

Resuscitation Care in Out-Of-Hospital Cardiac Arrest: a Survey of the Emergency Medical Services Personnel in the Republic of Crimea

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INTRODUCTION The choice of the ways for optimizing management of out-of-hospital cardiac arrest by emergency medical services (EMS) should be based on the evidence from existing practice of resuscitation care. The study was aimed at evaluating personal experience of cardiopulmonary resuscitation (CPR) performance, timing of last training in resuscitation and level of self-perceived knowledge and skills of CPR among the employees of the EMS of the Republic of Crimea, as well as to assess their beliefs on significance of individual CPR procedures in terms of influence on success of resuscitation and to study their perceptions on factors that may have positive or negative impact on effectiveness of resuscitation care.

MATERIAL AND METHODS An anonymous survey of the EMS personnel of the Republic of Crimea was conducted in July–December 2019. The questionnaire was utilized to collect demographic data, information on experience of conducting CPR for the last year, on a current practice of CPR debriefings and timing of last CPR training. The participants assessed their knowledge and skills of CPR and their perception of influence of early implementation of individual CPR procedures on success of resuscitation on a 5-point Likert scale, and indicated factors, that may limit or enhance the effectiveness of resuscitation.

RESULTS A total of 251 specialist of the EMS participated in the survey, including 63 physicians, 129 feldshers and 4 nurses of ambulance teams, 45 dispatchers and 5 senior officers of the EMS stations, which corresponds to 28.8% of physicians, 13.0% of feldsher/nursing staff and 17.4% of dispatcher specialists of the republic. Percentage of male respondents was 35.5%, mean age — 41.5 years, mean duration of EMS work experience — 15.5 years. The mean declared number of cases of CPR conducted in the last 12 months was 2.2 (range: 0–20), and 23.5% specialists of the ambulance teams have not participated in any CPR attempt over the last year. About 60.2% respondents were trained in CPR within the last year. When compared to other specialists of ambulance teams, feldshers who work alone (without a coworker), were significantly less commonly performing a real-life resuscitation ($p=0.008$) or receiving training in CPR ($p=0.020$). Dispatchers were least covered with resuscitation training (only 33.3% were trained within the last year) and had the lowest level of CPR knowledge and skills. 25.9% of the specialists had an erroneous judgement that early drug administration and/or tracheal intubation have higher influence on success of resuscitation when compared to chest compressions and/or defibrillation. The level of knowledge and skills of CPR depend on the timing of last training ($p<0.001$).

CONCLUSIONS The experience of participation in real-life attempts of CPR is severely limited for considerable part of the EMS employees, and many specialists have not been trained in resuscitation for a long time. The perceptions of the EMS specialists regarding the importance of individual CPR procedures are not always compliant with the statements of current international CPR guidelines. In order to enhance the effectiveness of resuscitation care in the Republic of Crimea, it is advisable to monitor the coverage of the EMS employees with resuscitation training and the rates of their participation in resuscitation attempts, as well as to perform additional targeted training in CPR, in particular, using alternative methods of education.

Keywords: cardiac arrest, cardiopulmonary resuscitation, CPR, emergency medical services, EMS, first aid, training, knowledge, skills

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CPR - Cardiopulmonary Resuscitation

EMS emergency medical service

ERC - European Resuscitation Council, Interdisciplinary Resuscitation and Emergency Medicine Council

ODD - operational dispatch department

OHCA - out-of-hospital cardiac arrest

SD - standard deviation

INTRODUCTION

Reducing mortality in out-of-hospital cardiac arrest (OHCA) is one of the most important public health problems [1, 2], which requires complex transformations aimed at improving the efficiency of the functioning of first aid and emergency medical care (EMS) systems [3, 4]. In Russia, OHCA is characterized by a high frequency of occurrence and extremely low chances of a favorable outcome [5–8], which indicates the need for urgent improvement in this area. In turn, identifying priority optimization pathways requires a clear understanding of existing organizational approaches and practices for providing resuscitation care in OHCA.

Foreign experience indicates that the age of training in cardiopulmonary resuscitation (CPR) and the experience of carrying out resuscitation measures in the daily work of EMS specialists can influence the practical skills of CPR and, ultimately, act as factors that determine the chances of survival of OHCA patients [9]. Understanding the relevant trends in EMS work at the regional level can help to find the ways to improve.

In addition, the components of the modern CPR complex, including chest compressions, electrical defibrillation, airway management, mechanical ventilation and drug administration, have varying efficacy, including in relation to the effect on the survival of victims with cardiac arrest [10, 11].

Accordingly, the success of resuscitation may depend on the correct choice and the correct sequence of CPR procedures performed by emergency specialists. Appropriate prioritization is particularly important in out-of-hospital resuscitation, where the number of people involved in a resuscitation attempt is often limited to one or two EMS providers. Therefore, in order to make a reasonable choice of measures to optimize prehospital care, it is advisable to study the awareness of EMS specialists about the modern basic principles of CPR.

The purpose of this study was to survey the perception of the EMS staff of the Republic of Crimea about the existing practice of providing resuscitation care in OHCA, assessing the duration of CPR training, determining the level of CPR knowledge and skills based on self-assessment data, as well as the trends in optimizing EMS in the region based on the results obtained. Additionally, the opinion of EMS employees on the priority of individual components of the resuscitation complex and the specialists' perceptions of the factors that impede and contribute to successful resuscitation in OHCA were studied.

MATERIAL AND METHODS

In the period from July to December 2019, an anonymous survey of the employees of the EMS of the Republic of Crimea was conducted. Given the voluntary nature of participation in the survey, the sample was formed based on the availability of respondents.

Information letters with a proposal to take part in the survey, a brief explanation of the purpose of the survey and the attached questionnaire forms were e-mailed by the Crimean Republican Center for Disaster Medicine and Emergency Medical Aid (hereinafter - the Center) to the Heads of EMS Stations of the Republic of Crimea. Completed paper questionnaires were returned to the Center. Additionally, a survey was conducted of EMS employees who were trained at the Center as part of advanced training courses.

