

## EXPERIENCE OF APPLYING TELEMEDICINE TECHNOLOGIES IN THE WORK OF VORONEZH REGIONAL CLINICAL CENTER FOR DISASTER MEDICINE

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**Abstract.** *The purpose of the study is to determine the role of telecommunication technologies in increasing the efficiency of Voronezh Regional Clinical Center for Disaster Medicine.*

*Materials and methods of research.* The data contained in analytical reports and other documentation of the Center for 2018-2020 in terms of identifying patterns of their change with the introduction of telecommunications technologies were analyzed.

*Results of the study and their analysis.* Introduction of telemedicine technologies in the work of the Center resulted in increase of volume of rendering of medical care by its specialists. The neurosurgeons were the most demanded specialists, who performed telemedical consultations, which is mostly related to the necessity of performing consultations for the doctors of trauma centers of the II and III levels, engaged in treatment of victims of car accidents.

Voronezh Regional Clinical Center for Disaster Medicine plans to further expand the use of telecommunication technologies not only in treating victims of road accidents, but also victims of other man-made and natural emergencies.

**Key words:** *pediatric field hospital, teleconsultations, telemedicine, Voronezh Regional Center of Disaster Medicine*

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

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## ОПЫТ ПРИМЕНЕНИЯ ТЕЛЕМЕДИЦИНСКИХ ТЕХНОЛОГИЙ В РАБОТЕ ВОРОНЕЖСКОГО ОБЛАСТНОГО КЛИНИЧЕСКОГО ЦЕНТРА МЕДИЦИНЫ КАТАСТРОФ

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**Резюме.** *Цель исследования – определить роль телекоммуникационных технологий в повышении эффективности работы Воронежского областного клинического центра медицины катастроф (ТЦМК, Центр).*

*Материалы и методы исследования.* Проанализированы данные, содержащиеся в аналитических справках и другой документации о работе Центра в 2018–2020 гг., в плане выявления закономерностей их изменения в результате внедрения телекоммуникационных технологий.

*Результаты исследования и их анализ.* Внедрение телемедицинских технологий в работу ТЦМК привело к увеличению объема оказания его специалистами регламентируемой медицинской помощи. Наиболее востребованными специалистами, проводившими телемедицинские консультации, были врачи-нейрохирурги, что в значительной степени связано с необходимостью проведения консультаций для врачей травмоцентров II и III уровня, занимающихся лечением пострадавших в дорожно-транспортных происшествиях (ДТП).

В планах работы Воронежского областного клинического центра медицины катастроф – дальнейшее расширение использования телекоммуникационных технологий не только при лечении пострадавших в ДТП, но и в других чрезвычайных ситуациях (ЧС) техногенного и природного характера.

**Ключевые слова:** *Воронежский областной клинический центр медицины катастроф, дорожно-транспортные происшествия, Полевой педиатрический госпиталь ВЦМК «Защита», пострадавшие, телемедицинские консультации, телемедицинские технологии, чрезвычайные ситуации*

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Since the late 1970s the number of man-made and natural disasters in the world has been steadily growing. For example, in a UN report (October 2020), the Office for Disaster Risk Reduction stated that 7,346 large-scale natural disasters occurred between 2000 and 2019. As a result, 4.2 billion people were affected, costing the global economy about \$2.97 trillion [1]. In the Russian Federation 150 man-made emergencies on average occur annually, in which hundreds of people die [2, 3].

In an interview with TASS at the end of 2020, EMERCOM Minister E.N. Zinichev said: "This year, the number of emergencies in our country has increased by 29% compared to last year. At the same time we managed to significantly reduce the number of casualties and fatalities while increasing the number of rescued" [4].

According to the minister, this was possible due to the introduction of information technologies, which makes it possible to predict and to prevent emergencies [4].

While carrying out rescue work in an emergency area, the organization of medical support for victims is of great importance [5-7].

The world experience of introducing telecommunication technologies in the organization of medical support to the population of hard-to-reach areas suggests the importance of this resource in the organization of medical support in various emergency situations [8].

Elimination of medical and sanitary consequences of any emergency situation requires a prompt response from the relevant services to make the right medical and tactical decision and to attract external consultants to strengthen the work of field medical hospitals [9].

The modern level of development of information and communication systems allows a remote dialogue between employees of services of extreme medicine in real time [10].

On August 27, 2001, the concept of development of telemedical technologies in Russia was approved. In accordance with the concept, information support for the work of the units and institutions of the All-Russian Disaster Medicine Service, including consultative support for medical teams in emergency situations, reached a higher level [11].

