest.

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CREATIVE COMMONS 4.0

RECEIVED	ACCEPTED
12.05.2022	15.11.2022

* 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.

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DOI: 10.36740/EmeMS202204104 **ORIGINAL ARTICLE**

PEDIATRIC PATIENT DURING EMERGENCY MEDICAL TEAM INTERVENTION

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Abstract

Aim: Analysis of Emergency Medical Teams' responses to patients below 18 years of age in operational region of Katowice Emergency Service between January 1st, 2014 and December 31st, 2017.
Material and methods: Retrospective analysis of medical documentation issued by the dispatcher and by the P and S type EMS teams of Katowice Emergency Service between January 1st, 2014 and December 31st, 2017 (n = 974839). Documents regarding response to patients below 18 years of age were included in research (n = 53643).
Results: EMS teams' responses to patients below 18 years of age were selected by patients' date of birth. These came out to be 5,38% of all responses in the defined time period. P-type EMS teams were dispatched to pediatric patients most frequently. This number decreased in months of summer vacation (July and August). The average number of responses was calculated for 10 months, January-June and September-December (n = 2322,75) and for July and August (n = 1797). Comparing the average results revealed decrease of responses in summer vacation period by n = 22.63%. Further patients below 18 years of age were divided into 4 age groups. It has been observed that among group I and III there is no statistical significance regarding responses in given daytime interval and given year in the time of research. However among group II and IV significance is high (p = 0.016) for group II and (p = 0.028) for group IV. Distribution between responses by EMS-S teams and EMS-P teams in daytime intervals shows that at night (12:00 am-5:59 am) EMS-S team is most frequently dispatched to patients from first three age groups: group I (69% *vs.* 31%), group II (64% *vs.* 36%) and group III (57% *vs.* 43%). In each age group there is high statistical significance.
Conclusions: Patient below 18 years of age is a problem for Emergency Medical Team because of very few responses, leading to lack of experience in examining such patients and undertaking emergency medical procedures. Research revealed relationship between EMS team responses in given months, daytime intervals, age and gender. Number of responses to patients aged 8-13 and 13-18 decreases during summer vacation months and also decreases at night; there are more responses to male patients.

Key words

emergency medical teams, pediatric patient, Voivodship Rescue Service in Katowice, dispatcher medical

INTRODUCTION

In order to provide aid for each person in medical distress in Poland, State Emergency Medical System was created. It functions on the basis of 2006 enactment (*Ustawa z dnia 8 września 2006 r. o Państwowym Ratownictwie Medycznym*) [1]. System comprises three basic elements: medical dispatch center, emergency medical team, therein helicopter emergency medical team and hospital emergency department [2]. Individual in medical distress usually has contact with these three elements. In order to activate the State Emergency Medical System, it is necessary to contact medical dispatch center, where phone call is responded by medical dispatcher [3]. After completing medical interview dispatcher decides to dispatch emergency medical team or not. After arriving on the scene, the team undertakes emergency medical procedures and then – if necessary – transports patient to emergency department. Patients are triaged there in order to prioritize initial diagnostics and treatment [4, 5].

According to data issued by the Main Statistical Office in 2020, EMS teams undertook medical action on scene 2,8 million times. 77,9% of these cases took place at patient's home, the remaining in public areas, schools or workplaces. 4,5% of 2,8 million patients in need of prehospital medical aid were aged under 18. The year before they presented 6% [6]. In reference to these statistics there is limited data regarding results of prehospital care among patients below 18. This is primarily related to the higher

percentage of medical distress situations among adults, which results in much more EMS team interventions among them [7].

Low number of EMS team responses to patients under 18 results in medical personnel having less experience in working with this group [7]. This especially concerns the younger ones, before the age of puberty, this means lacking the features of maturation. It has to be remembered that such patient is different from adult and many aspects regarding medical interview, physical examination and emergency medical procedures will be age-specific. Care of child with injuries or symptoms of acute illness requires different range of skills than skills useful for adult patients, therein paying attention to child's unique features and needs. This may cause prehospital emergency medical procedures among the youngest patients be not up to the level of treating adults. Furthermore pediatric aspects are just a small part of training programs attended by emergency medical team personnel [8-10].

STATE EMERGENCY MEDICAL SYSTEM IN POLAND

The aim of State Emergency Medical System functioning is saving the good of the highest value – human life, along with providing aid for each person in medical distress in Poland. The legal base of this system is 2006 enactment (*Ustawa o Państwowym Ratownictwie Medycznym z dnia 8 września 2006 roku Dz.U. 2006 Nr 191 poz. 1410*) effective since January 1st, 2007. It covers the rules of organizing, functioning and financing the system, and the ways of ensuring education in the field of first aid [1].

System is created by organs of government administration proper for fulfilling the tasks of the system, and by system units ensuring maintenance of readiness of people, resources and operational units. The system comprises three main elements: medical dispatch center, emergency medical team, therein helicopter emergency medical team and hospital emergency department. Each of these has legally predefined tasks and separate area of functioning [2].

The whole system in based on modern IT technology called System Wspomagania Dowodzenia Państwowego Ratownictwa Medycznego (System of Management Assist for State Emergency Medical Service). It is a unified software functioning nationwide. It is operated by all professionals on duty either as medical dispatcher, EMS team member or as emergency medical coordinator for administartive region of voivodeship. The whole system is monitored and upgraded by State Center of Emergency Medical Services Monitoring. Thanks to this, emergency dispatch centers manage more EMS teams. Therefore for each incident the closest EMS team available is dispatched. In case of any failure dispatch centers may work interchangeably [11-13].

Each day 1603 EMS teams are on duty in Poland (figure for October 31st, 2022) [11]. These are the units providing aid for each individual in the Republic of Poland, whenever life or health threatening accident or illness occurs in prehospital environment. EMS team's work in initiated upon medical dispatcher's decision, after collecting medical interview and recognizing health or life hazard. EMS teams are responsible for providing medical assistance in case of accident, injury, childbirth, sudden illness or sudden health deterioration and for transport to the closest emergency department or other hospital admission room. Each EMS team has to be maintained in readiness for immediate medical response. In the event of call issued by the medical dispatcher, the team has to arrive on

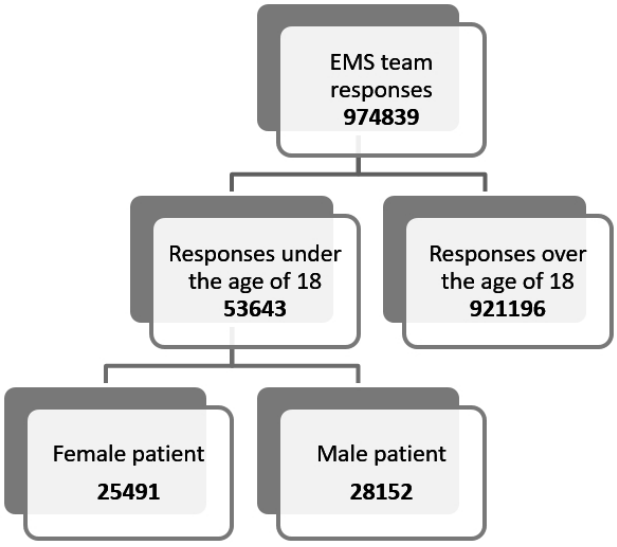
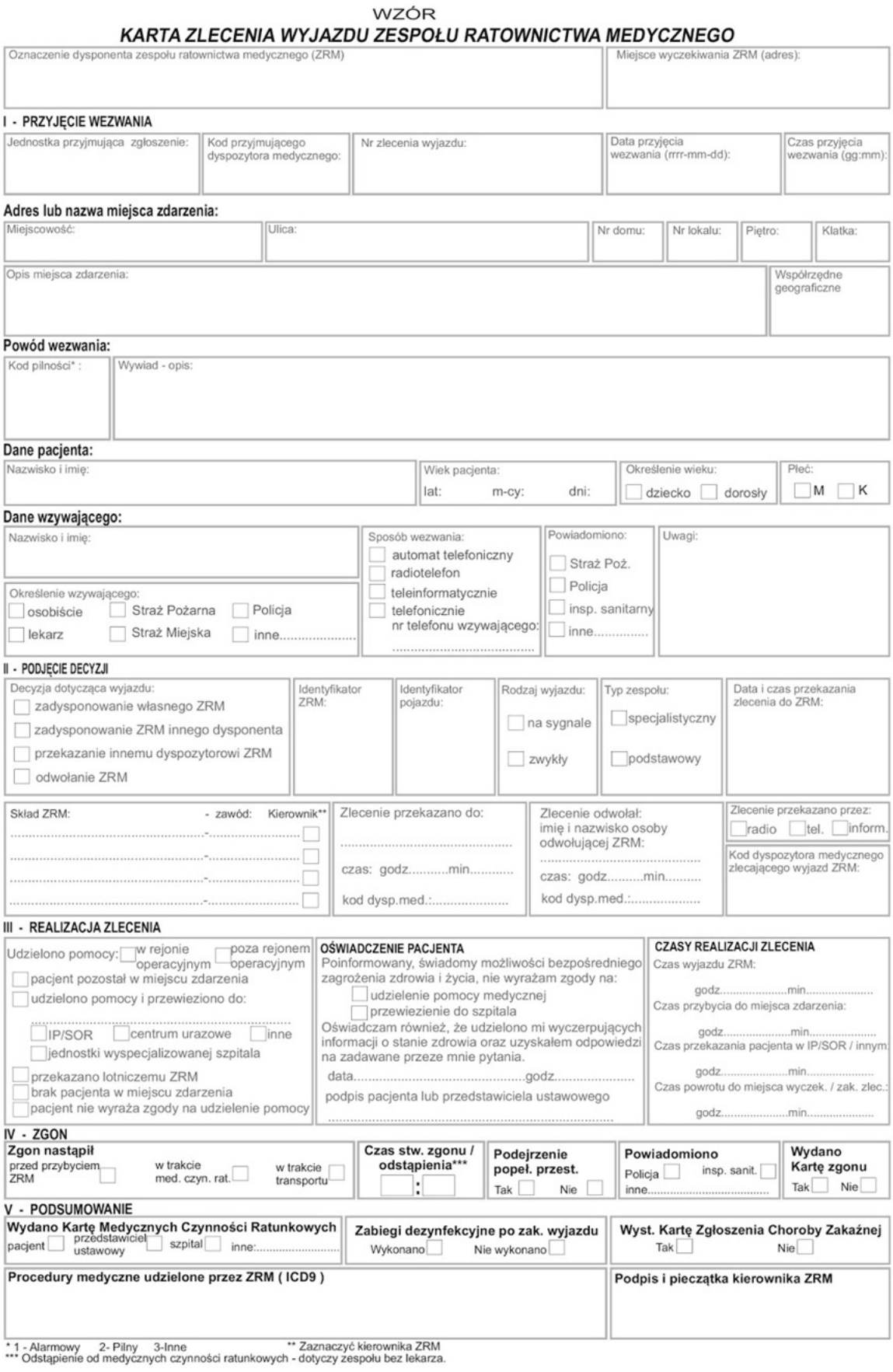


Fig. 1. EMS teams' responses in 2014-2017 divided by adults and individuals under the age of 18.



WZÓR

KARTA ZLECENIA WYJAZDU ZESPOŁU RATOWNICTWA MEDYCZNEGO

Oznaczenie dysponenta zespołu ratownictwa medycznego (ZRM) | Miejsce wyczekiwania ZRM (adres):

I - PRZYJĘCIE WEZWANIA

Jednostka przyjmująca zgłoszenie: | Kod przyjmującego dyspozytora medycznego: | Nr zlecenia wyjazdu: | Data przyjęcia wezwania (rrrr-mm-dd): | Czas przyjęcia wezwania (gg:mm):

Adres lub nazwa miejsca zdarzenia:

Miejscowość: | Ulica: | Nr domu: | Nr lokalu: | Piętro: | Klatka:

Opis miejsca zdarzenia: | Współrzędne geograficzne

Powód wezwania:

Kod pilności* : | Wywiad - opis:

Dane pacjenta:

Nazwisko i imię: | Wiek pacjenta: lat: m-cy: dni: | Określenie wieku: ☐ dziecko ☐ dorosły | Płeć: ☐ M ☐ K

Dane wzywającego:

Nazwisko i imię:

Określenie wzywającego: ☐ osobiście ☐ Straż Pożarna ☐ Policja ☐ lekarz ☐ Straż Miejska ☐ inne.....

Sposób wezwania: ☐ automat telefoniczny ☐ radiotelefon ☐ teleinformatycznie ☐ telefonicznie nr telefonu wzywającego: .....

Powiadomiono: ☐ Straż Poż. ☐ Policja ☐ insp. sanitarny ☐ inne.....

Uwagi:

II - PODJĘCIE DECYZJI

Decyzja dotycząca wyjazdu: ☐ zadysponowanie własnego ZRM ☐ zadysponowanie ZRM innego dysponenta ☐ przekazanie innemu dyspozytorowi ZRM ☐ odwołanie ZRM

Identyfikator ZRM: | Identyfikator pojazdu: | Rodzaj wyjazdu: ☐ na sygnale ☐ zwykły | Typ zespołu: ☐ specjalistyczny ☐ podstawowy | Data i czas przekazania zlecenia do ZRM:

Skład ZRM: - zawód: Kierownik** ☐

Zlecenie przekazano do: ..... czas: godz.....min..... kod dysp.med.:.....

Zlecenie odwołał: imię i nazwisko osoby odwołującej ZRM: ..... czas: godz.....min..... kod dysp.med.:.....

Zlecenie przekazano przez: ☐ radio ☐ tel. ☐ inform.

Kod dyspozytora medycznego zlecającego wyjazd ZRM:

III - REALIZACJA ZLECENIA

Udzielono pomocy: ☐ w rejonie operacyjnym ☐ poza rejonem operacyjnym

☐ pacjent pozostał w miejscu zdarzenia

☐ udzielono pomocy i przewieziono do: ..... ☐ IP/SOR ☐ centrum urazowe ☐ inne ☐ jednostki wyspecjalizowanej szpitala

☐ przekazano lotniczemu ZRM

☐ brak pacjenta w miejscu zdarzenia

☐ pacjent nie wyraża zgody na udzielenie pomocy

OŚWIADCZENIE PACJENTA

Poinformowany, świadomy możliwości bezpośredniego zagrożenia zdrowia i życia, nie wyrażam zgody na:

☐ udzielenie pomocy medycznej

☐ przewiezienie do szpitala

Oświadczam również, że udzielono mi wyczerpujących informacji o stanie zdrowia oraz uzyskałem odpowiedzi na zadawane przeze mnie pytania.

data.....godz.....

podpis pacjenta lub przedstawiciela ustawowego .....

CZASY REALIZACJI ZLECENIA

Czas wyjazdu ZRM: godz.....min.....

Czas przybycia do miejsca zdarzenia: godz.....min.....

Czas przekazania pacjenta w IP/SOR / innym: godz.....min.....

Czas powrotu do miejsca wyczek. / zak. zlec.: godz.....min.....

IV - ZGON

Zgon nastąpił przed przybyciem ZRM ☐ | w trakcie med. czyn. rat. ☐ | w trakcie transportu ☐

Czas stw. zgonu / odstąpienia***: ☐:☐

Podejrzenie popeł. przest. Tak ☐ Nie ☐

Powiadomiono Policja ☐ insp. sanit. ☐ inne.....

Wydano Kartę zgonu Tak ☐ Nie ☐

V - PODSUMOWANIE

Wydano Kartę Medycznych Czynności Ratunkowych pacjent ☐ przedstawiciel ustawowy ☐ szpital ☐ inne:.....

Zabiegi dezynfekcyjne po zak. wyjazdu Wykonano ☐ Nie wykonano ☐

Wyst. Kartę Zgłoszenia Choroby Zakaźnej Tak ☐ Nie ☐

Procedury medyczne udzielone przez ZRM (ICD9)

Podpis i pieczątka kierownika ZRM

* 1 - Alarmowy 2- Pilny 3-Inne ** Zaznaczyć kierownika ZRM

*** Odstąpienie od medycznych czynności ratunkowych - dotyczy zespołu bez lekarza.

Fig. 2. Response assignment card.