QUESTIONNAIRE FORM

The questionnaire of 17 items was developed by the authors for self-completion by respondents. The initial block of the questionnaire included questions about the position, place of work (urban/rural), EMS team staff, CPR experience in the last 12 months (including the number of successful resuscitations and the number of resuscitation cases by OHCA witnesses), and CPR case review practices (debriefing). The next group of questions assessed the respondent's opinion about the factors that impede successful resuscitation and those that can increase its efficacy (multiple choice questions with the ability to give an independent answer and a request to indicate the main factor), and also offered to assess the impact of early implementation of certain procedures of the resuscitation complex on the success of CPR, using a five-point scale. (from 1 - "does not affect at all" to 5 - "very strongly affects"). The third block of the questionnaire was intended for self-assessment on a five-point scale of general CPR knowledge and skills (from 1 - "I don't know anything / I don't have any skills" to 5 - "very good knowledge / I have perfect skills"), as well as knowledge of the current Guidelines of the European Resuscitation Council, ERC-2015, [11, 12]. "General CPR knowledge" is defined as the totality of respondents' ideas about the principles of basic and extended CPR, accumulated as a result of educational and cognitive activities within the framework of basic and additional professional medical education and self-study. The final block of the questionnaire included questions about the age of the last CPR training, work experience in EMS, age and gender of the respondent.

Before the start of the study, the content of the questionnaire was studied by a group of experts - doctors specializing in Emergency Medicine and Anesthesiology-Critical Care, followed by a number of changes to ensure clarity of understanding and correct wording. Given the voluntary nature of the survey, no consent was collected for participation. Completion of the questionnaire served as confirmation of consent.

STATISTICAL ANALYSIS

Along with descriptive statistics methods, the following nonparametric methods were used: chi-square test and Fisher's exact test for statistical comparison of qualitative variables, and Mann-Whitney U-test test for statistical comparison of quantitative variables. To measure the association between nominal variables the Cramér's V or phi coefficient was used. The Kolmogorov-Smirnov test was used to assess the agreement of the sample distribution to the normal distribution law. Differences were considered statistically significant at $p < 0.05$. For statistical calculations, the IBM SPSS Statistics 23.0 software package (IBM Corporation, USA) was used.

RESULTS

GENERAL CHARACTERISTICS OF THE SAMPLE

The survey involved 251 EMS employees, including 63 ambulance physicians (25.1% of respondents, including 1 resuscitation [advanced life support=ALS] team doctor), 129 feldshers (51.4%, including 3 resuscitation [ALS] feldshers), 5 EMS station senior officers (2.0%), 45 employees of Operational Dispatch Departments (ODD, 17.9%) and 4 nurses (1.6%). Five employees (2.0%) did not indicate their position.

Regarding the total contingent of EMS staff of the Republic of Crimea (as of November 2019) the following data are available: 236 doctors, 1021 mid-level EMS providers, 258 ODD employees; the survey covered 28.8% of doctors, 13.0% of mid-level medical staff, and 17.4% of ODD staff.

General characteristics of the study sample are presented in Table 1.

Table 1

Social and demographic and professional data of survey participants (n=251)

Parameters	n (%)
Gender	
male	89 (35.5)
female	157 (62.5)
non-responders	5 (2.0)
Age (years)	
19–29	54 (21.5)
30–39	62 (24.7)
40–49	52 (20.7)
50–59	46 (18.3)
60 and older	30 (12.0)
non-responders	7 (2.8)
Position	
EMS station Chief/Manager	5 (2.0)
Ambulance team doctor	62 (24.7)
Resuscitation [ALS] team doctor	1 (0.4)
Ambulance feldsher	126 (50.2)
Resuscitation [ALS] team feldsher	3 (1.2)
Ambulance nurse	4 (1.6)
ODD staff	45 (17.9)
Non-responders	5 (2.0)
Length of service in EMS (years)	
0–4	52 (20.7)
5–9	41 (16.3)
10–19	61 (24.3)
20–29	49 (19.5)
30 and over	41 (16.3)
non-responders	7 (2.8)
The ambulance team staff	
doctor and feldsher	86 (34.3)
one feldsher	71 (28.3)
two feldshers	24 (9.6)
other staff*	12 (4.8)
interchangeable staff	11 (4.4)
non-responders	2 (0.8)
not applicable (ODD staff)	45 (17.9)
Place of work	
urban	117 (46.6)
rural	22 (8.8)
both	67 (26.7)
non-applicable (ODD personnel)	45 (17.9)

Notes: *for example, a doctor and a nurse, a feldsher and a nurse, one doctor.

EMS: emergency medical services; ODD: operational dispatch department

The mean age of the respondents was 41.5 years (standard deviation (SD) = 13.7, median 40, range: 19–78), the mean length of service in EMS 15.5 years (SD = 11.4, median 13, range less than 1–48).

PRACTICE OF PROVIDING RESUSCITATION CARE (ADVANCED LIFE SUPPORT)

The study design did not include responses from ODD staff to relevant questions.

The mean number of CPR cases reported by EMS staff over the past 12 months was 2.2 (SD = 2.5, median 2, range 0–20).

During a year, 23.5% (46 of 196) of the ambulance team staff never participated in CPR. This parameter made up 7.9% (5 of 63) among doctors, 31.0% (40 of 129) among mid-level medical staff. Over the previous year, there were no significant differences in gender, age, the length of service in EMS, the area served (urban/rural) between the EMS staff

who participated and did not participate in CPR ($p > 0.05$). The share of EMS staff who reported no CPR practice over the previous year varied significantly depending on the team staff: 36.2% for a one-flasher ambulance team, 17.4% for a two-feldsher team, 14.0% for the team staffed by doctor and feldsher, 31.8% for other or varied staff teams ($p = 0.008$, Cramer's $V = 0.242$).

The average number of successful CPRs reported by ambulance teams over the past 12 months was 0.4 (SD = 0.8, median 0, range 0–6), which corresponded to 18.2% of the mean number of attempted CPRs. Absent cases of successful resuscitation for the year was reported by 67.9% (133 of 196) of the staff. The absence or presence of successful CPR cases in the past 12 months is not related to gender, age, length of service in EMS or the area served ($p > 0.05$). Ambulance team staff working independently (one feldsher) reported significantly fewer cases of successful resuscitation per year (22.9%, $n = 16$ of 70) than ambulance staff working in pairs (38.5%, $n = 42$ of 109; $p = 0.029$, $\phi = 0.163$).

The mean reported number of CPR cases was significantly higher for male specialists (2.6 versus 1.9 for women, $p = 0.037$), while the average number of successful CPR cases did not differ significantly depending on the gender of the respondents ($r = 0.55$ versus 0.35, respectively; $p = 0.195$).

According to the respondents, the number of cases in the last 12 months when witnesses performed CPR before the arrival of the EMS team to the victim ranged from 0 to 10, averaging 0.4 (SD = 1.0, median - 0); 72.4% (142 out of 196) of ambulance teams reported that they had never seen such cases in the previous year.

