

## РОЛЬ ДИСТАНЦИОННОЙ ПЕРЕДАЧИ ЭЛЕКТРОКАРДИОГРАММЫ В МАРШРУТИЗАЦИИ МЕДИЦИНСКОЙ ЭВАКУАЦИИ ПАЦИЕНТОВ

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**Резюме.** Цель исследования – изучить в субъектах Российской Федерации (субъекты) влияние внедрения дистанционной передачи электрокардиограммы (ЭКГ) на принятие решений сотрудниками бригад скорой медицинской помощи (СМП) о госпитализации пациента в профильную медицинскую организацию.

**Материалы и методы исследования.** Материалы исследования получены из 37 субъектов. В процессе исследования сопоставлялись данные, характеризующие работу медицинских специалистов бригад СМП за год до и на следующий год после внедрения в субъекте дистанционной передачи ЭКГ для бригад скорой медицинской помощи.

**Результаты исследования и их анализ.** Использование дистанционных систем передачи, анализа и хранения ЭКГ обеспечивает увеличение количества госпитализаций в профильные лечебные медицинские организации (ЛМО) пациентов с острым коронарным синдромом (ОКС), что позволяет своевременно провести необходимые лечебные мероприятия в стационарных условиях.

**Ключевые слова:** бригады скорой медицинской помощи, дистанционная передача, маршрутизация, медицинская эвакуация, острый инфаркт миокарда, пациенты, субъекты Российской Федерации, электрокардиограмма

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## THE ROLE OF DISTANCE ECHOCARDIOGRAPHY DELIVERY IN PATIENT'S MEDICAL EVACUATION ROUTING

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**Summary.** Investigation purpose – to research in the subjects of the Russian Federation (subjects) an impact of introduction of distance echocardiography (ECG) delivery on ambulance crew decision-making on patient hospitalization to profiled hospitals.

**Materials and methods of the investigation.** Investigation materials have been got from 37 subjects. During the investigation a data which characterize work of ambulance crew medical specialists a year before and a year after an introduction of distance ECG delivery for ambulance crews in the subject were compared.

**Investigation results and their analysis.** A usage of ECG distance delivery and analysis technologies provides an increase of number of hospitalizations to profiled medical treatment organizations of patients with acute coronary syndrome which allow to provide necessary treatment measures in stationary conditions promptly.

**Key words:** acute myocardial infarct, ambulance crew, distance delivery, electrocardiography, medical evacuation, patients, routing, subjects of the Russian Federation

**Conflict of interest.** The authors declare no conflict of interest

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Cardiovascular diseases (CVDs) continue to be one of the leading causes of mortality and disability at working age [1]. Annually in the world 16.7 million people die from CVDs, including 7.4 million from coronary heart disease (CHD) [2]. The main cause of CHD mortality is acute coronary syndrome (ACS) [3, 4]. In Russia, an average of 520 thousand cases of ACS are registered annually, the total number of which includes myocardial infarction (MI) and unstable angina (UA) of 36.4% and 63.6%, respectively [5]. The outcome of ACS largely depends on the timely diagnosis, the scope of therapeutic measures, tactical decisions of emergency medical teams (EMT) staff, as well as on the capabilities of the hospital where the patient was delivered [6]. In the domestic health care system, ambulance crews are staffed by paramedics and physicians who have received the necessary training and are able to make a decision on the need to hospitalize the patient [7].

Within the framework of algorithms for emergency medical care in the profile "Acute coronary syndrome", the leading method of investigation in the pre-hospital period remains registration of 12-channel electrocardiogram — ECG [8]. Correctness and timing of its interpretation are the most important factors in determining the further routing of the patient<sup>1</sup>.

Development of computer technologies, creation of a variety of medical equipment for remote transmission and remote analysis of ECG can help medical specialists of emergency medical teams to decide in the pre-hospital period of the ambulance to hospitalize a patient in a primary vascular unit (PVU) or a regional vascular center (RVC) with the possibility of specialized treatment of ACS [9]. The relevance of the considered problem became more acute due to the pandemic of a new coronavirus infection, when the use of a paper carrier was associated with the risk of contact spread of infection [10].

**The aim of the study** was to assess the influence of remote ECG transmission in the subjects of the Russian Federation (hereinafter referred to as subjects) on the decision-making by the staff of emergency medical teams to hospitalize patients in specialized medical treatment organizations (LMOs).

**Materials and methods of the study.** Based on the data provided by 37 subjects, we studied the impact of the introduction of remote ECG transmission on the provision of medical care to patients with acute myocardial infarction. We compared data from Table 2350, 4, subsection III, section "Activity of a medical organization in providing medical care in outpatient settings" of Form No. 30 "Information about a medical organization", obtained for the year before and the year following the introduction of remote ECG transmission for teams in the subject. If remote ECG transmission was not possible, the data for 2019 and 2020 were compared. Statistical analysis was performed using Student's t-test for related and unrelated populations.