Source: Obwieszczenie Ministra Zdrowia z dnia 6 czerwca 2013 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Zdrowia w sprawie rodzajów i zakresu dokumentacji medycznej oraz sposobu jej przetwarzania.

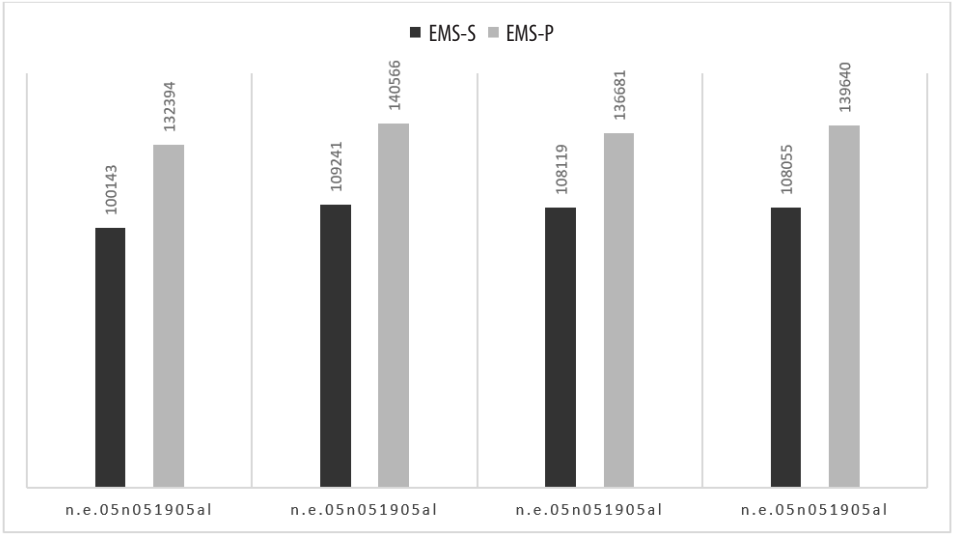


Fig. 3. S-type and P-type EMS team responses (2014-2017).

incident scene as quickly as possible, assess the hazard, takeover the coordination of medical procedures according to dispatcher's decision in case of incident with multiple casualties, undertake emergency medical procedures on scene, and provide proper transport as necessary to the closest emergency department or other hospital admission room [1, 14-17].

THE AIM

The aim of thesis presented is analysis of emergency medical teams' responses to patients below 18 years of age in operational region of Katowice Emergency Service between January 1st, 2014 and December 31st, 2017.

MATERIAL AND METHODS

Retrospective analysis of medical documentation issued by P- and S-type EMS teams of Katowice Emergency Service between January 1st, 2014 and December 31st, 2017 (n = 974839). Documents regarding response to patients below 18 years of age were included in research (n = 53643) (Fig. 1).

Medical documentation on the basis of which the research was done concerned the response assignment card [18]. Medical documentation functions within the system on the basis of 2013 enactment (*Obwieszczenie Ministra Zdrowia z dnia 6 czerwca 2013 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Zdrowia w sprawie rodzajów i zakresu dokumentacji medycznej oraz sposobu jej przetwarzania*). This card is a from initially filled in by the medical dispatcher. It contains: date, time, incident address, categorized call reason, patient's data, EMS team response priority level, EMS team callsign – these are point I and II of the card. Later, during intervention, person in charge of EMS team fills in the remaining part – starting with point III (realization of call) and ending with V (summary) (Fig. 2).

Demographic data of responses to patients under 18 was analyzed in detail: gender, age, city and administrative region of powiat. Documents were analyzed regarding the main categorized reason of call along with priority level and the way of finishing realization of response. Responses were divided into ones realized by S- and P-type EMS teams during various years, months, and time of day. The latter was divided into 4 time intervals: 12:00 am – 5:59 am, 6:00 am – 11:59 am, 12:00 pm – 5:59 pm and 6:00 pm – 11:59 pm. For the whole analysis patients were divided into 4 age groups, with distribution as follows [19]:

- newborns and babies, aged under 1 (Gr. I: 0-1),
- children between the age of 1 and 8 (Gr. II: 1-8),
- school-age, aged between 8 and 13 (Gr. III: 8-13),
- teenagers, aged between 13 and 18 (Gr. IV: 13-18).

Data used in research originates from 85 EMS teams remaining on 24 hour a day duty in part of Silesian Voivodeship administrative region managed by Katowice Emergency Service. 38 out of 85 EMS teams are S-type teams, the remaining 47 – P-type teams. They secure about 2,7 million inhabitants of Silesia region. The precise number of EMS teams in the time period researched is presented in Figure 3.

STATISTICAL ANALYSIS

Data from medical documentation has been processed by Excel 2010 software. All variables analyzed are expressed in nominal scale. Therefore statistical analysis of results used non-parametric dependency test in two variants: for two-way and multiway tables. In the latter case Yates's correction for continuity was implemented. Whenever justified the

result of dependency test for two-way table was complemented by Fisher's exact test. Moreover, the odds ratio and relative risk with 95% confidence interval were calculated. Odds ratio was statistically verified by Mantel-Haenszel test.

Statistical inference was conducted with the following significance levels:

- p>0.05 – no significance,
- p<0,05 – statistical significance,
- p<0,01 – high statistical significance,
- p<0,001 – very high statistical significance.

Software used for calculation was Statistica package and Excel spreadsheet.

RESULTS

Research covered 974839 EMS team responses undertaken between January 1st, 2014 and December 31st, 2017 managed by Katowice Emergency Medical Service. Interventions concerning patients below 18 years of age were selected by their birth date, this turned out to be 5,38% of all responses in the given time period (Fig. 4). In this analysis a division into specific years in the period researched was made and correlated with the gross number of EMS team responses, calculating percentage (Table 1).

EMS team responses were divided by types of EMS team – EMS-S and EMS-P team. This was compared to specific years of research period (Fig. 5). Here an increase in number of responses each year has been observed in case of EMS-P teams.

With the use of the same division of EMS types, a comparison of each month was made (Fig. 6). This has revealed a decrease in EMS-S and EMS-P team responses during summer vacation (July and August). The average number of responses for the other 10 months – January-June and September-December is n = 2322,75, while the average for July and August is n = 1797. Comparison of average numbers has shown a decrease in interventions during summer vacation by n = 22,63%.

The following division focused on EMS-S and EMS-P team responses in various day and night hours. Day was divided into four 4 time intervals: 12:00 am – 5:59 am, 6:00 am – 11:59 am, 12:00 pm – 5:59 pm and 6:00 pm – 11:59 pm (Fig. 7). During three intervals EMS-P team responses were the

Table 1. Analysis of EMS team interventions in relation to responses to patients under 18, divided into specific years.

	EMS team responses	Responses <18	Percentage <18
2014	232537	12410	5.34%
2015	249807	13528	5.42%
2016	244800	13706	5.60%
2017	247695	13999	5.65%
TOTAL	974839	53643	5.50%

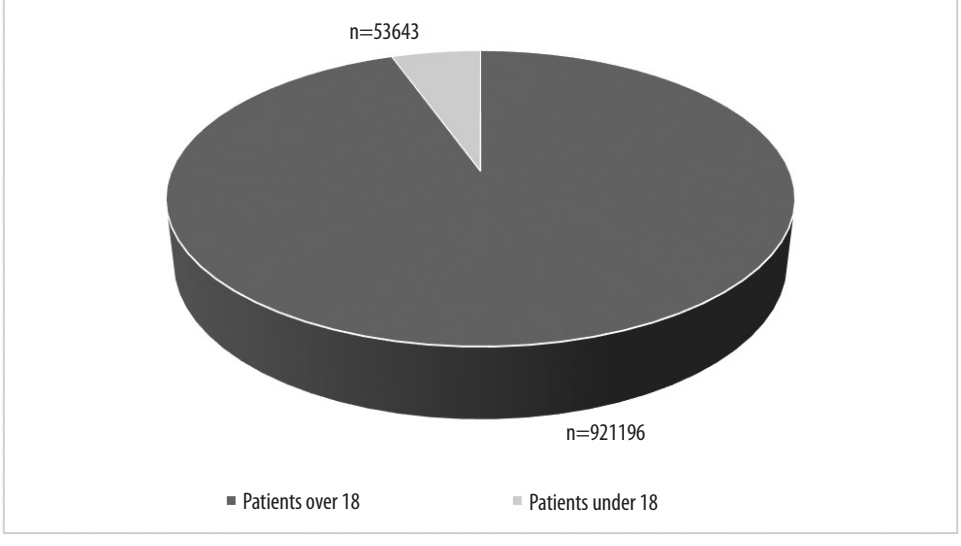


Fig. 4. EMS team responses in time period researched with division by patients' age: above 18 and under 18 (n = 974839).

majority, with the exception of night time (12:00 am – 5:59 am), when EMS-S responded more frequently by n = 20,05%. The greatest difference between EMS-P and EMS-S team response number was observed between 12:00 pm and 5:59 pm – n = 31,34% *vs*. 68,66%.

General analysis of EMS team responses covered the categorized reason of call assigned by medical dispatcher. In the time periods researched, dispatchers qualified incidents as: acute illness, accident or childbirth. In the first analysis these categories were divided into specific years (Fig. 8), later spread during time of day was analyzed (Fig. 9).

It has been observed that in 12:00 pm – 5:59 pm interval accidents occurred more frequently, but not more frequently than episodes of acute illness.

Patients under the age of 18 (n = 53643) from the time period researched were divided into male and female gender (Fig. 10). Slight majority of boys has been observed.

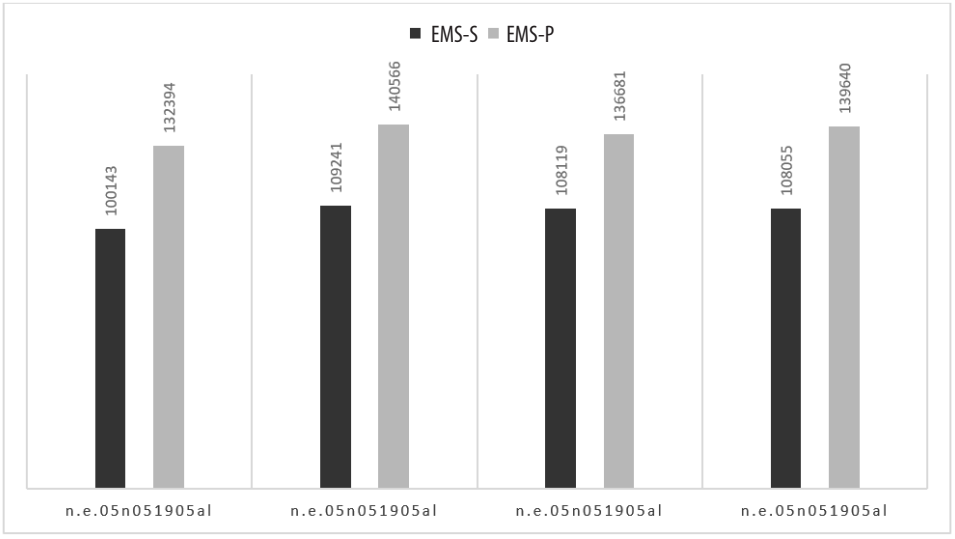


Fig. 5. EMS-S and EMS-P team responses divided into specific years in period researched.

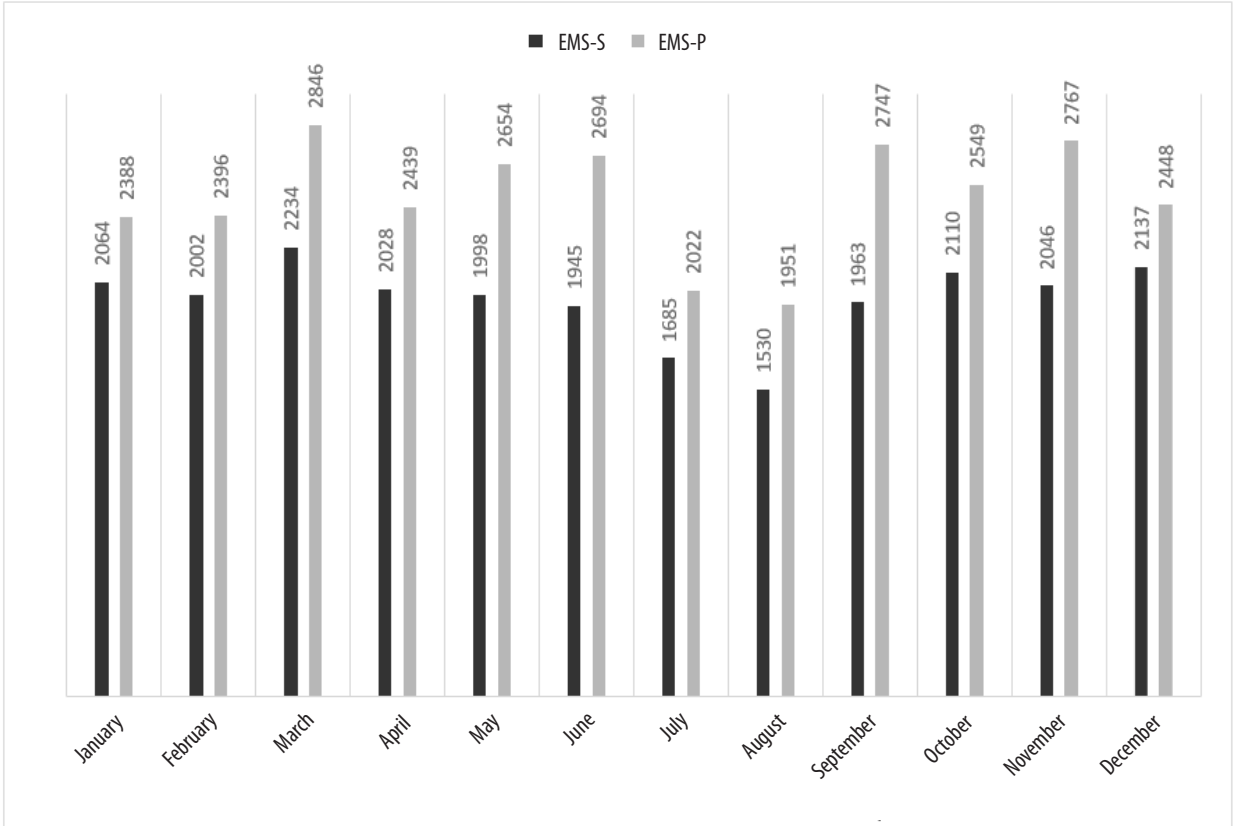


Fig. 6. EMS-S and EMS-P team responses divided into months in the period researched (2014-2017).

Dividing gender into daytime intervals also shows the majority of male patients (Fig. 11).

Then patients under the age of 18 were divided into 4 age groups. Decision concerning this division was made on the basis of medical references [69]. Classification created 4 following groups:

- newborns and babies, aged under 1 (Gr. I: 0-1),
- children between the age of 1 and 8 (Gr. II: 1-8),
- school-age, aged between 8 and 13 (Gr. III: 8-13),
- teenagers, aged between 13 and 18 (Gr. IV: 13-18).