Among the ambulance teams, 49.5% (97 of 196) indicated that they were involved in the analysis of all cases of CPR performed by their ambulance team, 22.4% (44 out of 196) reported that only some cases were discussed, 25.5% (50 out of 196) answered that such an analysis was never carried out (5 non-responders; 2.6%).

Only one of the five interviewed managing officers of the EMS stations reported of CPR performance for the previous 12 months (one unsuccessful CPR).

TIME SINCE THE LAST CPR TRAINING

Among the respondents, 22.7% ($n = 57$) reported that the last time they took full-time CPR training was less than 6 months ago, for 37.5% ($n = 94$) the time elapsed since training was from 6 months to 1 year, for 27.1% ($n = 68$) it was 1–5 years, 7.2% ($n = 18$) passed the training course more than 5 years ago, 1.6% ($n = 4$) indicated “I don't remember” (there were 10 non-responders; 4.0%).

No more than a year ago, 66.7% ($n = 42$) of doctors and 63.6% ($n = 82$) of feldshers of ambulance teams were trained in resuscitation, but only 33.3% ($n = 15$) of ODD staff.

The specialists trained in resuscitation within the previous year were significantly younger (39.4 years versus 44.6 years in the group of those trained more than 1 year ago, $p = 0.003$) and had less experience in EMS (14.4 years versus 17.8 years, $p = 0.010$).

Among the employees of ambulance teams working independently (one feldsher), the number of trained personnel within the previous year was significantly lower (60.0%, $n = 42$) than among specialists working in pairs (76.4%, $n = 81$; $p = 0.020$, $\phi = -0.175$).

There was no statistically significant relationship between the time elapsed from the previous of CPR training and the reported total number of CPR attempts made in the previous year, the number of successful CPRs, or place of work (urban / rural) ($p > 0.05$).

Three of five EMS station managing officers interviewed were trained in resuscitation within the past 12 months.

SELF-ASSESSMENT OF CPR KNOWLEDGE AND SKILLS

The distribution of self-assessment parameters of general theoretical CPR knowledge, resuscitation skills, and knowledge of the ERC current CPR guidelines among ambulance doctors, feldshers and ODD staff is shown, respectively, in Fig. 1-3, and in Table. 2.

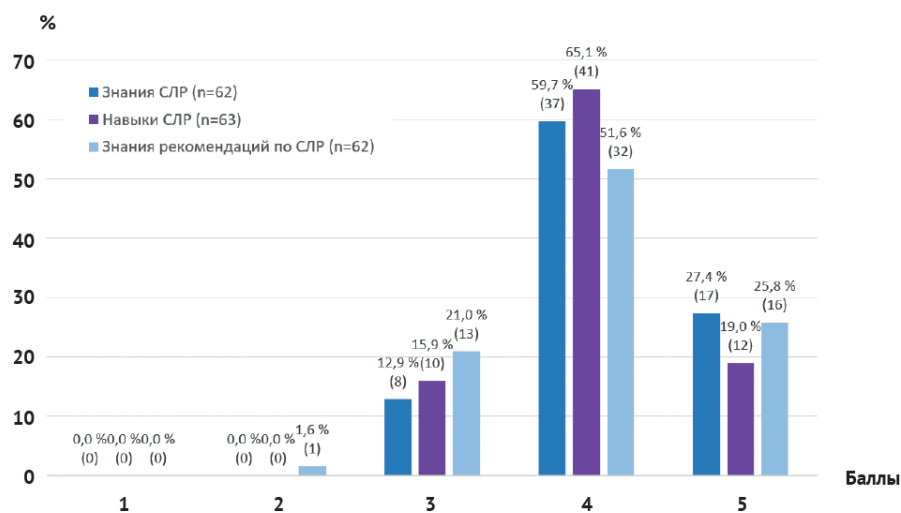


Fig. 1. Results of self-assessment of general knowledge of cardiopulmonary resuscitation (CPR), cardiopulmonary resuscitation skills and knowledge of ERC-2015 cardiopulmonary resuscitation recommendations by doctors of mobile ambulance teams

Scores

- Knowledge of CPR
- CPR skills
- Knowledge of ERC-2015 CPR Guidelines

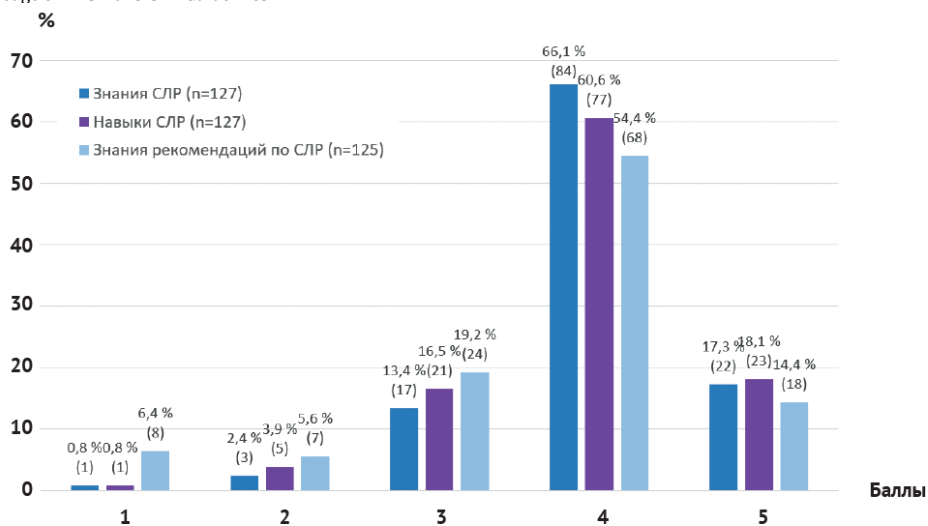


Fig. 2. Results of self-assessment of general knowledge of cardiopulmonary resuscitation (CPR), cardiopulmonary resuscitation skills, and knowledge of ERC-2015 cardiopulmonary resuscitation recommendations by paramedics of mobile emergency medical teams