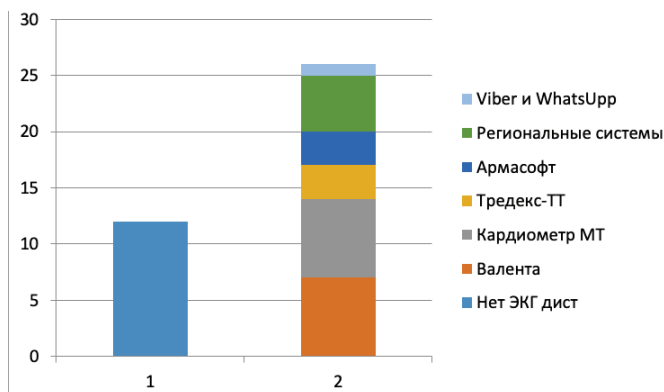
**Results of the study and their analysis.** One or another method of ECG transmission was used in 25 of 37 subjects. The most frequently used telemedicine complex "Valenta" and KFS-01.001 "Cardiometer-MT" — each of these systems was available in 28% of the subjects; three subjects reported using the system "Complex Medical Diagnostic

Telemetry Transtelephone Tredex"; three reported using the software "ArMaSoft-12-Cardio"; five subjects used different regional systems, including transmission of anonymized ECG via messengers WhatsApp and Viber (one case). The remaining 12 subjects did not have the ability to transmit data in real time (Figure).

When assessing the data it was decided to rely not on absolute values, since the population of the subjects, peculiarities of their infrastructure and transport accessibility are different, but on the frequency of one or another event in patients with AMI: performing thrombolysis, death during medical evacuation, ensuring proper routing. In our opinion, the key criterion for the effectiveness of implementation of remote ECG transmission and its analysis by an experienced medical specialist is the role of this factor in the set of others when deciding on the address of further medical evacuation of the patient. As we know, there is an extensive network of medical organizations in the subjects, where a patient with acute coronary syndrome should receive appropriate treatment within the established time limits. In case of incorrect routing, the patient may be deprived of such an opportunity. Thus, the importance of ECG examination as one of the few instrumental methods available in the prehospital period of emergency medical care cannot be overestimated when making a decision. The results of the study showed that provision of remote ECG examination by an experienced specialist in the subject allowed a significant increase in the proportion of patients hospitalized in specialized medical organizations within a year (table).

Some decrease in the rate of thrombolysis was, in our opinion, due to ensuring timely routing of patients requiring coronary interventions to medical organizations. During the COVID-19 pandemic that took place during the study period, excess mortality was observed in all subjects of the Russian Federation, including an increase in the number of fatalities in patients in ambulances [11]. The analysis showed that in the subjects where remote ECG transmission was implemented, the frequency of fatal outcomes in the ambulance did not increase significantly, in contrast to the subjects where this possibility was not implemented and the staff of the ECG teams had no opportunity to receive assistance from a cardiologist when providing emergency medical care.

This confirms the importance of using different options for ECG transmission to make the right logistical decisions.



**Рисунок.** Распределение субъектов по их оснащенности дистанционной передачей ЭКГ; 1 – субъекты без возможности передачи ЭКГ; 2 – субъекты с возможностью передачи ЭКГ

**Figure.** Distribution of subjects according to presence of facilities for distance electro cardiography (ECG) delivery; 1 – subjects without these facilities; 2 – subjects with these facilities

<sup>1</sup> On approval of the order of emergency, including specialized emergency medical care: Order of the Ministry of Health of Russia from 20.06.2013 № 388-н

**Сравнение субъектов с возможностью и без возможности дистанционной передачи ЭКГ**  
Comparison of subjects with and subjects without facilities of distance ECG delivery

Субъект Российской Федерации Subject of the Russian Federation		Частота события в общем числе пациентов с ОИМ Frequency of the occasion among total quantity of patients with acute myocardial infarction		
		тромболизис thrombolysis	смерть в машине СМП death in ambulance truck	госпитализация в ПСО/ПЦ hospitalization into PVU / RVS
С возможностью дистанционной передачи ЭКГ / With facilities of distance ECG delivery, n=25	До ее внедрения Before its implementation	0,113±0,015	0,0051±0,0007	<b>0,77±0,042</b>
	После ее внедрения After its implementation	0,111±0,014	0,0062±0,001	<b>0,87±0,022*</b>
Без возможности дистанционной передачи ЭКГ / Without facilities of distance ECG delivery, n=12	2019 г.	0,118±0,023	<b>0,0053±0,0009</b>	0,86±0,032
	2020 г.	0,105±0,013	<b>0,008±0,0009*</b>	0,84±0,039

Примечание. ЭКГ –электрокардиограмма; СМП –скорая медицинская помощь; ПСО / ПЦ –первичное сосудистое отделение / региональный сосудистый центр; \* различия достоверны, p<0,005

Note. ECG –electro cardiography; PVU / RVS –primary vessel unit / regional vessel center; \* differences are reliable, p<0,005

For subjects where there are problems with remote transmission of ECG due to communication difficulties, it seems logical to use equipment with built-in intelligent transcription capabilities, which is implemented, for example, in KFS-01.001 "Cardiometer-MT".

### Conclusion

Thus, the use of remote ECG transmission, analysis and storage systems allows to increase hospitalization of patients with acute coronary syndrome in specialized medical treatment organizations for timely implementation of the necessary therapeutic measures in inpatient settings.

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