



# Analysis of the Emergency Medical Service Call Centre Actions in Patients with Cardiac Arrest

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## Abstract

**Background/Aim:** Cardiac arrest (CA) is a leading cause of mortality in the last forty years worldwide. Immediately initiated cardiopulmonary resuscitation (CPR) improves chances for survival. Aim of this study was to determine the efficiency of the Emergency medical service (EMS) dispatch centre in the absence of the uniform emergency medical dispatch assessment protocols in the management of cardiac arrest.

**Methods:** The retrospective and observational study was conducted in Institute for Emergency Medical Service Novi Sad (IEMS Novi Sad) Serbia during a one-year follow-up. The study included patients with out-of-hospital cardiac arrests who underwent CPR.

**Results:** EMS teams of the IEMS Novi Sad had 198 CPRs in the follow-up period. In 142 (71.72 %) calls, the EMS dispatcher got information that the patient was unconscious. The reported reaction time I by the dispatchers for the unconscious patients was  $1.37 \pm 1.27$  minutes, actual duration of the conversation between the dispatcher and a caller – was longer:  $138.21 \pm 103.02$  seconds ( $p < 0.001$ ). The average conversation time with a caller was  $61.37 \pm 31.13$  seconds. In 6 (4.22 %) cases, the EMS team was dispatched to a patient before the phone call was terminated. At the moment of arrival, all patients were unconscious, 194 (94.37 %) were pulseless, while the remaining 8 (5.63 %) experienced cardiac arrest during the examination. The cardiac arrest was witnessed by a layman in 120 (84.51 %) cases and CPR was initiated by bystanders, before the arrival of the EMS team, only in 13 (10.83 %) patients. Twenty-seven (19.01 %) patients arrived in a hospital with vital signs.

**Conclusion:** The absence of the uniform EMS dispatch assessment protocols for the triage of incoming calls and phone assisted CPR for lay rescuers decreases the survival rate of patients with cardiac arrest.

**Key words:** Emergency medical service; Dispatcher; Out-of-hospital cardiac arrest; Cardiopulmonary resuscitation; Telephone CPR.

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## Introduction

Cardiac arrest (CA) is defined as a cessation of normal circulation of blood due to failure of the heart to contract effectively during the systole. CA

manifests with loss of consciousness, abnormal or absent breathing and pulselessness. CA occurs at home or in the public places and it is usually

witnessed by laymen. Appropriate, fast intervention by laymen and medical teams significantly increases chance of survival of patients with CA.<sup>1</sup>

Timely treatment of CA improves chances for survival up to three times.<sup>2,3</sup> Delay of cardiopulmonary resuscitation (CPR) measures increases mortality by 10 to 12 % per minute. On the other hand, if CPR measures are undertaken promptly, mortality increases by 3 to 4 % per minute until the defibrillation is delivered.<sup>4</sup>

Emergency Medical Service Call Centre (EMS Call Centre) occupies an important place in the pre-hospital treatment of patients with CA. Operators in the EMS Call Centre are the first responders in such conditions and their timely and adequate reaction may affect the outcome, both by instructing the laymen to start CPR until the arrival of emergency medical staff as well as by assigning such calls as first priorities.<sup>5</sup>

The aim of this study was to determine the efficiency of the EMS Call Centre in dealing with patients with CA in the absence of the standard questioning protocol.

## Methods

The study was retrospective and observational. It was conducted in the Institute for Emergency Medical Service Novi Sad (IEMS Novi Sad), in the one-year period.

The IEMS Novi Sad covers the municipalities of Novi Sad and Sremski Karlovci with 389,130 inhabitants.<sup>6</sup> It is the only health institution capable for prehospital dealing with medical urgencies in this territory. It consists of ambulance squads in each working shift, with a doctor, emergency medical technician and ambulance driver. Every ambulance squad has identical equipment and staff are trained to deliver advanced life support (ALS) measures and to treat urgent medical conditions. In addition to this, there are non-urgent transportation squads, consisting of an emergency medical technician and an ambulance driver.

A doctor and an emergency medical technician work 12-hour shifts in the EMS Call Centre, answer the calls for the medical emergencies and non-urgent patient transport and dispatch the ambulance squads.

The patients enrolled into this study were those with CA recognised by a layman. Data were collected from the recorded conversations data basis in the EMS Call Centre and from the official records written by the Call Centre personnel. Collected data included:

- reaction time I - a period between the moments when the priority I call is answered and when the ambulance squad is dispatched, reported by operators in minutes and measured in seconds from the recorded phone calls
- duration of a phone call, measured in seconds
- reaction time II - a period between the moment when the ambulance squad is dispatched and their arrival to the patient, measured in minutes
- information about a witness of CA
- information about sending the ambulance squad before the phone call is terminated
- information about phone assisted CPR
- initial rhythm on the cardiac monitoring
- information about the return of spontaneous circulation (ROSC) and its maintenance until the arrival to the hospital.