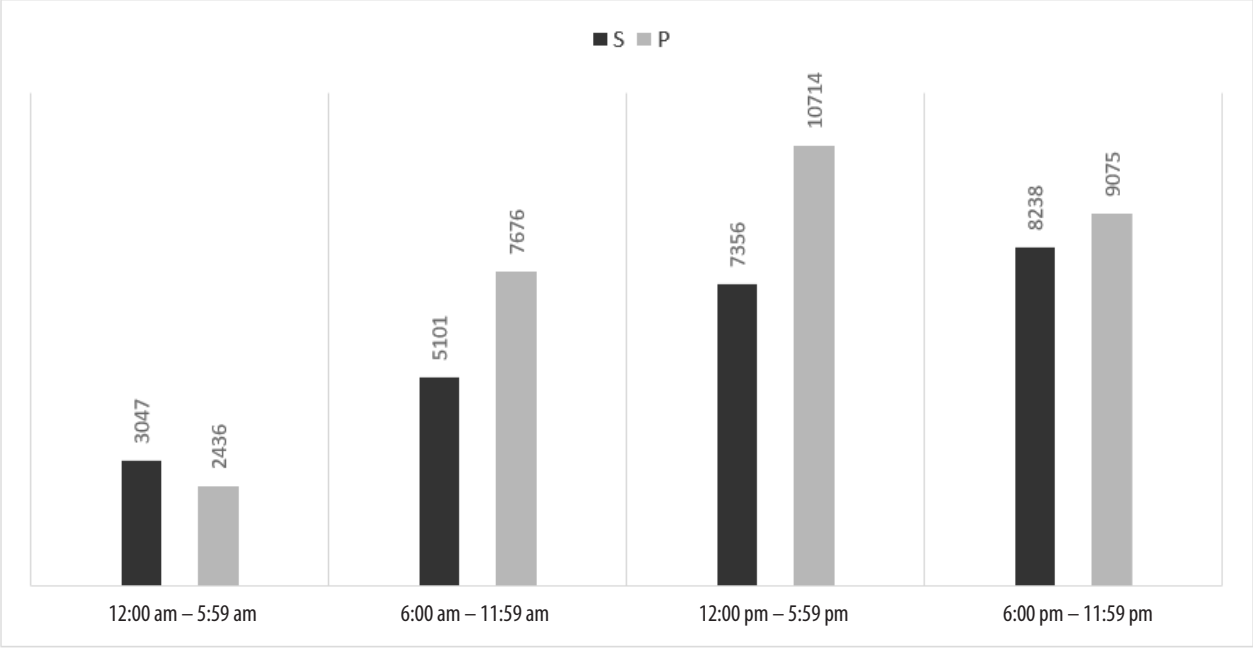


Fig. 7. EMS-S and EMS-P team responses divided into four daytime intervals in period researched (2014-2017).

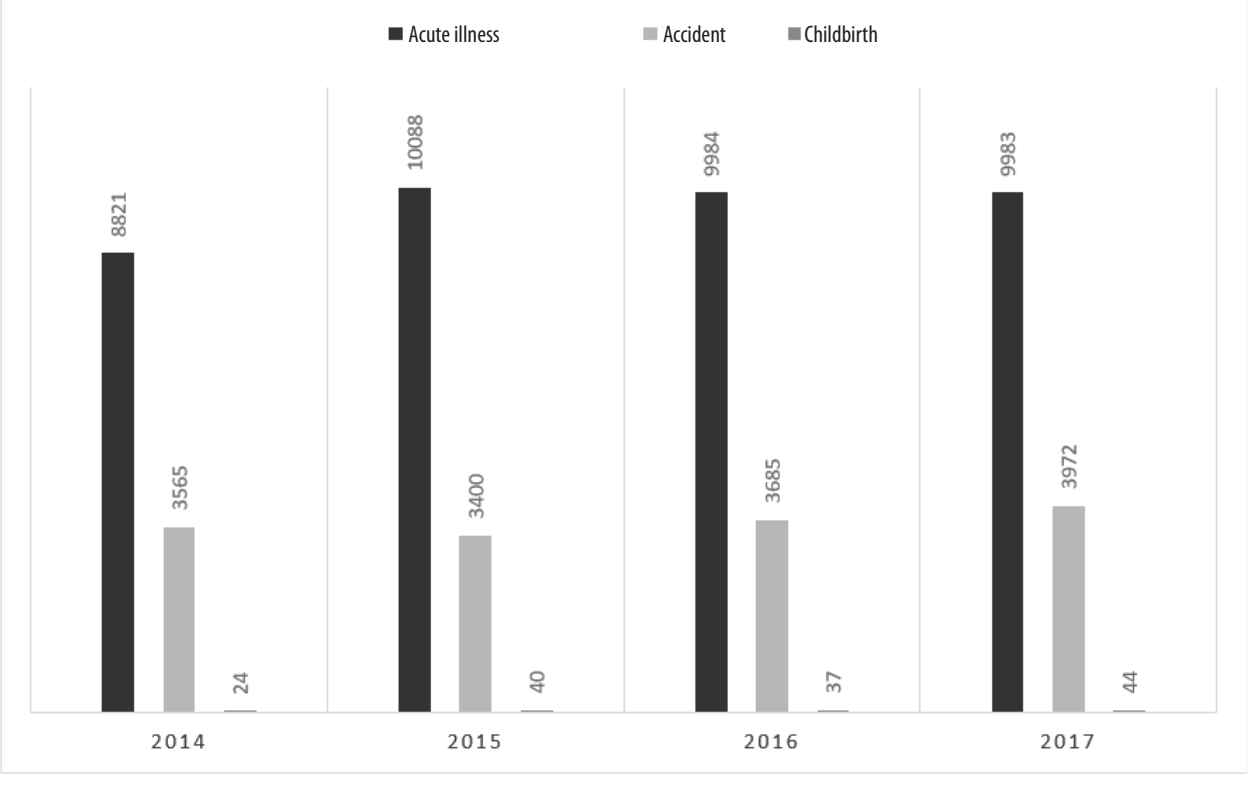


Fig. 8. Call reason categorization divided into research period years.

Initially attention was drawn toward the number of responses. Their number concerning patients below 18 was presented in specific years and months along with statistical significance (Table 2). Very high relationship between groups II, III and IV and specific months was observed. In order to verify significance more precisely, EMS team responses were divided into 4 daytime intervals of given years along with spread for age groups (Table 3). Among groups I and III there is no statistical significance in regard to daytime interval and specific year in the period researched. Among groups II and IV significance is high: (p = 0,016) for group II and (p = 0,028) for group IV.

Number of interventions in time period researched has been spread into specific cities and powiat adminirtative regions managed by Katowice Emergency Medical Service (Fig. 12). The highest number of interventions in each age group was in Katowice. Referring to Table 2, this city is inhabited by the highest number of people in the region researched. The lowest number of responses varied depending on the group researched. In 2014-2017 period the fewest responses for group I were in city of Żory (n = 24), for groups II and III in Świętochłowice (n = 192), and for group IV fewest responses were in Powiat Bieruńsko-Lędziński region (n = 389).

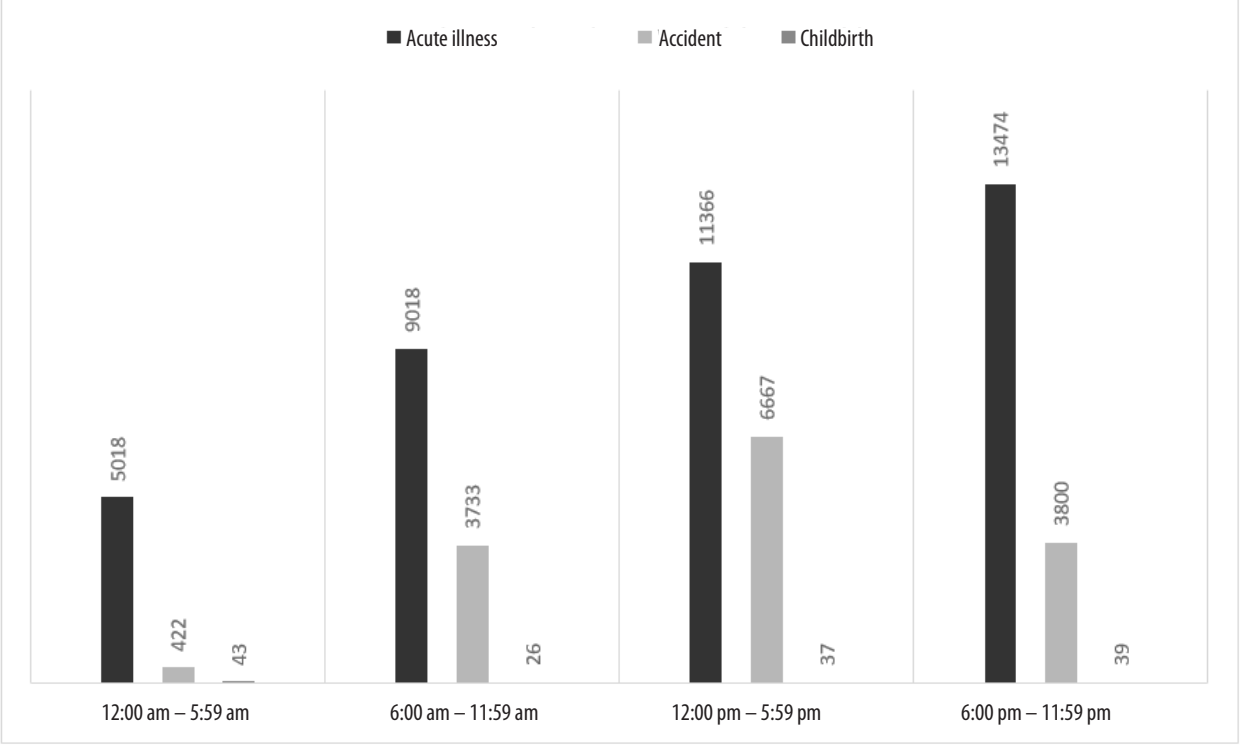


Fig. 9. Call reason categorization divided into daytime intervals in the research period.

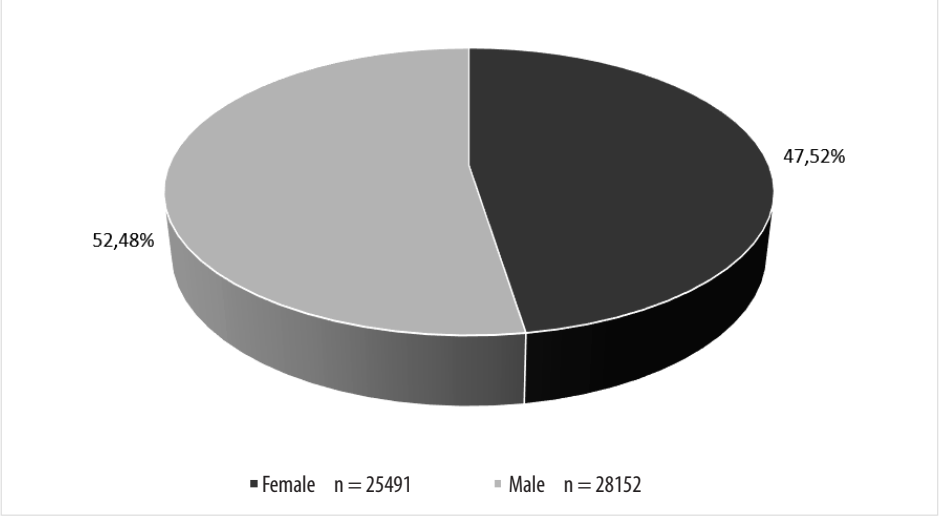


Fig. 10. Patients under 18 divided by gender.

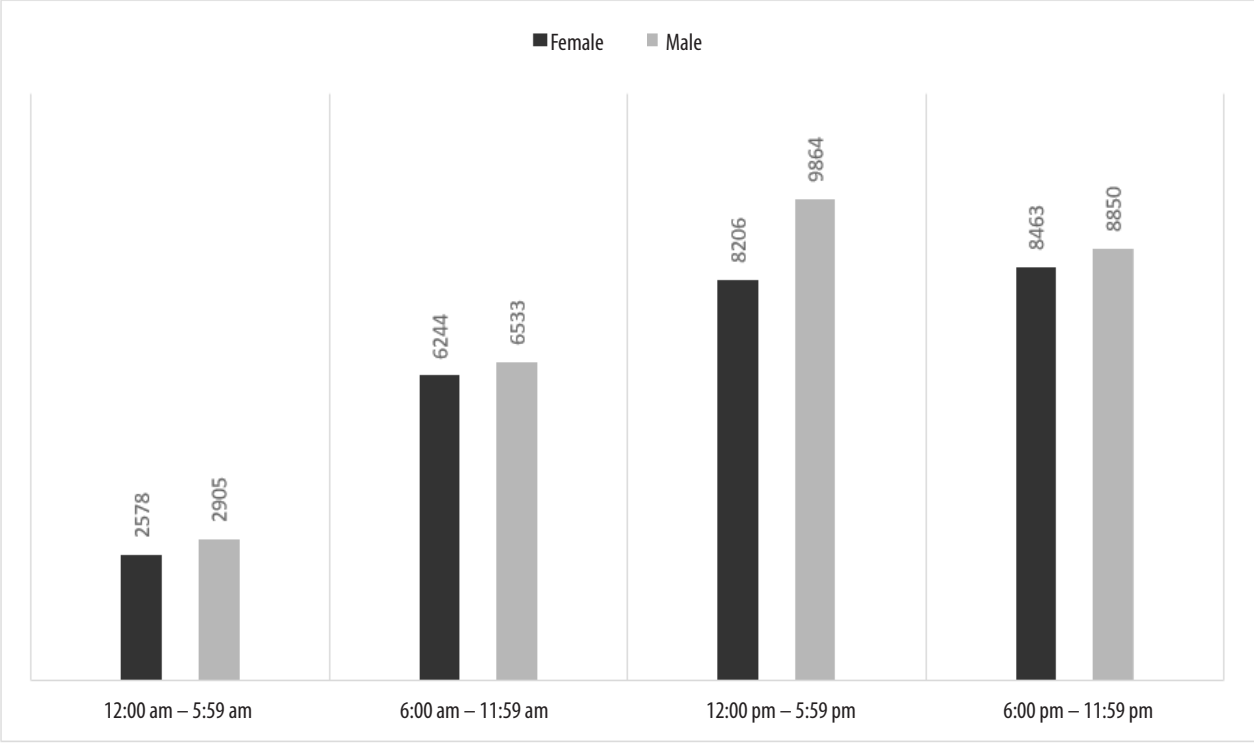


Fig. 11. Gender division in daytime intervals.

Further analysis considered gender. Patients of various age groups were divided by gender (Fig. 13). This level was enough to reveal an interesting correlation. Among three initial age groups the majority of responses considered male patients, while in group IV there were more responses to female patients by n = 11,8%.

Further gender analysis among given age groups included daytime intervals (Table 4). Group IV shows majority of responses to female patients throughout day and night. Statistical analysis has shown very high statistical significance ($p < 0,001$). Among groups II and III there is high statistical significance in case of responses to boys ($p = 0,001$). Among youngest patients, aged under 1 year, statistical analysis has shown no significance ($p = 0,668$).

Analysis of EMS teams dispatched in given years with division by age groups shows that EMS-S team is more frequently dispatched to the youngest patients (Table 5). EMS-P team was dispatched most frequently to older groups (III and IV) in each year. Statistical analysis of EMS-P and EMS-S team dispatching to specific age groups shows very high significance in group II ($p < 0,001$). Such significance appears also for groups III and IV.

Spread of EMS-S and EMS-P team responses in various daytime intervals reveals that at night (12:00 am – 5:59 am) EMS-S team is more frequently dispatched to three initial age groups: group I (69% *vs.* 31%), gr. II (64% *vs.* 36%) and gr. III (57% *vs.* 43%) (Table 6). There is high statistical significance in each age group.

After dispatching EMS team, attention was drawn towards the priority code assigned by the medical dispatcher. Codes K-1 and K-2 functioning in Emergency Medical System [37, 53] were compared to given age groups and years (Table 7). Medical dispatchers more frequently assigned K-1 code for the youngest group (844 [53%] *vs.* 757 [47%]), while among older groups K-2 prevailed.

Table 8 shows the way EMS team response was finalized with division to years and age groups. In medical documentation leader of the EMS team has to choose one of six options regarding future proceeding with patient. Patient aged under 18 most frequently was transported to hospital (74,3%). In 21,2% of cases EMS team ended intervention by aiding the patient on scene. In 3% of cases parent or legal guardian refused transport to the hospital. The most rare case was handing the patient over to other

Table 2. Analysis of EMS team responses to various age groups of patients under 18 in relation to specific months and years.