At present in the field of emergency medicine telemedicine technologies are used in the following ways: rapid transmission of information about the nature and peculiarities of an emergency situation in order to make an objective decision on the specifics of medical and evacuation measures; consultations with leading clinicians to provide medical assistance to rescue workers and doctors working in the foci of an emergency situation; coordination and interaction of specialists from different departments, including those from different countries, on the liquidation of medical and sanitary consequences of emergency situations.

The first telemedical consultations in an emergency situation were performed in 1997 in the framework of the activities of the Disaster Medicine Service of the Russian Ministry of Health during the liquidation of the conse-

quences of the plane crash on a residential area in Irkutsk. The telemedicine consultation was conducted by the Center for Children's Telemedicine. Specialists from the Moscow Research Institute of Pediatrics and Children's Surgery conducted the consultations. The expedience of the newly created Children's Telemedical Center for conducting telemedical consultations by the staff of the leading Children's Research Institute was due to a large number of injured children. There was a children's boarding school at the center of the emergency situation — 14 children died in the plane crash [12].

A new stage in the development of telemedicine within the framework of the All-Russian Disaster Medicine Service began in April 2001, when the Field Pediatric Hospital of the All-Russian Center for Disaster Medicine "Zaschita" was set up in Gudermessky District of the Chechen Republic. In 2001, more than 34,000 outpatients were treated in the hospital, and 2,847 inpatients were treated. Since the healthcare system of the Chechen Republic was destroyed in the early 2000s, the Field Pediatric Hospital replaced the Republican Hospital. Many specialized medical care activities were carried out on its basis [9].

Telemedical consultations were widely used in the work of the hospital. The activity peaked in 2002, when a total of 64 telemedicine consultations were performed on 54 patients, 10 patients being consulted twice. Teleconsultations were performed for 16 clinical areas. Most of the consultations (36) were performed for different traumas and orthopedic disorders — there were 13 patients with orthopedic pathology only. A plastic surgeon consulted 9 patients, a trauma surgeon — 5 patients, and a neurosurgeon — 4 patients. A combustiologist consulted two patients with deep extensive burns. The therapists consulted 19 patients, including a cardiologist for four patients, a medical geneticist for four children with congenital pathologies, and a hematologist for three patients.

The telemedicine consultations resulted not only in the determination and clarification of treatment tactics, but also the medical evacuation of some patients to other medical treatment organizations (four to Moscow, two to Makhachkala, and two to Stavropol).

In an interview (2004), the head of the hospital said: "Equipment with modern diagnostic and therapeutic apparatus is a distinctive feature of our hospital... Children with severe burns were admitted to the hospital. It was possible to save them only by applying modern methods of treatment ... Masha and Ruslan, ten years old, are especially remembered. Their overall treatment plan was coordinated with the head of the Children's Burn Center at Moscow Hospital No. 9, Lyudmila Budkevich, using satellite telemedicine technology... As a result, the young patients returned home practically healthy" [13].

Telemedicine consultations were especially important when physicians "were confronted with a particularly severe course of diseases and traumas or with rare and

little-known congenital diseases. For example, a child is brought in with a suspected blood disorder. There is no hematologist among our doctors. In the hospital you can make an ultrasound, X-ray, general and biochemical blood tests. We collected as much objective information as possible, prepared a package of documents digitally and sent it all for consultation via e-mail. Most often — to the Moscow Research Institute of Pediatrics and Pediatric Surgery" [13].

Doctors at the hospital not only received consultations from leading specialists, but also "often coordinated the transfer of a child to a specialized department. The most complicated ones were sent to Moscow — to the Children's City Hospital No. 9, the Russian Children's Clinical Hospital, and other medical institutions" [13].

High efficiency of using telemedicine technology not only to address some issues of treatment tactics, but also for further hospitalization of patients should be noted.

In recent years, the Voronezh region has paid a lot of attention to the development of telemedicine technologies and their implementation in health care. According to the director of the Medical Information and Analytical Center in Voronezh, "by May 2020, the healthcare department of the Voronezh region had connected 32 regional hospitals, 11 municipal hospitals, and 9 specialized healthcare organizations to the telemedicine consultation system; in total, there are 144 units in the region that have the telemedicine consultation system" [14]. [14]. Since the beginning of the COVID-19 pandemic, the workload of the regional center for telemedicine has increased manifold. According to its head, "since mid-April 2020, the number of consultations via our center with doctors from district hospitals and city medical organizations has more than tripled" [14].