Scores

- Knowledge of CPR
- CPR skills
- Knowledge of ERC-2015 CPR Guidelines

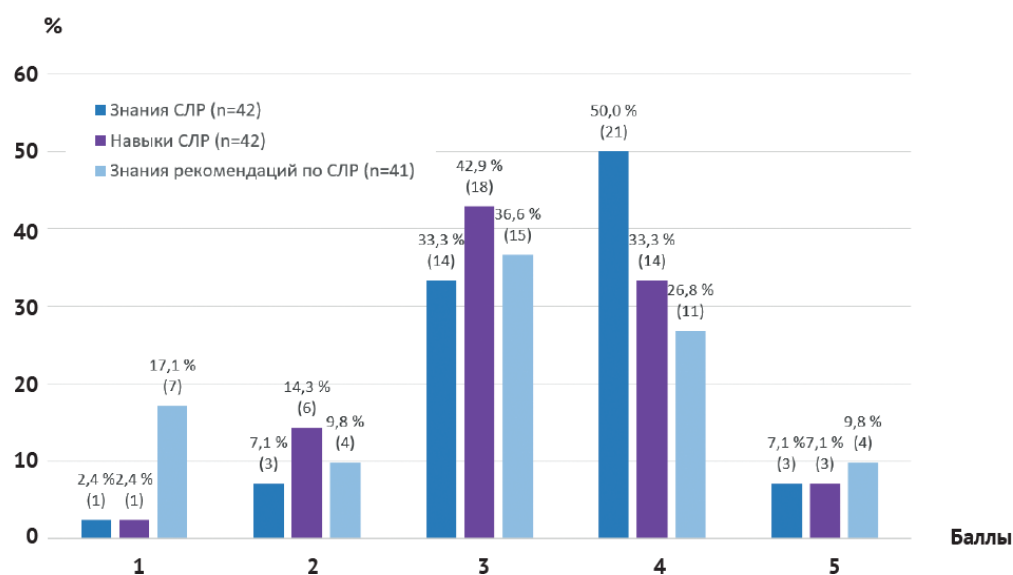


Fig. 3. Self-assessment results of general knowledge of cardiopulmonary resuscitation (CPR), cardiopulmonary resuscitation skills, and knowledge of ERC-2015 cardiopulmonary resuscitation guidelines for emergency room personnel

Scores

- Knowledge of CPR
- CPR skills
- Knowledge of ERC-2015 CPR Guidelines

Table 2

Distribution of self-assessment indicators of general knowledge on cardiopulmonary resuscitation, cardiopulmonary resuscitation skills and knowledge of ERC-2015 resuscitation recommendations depending on the position

Parameters	Doctors of ambulance teams	Feldshers of ambulance teams	ODD staff
Mean assessment of CPR general knowledge (SD)	4.1 (0.6)	4.0 (0.7)	3.5 (0.8)
The share of staff reported of the knowledge level above average (4-5 points), %	87.1	83.5	57.1
Mean assessment of the level of knowledge of the current CPR guidelines (SD)	4.0 (0.7)	3.6 (1.0)	3.0 (1.2)
The share of staff who reported of the knowledge level above average (4-5 points),%	77.4	68.8	36.6
Mean assessment of CPR skills (SD)	4.0 (0.6)	3.9 (0.8)	3.3 (0.9)
The share of staff who reported on the level of proficiency in skills above average (4-5 points),%	84.1	78.7	40.5

Notes: CPR — cardiopulmonary resuscitation, SD — standard deviation

Both the level of CPR knowledge in general and the level of knowledge of the ERC-2015 guidelines were not related to gender, age, length of service, place of work (city / countryside) or the team staff ($p > 0.05$).

The level of CPR skills did not co-related with gender, place of work, or team staff ($p > 0.05$), but co-related with the age ($p = 0.005$, Cramer's $V = 0.181$) and EMS experience ($p = 0.008$, Cramer's $V = 0.189$). The parameters and percentage of the staff who assessed their qualifications above the average level (4-5 points) were distributed with regard to age as follows: 64.8% of those aged 19-29 years old, 83.9% of the aged 30-39 years old, 74.5% of the aged 40-49 years old, 71.1% of the aged 50-59 years old, 66.7% of the aged 60 years and older; with regard to the length of service: 65.4% of those working for 0-4 years, 67.5% of the staff working for 5-9 years, 82.0% of those working in EMS for 10-19 years, 79.6% of those working in EMS for 20-29 years, and 65.9% of those working for 30 years and longer.

There was no statistically significant relationship between general CPR knowledge or CPR skill proficiency and the experience with at least one CPR participation in the last year ($p > 0.05$). However, the level of knowledge of the current CPR guidelines turned out to co-relate with participation in CPR ($p < 0.001$, Cramer's $V = 0.321$): the percentage of respondents who reported a level of knowledge of the CPR guidelines above average (4-5 points) was 66.7% among those who had no practice CPR for the previous 12 months, and 72.7% among those who participated in CPR.

A statistically significant co-relation was confirmed between the time since the last CPR training and the level of general knowledge according to self-assessment data ($p < 0.001$, Cramer's $V = 0.289$). The percentage of people who rated their knowledge above the average level among the EMS staff trained in CPR within the previous 12 months was 87.4%, compared to 68.9% among the staff employees who were trained more than 1 year ago. The same relationship was found for the level of knowledge of CPR guidelines (73.6% versus 54.4%, respectively; $p = 0.002$, Cramer's $V = 0.271$) and the level of proficiency in resuscitation skills (81.5% versus 61.1%; $p < 0.001$, Cramer's $V = 0.296$).

Four of the five interviewed manager officers of EMS stations rated their knowledge of CPR above average; three rated their knowledge of the current ERC-2015 CPR guidelines above average, and 2 rated their CPR skills above average.

THE IMPACT OF THE RESUSCITATION COMPONENTS ON THE CARE RESULTS

The results of the assessment by different groups of EMS staff of the effect of early performance of various CPR components on the success of resuscitation are shown in Fig. 4 and 5.