Data were stored in the specially created database. All the data were calculated by using a statistic package SPSS 11. Statistical significance was determined by using Student t-test and  $\chi^2$  test. Influence of a particular factor on the outcome was determined by using univariate logistic regression analysis.

## Results

In the one year, there were 198 prehospital CPRs in the territory covered by IEMS Novi Sad. In most cases, they were witnessed by a layman (Table 1) ( $\chi^2 = 154.758$ ,  $p < 0.001$ ). In 142 cases (71.72 %), EMS Call Centre operator was informed that a patient was unconscious ( $\chi^2 = 39.510$ ,  $p < 0.001$ ). After this information was obtained, the operator asked if the patient breathed in 36 (25.35 %) cases. The patient did not breathe in 30 cases (21.13 %) and was pulseless in 3 cases (2.11 %). In another 3 cases (2.11 %), the operator said to caller that it was necessary to undertake CPR.

Reaction time I, reported by the operators, was 1.37 minutes ( $SD \pm 1.27$ , min 0, max 11, Me 1). On the other hand, the average reaction time I, measured from the recorded phone calls, was a bit longer: 138.21 seconds ( $SD \pm 103.02$ , min 16, max

840, Me 120) ( $t = -5.177$ ,  $p < 0.001$ ). Average phone call duration was 61.37 seconds ( $SD \pm 31.13$ , min 10, max 193, Me 54). In six cases (4.22 %), the urgent ambulance squad was dispatched before the phone call was terminated.

Average reaction time II was 7.18 minutes ( $SD \pm 3.87$ , min 2, max 24, Me 6). All patients were unconscious at the moment of arrival of the ambulance squad, 134 patients (94.37 %) were pulseless, and the remaining 8 patients (5.63 %) experienced cardiac arrest in the presence of the ambulance squad.

**Table 1:** Witnesses of sudden cardiac arrest in relation to the total number of cardiopulmonary resuscitations (CPRs)

CPR witnessed by	N	%
Laymen	148	74.75
Ambulance squad	33	16.67
Health professionals	17	8.58
Total	198	100.00

N: number of patients;

**Table 2:** Witnesses of sudden cardiac arrest and immediately initiated cardiopulmonary resuscitation (CPR)

CPR witnessed by	N	%	CPR	%	p
Laymen	84.51	74.75	13	10.83	$p < 0.001$
Ambulance squad	5.63	16.67	8	100.00	$p = 0.285$
Health professionals	9.86	8.58	9	64.29	$p < 0.001$
Total	100.00	100.00	30	21.13	

N: number of patients;

**Table 3:** Univariate binary logistic regression analysis of predictors determining the early survival (until the hospital admission)

Predictors	OR	95 % CI	p
Reaction time I reported by EMS			
Call Centre operators <sup>1</sup>	1.532	0.721-3.255	0.267
Recorded reaction time I <sup>2</sup>	1.002	0.997-1.006	0.511
Duration of phone calls <sup>3</sup>	1.020	1.001-1.038	0.035
Reaction time II <sup>4</sup>	1.064	0.942-1.203	0.318
Witnessed CA	0.719	0.394-1.313	0.283
Initial cardiac rhythm	2.896	1.383-6.066	0.005
Immediately initiated CPR	3.474	1.396-8.646	0.007
Phone-assisted CPR	0.460	0.040-5.269	0.532

CPR: cardiopulmonary resuscitation; CA: cardiac arrest; EMS: emergency medical service;

Univariate binary logistic regression analysis determines the significance of particular predictors on establishing and maintaining return of spontaneous circulation until the hospital admission.

**Odds Ratio (OR)** - probability of establishing return of spontaneous circulation in a patient with CA and its maintenance to the hospital admission, depending on the presence or absence of a particular predictor.

<sup>1</sup> period of time between the phone call reporting CA and dispatching the ambulance, measured in minutes by EMS Call Centre operators.

<sup>2</sup> period of time between the phone call reporting CA and dispatching the ambulance, measured in seconds, based on the recorded time.

<sup>3</sup> duration of phone calls reporting CA, measured in seconds.

<sup>4</sup> period of time between dispatching the ambulance and its arrival to the patient with CA, measured in minutes.

CA was in most cases witnessed by a layman and CPR measures were initiated before the arrival of the ambulance squad in small number of patients (Table 2). Automatised external defibrillator (AED) was used in one patient (0.70 %). In 3 patients (2.11 %), EMS Call Centre operator gave instructions how to start CPR before the arrival of the ambulance.

The initial cardiac rhythm was non-shockable (pulseless electrical activity or asystole) in 27 patients (19.01 %), while shockable rhythm (ventricular fibrillation or pulseless ventricular tachycardia) was present in 55 patients (38.73 %).

At the hospital admission, ROSC was maintained in 27 patients (19.01 %). The immediate survival was determined by three variables: phone call duration, initial cardiac rhythm and immediately attempted CPR (Table 3).