		Group I 0-1	Group II 1-8	Group III 8-13	Group IV 13-18
2014	January	38	331	124	349
	February	35	394	155	446
	March	37	451	190	519
	April	35	397	189	460
	May	18	325	208	527
	June	33	346	189	474
	July	19	332	141	384
	August	25	299	121	343
	September	23	419	206	507
	October	32	387	208	532
	November	26	336	192	481
	December	32	430	197	468
	Total	353	4447	2120	5490
2015	January	41	417	176	503
	February	44	492	146	398
	March	51	468	230	580
	April	35	420	201	501
	May	25	350	237	616
	June	25	357	217	536
	July	42	343	133	526
	August	24	348	140	406
	September	35	375	185	519
	October	30	435	203	534
	November	41	394	195	494
	December	36	347	212	465
	Total	429	4746	2275	6078
2016	January	49	462	212	575
	February	43	477	167	380
	March	38	415	209	550
	April	25	400	212	508
	May	23	353	235	534
	June	29	377	266	519
	July	39	326	134	346
	August	34	281	138	353
	September	42	401	248	549
	October	32	421	194	512
	November	40	419	282	586
	December	36	430	245	560
	Total	430	4762	2542	5972
2017	January	37	490	213	435
	February	33	455	203	530
	March	29	431	238	644
	April	34	350	219	481
	May	25	363	255	558
	June	37	428	277	529
	July	26	350	170	396
	August	28	366	167	408
	September	40	363	251	547
	October	28	377	197	537
	November	40	419	282	586
	December	32	430	197	468
	Total	389	4822	2669	6119
GROSS TOTAL		1601	18777	9606	23659
Statistical analysis		χ^2=32,067 p=0,513	χ^2=102,836 p<0,001	χ^2=67,288 p<0,001	χ^2=166,7527 p<0,001

Table 3. Analysis of EMS team responses to various age groups of patients under 18 in relation to daytime intervals in 2014-2017 period.

	Daytime interval	Group I 0-1	Group II 1-8	Group III 8-13	Group IV 13-18	Total
2014	12:00 am – 5:59 am	49	669	127	459	1304
	6:00 am – 11:59 am	56	817	568	1421	2862
	12:00 pm – 5:59 pm	105	1331	865	1809	4110
	6:00 pm – 11:59 pm	143	1630	560	1801	4134
2015	12:00 am – 5:59 am	58	683	123	458	1322
	6:00 am – 11:59 am	82	875	637	1637	3231
	12:00 pm – 5:59 pm	137	1475	925	2028	4565
	6:00 pm – 11:59 pm	152	1713	590	1955	4410
2016	12:00 am – 5:59 am	63	719	145	571	1498
	6:00 am – 11:59 am	79	919	672	1584	3254
	12:00 pm – 5:59 pm	139	1480	1054	1937	4610
	6:00 pm – 11:59 pm	149	1644	671	1880	4344
2017	12:00 am – 5:59 am	53	651	138	517	1359
	6:00 am – 11:59 am	75	950	782	1623	3430
	12:00 pm – 5:59 pm	108	1576	1064	2037	4785
	6:00 pm – 11:59 pm	153	1645	685	1942	4425
Statistical analysis		χ^2=6,14 p=0,726	χ^2=20,25 p=0,016	χ^2=7,476 p=0,588	χ^2=18,73 p=0,028	

Table 4. Analysis of EMS team responses to specific age groups, divided by gender and in relation to daytime interval.

Daytime interval	Group I 0-1		Group II 1-8		Group III 8-13		Group IV 13-18		Total	
	F	M	F	M	F	M	F	M	F	M
12:00 am-5:59 am	93	130	1134	1588	261	272	1090	915	2578	2905
6:00 am-11:59 m	135	157	1515	2046	1177	1482	3417	2848	6244	6533
12:00 pm-5:59 pm	209	280	2379	3483	1667	2241	3951	3860	8206	9864
6:00 pm-11:59 pm	252	345	2923	3709	1175	1331	4113	3465	8463	8850
Statistical analysis	χ^2=1,562 p=0,668		χ^2=16,154 p=0,001		χ^2=15,516 p=0,001		χ^2=30,586 p<0,001			

F – female gender, M – male gender

services (0,7%). There were also situations of patient not present on the call scene (0,6%) and interventions where patient has died (0,2%).

DISCUSSION

Prehospital care is an important link in survival chain of patients in sudden health-related distress. There are many emergency medical systems which have proven beneficial to patients in terms of survival by assuring early emergency medical procedures administered by EMS team [20-22]. The great majority of research regarding emergency medical procedures has been done on population of adult patients. There is limited data regarding the results of prehospital care among patients under 18 years of age. This results from much higher percentage of EMS team responses to adults, and greater experience of medical personnel in treating adult patients [7, 23].

Polish State Emergency System is healthcare system element, which is directed towards patients in sudden distress in prehospital environment [1, 24]. Among such patients there are also ones aged under 18. This thesis aimed at analyzing EMS team interventions to patients aged under 18, within the region managed by Katowice Emergency Service. Medical documentation issued by medical

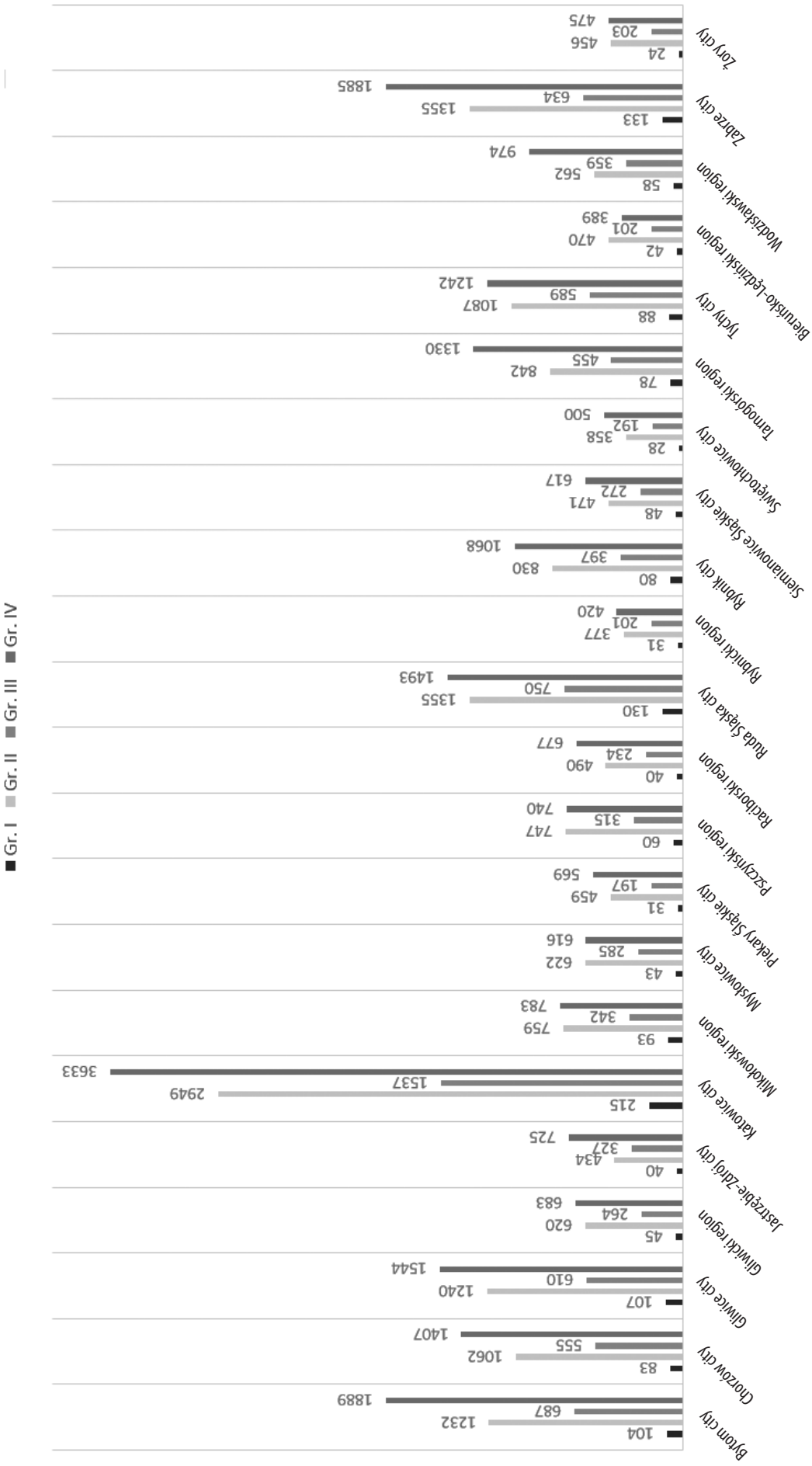


Fig. 12. Responses in specific cities and administrative regions.

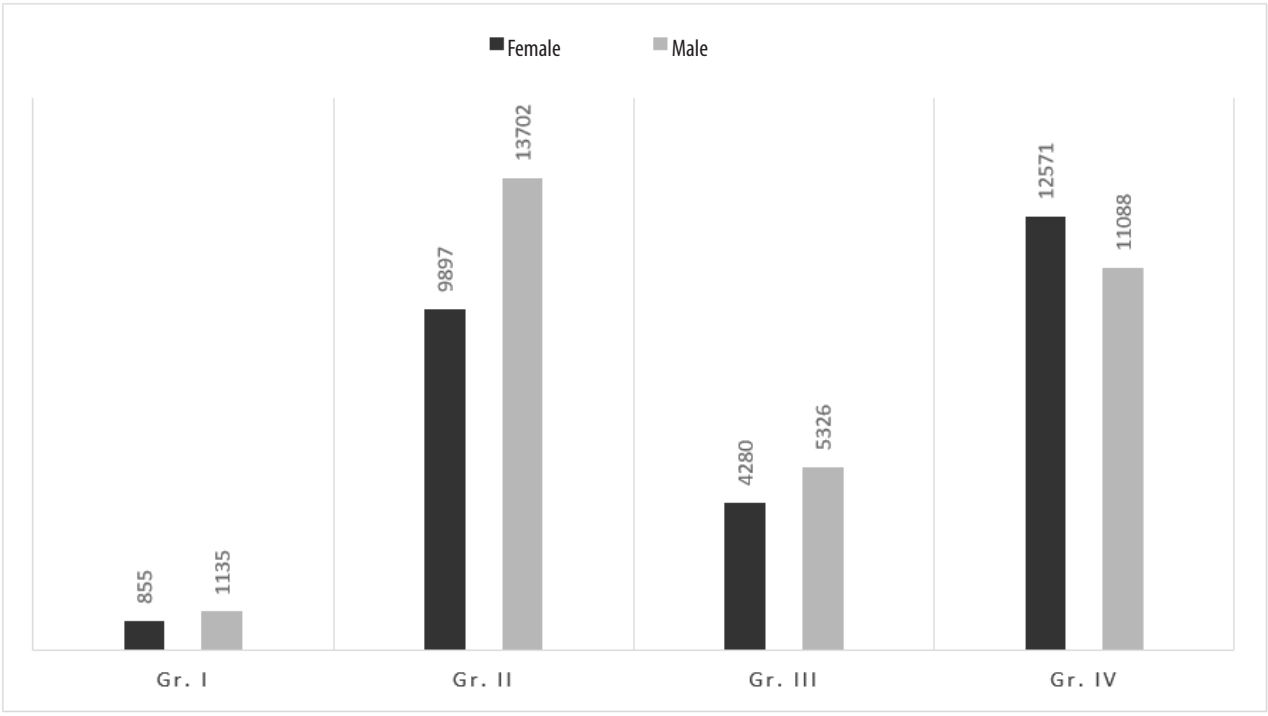


Fig. 13. Age groups divided by gender.

dispatchers and EMS teams from years 2014-2017 covered 53634 pediatric patients, which equaled n = 5,36% interventions compared to adult patients. In 2020 n = 4,5% [6] of EMS team responses throughout Poland considered patients under 18. This shows that for EMS teams pediatric patients are a small percentage. Therefore EMS teams consider treating pediatric patients challenging [25, 26].

After analyzing national and foreign references regarding EMS team responses, the great majority of patients turn out to be adults. Patients aged over 18 outnumber younger ones by over n = 90% [23, 27-37]. The article of Ramgopal et al. retrospective analysis shown n = 44290 pediatric patients among research group of n = 799894 patients, which equaled n=6,4% of all EMS team responses [38]. Drayn et al. research concerning patients aged under 18 gives n=10% ratio of prehospital care for children compared to adult patients[35]. Joyce et al. proved that in the United States patients researched are n = 4% of

Table 5. Analysis of two EMS team types responses to patients of various age groups in given years (2014-2017).

		Group I 0-1	Group II 1-8	Group III 8-13	Group IV 13-18	Total
2014	S-Team	197	2361	863	2191	5612
	P-Team	156	2086	1257	3299	6798
2015	S-Team	275	2394	945	2453	6067
	P-Team	154	2352	1330	3625	7461
2016	S-Team	250	2381	1101	2401	6133
	P-Team	180	2381	1441	3571	7573
2017	S-Team	224	2343	1036	2327	5930
	P-Team	165	2479	1633	3792	8069
TOTAL	S-Team	946	9479	3945	9372	23742
	P-Team	655	9298	5661	14287	29901
Statistical analysis		χ^2=6,558 p=0,087	χ^2=19,47 p<0,001	χ^2=11,205 p=0,011	χ^2=8,904 p=0,031	

Table 6. Analysis of EMS team responses to given age groups divided by EMS team type and daytime interval.

Daytime interval	Group I 0-1		Group II 1-8		Group III 8-13		Group IV 13-18		Total	
	S	P	S	P	S	P	S	P	S	P
12:00 am-5:59 am	154	69	1731	991	303	230	859	1146	3047	2436
6:00 am-11:59 m	179	113	1651	1910	986	1673	2285	3980	5101	7676
12:00 pm-5:59 pm	269	220	2638	3224	1462	2446	2987	4824	7356	10714
6:00 pm-11:59 pm	344	253	3459	3173	1194	1312	3241	4337	8238	9075
Statistical analysis	χ^2=13,657 p=0,003		χ^2=289,209 p<0,001		χ^2=138,698 p<0,001		χ^2=72,267 p<0,001			

S – S-type EMS team, P – P-type EMS team

Table 7. Analysis of EMS team dispatch code in given age groups divided by years 2014-2017.

		Group I 0-1	Group II 1-8	Group III 8-13	Group IV 13-18	Total
2014	K-1	196	2048	749	1956	4949
	K-2	157	2399	1371	3534	7461
2015	K-1	234	1919	710	1918	4781
	K-2	195	2827	1565	4160	8747
2016	K-1	213	1853	700	1642	4408
	K-2	217	2909	1842	4330	9298
2017	K-1	201	1895	709	1659	4464
	K-2	188	2927	1960	4460	9535
TOTAL	K-1	844	7715	2868	7175	18602
	K-2	757	11062	6738	16484	35041
Statistical analysis		χ^2=3,609 p=0,307	χ^2=61,825 p<0,001	χ^2=52,658 p<0,001	χ^2=129,968 p<0,001	

EMS team responses, which is the lowest number in references analyzed [39]. Knowlton et al. present n = 9% EMS team responses compared to patients over 18 [40]. Foltin et al. present that each year American EMS teams aid about 3 million pediatric patients nationwide [41]. The highest percentage was described by Schmucker et al. and it equals n = 13% [42]. The same high ratio, with pediatric patients being n = 13% of all EMS team responses, is presented also by Shah et al. [43]. In analysis conducted in Switzerland between 2000 and 2010 percentage of responses to pediatric patients was n = 5,1-6,6% depending on specific year [44]. In Great Britain Schnegg et al. present n = 5,5% of all responses concerning patients under 18, based on three-year observation [45]. Referring to EMS team responses to pediatric patients in Poland, Białczak et al. present n=3591 responses (n = 5,68%) out of n=63208 in North-West Mazowsze Region in 2013-2016 [7]. Gawełko et al. researched Rzeszów Emergency Service in 2010-2013, where out of n = 87530 EMS team responses, n = 6,25% concerned children [33]. Filip et al. presents three patient age groups with EMS team response percentage: under the age of 1 year (n = 0,35%), 1-10 years (n = 2,07%), 11-20 years (n = 5,4%) [27]. The results of research in Poland quoted above refer to a large rural region and are higher of results presented in this thesis. Results of this thesis are influenced by the fact that n=53643 EMS team responses were in mainly urban region, with 16 powiat-level cities [46].

In emergency medical services worldwide medical dispatchers decide about dispatching emergency medical team. Medical dispatchers' work covers answering and selecting calls, prioritizing and instructing callers [47]. This is related to many difficulties which may lead to mistake, and legal liability [48]. While undertaking medical interview dispatcher categorizes the reason of call [49]. Møller et al. describe general requirements of proper categorization emergency calls and prioritizing emergencies by medical dispatchers

Table 8. Ways of finalizing EMS team intervention divided into age groups and years researched.