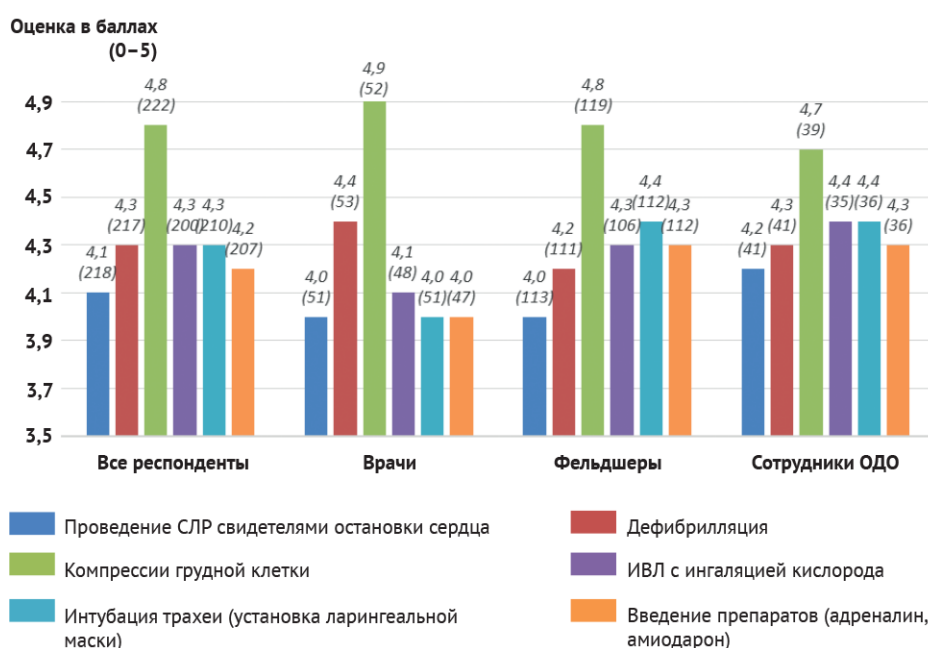


Fig. 4. Scoring the impact of early implementation of individual procedures in the complex of cardiopulmonary resuscitation on the success of resuscitation
Notes: the number of experts who provided the corresponding assessment is given in brackets. MLV — mechanical lung ventilation; ODD — operational dispatch department; CPR — Cardiopulmonary Resuscitation

Assessment score

All respondents; Doctors; Feldshers; ODD staff

CPR performed by a cardiac arrest witness

Chest compression

Tracheal intubation (laryngeal mask)

Defibrillation

MLV with O₂ inhalation

Drug administration (epinephrine, amiodarone)



Fig. 5. Percentage of respondents who gave the maximum score (5 points) to individual components of the cardiopulmonary resuscitation complex
Notes: MLV — mechanical lung ventilation; ODD — operational dispatch department; CPR — Cardiopulmonary Resuscitation

All respondents; Doctors; Feldshers; ODD staff

CPR performed by a cardiac arrest witness

Defibrillation

Chest compression

MLV with O2 inhalation

Tracheal intubation (laryngeal mask)

Drug administration (epinephrine, amiodarone)

According to 25.9% (n = 65) of the survey participants, early drug administration and/or tracheal intubation (laryngeal mask placement) have a greater impact on the success of resuscitation than early defibrillation and/or chest compression, which contradicts the current perceptions of CPR priorities (insufficient data for assessment 14.3%; n = 36) [11]. This figure was 20.6% (13 of 63) for ambulance doctors, 27.1% (35 of 129) for paramedics, and 26.7% (12 out of 45) for ODD staff.

There was no statistically significant relationship with factors such as gender, age, EMS experience, team staff (single feldsher or paired work), area served (urban or rural), number of CPRs undertaken and number of successful CPRs over the past 12 months, the practice of discussing all CPR cases with the participation of team members, the time since the last CPR training and the level of knowledge and skills of CPR according to self-assessment data. There was a tendency towards a higher frequency of incorrect prioritization with a lower declared level of knowledge of the current ERC guidelines (p = 0.081, Cramer's V = 0.199): among the staff employees who identified priorities incorrectly, the proportion of respondents who indicated the level of guidelines knowledge as below average (1–2 points), amounted to 23.4% in contrast to 8.9% among the rest of the respondents.

The EMS station managers who answered this question (n = 4) gave the highest score (5 points) to the items of providing assistance by the witnesses of the cardiac arrest and chest compressions. Two of them misidentified the priorities of resuscitation measures.

FACTORS HINDERING SUCCESSFUL RESUSCITATION

The number of hindrances to successful CPR indicated by respondents varied from 0 to 11 (average 2.7, median 2). Seven (2.8%) survey participants did not indicate a single obstacle. The distribution of answers to the corresponding question is presented in Table. 3.

Table 3

Number and percentage (%) of respondents who indicated difficulties of successful resuscitation

Answer variants	All respondents (n=251)	Doctors(n=63)	Feldshers (n=129)	ODD staff (n=45)	EMS station managers(n=5)
Delayed call for care from citizens	145 (57.8)	37 (58.7)	69 (53.5)	31 (68.9)	3 (60.0)
Cardiac arrest eyewitnesses do not perform CPR until EMS arrives	123 (49.0)	37 (58.7)	52 (40.3)	27 (60.0)	2 (40.0)
Delayed arrival of the EMS team to the site (traffic jams, lack of vacant ambulance team, etc.)	117 (46.6)	28 (44.4)	55 (42.6)	27 (60.0)	2 (40.0)
Lack of knowledge and skills among EMS staff	26 (10.4)	2 (3.2)	15 (11.6)	9 (20.0)	0 (0.0)
Lack of clear algorithm/standard for CPR measures	8 (3.2)	1 (1.6)	4 (3.1)	3 (6.7)	0 (0.0)
Insufficient supply of EMS equipment/medicines	15 (6.0)	1 (1.6)	9 (7.0)	4 (8.9)	0 (0.0)
Resuscitation by one specialist	112 (44.6)	14 (22.2)	66 (51.2)	29 (64.4)	2 (40.0)
Lack of well-coordinated team work	19 (7.6)	3 (4.8)	11 (8.5)	5 (11.1)	0 (0.0)
Insufficient motivation of EMS staff to conduct a quality CPR	18 (7.2)	7 (11.1)	10 (7.8)	1 (2.2)	0 (0.0)
EMS staff overloaded/overworked	46 (18.3)	10 (15.9)	28 (21.7)	6 (13.3)	0 (0.0)
The presence/actions of relatives and other eyewitnesses at the time of rendering care	35 (13.9)	12 (19.0)	14 (10.9)	6 (13.3)	0 (0.0)
Other *	2 (0.8)	2 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)

Notes: * — severe chronic disease. CPR — cardiopulmonary resuscitation; EMS — emergency medical services; ODD — operational dispatch department

The main hindrance to successful CPR was emphasized by 56.6% (n = 142) of survey participants (Fig. 6).