In the Voronezh region, the system of emergency medical care is also undergoing changes, including those associated with the introduction of the latest digital technologies — especially in various emergencies.

The Voronezh Regional Clinical Center of Disaster Medicine (hereinafter referred to as the Center) is a medical organization of a special type. It consists of 3 departments: emergency consultative medical care, medical evacuation, anesthesiology and resuscitation. Such a structure of the Center's medical unit fully meets the tasks it performs. "Narrow" specialists provide specialized emergency medical care; resuscitation physicians provide medical evacuation of patients requiring resuscitation support during transportation (if necessary, they perform anesthesiology aid during operations). 24 hours a day the ambulance doctors provide medical aid to the victims of road accidents in the area of responsibility of the emergency center on the highway M-4 "Don" and ensure interaction with the rescue service — structural subdivision of the institution "Civil defense, population protection and fire safety of the Voronezh region".

**The aim of the research** is to define the role of telecommunication technologies in increasing the performance efficiency of the Voronezh Regional Clinical Center of Disaster Medicine.

**Materials and methods of the research.** The data contained in the analytical reports and other documentation of the Center for 2018-2020 were analyzed in terms of identifying patterns of their change with the introduction of telecommunication technologies in the work of the Center.

**Results of the study and their analysis.** Table 1 presents the main indicators of the Center's work in 2018-2020.

As can be seen from the analysis of data on the work of the Center in 2018-2020, in these years there was a tendency to increase the volume of specialized emergency and ambulance medical care to the population of the Voronezh region. Thus, in 2020 the number of patients who received medical care, taking into account remote telephone consultations, increased by 12.7% compared to 2019. The increase was due to the growth: the number of remote telemedicine consultations — by 53 (9.2%); the number of outreaches by ambulance vehicles — by 624 (31.0%); the number of evacuations — by 1401 (123%).

Data on the provision of medical care by specialists of the Center and by regional medical treatment organizations to patients in district hospitals in 2018-2020.

Resuscitation specialists accounted for the largest proportion (50.4%) of the total number of specialists who performed sanitary tasks in 2020. This is due to an increase in the number of patients, mainly COVID-19 patients, who required resuscitation support during medical evacuations — compared to 2019, the number of visits increased by 6.8%. For the same reason, emergency physicians performed 699 missions in 2020. Endoscopy physicians were very active — they made 174 missions in 2020.

A large number of surgeries were performed by specialists of the Center and regional medical treatment organizations in district hospitals in 2018-2020 (Table 3). (Table 3).

As can be seen from the data in Table 3, the number of surgeries performed by all surgeons in 2020 decreased by 61 compared to 2019. This was due to a decrease in the number of vascular surgeries — vascular surgeons operated on 116 fewer patients in 2020 than in 2019. At the same time, more (by 38) general surgeries were performed. This was due to surgical manipulations in patients with acute gastrointestinal bleeding during therapeutic fibrogastroduodenoscopies. Decrease of operative activity can be related to restrictive measures in connection with the COVID-19 pandemic.

Of all the medical teams at the Center, the neurosurgical team was the most in demand. Its specialists took an active part in providing medical aid to the victims of traffic accidents (Table 4).

As we can see from Table 4, in 2020 the volume of neurosurgical care increased due to the increase of telemedicine consultations (by 53). The total number of consulted patients increased by 47 (5.2%).

Telemedicine consultations for II and III level trauma center physicians are extensively introduced into the Center's practice (Table 5).

The data in Table 5 show the growing demand for telemedicine consultations by neurosurgeons. This seems to be due to the increased attention to solving the problem of medical care for victims of road accidents. These accidents are accompanied by a large number of lethal outcomes as a consequence of craniocerebral injuries.

Thus, the use of telemedicine technology has enabled neurosurgeons to make real-time decisions about the need to travel to regional hospitals to provide emergency medical care to patients or to conduct remote telemedical consultations. For example, in 2020 there were 955 requests to neurosurgeons from district hospitals in Voronezh Oblast

**Основные показатели работы ТЦМК в 2018–2020 гг.**  
Key performance indicators of the territorial disaster medicine center in 2018-2020