			Group I 0-1	Group II 1-8	Group III 8-13	Group IV 13-18	TOTAL
Finalization of intervention	Aid on scene	2014	62	898	408	1115	2483
		2015	89	1026	447	1254	2816
		2016	84	1094	564	1342	3084
		2017	72	1100	543	1278	2993
		Total	307	4118	1962	4989	11376
	Transport to hospital	2014	279	3427	1660	4140	9506
		2015	329	3527	1748	4498	10102
		2016	333	3432	1874	4309	9948
		2017	305	3513	2025	4467	10310
		Total	1246	13899	7307	17414	39866
	Patient's refusal	2014	11	85	36	124	256
		2015	6	133	54	201	394
		2016	10	192	79	204	485
		2017	10	168	75	222	475
		Total	37	578	244	751	1610
	Handing over to other service	2014	0	14	13	43	70
		2015	1	24	9	54	88
		2016	2	22	9	64	97
		2017	0	18	9	92	119
		Total	3	78	40	253	374
	No patient on scene	2014	1	14	6	53	74
		2015	2	21	13	61	97
		2016	1	11	14	45	71
		2017	1	17	9	48	75
		Total	5	63	42	207	317
	Death	2014	0	9	1	15	25
		2015	2	15	4	10	31
		2016	0	11	2	8	21
		2017	1	6	4	12	23
		Total	3	41	11	45	100
Statistical analysis			χ^2=10,978 p=0,754	χ^2=66,69 p<0,001	χ^2=25,764 p=0,041	χ^2=55,492 p<0,001	

based on a group of n=78040 callers. Results reveal complexity of emergency calls and the need of further improvement. Systematic training for medical dispatch centers may make call handling more efficient [50]. After collecting research material attention has been drawn toward general categorizing of emergency calls in medical dispatch center of Katowice and Gliwice. There were two general call categories: acute illness and accident. Division to specific years revealed a constant tendency: acute illness to accident ratio is about n = 70% *vs.* 30%. Change in categorization by medical dispatcher was noticeable in division by daytime interval. Between 12:00 am and 5:59 am number of calls to traumatic patient under 18,

categorized by the dispatcher as accident, equaled n = 7,76%. Between 12:00 pm and 5:59 pm this number increased to n = 37% of call reasons.

In the analysis of own material, number of responses was divided into specific months and daytime intervals. Monthly profile revealed decrease in EMS team response number in summer vacation time (July and August). Comparison of average numbers revealed decrease in responses during vacation by n = 22,63%. July and August are the time of summer vacation for schoolchildren. In this time summer camps are organized, especially for children from urban areas. Considerable decrease in EMS team responses is visible for patients aged 8-13 and 13-18. In 2012 research by Szarpak has also revealed decrease in response number during summer vacation [51]. Vuilleumier et al. and Gawełka et al. point out decrease in response number in February [33, 52]. Article by Møller et al. analyzing EMS team work in Copenhagen reveals increase in EMS team responses in summer. Authors also describe EMS team responses in daytime intervals, with the largest number during the day [53]. Analysis of Rzeszów Emergency Service interventions by Filip et al. presents that most EMS team responses take place between 8:00 am and 11:59 am [27]. Similar result was published by Vuilleumier et al. regarding Vaud state in Switzerland in 2018 between 9:00 am and 12:00 pm [52]. Analysis of region managed by Katowice Emergency Service shows ambulances respond pediatric patients most frequently between 12:00 pm and 5:59 pm.

Two types of EMS teams function within the State Emergency Medical System in Poland. These are the specialist (EMS-S) and paramedical (EMS-P) team. EMS-S team is led by system physician. EMS-P team is led by paramedic or system nurse [1, 54-56]. Division into EMS-S and EMS-P teams is a solution created on the basis of two main emergency medical systems in the world: FGS ans AAS. FGS system is based on emergency medicine physician, responsible for action on scene and for transport to hospital. If paramedics reach the scene first, they undertake emergency medical procedures until physician arrives. Then the physician takes over further procedures and supervises the patient during transport to hospital. AAS system is closely related to action by paramedics. In such system there are no emergency physicians [5, 7]. Polish system is based mainly on EMS-P teams, which is reflected in data published by the Ministry of Health. As of January 31st, 2022, the number of EMS-P teams was n = 1270, and EMS-S teams n = 324 (80% *vs.* 20%) [11]. Team type is chosen by medical dispatcher. There are no strict rules or procedures indicating team type to be dispatched. At first dispatcher takes estimated time of arrival into account [59]. Since the State Emergency Medical System has been introduced, no broad and in-depth analysis of the role of EMS-S and EMS-P teams was made. There are only single Polish publications focusing on EMS-S team to EMS-P team response number ratio. Each author of such comparison concludes that the majority of teams dispatched are EMS-P teams. Guła et al., having researched n = 21896 responses reveal that EMS-P was dispatched n = 15877 times, and EMS-S team n = 6019 times (72,5% *vs.* 27,5%) [23]. Similar conclusion was made by Gawełko et al., Białczak et al., Celiński et al., Andrzejewski et al., Kucap et al., Nadolny et al., Filip et al. and Aftyka et al., all showing the great majority of EMS-P team responses [7, 27, 28, 30-34, 56, 60]. In own material this difference has been confirmed, but not to such great extent. In case of responses to patients aged under 18 the ratio was: EMS-P team n=29901 *vs.* EMS-S team n = 23742 (56% *vs.* 44%). Research revealed that EMS-S teams responses outnumbered responses by EMS-P teams between 12:00 am and 5:59 am, when total number of EMS team responses was lower, but with most of them being EMS-S type. EMS-P teams are dispatched more frequently, as they are dominant type of EMS team. Emergency medical procedures undertaken by a paramedic of EMS-P team are specifically legally regulated [61]. Randomized research made by Rörtgen et al. concluded that care taken by paramedics was not inferior to team with physician [62].

Each ambulance dispatched by the medical dispatcher to patient is given response priority. According to Polish legislation, medical dispatcher can assign priority code K-1 or K-2 [55, 59]. Dispatching in K-1 code requires driving an ambulance as an emergency vehicle, understood in Polish highway code as a vehicle with low- or high-beam headlights on, flashing blue lights on and variable-tone siren on (regardless of day or night time) [55]. In research presented, medical dispatcher would most frequently assign K-2 code (n = 65%). Polish publications reveal differences in percentage of K-2 code assigning. Celiński et al. present K-2 dispatching in N = 62,3% of cases [56]. While analyzing work of Lublin Emergency Medical Service Aftyka et al. have shown K-2 code in 88,1% of cases [27]. Filip et al., having analyzed Rzeszów Emergency Medical Service, revealed N = 90,6% of responses in K-1 code [27]. Such difference may result from dispatchers' will to make EMS team reach scene as quickly as possible, within time median since receiving the call. It is 8 minutes within city limits, and should not exceed 15 minutes elsewhere. Own analysis with

division of pediatric patients into age groups reveal that K-1 code dispatching prevailed over K-2 code (53% *vs.* 47%) for patients under the age of 1 year. Among all other groups (1-8 years), (8-13 years) and (13-18 years) there were fewer dispatches in K-1 code.

Considering division into gender of patients under 18, treated between 2014 and 2017, number of responses to male patients was n=28152, and to female patients n = 25491 (52,48% *vs.* 47,52%). This result is very close to result of research by Ramgopal et al., who claims that n = 52,9% of responses were to boys [38]. Gawełko et al. found no considerable difference among patients under the age of 18 [33]. Epidemiology presented by Shah et al. regarding children treated at pediatric Emergency Department shows female gender majority with n = 52,9% [44]. Own material analysis with spread of specific age groups shows that EMS teams responded female patients more frequently in the eldest-under-18-group – group IV. N = 53% of patients therein were girls. Results regarding group between 13 and 18 (group IV) coincide with data presented by Shah et al. [43].

CONCLUSIONS

1. Patient under 18 years of age is a challenge for emergency medical team due to very little number of responses, and therefore lack of experience in physical ex-amination and implementing emergency medical procedures.
2. Main reason of EMS team response to pediatric patient are episodes of acute ill-ness in each age group.
3. There is dependency in Emergency Medical Team response regarding given months, daytime intervals and gender. In age groups of 8-13 and 13-18 years number of responses decreases during summer vacation and at night; there are more responses to male patients.
4. There is dependency on age and gender between traumatic and non-traumatic patient. The highest trauma to illness ratio has been observed in age group 8-13 years, the lowest in group of under 1 year of age. Among non-traumatic patients aged 13-18 the vast majority of responses is to female patients.

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DOI: 10.36740/EmeMS202204105 **REVIEW ARTICLE**

TOCOPHOBIA – SHORT REVIEW OF CURRENT LITERATURE

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Abstract

For every woman, childbirth is a multifaceted and unique experience that can be associated with both positive feelings, such as joy, happiness, faith, and negative feelings – fear, anxiety, anxiety, but also physical effects. Fear of childbirth is a common problem affecting women's well-being and health, prevalence of tocophobia continues to increase and varies from country to country. The aim of this review was to summarize published studies on the prevalence of childbirth anxiety in women and how it is defined, its possible causes and effects, and to look for different methods of management. The research area described is complex and difficult to interpret when there is no consensus on a precise and clear definition of tocophobia. What is certain, however, is that every woman, whether with suspected tocophobia or not, should be treated individually and receive specialist care at every stage of pregnancy and the postpartum period.

Key words

pregnancy, prevalence, postpartum period, woman

INTRODUCTION

For every woman, childbirth is a multifaceted and unique experience that can be associated with both positive feelings, such as joy, happiness, faith, and negative feelings – fear, anxiety, anxiety, but also physical effects [1]. Traumatic and negative experiences are increasingly described in clinical practice and research [2]. Birth anxiety was first characterized by French psychiatrist Louis Victor Marcé in 1858 [3]. The intense fear of childbirth and pregnancy, affecting women from childhood to old age, and carrying short- and long-term negative consequences for both the child and the mother is called tocophobia or maieusophobia. Primary tocophobia can be distinguished (occurs in women who have not experienced childbirth) and secondary tocophobia (in women who have previously given birth) [4 ,5]. The literature defines tocophobia less frequently as "an unfounded fear of childbirth" than "severe fear of childbirth". (Fear of Childbirth – FOC; Fear of Birth – FOB) [6]. However, it is worth noting that generalized anxiety and fear of childbirth are not synonymous and should be treated as separate entities [7].

The described research field is complex and difficult to interpret when there is no consensus on a precise and clear definition of tocophobia. Most types of fear or anxiety experienced by women in relation to childbirth and pregnancy do not have clear boundaries. Also, the level of the anxiety scale that is considered the beginning of a phobic reaction has not been defined [5]. This may be due to inconsistencies in survey instruments and the lack of criteria that allow tocophobia to be defined as a disease entity [8, 9]. The Wijm Birth Expectations Questionnaire Part A (W-DEQ A) is the most commonly used tool for diagnosis and assessment [10]. Other studies include the Fear Before Childbirth Scale (FOBS) and the Childbirth Attitudes Questionnaire [10]. However, each of the mentioned tests does not have an explicitly determined number of points to which the appropriate intensity of anxiety may be assigned. Each researcher determines the cut-off point on his/her own.

It is noteworthy that the fear of childbirth (FOB) is the reason of increasing anxiety worldwide [11]. In the UK following recommendations – depression and generalized anxiety should be diagnosed during pregnancy- CG62. However, in many countries, anxiety is not identified or screened for in prenatal care [12].

Despite the lack of consensus on the definition and optimal measure to assess women's condition, which has led to a noticeable variation in the estimation of the prevalence of tocophobia [5], there has been an increase in the number of women experiencing anxiety before childbirth worldwide [11].

THE AIM

The aim of this review was to summarize published studies on the prevalence of childbirth anxiety in women

and how it is defined, its possible causes and effects, and to look for different methods of management.

REVIEW AND DISCUSSION

PREVALENCE OF TOCOPHOBIA

It is estimated that as many as one in 10 pregnant women may experience anxiety about childbirth [13]. However, the prevalence of tocophobia varies by region of the world. Surprisingly, a significant difference can be observed comparing Australia, where FOC is approximately 30%, whereas in Europe it varies depending on the country, ranging from 1.9% to 14% [14]. The upper European limit is confirmed by O'Connell et al. and Hofberg and Brockington – tocophobia concerns 14% of pregnant women [5, 15].

Another important factor in the prevalence of tocophobia, which indicates significant discrepancies, is the structure of national development – in developed countries, the occurrence of anxiety during pregnancy remains at 10%, whereas in developing countries this percentage is much higher and amounts to 25% [16, 17].

The phenomenon of anxiety during pregnancy may assume different severity. Gosselin et al. indicate that 6% of women during their first pregnancy develop excessive and irrational anxiety understood as tocophobia and 20% present moderate or mild fear of childbirth [18]. In the study by Demšar et al. 191 pregnant women were assessed using several questionnaires related to anxiety experienced during pregnancy – low or moderate level of tocophobia was reported by 75% of the respondents, high or very high – 25%, and pathological fear appeared in 1.6% of the participants [4]. It was also demonstrated that the degree of experienced anxiety was largely determined by the number of deliveries. The highest level of anxiety was observed in first-born women. The age of pregnant women was also found to be a factor affecting the level of perceived anxiety and thus the prevalence – women over 30 years of age showed higher fear of traumatic delivery than younger patients [9].

The intensity of labour anxiety also varies depending on the stage of pregnancy. According to studies, childbirth anxiety decreases from the second to the third trimester [19]. This is somewhat confirmed by Hildingsson et al. who found that the fear connected with labour decreased from the mid to late pregnancy (its prevalence in the FOBS scale was 22% in the mid and 19% at the end of pregnancy) [20]. However, a Finnish analysis of 1348 pregnant women found that anxiety levels at 20 weeks of pregnancy and below were lower than those of women who were 21 and beyond [13].

Despite various reports on the prevalence and severity of tocophobia, referring to the analysis by O'Connell et al. it should be considered that the problem of tocophobia, as a phenomenon constantly increasing since the 2000s, deserves particular interest and involvement in its study [5].

CAUSES

The causes of tocophobia vary widely. There is still not enough research describing the psychological mechanisms of tocophobia [21]. However, it seems that some women are more prone to anxiety about childbirth than others. The etiology of tocophobia is complex and multifactorial. It may combine various combinations of predisposing stimuli, such as a tendency toward depression and anxiety, both depressive and compulsive personalities, other psychiatric disorders, traumatic experiences of past births, episodes of sexual abuse, low self-esteem, or a history of abuse [5, 7, 14, 22-25]. O'Connell et al. and other authors point out that traumatic experiences in medical care other than childbirth, previous miscarriages, long duration of infertility or smoking and low social support are also likely causes of tocophobia [5]. All of these factors have been linked to both primary and secondary tocophobia [26]. Various sources also point to other causes directly related to pregnancy and childbirth correlating with elevated levels of anxiety, such as prolonged labor in the past and greater likelihood of emergency cesarean section. It is worth noting that these factors significantly affect the possibility of elective cesarean section [27-31]. However, it should be mentioned that such a procedure on the patient's request, without medical indications, which is the ultimate solution to the phobia, often causes ethical problems for attending physicians [32].

The authors of the study "Establishing a valid construct of fear of childbirth: findings from in-depth interviews with women and midwives" pointed to other important elements of FOC, which they developed in collaboration with women who experienced tocophobia and midwives consultants in this field. These include fear of being abandoned and alone; fear of not knowing and not being able to plan for the unpredictable; fear of harm or stress to the baby; of not having a voice in decision-making; fear of harming oneself during labor and in the postpartum period; and fear of internal loss of control. According to Slade et al. [33] poor partner relationships are another of the factors that have a significant impact on the occurrence of tocophobia, while a study by other authors did not find that relationships with the spouse had any relationship with FOC [28, 30, 31, 34].

The fear of not being able to cope with pain associated w et al.ith previous experiences or experienced without a clear basis is also a contributing circumstance to tocophobia [33]. The researchers concluded that experiencing labour pain in women giving birth naturally without anaesthesia significantly correlates with the fear of delivery [18]. It is worth emphasizing the reports by other authors presenting the relation between care of women and analgesic management during labour and the occurrence of anxiety [35]. Due to the fear of pain or unpleasant symptoms during past deliveries, women often decide to resign from natural deliveries. Such decisions are also dictated by the fear of losing sexual attraction and pleasure, which are also components of the existence of tocophobia [36]. Some sources in the context of fear of childbirth also draw attention to previous relationships and behaviors on the part of medical personnel [37].