Fig. 6. Distribution of factors hindering successful resuscitation, which were identified by respondents as the main ones (n=142)

Notes: Distribution of factors hindering successful resuscitation, which were identified by respondents as the main ones (n=142)

Delayed call for care from citizens

Heart failure eyewitnesses do not perform CPR until EMS arrives

Delayed arrival of the EMS team to the site

Lack of knowledge and skills among EMS staff

Insufficient supply of EMS equipment/medicines

Resuscitation by one specialist

Lack of well-coordinated team work

EMS staff overloaded/overworked

The analysis of contingency tables showed that the choice of the key obstacles to successful resuscitation was associated with several factors. Thus, the choice of the insufficient participation of eyewitnesses in providing assistance as the main obstacle to successful CPR was associated with an older age of respondents ($p = 0.016$, Cramer's $V = 0.300$), and the choice of the item on resuscitation by one specialist was associated with working in rural areas ($p = 0.026$, Cramer's $V = 0.245$), working without a partner ($p < 0.001$, $\phi = -0.446$), a lower level of CPR skills according to self-esteem ($p = 0.023$, Cramer's $V = 0.328$), and a younger age ($p = 0.007$, Cramer's $V = 0.322$).

FACTORS ABLE TO INCREASE THE RESUSCITATION EFFICIENCY

Survey participants indicated from 0 to 8 factors that could improve the CPR efficiency (mean 2.4, median 2). No factor was indicated by seven (2.8%) respondents. The distribution of answers to this question is presented in Table 4.

Table 4

Number and proportion (%) of respondents who indicated factors that can increase the effectiveness of resuscitation

Answer variants	All respondents (n=251)	Doctors (n=63)	Feldshers (n=129)	ODD staff (n=45)	EMS station managers (n=5)
CPR skills training for the population	153 (61.0)	42 (66.7)	70 (54.3)	33 (73.3)	2 (40.0)
Placement of defibrillators in public places for eyewitness use	39 (15.5)	14 (22.2)	15 (11.6)	5 (11.1)	2 (40.0)
Setting eyewitnesses liable for non-rendering care	27 (10.8)	7 (11.1)	14 (10.9)	4 (8.9)	1 (20.0)
Providing legal protection for eyewitnesses who provide assistance	38 (15.1)	8 (12.7)	13 (10.1)	11 (24.4)	1 (20.0)
Additional training for EMS staff	61 (24.3)	18 (28.6)	32 (24.8)	9 (20.0)	0 (0.0)
Increasing the number of available EMS teams	158 (62.9)	32 (50.8)	88 (68.2)	30 (66.7)	2 (40.0)
Rewarding EMS staff for a successful CPR	56 (22.3)	12 (19.0)	27 (20.9)	13 (28.9)	2 (40.0)
Providing legal protection for EMS employees	68 (27.1)	19 (30.2)	29 (22.5)	13 (28.9)	2 (40.0)
Improving the quality assurance of CPR by EMS staff	8 (3.2)	0 (0.0)	2 (1.6)	6 (13.3)	0 (0.0)
Other *	4 (1.6)	1 (1.6)	2 (1.6)	0 (0.0)	1 (20.0)

Notes: * — ensuring the staffing of the ambulance teams with employees. CPR — cardiopulmonary resuscitation; EMS — emergency medical services; ODD — operational dispatch department

Among respondents, 53.4% (n=134) indicated a key factor that, in their opinion, can increase the efficacy of resuscitation care (Fig. 7).

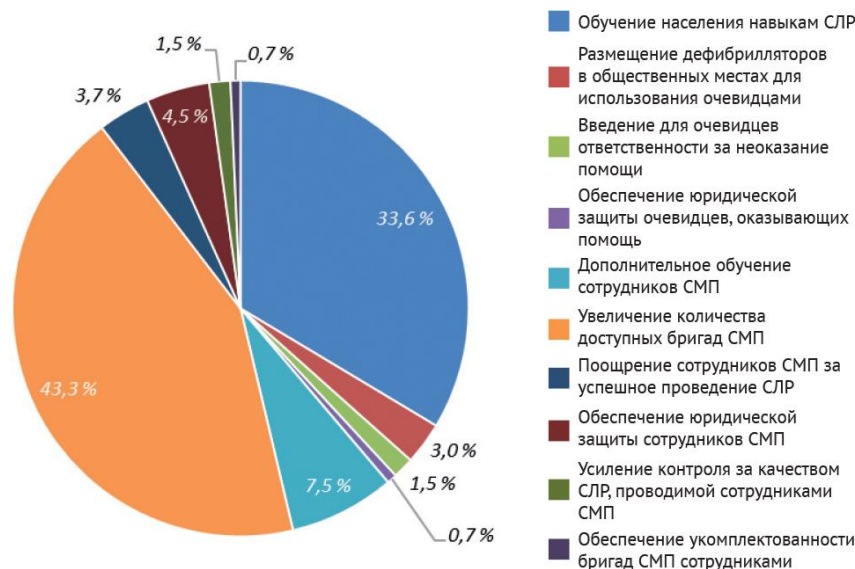


Fig. 7. Distribution of factors that can increase the effectiveness of resuscitation, which were identified by the respondents as the main (n=134)

Notes: CPR — cardiopulmonary resuscitation; EMS — emergency medical services

CPR skills training for the population

Placement of defibrillators in public places for eyewitness use

Setting eyewitnesses liable for non-rendering care

Providing legal protection for eyewitnesses who provide assistance

Additional training for EMS staff

Increase in the number of available EMS teams

Rewarding EMS staff for a successful CPR

Providing legal protection for EMS employees

Improving the quality assurance of CPR by EMS staff

Ensuring the staffing of teams with employees

The choice of the item on increasing the number of available EMS teams as a key factor that respondents believe can improve the efficacy of care was associated with working without a partner ($p < 0.001$, $\phi = -0.352$) and a lower level of resuscitation skills according to self-reported data ($p = 0.020$, Cramer's $V = 0.267$).

DISCUSSION

As can be seen from the data provided, almost a quarter of the surveyed employees of EMS ambulance teams did not participate in CPR over the past year. Feldshers who work without partners have the least practice in resuscitation and are less likely to report a successful CPR outcome.

Insufficient experience in performing CPR in the daily activities of EMS specialists can have a negative impact on the level of proficiency in resuscitation skills, the quality of care, and the survival rate of victims with OHCA [9, 13, 14]. According to foreign studies of the practice of resuscitation care by feldshers, the average number of CPR cases per specialist per year varies from 2.1 [14] to 9.4 [15]. The comparatively low rate recorded in this study (2.2) indicates the need for additional training of EMS employees in order to maintain CPR skills. In order to identify specialists with the least daily experience of CPR and to train them specifically, it is advisable to continuously monitor the participation of EMS employees in resuscitation activities [14].

The rate of successful resuscitation reported by EMS specialists was higher than that established in the recent epidemiological analysis of OHCA cases with CPR [16]. If the share of successful CPR cases according to the survey data averaged 18%, then, according to the primary EMS documentation, the frequency of cases of spontaneous blood circulation restoration in OHCA in the Republic of Crimea does not exceed 7% [16].