## Discussion

CA is a leading cause of mortality in the last forty years worldwide.<sup>7</sup> It is experienced by approximately 700,000 people in Europe and 400,000 people in USA every year.<sup>8,9</sup> Prehospital survival of patients with CA is very low and is greatly determined by immediately initiated CPR by CA witnesses.<sup>10</sup> Immediately initiated CPR improves the chances for the initial shockable rhythm, thus improving chances for survival.<sup>11,12</sup> Besides, quality of life is better in CA patients with immediately initiated CPR.<sup>13</sup>

If EMS Call Centre operator asks adequate questions, recognition rate of CA by laymen could rise up to 83 %.<sup>14</sup> Reaction time I for the priority I calls should be less than one minute.<sup>15</sup> After the recognition of CA, the operator should dispatch the ambulance squad without terminating the phone call and also give instructions how to initiate CPR before the arrival of ambulance.<sup>16</sup> In this study, more than 70 % of callers recognised the unresponsiveness. When asked if the patient breathed, all the callers gave correct answer. However, operators asked that question in about 25 % of cases. Another problem was that operators measure reaction time I in minutes, taking into consideration the period between the moments they wrote entry for a new patient and dispatched the ambulance squad. The reported reac-

tion time I is therefore longer than it should be and even the recorded reaction time I is longer than two minutes. There was no standard questioning protocol with adequate questioning techniques in the critical problems, so the EMS operators dealt with the callers according to their best knowledge and experience. This resulted in longer duration of phone calls and omission of relevant information in some cases. The operator usually terminated the phone call in order to dispatch the ambulance squad, which lengthened the reaction time I. Due to the lack of standard questioning protocol and undermanned EMS personnel, operators are not able to deliver phone assisted CPR, so the duration of calls is shorter than reaction time I.

In most European countries, it takes six minutes on average for the ambulance squad to arrive to the patient with CA.<sup>17,18</sup> If CA is in the presence of witnesses, the initial rhythm is shockable in 75 % of cases. If CA is not witnessed at the moment of collapse, the shockable rhythm is initially present in only 40 % of cases.<sup>19</sup> In this study, reaction time II was over 7 minutes. If reaction times I and II are summed up, it turns out that it took more than 9 minutes for the ambulance squad to arrive to the patient with CA. In the presence of witnesses, the initial rhythm was shockable in only 40 % of patients.

Low incidence of the shockable rhythm could also be attributed to the fact that only small number of witnesses attempted CPR before the arrival of the ambulance squad. The percentage of the laymen initiated CPR ranges from 3 % in the undeveloped countries to 45 % in urban areas, or 16-33 % on average.<sup>19-21</sup> A rise in the laymen initiated CPR was observed in the last 15 years due to the Basic life support (BLS) trainings of the non-medical staff and introduction of standard questioning protocols in EMS Call Centres. This study showed that CPR was most often witnessed by a layman and that CPR was initiated before the arrival of the medical staff on every tenth patient. Number of phone-guided CPRs was negligible. All these facts attributed to the small number of initial presentation with shockable rhythm.

It is well known that initiated CPR in patients with CA improves the chances for survival by two or three times. It also improves the probability of finding the patient in the initial shockable rhythm, with the survival rate which is doubly higher than in those with non-shockable rhythm.<sup>2, 3, 19</sup>

Univariate binary logistic regression analysis showed that the survival rate was determined not by the presence of witnesses, but by the attempted CPR. Immediately initiated CPR improves the chances for ROSC to be established and sustained to the hospital admission. However, small rate of patients with immediately initiated CPR attributed to the small survival rate of patients with out-of-hospital CA.

Most studies in the world literature did not take into consideration the period between the collapse and the phone call to the EMS. Most data regarding this period are taken to be unreliable due to the emotional stress on the part of the witnesses. Most witnesses claim that they called EMS in the first minute after the collapse.<sup>11</sup> The same result is found in this study as well.

ERC Guidelines for Resuscitation 2010 recommend the prehospital use of therapeutic hypothermia in comatose survivors of CA.<sup>22, 23</sup> In Serbia, therapeutic hypothermia is currently applied only in the tertiary medical centres. For this reason, IEMS Novi Sad cannot apply this method pre-hospitally.

A drawback of this study is its limitation to the prehospital level. Data regarding the short-term survival (from the admission to the discharge from the hospital) and neurological evaluation of patients after CA were not included.

## Conclusion

CA is one of the most urgent medical conditions and reaction time I should be lower than one minute. EMS operators should quickly interrogate callers with strict protocols to elicit information, focusing on the recognition of unresponsiveness and the quality of breathing. The ambulance squad should be dispatched without terminating the phone call and a protocol for CA should be started. In order to achieve this, standard questioning protocols and up-to-date information technologies in the EMS Call Centres are necessary, as well as regular training of EMS operators in encouraging witnesses to initiate CPR. Work in the modern EMS Call Centre also necessitates employment of the new personnel.

## Ethics Approval

This study was conducted with the approval of the Institute for Emergency Medical Service Novi Sad Ethics Committee.

## Acknowledgements

None.

## Conflict of interest

None.

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