It is difficult to identify a single, leading cause. Their occurrence may have a social, cultural or personal background [38]. Therefore, each patient with suspected tocophobia should be treated individually and a thorough history should be taken, with the aim of providing specialist support and care during pregnancy, labour and the postpartum period.

EFFECTS

According to the authors, it is extremely important to determine the effects of tocophobia. It is not without significance for both the mother and her baby. According to scientific reports, anxiety in early pregnancy can be related to birth weight, lead to increased hypothalamic-adrenal axis activity, and even fetal loss [39]. A correlation between infant growth and anxiety in the pregnant woman has also been shown [40, 41]. However, other studies have not observed a significant difference in Apgar scores, head circumference, length and birth weight, fetal growth restriction in pregnant women affected by tocophobia and women without this condition [41-43]. O'Connell et al. reported the results of a study, conducted on 389 women with and without associated fear of childbirth, where there was little association between severe FOC (Wijma Delivery Experience Questionnaire Part A was used; severe tocophobia defined as A $\geq$ 85) and Apgar scores [44]. However, there was no difference between mean birth weight percentile, mean birth weight, or mean gestational age among children of women struggling with and without tocophobia. Interestingly, the anxiety experienced by the mother during pregnancy may also result in irritability, restlessness, prolonged crying of the newborn, or poor interactions between the woman and child [45, 46].

This anxiety also carries negative consequences that adversely affect the ability to cope with postpartum, but it also impairs the activity of pregnant women [47]. It may become the dominant emotion accompanying pregnancy, as well as prolong or complicate labor [27].

It is important to note that research findings indicate that children of anxious women are at greater risk of developing serious illnesses in both childhood and adulthood, such as dyspnea, rash, asthma, coronary heart disease in adulthood, and decreased HRV parameters in children [48, 49].

Socio-economic implications are not insignificant. It has been determined that the choice of epidural anesthesia during labor is associated with a higher incidence of patients experiencing labor anxiety [50]. Moreover, according to the study conducted by Nieminen et al. on two groups of women – with severe FOC and no anxiety, the former group used sick leaves more often and had more visits with the attending physician [51]. They also had more frequent elective Caesarean sections, stayed longer in the postpartum ward and had more frequent visits to the ward due to negative birth experiences and to the outpatient clinic due to complications. Other researchers have also recognized that increasing numbers of cesarean sections significantly correlate with FOC [52-55]. According to the study, it is associated with up to 38% increase in the cost of care for pregnant women with severe tocophobia compared to women with low FOC [50].

Significant disruptions caused by severe fear of childbirth have also been noted in aspects such as relationships with other pregnant women, work life, social activities or even the performance of daily duties [56]. It also affects multilevel relationships with family and child while increasing the risk of postpartum depression as well as posttraumatic stress disorder [57].

MANAGEMENT AND TREATMENT

It is very important to identify clear management methods to help women with FOB. It is difficult to identify one specific treatment, as each fear of childbirth may have different causes, but also different degrees of severity. Slade et al. based on their findings suggest that there is a need for an aid to measure fear of childbirth [58]. Perhaps this would contribute to the development of unambiguous methods of management.

It is worth noting how important and helpful it might be for patients to create special birthing environments that would be fully focused on pregnant women minimizing the risk of birth trauma and thus anxiety [26]. Treatment should focus on

improving psychological well-being. This is evidenced by numerous studies. Women with PTSD indicate as a possible cause of their trauma the lack of fulfillment of their expectations regarding the mode of delivery. Therefore, training midwives on the birthing experience and how to deal with it could help prevent posttraumatic stress disorder [59]. Many research reports also treat the need to improve perinatal psychological support [60]. Reduction of childbirth anxiety can also be achieved through antenatal education or cognitive-behavioral therapy [61-63]. Other authors include biofeedback and hypnosis among promising treatments in addition to the aforementioned therapy and education [59]. On the other hand, Moghaddam Hosseini et al. demonstrated that hypnosis can reduce childbirth-related anxiety with twice less effectiveness than educational interventions [64]. Other authors investigated the experience of childbirth among women experiencing severe anxiety in the third postpartum month. They proved the beneficial importance of relaxation exercises and group psycho-educational classes [65]. Still another proposed approach includes haptotherapy, which aims to develop specific skills to make childbirth a more positive and normal life event. Such therapy seems to be promising and more effective for women struggling with antenatal anxiety than the usual perinatal care and online psychoeducation. Moreover, it has been noted to have beneficial effects on symptoms of PTSD, birth anxiety, as well as depressive symptoms and antenatal distress [66]. Interestingly, therapies conducted with the participation of psychologists, gynecologists, and midwives make it possible to prepare for a natural childbirth and simultaneously avoid a cesarean section in 50-87% of women with tocophobia (FOC) [67, 68]. A woman's well-being during the birth itself is also important – she needs to feel safe and cared for, so she cannot feel the stress of the birth team attending to her.

Sweden, among others, is an example of a country that lacks consistent and unambiguous guidelines for the work of teams dealing with women suffering from anxiety and how to conduct treatment. This situation has resulted in more frequent referral of patients with FOB for cesarean section [69].

DOES TOCOPHOBIA AFFECT ONLY WOMEN?

Does the phenomenon of tocophobia affect only women? Ryding et al. conducted a study on partners of non-birth women with FOC, which was described as severe. The researchers report that the men did not report postpartum stress symptoms and showed better psychological well-being than their female partners both during and after pregnancy. The only negative experience cited by the authors was an unplanned cesarean section [70]. However, there are studies that indicate that the phenomenon of tocophobia may also affect men [32]. report the phenomenon of male tocophobia, which includes actions that negatively affect pregnant partners thus increasing their anxiety and fears.

CONCLUSIONS

Fear of childbirth is a common problem affecting women's well-being and health. It is not possible to provide a clear definition and levels of severity of tocophobia. It is also not easy to determine its unequivocal cause, and therefore, it is difficult to choose an effective, causal treatment for FOB. Fear of childbirth undoubtedly also affects the health of the child. The socio-economic consequences are also not insignificant. These consequences require strong preventive measures.

However, this topic is still not fully understood. Therefore, further research is needed to validate the research tool, which would facilitate the determination of the management of a woman experiencing anxiety and, consequently, could perhaps prevent negative consequences of tocophobia.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest.

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DOI: 10.36740/EmeMS202204106 **REVIEW ARTICLE**

PAIN TREATMENT IN THE PRACTICE OF PARAMEDICS

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Abstract

The feeling of pain accompanies a significant proportion of Medical Emergency Teams (METs) and emergency department patients, especially those with trauma. Modern medicine focuses on combating this unpleasant sensation, as it can negatively affect the patient's condition. Paramedics, who are the first on the scene, in today's emergency care system work in primary teams, i.e. without a doctor, so it is their responsibility to implement appropriate pharmacotherapy. Assessment and treatment of pain in the pre-hospital care setting are among the key aspects of the role of paramedics. In view of the scarcity of diagnostic tools, decisions are made on the basis of simple clinical tests, so the knowledge and experience of medical personnel seem to be paramount here. It is important to keep in mind the current state of the patient, as well as potential disorders that may occur during transport to the hospital. Massive injuries to organs, multiple areas of the body, as well as an advanced stage of disease, require the administration of strong analgesics. The use of appropriate analgesia in the prehospital setting, significantly improves the patient's comfort and often contributes to a huge improvement in the clinical condition. Undertaking pain management from an ethical and moral point of view is one of the essential tasks of medical personnel, and also demonstrates commitment and professionalism.

Key words

pain,
paramedics,
pain medications,
pain scales,
analgesic ladder

INTRODUCTION

According to the definition of the International Association for the Study of Pain (IASP), pain is an unpleasant sensory experience associated with the appearance of a damaging stimulus, as well as a perception arising from a mental interpretation of the phenomena taking place, which is modified by previous experiences and psychosomatic conditions. With regard to the criterion of time, we divide it into acute (post-traumatic, post-operative, childbirth) lasting up to 3 months, and chronic – receptor (somatic or visceral) and non-receptor (neuropathic, functional, psychogenic) and mixed, lasting more than 3 months. The process of pain sensation is called nociception and involves 4 stages: transduction, conduction, modulation and perception [1]. Acute pain is usually associated with injury and serves as a warning signal of actual or potential tissue damage. Pain receptors – nociceptors, consist of naked nerve endings that pass through all types of body cells except those in the brain. Activation of nociceptors induces an action potential, transmitted through the axons of the afferent or sensory nerves. Peripheral nerve pathways are composed of two types of nociceptive fibers: myelinated A fibers, sensitive to mechanical and thermal stimuli, and nonmyelinated C fibers, responsive to mechanical, thermal and chemical stimuli. A-fibers can transmit the signal quickly, so they are responsible for localized acute pain, while C-fibers are slow to conduct the impulse, so their signals are perceived as poorly localized, dull and painful. As a result of mechanical, thermal or chemical damage, substances such as leukotrienes, bradykinin, serotonin, histamine, thromboxane are released, which in turn activate nociceptors. Prostaglandins are also released, but they do not activate these receptors. Instead, they dilate the small blood vessels of the damaged areas, which leads to redness and swelling, this causes pressure on the nerve endings, and this results in pain [2]. Learning about the mechanisms of the emergence of the pain phenomenon has contributed to the development of research into the use of many new analgesic drugs. The goal of effective management is to create comfort for the patient, facilitate recovery, and inhibit the cascade of pathophysiological processes occurring in the body [1].

THE AIM

The aim of this paper is to review the current literature on analgesics available in Medical Emergency Teams (METs) in Poland.

REVIEW AND DISCUSSION

STARTING PAIN MANAGEMENT

Assessment of pain

Pain is a subjective sensation, so in assessing it, it is important to take a proper history and gather the necessary information about its characteristics.

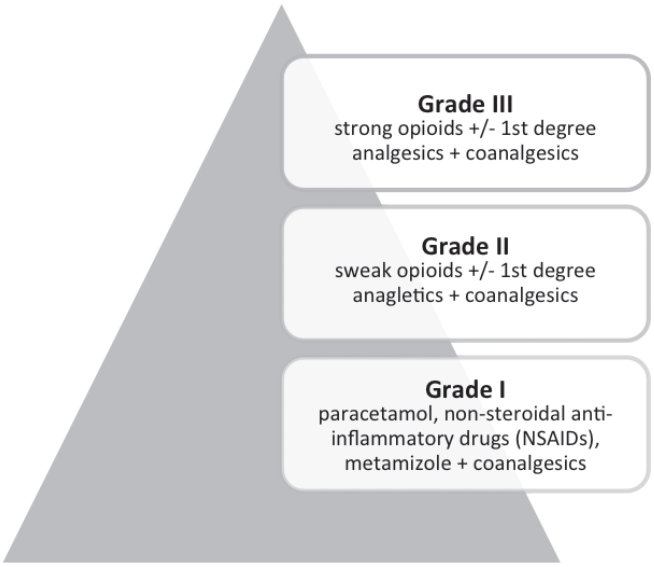

Fig. 1. WHO analgesic ladder, own development (based on: https://www.ncbi.nlm.nih.gov/books/NBK554435/).

During the subjective examination, it is necessary to find out where it is located, how long it lasts, to what part of the body it radiates, what type of pain it is (sharp, stabbing, girdling, burning, dull, burning), whether it intensifies or relieves during various activities, and its nature (constant, recurrent). It is necessary to obtain data on hypersensitivity to medications, previous pain episodes, body weight, currently used analgesics. According to the recommendations, pain at the scene should always be determined. When assessing the strength of pain, one can use the self-report method, in which the patient himself provides the information needed for analysis. This is a basic method based on the patient's subjective perception of pain. This is served by questionnaires, which consist of a section specifying the nature of the pain, its course over time, directly assessing the intensity of pain felt now and experienced in the past, and describing the location of the pain. An example of such a questionnaire is the McGill Pain Questionnaire (MPQ). It provides both quantitative and qualitative assessment of pain, but the main task is to describe the pain. The aforementioned questionnaires assess chronic pain, while the following pain assessment scales are used at the scene: verbal, numerical and visual-analog [3].

The verbal rating scale (Verbal Rating Scale , VRS) contains a series of consecutively set numbers to which specific degrees of pain intensity are assigned. On a four-point scale, "0" indicates no pain, "1" mild pain, "2" severe pain, while "3" is unbearable pain. Its disadvantages include the patient's different interpretation of the various terms, as well as too few options for describing pain. The VRS scale is not used in children under 7 years of age

On the numerical rating scale (NRS), the patient specifies how severe the pain is by indicating the corresponding digit, where "0" corresponds-to no pain at all, and "10"-to the worst pain I can imagine.

The visual-analog scale (VAS) is formed by a straight line, usually 10 cm long, on which the different sections are marked. The patient's task is to mark a point on this line that corresponds to the intensity of the pain experienced. Its advantages are the possibility of using several graphical versions and the reliability of the results obtained [4].

There are other methods of assessing pain such as pain diagrams or self-efficacy scales, but the most appropriate methods are those that are clear, quick, understandable and effective [5].

The greatest challenge is in assessing pain in young children and unconscious patients. In newborns, premature infants and toddlers, a special scale called the MIPS/NIPS (Modified Infant Pain Scale/ Neonatal Infant Pain Scale) is used, while for children under 3 years of age or unconscious patients, a behavioral scale based on the assessment of facial expressions, leg positioning, general activity, crying and ability to soothe (Face, Legs, Activity, Cry, Consolability Scale – FLACC) is used. For children 3 years of age and older, scales depicting various facial expressions are available, and for school-aged children, visual and numeric scales (VAS, NRS) can be used. In unconscious patients, behavior-based classifications are used to assess pain [3].

Selecting the appropriate analgesic

After examining the patient and taking a history, the paramedic proceeds to alleviate the discomfort.

To relieve pain, analgesics are used according to the analgesic ladder developed by the WHO, depending on the severity of symptoms, and if necessary, the use of adjunctive drugs – coanalgesics – is also applied (Fig. 1).

Analgesics included in level I of the analgesic ladder that are available to the paramedic include: Paracetamol (*Paracetamolum*), Ibuprofen (*Ibuprofenum*), Ketoprofen (*Ketoprofenum*), Metamizole (*Metamizolum natricum*), Acetylsalicylic Acid (*Acidum acetylsalicylicum*). Drugs in Grade II are not available for self-administration by the rescuer, while from Grade III, morphine (*Morphi sulfas*) and, on doctor's orders, fentanyl (*Fentanylum*) are possible [6].

A key role in selecting the appropriate analgesic is played by the NRS scale, through which the paramedic is able to determine which drug will be appropriate for a given patient.

Minor discomfort, which is 1-3 on the NRS scale, can be relieved by NSAIDs, paracetamol or metamizole. A large proportion of the drugs on step I of the ladder have analgesic, antipyretic and analgesic effects. Pain intensity of 4-6 indicates the use of grade II analgesics, while 7-10 indicate grade III [7].

MEDICATIONS AVAILABLE IN MET

According to the Regulation of the Minister of Health of December 16, 2019 on emergency medical activities and health services other than emergency medical activities that can be provided by a paramedic, a paramedic can self-administer 47 medications, including 7 pain medications [6]. A brief description of these drugs will be presented below.

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS)

This is a broad and heterogeneous group of the most widely used drugs in the world. Their widespread occurrence is due to their special properties and wide availability, especially since some of them are available without a prescription. Their action is based on inhibiting the activity of the cyclooxygenase (COX) enzyme. There are two isoforms of this enzyme – COX-1 and COX-2, both of which are involved in the conversion of arachidonic acid, among other things, into prostaglandins, the transmitters that stimulate pain receptors and promote inflammation. COX-1 is a constitutive enzyme that, via the prostaglandins produced, exhibits protective effects on the gastric and intestinal mucosa, positively influences renal blood flow and regulates platelet function. COX-2, on the other hand, is an inducible isoform that appears mainly at sites of inflammation, and also occurs in the central nervous system (CNS) [8]. In addition, NSAIDs have an antiaggregative effect on platelets, thus increasing the risk of bleeding and prolonging bleeding time [9]. Due to the availability of NSAIDs, which can be purchased over-the-counter, abuse of NSAIDs is currently a major problem, especially among the elderly. Therefore, it is important to choose the right drug and the right dose. In practice, once an NSAID is selected, the dose should be gradually increased until the pain subsides or the maximum daily dose is reached. If the patient does not respond to the maximum allowable dose then the drug should be changed to another. In doing so, it is important to keep in mind the existence of a ceiling (ceiling) effect when selecting an NSAID, which is that further dose increases will not improve the clinical condition [10].