Показатель / Indicator	2018	2019	2020
1. Количество обращений об оказании скорой и скорой специализированной медицинской помощи, в т.ч. о проведении медицинской эвакуации, абс. Number of requests for emergency and specialised emergency medical care, including medical evacuation, abs.	3258	4114	4636
1.1. в т.ч. обращений о проведении медицинской эвакуации больных Covid-19 of which requests for medical evacuation of patients Covid-19	–	–	1698
2. Оказана медицинская помощь, чел., всего, из них: Medical care provided, people, total, of which:	3258	4114	4636
2.1. медицинская эвакуация больных Covid-19 medical evacuation of patients with Covid-19	–	–	1698
2.2. консультации по телефону / consultations by phone	780	1263	837
2.3. телемедицинские консультации / telemedicine consultations	536	577	630
2.4. выезды специалистов на санитарном автотранспорте visits of specialists by sanitary vehicles	1951	2014	2638
2.4.1. в том числе для эвакуации больных Covid-19 of which for evacuation of patients Covid-19	–	–	1167
2.5. количество вылетов санитарной авиации, абс. number of air ambulance flights, abs.	291	263	166
3. Количество операций, выполненных специалистами Центра в ЛМО области, абс. / Number of surgeries performed by specialists of the center in regional medical treatment organisations, abs.	448	451	390
4. Количество оперативных пособий, выполненных специалистами Центра в ЛМО области (фиброзофагогастродуоденоскопии, бронхоскопии, колоноскопии), абс. Number of surgical procedures performed by specialists of the center in regional medical treatment organisations (fibroesophagogastroduodenoscopy, bronchoscopy, colonoscopy), abs.	219	212 (179 гастродуоденоскопий; 33 бронхоскопии) / 212 (179 gastroduodenoscopies; 33 bronchoscopies)	174 (4 бронхоскопии; 2 колоноскопии) / 174 (4 bronchoscopies; 2 colonoscopies)
5. Число эвакуированных, чел., из них: / Number of evacuees, people, of them:	1148	1139	2540
5.1. - с острой хирургической патологией / with acute surgical pathology	550	503	338
5.2. - с терапевтической патологией / with therapeutic pathology	517	552	445
5.3. - с Covid-19 / with Covid-19	–	–	1698
5.4. - детей / children	70	64	44
5.5. - с акушерской и гинекологической патологией - with obstetric and gynecological pathology	11	20	15
6. Доставлено в экстренном порядке компонентов крови в ЛМО области, л, из них: Blood components urgently delivered to regional medical treatment organisations, l, of which:	40,8	55,5	45,1
- эритроцитарная масса / red blood cell mass	17,3	28,0	20,6
- свежзамороженная плазма / fresh frozen plasma	23,5	27,5	24,5

Таблица 2 / Table No. 2

**Количество выездов специалистов ТЦМК и областных ЛМО в районные больницы в 2018–2020 гг., абс./ %**  
Number of trips by specialists of the territorial disaster medicine center and regional medical treatment organisations to the regional hospitals in 2018-2020, abs.

Специалисты / Specialists	2018	2019	2020
Анестезиологи-реаниматологи ТЦМК / Anesthesiologists-resuscitators of the territorial disaster medicine center	832/46,5	962/43,6	<b>1337/50,4</b>
Нейрохирурги ТЦМК, ВОДКБ* /Neurosurgeons of center and VRCCH*	130/5,8	171/7,8	<b>163/6,1</b>
Хирурги, кроме нейрохирургов – все областные ЛМО / Surgeons other than neurosurgeons of regional medical treatment organisations	606/26,8	436/19,8	<b>226/8,5</b>
- в т.ч. общие хирурги / including general surgeons	167/7,4	112/5,1	<b>77/2,9</b>
Другие специалисты / Other specialists	474/20,0	636/28,8	<b>928/35</b>
Всего / Total	2242/100,0	2205/100,0	<b>2654/100,0</b>

\* ВОДКБ – Воронежская областная детская клиническая больница / \* VRCCH – Voronezh Regional Children's Clinical Hospital

for emergency consultative medical care. In 163 cases (17.1%) neurosurgeons visited patients, and 137 patients were operated on in 84% of the visits. The number of telemedicine consultations was 630 (66% of the total number of visits). The presented data testify the high efficiency of applying the telemedical technologies in the work of the Center providing the emergency specialized neurosurgical aid to the population of the Voronezh region.

### Conclusion

1. The introduction of telemedical technologies in the work of the Center resulted in the increase of volume of rendering medical care by the specialists of the Center.

2. The neurosurgeons were the most demanded specialists, who performed telemedicine consultations, which is mostly related to the necessity of consultations for II and III level trauma centers doctors, involved in the treatment of the victims of traffic accidents.