The rare participation of OHCA witnesses in providing care is consistent with the results of previous epidemiological and sociological studies in the Crimean population [16, 17], as well as with data from other native studies in Russia [18, 19].

Approximately half of the ambulance team staff reported that CPR cases were either not always reviewed directly with their ambulance teams or such reviews were not conducted at all. At the same time, the international resuscitation community recommends conducting debriefings after CPR, since this practice contributes to improving the efficacy of resuscitation and positively affects the outcome of cardiac arrest [20].

Just over 60% of the EMS employees surveyed had last completed CPR training within the previous 12 months, and at least 7% had been trained for more than 5 years. Older specialists, employees who have more experience in EMS, and feldshers who work without a partner are more likely to have a long time elapsed from their training. EMS specialists are the more confident in their own CPR knowledge and skills, the shorter was the time elapsed since their previous CPR training.

International experience shows that regular CPR training with a frequency of once a year or less is not enough to maintain appropriate skills [20]. Therefore, more frequent training is recommended for professionals who are highly likely to render care for cardiac arrest in their daily practice, including EMS employees [20].

For the system of additional professional education of medical professionals, including EMS specialists operating in the Russian Federation, a mandatory periodic CPR training is not regulated by law. The qualification requirements for EMS specialists provide for "professional advanced training at least once every 5 years during the entire working life" [21, 22]. At the same time, the content of training in additional professional education programs is independently determined by educational organizations that implement their corresponding program [23], which can not exclude the lack or insufficient extent of CPR training.

According to this study result, the greatest deficit in CPR training was observed in the group of ODD staff, of whom two-thirds were trained in resuscitation more than a year ago. Compared to doctors and feldshers of ambulance teams, dispatchers showed the lowest level of knowledge and proficiency in CPR.

In accordance with the concept of the "chain of survival" [12], the EMS dispatcher plays a key role in ensuring the integrity of the process, speed and quality of pre-hospital care in OHCA. The dispatcher's tasks include early detection of cardiac arrest based on data provided by a witness over the phone, instructing OHCA eyewitnesses to perform basic resuscitation and early defibrillation prior to the arrival of EMS, and effectively coordinating appropriate EMS resources to implement advanced resuscitation measures as soon as possible [12]. The crucial role of dispatcher requires regular CPR training, including special training in remote first aid support at OHCA [24].

To increase the availability of resuscitation training, it is considered appropriate to use alternative training methods, including blended learning, which involves complete or partial replacement of full-time theoretical training with independent distance learning of the material [20, 24]. As effective as traditional classroom training, this approach reduces the duration of face-to-face training, reduces the burden on instructors, and reduces the cost of training [24, 25].

A number of studies indicate that the practical implementation of international CPR guidelines provides an increase in survival in cardiac arrest [26-28]. According to our data, the level of knowledge of the current ERC2015 ERC guidelines [11, 12] is generally low among EMS staff. Approximately 12% of professionals (29 of 242 respondents) reported a lack or minimal level of relevant knowledge. At the same time, it was found that a higher frequency of resuscitation is associated with a higher level of knowledge of international recommendations.

There are few Russian original studies devoted to the issues of training and practice of resuscitation care by EMS employees, and methodological differences do not allow direct comparison of the published data with the results of this study.

T. P. Mishina et al. (2009) in a small group of EMS doctors (n=18) evaluated basic CPR skills on a dummy and recorded objective parameters of resuscitation quality. The share of specialists with unsatisfactory assessment results was 33.3% before practical training and 11.1% after training in practical skills [29]. Insufficient satisfaction with the quality of training at advanced training courses, primarily due to the lack of practical training, was demonstrated by a survey of secondary medical personnel at EMS stations in St. Petersburg [30]. Permsky Kray Territorial Center for Disaster Medicine reports on a number of indicators of the resuscitation efficacy parameters by EMS staff, including finding a point for chest compression from the 1st attempt (77%), performance of compression with correct depth (78%) and rate (94%), making proper respiratory movements (76%); it also reported on the implementation of systems of personalized accounting of the effectiveness of training EMS staff, covering more than 86% of the total number of EMS professionals in Perm region [31]. V. I. Barclay and V. Yu. Piously (2002) assessed the level of practical CPR skills in the EMS staff at 1, 2, 3, and 6 months after the initial training and found that in order to maintain resuscitation skills, it was necessary to conduct re-training at least once in two months [32].

According to the current international ERC guidelines [11, 12], CPR procedures that undoubtedly have a positive impact on survival include early basic resuscitation performed after cardiac arrest, continuous high-performance chest compressions, and early defibrillation for ventricular fibrillation or pulse less ventricular tachycardia. The drug administration and the use of advanced methods to ensure airway patency, such as tracheal intubation, are of secondary importance.

In particular, the use of epinephrine increases the probability of restoring spontaneous blood circulation, but does not improve survival rates until discharge from the hospital [33, 34]. There are no data from randomized controlled trials indicating a positive effect of tracheal intubation or other advanced airway patency methods on survival in cardiac arrest [10]. In this regard, the guidelines emphasize that epinephrine administration and tracheal intubation should not interrupt the CPR process (primarily chest compressions) or cause a delay in defibrillation [11].

The survey results have shown that the overwhelming majority of EMS specialists in the Republic of Crimea consider chest compressions to be a priority early CPR procedure, which corresponds to current science-based ideas [11].

At the same time, it is noted that the importance of early implementation of various resuscitation components has been variously assessed depending on the position of EMS employees. Unlike ambulance team doctors, feldshers and ODD staff consider early drug administration, tracheal intubation, or mechanical ventilation with oxygen inhalation to be just as important or more important than performing defibrillation.

More than a quarter of the specialists surveyed mistakenly believed that the drug administration and/or ensuring airway patency by using an endotracheal tube or laryngeal mask have a higher priority than early defibrillation and/or chest compressions.

A relatively low overall assessment of the importance of early electrical defibrillation may indicate a lack of knowledge of current international CPR guidelines. In addition, specialists who incorrectly identified resuscitation priorities were almost three times more likely to evaluate their own knowledge of the current ERC Guidelines below the average level. In general, this indicates the need for appropriate optimization of professional training programs for EMS employees in the Region.