The effect of NSAIDs is anti-inflammatory, analgesic and antipyretic.

Ibuprofenum (Ibuprofen) – the drug is available in tablet form (in Poland, it can also be administered intravenously, but this form is not currently available for primary-type NSAIDs). Dosage: 200-400 mg (maximum daily dose of 3200 mg) [7]. Ibuprofen irreversibly inhibits COX-1 and COX-2 enzyme activity, exhibiting analgesic, anti-inflammatory and antipyretic effects. In addition, ibuprofen increases the release of β-endorphins, resulting in reduced pain sensation, stress reduction and feelings of bliss and euphoric state. Its use in acute conditions is limited, due to its slow onset of action compared to other intravenous drugs [11].

Ketoprofenum (ketoprofen, Ketonal) – a drug administered both orally and by injection (intravenously and intramuscularly), in doses of 50-200 mg (maximum daily dose 200 mg). It inhibits the activity of both cyclooxygenases, slightly more strongly the COX-1 isoform, resulting in a decrease in prostaglandin synthesis, reducing inflammation and pain sensation. In addition, it has an analgesic effect by affecting the modulation of supraspinal cholinergic pathways. The most effective route of administration is the intravenous form in an infusion lasting up to 30 minutes. Intramuscular administration of ketoprofen, on the other hand, is not recommended, due to its late therapeutic effect. Ketoprofen is used to treat pain of mild to moderate severity (stage I of the analgesic ladder) [11, 12].

Acidum acetylsalicylicum (acetylsalicylic acid, ASA) – a drug available in tablet form, inhibits COX-1 more potently than COX-2. In addition to its analgesic, anti-inflammatory and antipyretic effects, it also produces an antiaggregative effect by reducing the release of thromboxane A2 from platelets. As a result, ASA is particularly used in emergency

medicine for the treatment of acute coronary syndromes at a dose of 150-300 mg. Note that when used together with alcohol, it increases gastrointestinal bleeding [13, 14].

The main contraindications to the supply of NSAIDs are hypersensitivity to the components of the preparation, gastric or duodenal ulcer disease, hepatic or renal failure, hemorrhagic diathesis, aspirin asthma [7].

NON-OPIOID ANALGESICS

Paracetamolum (Paracetamol) – the most widely used analgesic and antipyretic due to its low risk of causing side effects. Unlike NSAIDs, it is devoid of anti-inflammatory effects. Available in the form of tablets, solution for injection and suppositories, Dosage: 500-1000 mg orally or 1000 mg intravenously (maximum daily dose of 4 g). This drug is used for the treatment of moderate pain and fever/hyperthermia in both adults and infants. Paracetamol exhibits multiple mechanisms of action, such as: blockade of prostaglandin synthesis in the CNS, activation of descending serotonergic pathways (stimulation of 5-HT3 receptors, leading to an increase in serotonin concentration in the CNS), antagonistic action against the NMDA (N-methyl-D-aspartate) receptor and substance P in the spinal cord, modulates nitric oxide (NO) production by being an inhibitor of the neuronal isoform of NO synthase. In addition, it is a cannabinoid receptor agonist, producing an analgesic effect. The following contraindications to use are distinguished: hypersensitivity to the components of the product, liver failure, renal failure, alcoholic disease, glucose-6-phosphate dehydrogenase deficiency [7,15]. Although the effect of alcohol on the metabolism of paracetamol is complex, many studies have shown that it is underpinned by the activity of cytochrome CYP2E1 in the liver, which is responsible for converting paracetamol to the toxic metabolite N-acetyl-p-benzoquinonoimine (NAPQI). Under normal conditions, this metabolite is captured by glutathione and excreted from the body. It has been noted that CYP2E1 is responsible for both paracetamol and ethanol metabolism. As a result, alcohol abusers have a significant increase in its activity and when paracetamol is administered simultaneously, there is an increase in the level of NAPQI, which exhibits hepatotoxic effects. In addition, reduced hepatic glutathione content has been observed in chronic alcohol users, which is likely related to the malnutrition common among alcoholics [16].

Metamizolum natricum (Metamizol, Pyralgina) – a drug with analgesic, antipyretic and diastolic effects. The maximum daily dose of the drug is 5 g. Unlike NSAIDs, it does not have an anti-inflammatory effect. It can be administered by oral, intravenous or intramuscular routes. It inhibits prostaglandin synthesis by blocking COX-1 and COX-2 activity and inhibiting substance P. Metamizole has a favorable side effect profile compared to NSAIDs and a low risk of interaction with other drugs, as it is not metabolized by the CYP450 liver enzyme system. Its analgesic and antipyretic effects are also due to its effects on the cannabinoid (cannabinoids, CB) system through activation of CB1 and CB2 receptors. Diastolic effects are due to inhibition of adenosine reuptake in the CNS and effects on the cannabinoid system. As a result, in the ICS, metamizol is used in relieving pain in renal colic, visceral pain and painful menstruation, while also showing spasmolytic effects [17-19].

OPIOID DRUGS

Opioids – are drugs very effective in relieving acute pain, and should be used in moderate to severe pain. Their analgesic effect is due to binding to the following opioid receptors: μ (mi), κ (kappa), δ (delta), which are located in the brain, spinal cord and peripheral tissues. Opioids exhibit effects:

- Central: respiratory center depression, coughing, analgesic, euphoric, sleep and anxiolytic effects,
- Peripheral: bronchospasm, pupil constriction, constipation, biliary and urinary tract spasm, urticaria, pruritus of the skin [20, 21].

During their use, it is important to keep in mind the risk of so-called opioid-induced hyperalgesia, or opioid paradox, manifested by worsening pain despite increasing the dose of the opioid drug used. Since paramedics do not have at their disposal to self-administer drugs from the second step of the analgesic ladder, so in moderate pain they should consider the use of low-dose opioids [17]. The most important principle of the administration of strong opioids by PCPs is titration, i.e., gradually increasing the dose of the drug until the analgesic effect occurs, without exceeding the recommended maximum dose. The use of opioids can be associated with very dangerous side effects, such as respiratory depression, hypotension, cardiac arrhythmias, and muscle rigidity. Other side effects include nausea, vomiting, constipation (especially during chronic use) and dizziness. They also have a high addictive potential, but in a situation of imminent danger to health and life, this information does not seem to be of primary importance [11, 22, 23]. At the scene of an accident in a patient with a pain intensity of more than 6 on the NRS scale, the

drug of choice is fentanyl because of its rapid effect and short duration of action, which allows comfortable transport to the hospital. In injuries of lesser pain intensity, tramadol has been successfully used; administered in drops, it allows the dose to be adjusted to the individual patient's needs. Opioids can give a misleading assessment of the clinical condition of a head injury patient. On the other hand, ineffective analgesic therapy can be associated with an increase in blood pressure, which can cause dangerous intracranial hypertension, so their use must be justified. In the case of multi-organ trauma, stabilization of the respiratory and circulatory systems is crucial, so their use seems justified if there is a need for endotracheal intubation and controlled ventilation [24].

Morphini sulfas (Morphine) – a drug available as an injectable solution, administered as 2 mg intravenously. A pure μ opioid receptor agonist. It is metabolized in the liver, intestinal wall, kidneys and CNS by coupling with glucuronic acid, resulting in the following metabolites: morphine-3-glucuronate (M3G) and morphine-6-glucuronate (M6G). M6G has many times stronger analgesic effects than morphine, while M3G has no analgesic effect, but has neurotoxic properties. If it accumulates, the following symptoms can occur: cognitive impairment, delirium, agitation and seizures [25]. Morphine causes analgesia, sedation, euphoria, reduces the ability to concentrate and slows down thought processes. It depresses the respiratory and coughing centers and causes pupil constriction. In addition, it weakens intestinal peristalsis, leading to constipation, and increases muscle tension in the bile and urinary tracts. Side effects include nausea and vomiting, which result from stimulation of brainstem chemoreceptors [1]. It is used in the treatment of pain in myocardial infarction, angina pectoris, in cancer patients with dyspnea, after severe trauma, crushing and burns. In terminal patients with severe, prolonged pain, morphine is used orally, strictly on the clock (usually every 12 hours). In addition to its analgesic effect, it also abolishes other symptoms accompanying, for example, cancer, including shortness of breath and has an antitussive effect. Treatment with oral morphine should be started with low, single doses, following the doctor's instructions [22].

Fentanylum (Fentanyl) – a drug available as a solution for injection, administered in a dose of 0.05 mg intravenously (maximum daily dose of 0.2 mg). An μ opioid receptor agonist, it acts more than 100 times more potent than morphine. It easily crosses the blood-brain barrier due to its high lipophilicity and low molecular weight. It is metabolized in the liver by the CYP3A4 enzyme, which is responsible for the metabolism of many other drugs. Therefore, it is important to be aware of possible interactions and potentiation/weakening of the analgesic effect of fentanyl when other drugs are taken at the same time [17,26]. The advantage of fentanyl is that, unlike morphine, it lacks the effect of increasing gastrointestinal muscular tone, so the significance is less likely to cause constipation, nausea and vomiting. When used in the transdermal form, it allows stable analgesia due to the constant serum level of the drug and reduces the incidence of breakthrough pain by up to 20%. In its transmucosal form (intranasal, sublingual, sublingual), it is used exclusively for the relief of breakthrough pain [1].

COANALGESICS

Complementary drugs, used to potentiate the effect of analgesics and reduce their possible side effects. This includes antidepressants, antiepileptic drugs and myorelaxants (muscle relaxants). Unfortunately, in the practice of paramedics, only the following are available:

- *Lidocaini hydrochloridum* (lidocaine) – a local anesthetic and antiarrhythmic drug, administered as a gel or solution for injection. Lidocaine is effective in the treatment of neuropathic pain, acting by inhibiting neuronal activity in the pathologically altered area.
- Diastolic drugs:
  - *Papaverini hydrochloridum* (papaverine) – a drug available as a solution for injection. Used in the treatment of spasmodic conditions of smooth muscle in the abdominal cavity.
  - *Drotaverini hydrochloridum* (drotaverin, No-Spa) – more potent than papaverine, a drug available as a solution for injection. Drotaverin is used in the treatment of smooth muscle spasm of the gastrointestinal tract, urinary tract and biliary tract [11,27].
- *Clonazepamum* (clonazepam) – anticonvulsant drug, used in acute, wrenching neuropathic pain, such as trigeminal neuralgia.
- *Diazepamum* (diazepam) – an anticonvulsant drug that relieves pain in states of increased muscle tension by acting as a myorelaxant, such as in cases of sciatic nerve compression. In addition, it exhibits an anxiolytic effect.
- *Dexamethasoni phosphas* (dexamethasone), Hydrocortisonum (hydrocortisone) – in the form of solutions for injection, glucocorticosteroids administered to cancer patients to reduce swelling of peri-tumor tissue and tumor pressure on nerves.

- *Mannitolum* (mannitol), a drug that lowers intraocular pressure, provides relief from painful glaucoma attacks [28].

CONCLUSIONS

The implementation of pain management at the scene is of paramount importance to the comfort of the victim. The key to incorporating appropriate therapy is the use of available pain assessment scales. Based on this, paramedics are able to select the appropriate analgesic located on a specific step of the analgesic ladder. The positive effect of immediately incorporating treatment is to reduce the chances of the victim developing post-traumatic stress disorder. An important principle in pain relief is so-called multimodal analgesia, which involves the use of several drugs with different mechanisms of action and non-pharmacological methods of pain relief. This makes it possible to interact at multiple levels of pain stimulus generation and conduction, thus providing more effective analgesic treatment [29]. Each time an analgesic is administered, paramedics should assess the effect achieved by asking the patient about the reduction in pain intensity. If it appears that the pain has not decreased or has not decreased sufficiently then the members of the METs should consider increasing the dose or adding another analgesic. At the same time, it should be remembered that the METs has only 7 analgesics as part of its drug equipment. There have been discussions for many years about expanding the powers of paramedics and the availability of more or changing some medications.

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FOURNIER'S GANGRENE – A LIFE THREATENING UROLOGICAL EMERGENCY

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Abstract

Fournier's gangrene (FG) is a necrotizing inflammation of the penis, scrotum and perineum subcutaneous tissues, that frequently spreads to the anterior abdominal wall and the upper surfaces of the thighs. Despite being an extremely rare disease, it has a very high mortality rate. It is one of the most difficult emergency conditions in urology. Infection is the most common cause of Fournier gangrene development. Men who have diabetes, use immunosuppressive therapy or abuse alcohol and steroids are especially vulnerable. Early detection and treatment are critical because the developing infection causes severe necrosis, septic shock and leads to death. Therefore, it is important to correctly diagnose the disease while still in the emergency department or emergency room. A review of the literature on diagnosis, therapy, and prognosis, as well as the role of Hospital Emergency Departments in the therapeutic process, was conducted in this review paper.

Key words

emergency, infection, urology, necrosis, debridement, Fournier gangrene

INTRODUCTION

First discovered in 1883 by Dr. Alfred Fournier, necrotizing fasciitis, known as Fournier's gangrene, is an extremely rare condition (1:7,500 to 1:750,000) [1], caused by a variety of microorganisms, the most common of which are *Escherichia coli*, *Klebsiella* spp, *Proteus* spp., staphylococci, streptococci, enterococci, as well as anaerobic bacilli *Clostridium* spp., *Bacteroides* spp., *Fusobacterium* spp., *Peptococcus* spp., *Peptostreptococcus* spp.[2]. It is a necrotizing inflammation of the penis, scrotum, and perineum subcutaneous tissues that frequently spreads to the anterior abdominal wall and the upper surfaces of the thighs [3]. The condition affects both men and women, with a significant prevalence in middle-aged men. Risk factors include diabetes, hypertension, alcoholism, immunosuppression, as well as advanced age and obesity [4]. The symptoms of this disease are nonspecific. The diagnosis of acute testicular and epididymitis and testicular torsion is often mistaken. The main symptom is severe pelvic pain, which is accompanied by perianal skin lesions and systemic symptoms like fever, hypertension and tachycardia [5]. The outcome of Fournier's gangrene largely depends on prompt diagnosis and appropriate treatment. It is delayed therapy that is the main cause of the high mortality rate, even up to 67% [1], due to the development of septic shock [6]. Therefore, it is necessary to quickly recognize the symptoms of the disease and quickly initiate the necessary procedures to ensure patient survival. Since this is a condition with which patients rarely present to the emergency room it poses an unusual challenge for medical personnel.

THE AIM

In this work we would like to highlight the symptoms, treatment and prognosis of patients with fournier's gangrene, so that this infrequent disease does not present diagnostic difficulties in the Hospital Emergency Department.

MATERIAL AND METHODS

The study was conducted by reviewing the latest available literature on the issue, particularly articles found in PubMed databases.

REVIEW AND DISCUSSION

To understand why FG has such a very high mortality rate, it is important to know the anatomy of the

pelvic floor. Colles' fascia is a membranous layer of subcutaneous tissue that extends to the anterior abdominal wall, where it joins Scarpa's fascia. It attaches posteriorly along the edges of the ischiofemoral arm. The Dartos fascia, which contains muscle fibers and crosses the scrotum to form the scrotal septum, is also continuous with the Colles fascia. Buck's fascia covers the periurethral area and deeper penile structures [7]. As long as Colles' fascia is connected to the surrounding fascial planes, infection can move quickly from each of these key regions to the abdomen and then the thorax through the use of Scarpa's fascia, as well as to the scrotum through the use of Dartos' and Buck's fascia. The testes are mostly supplied by the exterior and internal pudendal arteries, which accounts for the little participation of the testes in FG. In contrast, because the Camper fascia is considered necessary to supply the abdominal wall, the circumflex iliac and inferior epigastric arteries are more susceptible to thrombosis [4].