Таблица 3 / Table No. 3

**Количество операций, выполненных в районных больницах хирургами ЦЦМК и областных ЛМО в 2018–2020 гг., абс.**  
Number of surgeries performed by specialists of the territorial disaster medicine center and regional medical treatment organisations in the regional hospitals, abs.

Показатель / Indicator	2018	2019	2020
Выполнено операций, всего, из них: Number of surgeries, total, of which:	448	451	<b>390</b>
• нейрохирургами / by neurosurgeons	116	127	<b>137</b>
• другими хирургами, всего, из них: by other surgeons, total, of which:	332	324	<b>253</b>
- общими хирургами - by general surgeons	96	70	<b>118</b>
- травматологами - by traumatologists	26	5	<b>8</b>
- сосудистыми хирургами - by vascular surgeons	186	235	<b>119</b>
- челюстно-лицевыми хирургами - by maxillofacial surgeons	5	3	<b>3</b>
- торакальными хирургами - by thoracic surgeons	7	4	<b>3</b>
- отоларингологами - by otolaryngologists	10	2	<b>1</b>
- урологами / by urologists	–	3	<b>0</b>
- акушерами-гинекологами - by obstetricians-gynecologists	2	2	<b>1</b>

Таблица 4 / Table No. 4

**Характеристика работы специалистов нейрохирургической бригады ЦЦМК в 2018–2020 гг.**  
Characteristics of the work of specialists of the neurosurgical team of the territorial disaster medicine center in 2018-2020

Показатель / Indicator	2018	2019	2020
Количество выездов, абс. / Number of trips, abs.	130	172	<b>163</b>
Количество выполненных операций, абс. / Number of surgeries performed, abs.	116	127	<b>137</b>
Количество консультаций по телефону, абс. / Number of phone consultations, abs.	156	331	<b>325</b>
Количество телемедицинских консультаций, абс. / Number of telemedicine consultations, abs.	536	577	<b>630</b>
Число проконсультированных пациентов, чел. / Number of persons consulted, people	822	908	<b>955</b>

3. The Voronezh Regional Clinical Center for Disaster Medicine plans to further expand the use of telecommunication technologies not only for treatment of victims of road accidents, but also for treatment of victims of other

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Таблица 5 / Table No. 5

**Количество экстренных ТМК, выполненных нейрохирургами Центра для врачей травмоцентров II и III уровня в 2018–2020 гг.**  
Number of emergency telemedicine consultations given by the Center's neurosurgeons for Level II and Level III trauma center doctors in 2018-2020

Лечебная медицинская организация, для врачей которой проведена экстренная ТМК Medical treatment organisation, for doctors of which an emergency telemedicine consultation was given	Количество телемедицинских консультаций, абс. Number of telemedicine consultations, abs.		
	2018	2019	2020
Борисоглебская районная больница (РБ) / Borisoglebskaya District Hospital	101	74	<b>146</b>
Павловская РБ / Pavlovskaya District Hospital	110	158	<b>139</b>
Россошанская РБ / Rossoshanskaya District Hospital	141	104	<b>112</b>
Бобровская РБ / Bobrovskaya District Hospital	44	98	<b>91</b>
Клиническая больница №33 ФМБА России / Clinical Hospital №33 of the Federal Medical and Biological Agency of Russia	76	57	<b>56</b>
Лискинская РБ / Liskinskaya District Hospital	5	45	<b>44</b>
Богучарская РБ / Bogucharskaya District Hospital	20	11	<b>19</b>
Калачеевская РБ / Kalachevskaya District Hospital	32	28	<b>19</b>
Анинская РБ / Anninskaya District Hospital	1	–	<b>2</b>
Таловская РБ / Talovskaya District Hospital	–	–	<b>1</b>
Бутурлиновская РБ / Buturlinovskaya District Hospital	1	1	<b>–</b>
Репьевская РБ / Repyovskaya District Hospital	–	1	<b>–</b>
Каменская РБ / Kamenskaya District Hospital	1	–	<b>–</b>
Семилукская РБ / Semilukskaya District Hospital	1	–	<b>–</b>
Эртильская РБ / Ertliskaya District Hospital	1	–	<b>–</b>
Поворинская РБ / Povorinskaya District Hospital	–	–	<b>1</b>
<b>Всего / Total</b>	<b>536</b>	<b>577</b>	<b>630</b>

emergencies of man-made and natural origin. This includes the expansion of the list of specialists involved in providing emergency medical aid at different stages of medical evacuation.

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