Currently, the priorities of the CPR complex components are not regulated in the RF legal regulations. The current procedure for rendering EMS provides for the use of medical care standards, and the only standard that currently applies to cases of OHCA is the "EMS Standard for sudden cardiac death", approved by the Healthcare Ministry of the Russian Federation in 2012 [35]. This standard is a list of diagnostic and therapeutic procedures and medications for helping with cardiac arrest, which in many respects does not comply with modern international guidelines on CPR (for example, the lack of methods for ensuring airway patency, the presence of a non-recommended endotracheal route of drug administration) [11].

To improve the efficacy of resuscitation care at the Federal level, it is important to develop unified clinical guidelines for care in cardiac arrest and new standards for OHCA care that comply with international guidelines, including provisions that determine the priority and stage of undertaking the resuscitation procedures based on available resources (for example, the number of specialists involved in resuscitation attempts, the equipment of the EMS team).

According to the survey, among the key obstacles to successful resuscitation, EMS staff, in particular, include the fact that people are delayed in seeking for medical care, and witnesses of cardiac arrest do not attempt resuscitation until the EMS team arrives to the victim. These factors correspond to the two initial links of the generally accepted concept of the "survival chain", according to which the early recognition of the problem and calling for help, as well as early initiation and implementation of basic CPR by OHCA witnesses, are crucial for saving lives [12].

High-quality instructing in basic CPR contributes to an increased number of people who are ready to help with OHCA [36]. The surveyed EMS specialists identified instructing in CPR as one of the most important factors determining the resuscitation efficacy. Respondents pointed out much less often such factors as the introduction of liability for witnesses of an incident for failure to provide assistance and provision of the legal protection for eyewitnesses.

Among the obstacles to successful CPR performance by EMS, there were delayed arrival of EMS teams to site and the resuscitation by one specialist, which is consistent with the known problems of the EMS service organization and functioning in the Russian Federation, including insufficient staffing of ambulance teams [4, 37]. Respondents most often pointed to the increase in the number of available teams as the main factor that can improve the resuscitation efficacy.

EMS employees who are less confident in their own CPR skills and work independently (without a partner) were significantly more likely to point out CPR by a single specialist as the main obstacle to successful resuscitation and expressed the opinion that increasing the number of available EMS teams is the main factor affecting the efficacy of care.

Meanwhile, only 10% of respondents indicated that the lack of knowledge and skills in ambulance personnel is an obstacle to successful CPR, while 24% believed that additional training of EMS specialists could improve the efficacy of rendering care in cardiac arrest. The percentage of ODD staff who identified a lack of knowledge and skills as a limiting factor in resuscitation success was 6 and 2 times higher than that recorded for doctors and feldshers, respectively.

More than 20% of respondents believe that the result of resuscitation can be improved if EMS employees are rewarded for successful CPR implementation and if the legal protection of specialists is guaranteed. However, the vast majority did not believe that measures such as placement of defibrillators in public areas, as well as an increased control over the quality of CPR performed by the employees EMS, may be a way to promote the improvement of the resuscitation results, which in general indicates a lack of awareness of specialists about modern approaches to organizing care for OHCA [12, 20].

The search for domestic studies that would assess the perception of EMS employees about the importance of individual CPR complex components and factors affecting the efficacy of resuscitation did not bring results. A number of foreign studies aimed at the assessment of CPR skills of medical care providers in simulation experiments indicate a tendency to a decreased correctness in reproducing the sequence (i.e., maintaining priorities) of resuscitation measures over time after training [38-41]. In the present study, the statistically significant relationship between the incorrect prioritization and the time since the last CPR training has not been confirmed.

The small number of manager staff of EMS stations who wanted to participate in the survey did not give us the opportunity to draw general conclusions for this category of employees. At the same time, it is shown that among the managers surveyed, 80% had no experience in performing CPR in the previous year, and for 40%, the previous CPR training took place over a year ago. Some of them had a wrong idea about the priority of resuscitation procedures.

LIMITATIONS

This paper describes the understanding of EMS specialists about the existing practice and organization of rendering care for OHCA. The study is exploratory in nature, and the subjective assessment presented in it may not correspond to the true state of affairs in the region, which determines the appropriateness of further research, including an objective assessment of the care efficacy parameters and the readiness of specialists to render care for OHCA.

The study sample size is limited to EMS employees who wished to complete the questionnaire. Although the sample size formed is not representative of the entire cohort of EMS specialists in the Republic of Crimea, it is assumed that voluntary and anonymous participation made it possible to ensure the reliability of the answers to the questions posed, as well as the scientific and practical significance of the results obtained.

The design of this study excluded the possibility of conducting an objective assessment of EMS employees' knowledge of CPR issues. Further research aimed at determining the true level of knowledge and proficiency in resuscitation skills will allow us to identify defects in training and optimize existing training programs for EMS specialists.

When assessing the effect of individual CPR procedures on the success of resuscitation, some respondents may have been based on their own clinical experience rather than on generally accepted science-based concepts, and this may have confounded the study results.

CONCLUSIONS

1. A large number of the emergency medical service employees of the Republic of Crimea have little experience of participating in cardiopulmonary resuscitation in their daily practice and have not been trained in resuscitation for a long time, which generally reduces the potential of the emergency medical service in terms of rendering high-quality medical care for out-of-hospital cardiac arrest. The staff least involved in cardiac arrest care and least covered by cardiopulmonary resuscitation training are feldshers working without partners and the staff of operational dispatch departments. The ideas about the priorities in the cardiopulmonary resuscitation components among emergency medical personnel do not always agree with current international guidelines.

2. In order to improve the resuscitation care efficiency and increase the survival rate for out-of-hospital cardiac arrest in the region, the following areas of optimization of the emergency medical service of the Republic of Crimea are considered appropriate: 1) organization of constant objective monitoring of the coverage of emergency medical personnel with training in cardiopulmonary resuscitation and the frequency of their participation in resuscitation activities; 2) according to the monitoring results, the optimization of training programs and the conduct of targeted training of emergency medical personnel on the theoretical foundations and skills of cardiopulmonary resuscitation in accordance with the current international guidelines; 3) the implementation of alternative teaching technologies into the process of training specialists (for example, methods of blended distance learning) in order to increase the availability of training in cardiopulmonary resuscitation; 4) the introduction of a mandatory practice of discussing all cases of cardiopulmonary resuscitation with the participation of staff who performed resuscitation procedures.

5. The approval at the level of the Russian Federation of regulatory provisions that determine the frequency, content and form of training in cardiopulmonary resuscitation for health professionals and citizens, as well as the adoption at the Federal regulatory level of the hierarchy of priorities in resuscitation complex components may improve the quality of care in out-hospital cardiac arrest and reduce mortality rates of the population.

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