The main cause of FG, microbial infection, triggers a response from the immune system. The immune system reacts to the primary cause of FG, microbial infection. Release of inflammatory mediators results in swelling, heating, and redness. In the beginning, due to the inflammatory process, small vessel thrombosis and local tissue necrosis is presented. Reduced oxygen tension stimulates microbial growth and the generation of toxins, which causes deeper migration into the muscle due to favorable anatomical circumstances [7].

CLINICAL PRESENTATION

A patient with FG who presents to the hospital emergency department frequently has a history of diabetes, HIV, alcoholism, or malignancy. He could be abusing steroids and have recently suffered a perineal trauma. He will frequently complain of pain, swelling, scrotal erythema, or penile tenderness. He may also have an elevated body temperature, muscle stiffness, tachycardia and chills. The disease's onset can be subtle, delaying diagnosis and treatment. The patient may report that he has been suffering from discomfort, pruritus, and dysuria for several days and has come in because the symptoms have worsened and he is unable to manage them. Purulent discharge, crepitations, dark purple or black discoloration of the skin, and patches of necrotic tissue with surrounding swelling may be seen on physical examination [8, 9].

DIAGNOSIS

Diagnosis of Fournier's Gangrene is certain only after laboratory tests, surgical exploration and radiological evaluation. There are some tests such as Laboratory Risk Indicator for Necrotising Fasciitis (LRINEC) and Fournier's Gangrene Severity Index (FGSI) that might be useful when working in the Emergency Department.

A clinical instrument called LRINEC was initially introduced by Wong C. et al. [10]. The technique is based on six commonly used serum markers: C-reactive protein (CRP), total white blood cell count, hemoglobin, serum sodium, creatinine, and glucose. A higher risk of necrotizing fasciitis is associated with LRINEC values of six or higher.

The Fournier's Gangrene Severity Index (FGSI), created in 1995 by Laor et al., allows patients' prognoses to be predicted. It has 9 parameters, including leukocyte counts, heart rate, bicarbonate levels, creatinine, serum sodium, and potassium. Patients with a FGSI score of 9 or higher have a worse prognosis and a 75% chance of dying. The prognosis is substantially better with a score under 9, and patients have a 78% chance of surviving [11].

Blood, urine, and any wounds should all have cultures taken because these fluids frequently contain numerous bacteria such *Staphylococcus*, *Streptococcus*, *Klebsiella* and *Proteus* [9].

As time is of the importance, X-rays are no longer used because they can reveal the existence of subcutaneous gas on radiographs, which is a non-specific symptom. Due to its ability to detect gas, fluid and thickening of the fascia, ultrasonography is very helpful. The superficial fascia can contain fluid and gas and a CT scan can also reveal thickening of the fascia. MRI is not cost-effective due to the price and availability, despite the fact that it can more accurately assess the amount of necrotic infection [7].

TREATMENT

A urological emergency, Fournier's Gangrene, still exists. Early drastic necrotic tissue removal, drainage, antimicrobial treatment, and hemodynamic stabilization of the patient are the cornerstones of its treatment [2].

Fluid resuscitation should begin right away. Electrolyte imbalances and elevated blood glucose levels are common in patients with FG. They are frequently patients with uncontrolled diabetes who have developed ketoacidosis. Because poor diabetic control is associated with a more severe course of the disease, glucose levels should be corrected as soon as possible [12].

Due to the polymicrobial flora, second- to third-generation cephalosporins in combination with fluoroquinolone, nitroimidazole, and aminoglycoside classes

are the drugs of choice for the therapy of FG. In severe cases, carbapenem antibiotics are being used [6].

According to Zhang et al., debridement must proceed until normal-appearing fascia is reached [13].

Significant surgical debridement lowers mortality and retards FG progression. According to research by Goh et al., delaying debridement from 24 to 48 hours reduces survival from 93.2% to 75.2% [14].

Following the development of granulation tissue, reconstructive surgical treatment is carried out which incorporates split autodermoplasty, skin plasty by local tissues, muscle plastic and stem plastic. Rehabilitation and orthopaedic interventions are necessary over all cases [6].

Hyperbaric oxygen therapy (HBOT) is used as an adjunctive therapy to improve the oxygenation of damaged tissue and for its bactericidal and bacteriostatic properties, particularly in the postoperative period [4].

Mazur et al. described the case of a patient with FG who had clean, granulating wounds after seventeen days of receiving a 90-minute session of hyperbaric oxygen therapy using 100% oxygen at a pressure of 2.8 ATA, with two 10-minute air brakes [15].

CONCLUSIONS

Fournier's Gangrene is an extremely rare, life-threatening urological emergency that must be diagnosed and treated as soon as possible to reduce its mortality. For good diagnosis and patient management, suspicion, knowledge of risk factors and symptoms are required. In this disease, time is of the utmost importance. If FG is suspected, emergency department personnel should use risk scales and order a urological consultation as soon as possible. Physical examination and surgical evaluation serve as the foundation for diagnosis. Laboratory and radiological tests can be used as supplements, but the low importance of X-rays should be remembered, and the benefits of performing a specific test should be weighed against the risks, such as the length of a particular examination. Professionals should be on the lookout for symptoms of Fournier's Gangrene and take appropriate action as soon as possible.

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STRESS IN THE WORK OF PARAMEDICS DURING THE COVID-19 PANDEMIC

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Abstract

On March 11, 2020, the World Health Organization (WHO) announced the COVID-19 pandemic, caused by the SARS-CoV-2 virus. It caused chaos in public spaces in almost every country, and the public was forced to reorganize their daily functioning. People began to experience severe stress due to the risk of infection from an unexplored and dangerous pathogen. During this specific period, working in health care became extremely difficult. One of the groups particularly exposed to stress factors turned out to be paramedics. Having daily contact with an infected person, they became the first link in the fight against this virus. Therefore, it was extremely important to develop appropriate ways to cope with stress. The following strategies proved to be effective: active coping strategy, learning, and acceptance, understood as acceptance of the situation. A significant factor in mitigating the effects of traumatic events was the ability to respond to stress in a healthy way, which depended on many factors, i.e. personality dispositions, defense mechanisms, and health-promoting behaviors.

Key words

stress, paramedics, COVID-19, SARS-CoV-2

INTRODUCTION

In December 2019, an outbreak of SARS-CoV-2 coronavirus infection, causing acute respiratory distress syndrome 2, occurred in China's Wuhan Province in February 2020. The World Health Organization (WHO) officially named the disease caused by the new virus COVID-19 [1]. The infection quickly began to spread to other countries due to the easy transmission and the droplet, aerosol, and oral route of the pathogen's bristling. In most patients, the disease is asymptomatic or mild in the form of fever, dry cough, headache and gastrointestinal distress. Only a few develop shortness of breath, respiratory distress and severe symptoms such as acute respiratory failure, septic shock or multiple organ failure [2]. Due to the rapidly increasing number of cases and the unfamiliarity of the unexplored and dangerous pathogen, SARS-CoV-2, people have begun to be severely stressed by the risk of infection. A group particularly vulnerable to infection are paramedics, who are the first to arrive on the scene, having direct contact with patients infected with SARS-CoV-2 [3]. Both the fear of contracting the disease, causing chaos in public spaces, as well as the lack of basic personal protective equipment, cause deterioration of mental health among medical personnel to be observed [4]. In order to reduce the incidence of complications resulting from working in stressful conditions, it is necessary to find effective methods and techniques for coping with stress. Early and effective intervention will improve the physical and mental state among paramedics working in Emergency Medical Teams (EMTs) during the COVID-19 pandemic.

THE AIM

The aim of this paper is to analyse the available literature presenting the main causes of stress in paramedics working in the Emergency Department during the COVID-19 pandemic and to describe selected stress coping techniques.

REVIEW AND DISCUSSION

STRESSORS DURING THE COVID-19 PANDEMIC

Stress is an inherent part of the paramedic profession, which requires special personal commitment, the ability to meet the demands of society, and to perform varied and sometimes risky tasks. This remains relevant to the current situation related to the COVID-19 pandemic, as in the dynamically changing reality, paramedics and other medical professionals have faced the challenges of a barking infection and the need to adapt to changes in the functioning of society and health care [5].

There are a number of publications confirming the negative impact of stress on mental health among

emergency workers working during the epidemic caused by SARS-CoV-2. A study by Al Barbari et al. that assessed the level of stress experienced by paramedics before and during the COVID-19 pandemic showed higher levels during the pandemic compared to before the outbreak [4].

In turn, Couarraze et al. proved that the first wave of COVID-19 was a highly stressful event for health care workers, among whom the highest levels were characterized by Emergency Medical Service personnel. Comparing the two genders, it was shown, that women were at greater risk of developing the disorder than men, in all occupational categories. On the other hand, a higher risk of high levels of stress was noted in younger people under the age of 50, indicating the protective effect of age and the development of coping strategies by older people under stressful circumstances [6]. The large COVISTRESS study also revealed that paramedics are characterized by higher emotional strain than medical personnel. Despite their professionalism, an overburdened and under-resourced health care system compromises workers' mental health. In the absence of targeted therapy to combat SARS-CoV-2 infection, paramedics must provide primary health care to sick people, risking self-infection during direct contact with the patient, with paramedic staff more vulnerable to lack of material resources than doctors. In addition, some health care workers have been transferred to understaffed units to provide assistance and increase the workforce, which also caused negative emotions. The high level of stress associated with working during the COVID-19 pandemic is causing increased levels of burnout among paramedics, and thus leading to a to a decline in the quality of medical care [6-8].

When faced with a new situation like the COVID-19 pandemic, additional stressors such as fear of contagion, fear for the future and the health of one's family, the need for isolation and quarantine emerge. The unexpected increase in the number of confirmed cases of SARS-CoV-2 infection has undoubtedly caused a tremendous amount of stress, due to the threat of self-infection and the physical and psychological pressure exerted on paramedics. Seeing how many health care workers became ill and died also contributed to the deepening fear. Another cause for concern was the new nature of the SARS-CoV-2 virus and its very rapid spread compared to other diseases that rescuers encounter on a daily basis. In addition, the lack of availability of appropriate drugs and therapies aimed at combating and stopping the spread of the coronavirus contributed to a high sense of insecurity [9].

A study by Shahzad et al. found that stress factors and the threat of the COVID-19 pandemic cause the following disorders among paramedics: anxiety, depression and emotional exhaustion.

These factors included the high mortality rate associated with SARS-CoV-2 infection, the high risk of self-infection and the excessive workload resulting from other paramedic members becoming ill or being in quarantine [10]. In addition, the need to curb the spread of the SARS-CoV-2 virus has forced medical workers to change their current work behavior and to follow to the new procedures. They have been required to perform their work, often in increased hours, despite the risks of infection [11, 12].

Shahzad et al. also observed that a period of increased stress, such as the COVID-19 pandemic, affects people's behavior. The authors showed that the perceived threat of SARS-CoV-2 infection triggers adaptive behaviors such as defense, avoidance, aggression, and anti-social and destructive actions. In this case, humans react similarly to animals in that they have a similar defense system against threats, such as fear of infection. Human behavior is partly genetic, but generally results from learning to live in society. However, under unfavorable conditions and in threatening situations, negative emotions emerge, which can increase the risk of aggression and vulnerability to stress [10, 13]. Also Sorokin et al. proved that during the COVID-19 pandemic, health care workers showed increased levels of it. The increasing likelihood of direct contact with infected individuals was associated with more intense stress reactions [14]. Another study, conducted in the form of a questionnaire by Ilczak et al, indicated what factors could be considered predictors of occupational stress. These included: fear of contracting COVID-19, decreased safety when performing emergency procedures, and reduced access to medical care for patients not affected by COVID-19 [15].

In view of the above, it seems necessary to introduce strategies and methods to effectively reduce stress levels so that paramedics are able to perform their functions and provide effective medical care, and not succumb to mental and physical disorders.

METHODS AND TECHNIQUES FOR COPING WITH STRESS

Persistent chronic stress undoubtedly has an impact on the increased mental burden on health care workers. In addition to the global health crisis, the COVID-19 pandemic may also have a negative impact on the mental health of paramedics. Therefore, it is important to seek effective methods of coping with stressful situations to prevent the development of unwanted complications in the future.

A study by Shahzad et al. found that for people with anxiety and depression, social support can have a salutary effect on mental health. Social support can be understood as a sense of belonging to people one can rely on, being surrounded by love and being taken care of [10]. In turn, Wang et al. observed that, depending on the ways in which they respond to stress, health care workers are more or less prone to developing PTSD (post-traumatic stress disorder). It turns out that so-called "proactive" coping with stress has a positive impact on mental health and involving taking actions and steps to remove or bypass the stressor. In contrast, "negative" coping – avoiding or ignoring the problem, blaming oneself and others, and unloading – significantly worsens the daily functioning of medical personnel who struggle with many traumatic events at work [16]. It follows that it is necessary to strengthen the mental state of paramedics through education and training programs to acquire stress management skills. In addition, achieving desired goals, both on an individual and team level, leading to career development, undoubtedly increases the level of self-satisfaction and satisfaction with work. In addition, effective and long-term psychological counseling available to paramedics aimed at reducing the risk of chronic stress complications should be launched [17, 18].

The current situation highlights the inadequacies of mental health care and shows that paramedics are not adequately trained to effectively protect and care for their well-being. This may be due to the lack of protective psychosocial interventions and the stigmatization of mental illness. There is a perception among many that mental illness is an insult to a person, which may be due to the culture of some societies, institutions and covertly discouraging discussion of mental health.

Dealing with stress during the COVID-19 pandemic requires proactive and intelligent management. As such, those who manage medical staff should both focus on carrying out daily duties, but at the same time be able to sense and respond to the fears and concerns of employees. Their actions could support and maintain harmony among paramedics [19, 20]. Among the most important interventions that should be undertaken immediately are the development of and adherence to guidelines on the most effective practices that would ensure that paramedics have the least possible risk of contracting and spreading COVID.19 In addition, Awais et al. showed that it would be important to update and transparently communicate information about COVID-19 so that paramedic members can make informed decisions about next steps for new and difficult clinical cases. Easy access to mental health services, including screening for a variety of mental disorders and for suicide, also appears to be a key solution, providing a point to which paramedics and other staff could report when their moods deteriorate. Another important step is to encourage health-promoting behavior among employees by providing gym memberships or in organized sports activities. It would be advisable to develop online support programs and online forums so that paramedics can share their emotions, which would have the effect of keeping them motivated to perform and reducing burnout. For unambiguous disorders, such as PTSD, cognitive-behavioral psychological therapy, which is used to treat anxiety disorders and trauma, reducing associated feelings of guilt and shame, would be important. In low-resource countries, it would also be necessary to provide support in the form of personal protective equipment (PPE) supplies, guaranteed to all medical workers working in contact with SARS-CoV-2-infected patients. Organizations should also implement appropriate strategies to encourage paramedics to engage in mental health support by providing adequate compensation and workplace safety and security [19, 21, 22].

In a study conducted on paramedic students by Wild et al. also showed that cognitive therapy is effective in treating PTSD. They developed an intervention to change thinking through appropriate training by focusing on objective details and the sequence of events, and updating the memory of the traumatic event with helpful information that helps reduce recurring PTSD symptoms. In addition, it has been proven, that exposure to trauma or stressful scenarios through visualization reduces anxiety in police officers and other at-risk populations, which is the primary role of cognitive treatment, which includes attention and mindfulness training as a core component [5, 23].

The above activities and methods mentioned could play a key role in reducing the risk of mental disorders in the vulnerable group of paramedics working during the COVID-19 pandemic.

CONCLUSIONS

The COVID-19 pandemic is triggering a global health crisis, negatively affecting the mental state of the public and, most importantly, health care workers. Paramedics are among those who are most exposed to patients infected with SARS-CoV-2, playing a key role in in responding to emergencies and saving people's lives. Due to the risk of infection and the fear of isolation, emergency workers are now even more vulnerable to mental health problems [19]. Therefore, it is important to find effective ways of coping with

stress that could prevent the development of serious complications related to exposure to stressors. Implementing interventions in the form of mental health counseling or social support has been shown to be highly effective. There are a number of other techniques that could prove equally fruitful in the work of emergency responders. However, there is still a lack of research and interventions targeting the specific psychological problems experienced by paramedics during the COVID-19 pandemic.

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