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Original article

CURRENT STATE OF THE PROBLEM OF ORGANIZING AND CONDUCTING MEDICAL EVACUATION OF VICTIMS IN EMERGENCIES

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Abstract. *Relevance of the study.* The increase in the number of natural and man-made emergencies (ChS), terrorist acts, social and armed conflicts leads to an increase in the number of victims and suffered, a shortage of medical personnel, medicines and equipment, and a delay in the provision of medical care in the conditions of failure of medical organizations (LMO).
Each disaster is usually prolonged in nature, poses a danger to the social infrastructure and requires organized medical and evacuation measures.
The relevance of the problem of improving the quality and efficiency of medical care and medical evacuation of victims in ChS is confirmed by the data of state reports "On the state of protection of the population and territories from natural and man-made emergencies..." for 2018-2019.
The purpose of the study is to analyze the organization and conduct of medical evacuation of victims in ChS in modern conditions.
Materials and methods of research. Based on the analysis of experience in organizing and conducting medical evacuation measures in emergencies, analysis of the results of scientific research on various aspects of medical evacuation of patients and victims of natural disasters, man-made accidents, terrorist acts and armed conflicts, materials on the use of digital technologies, and many years of own experience, an information search was conducted for ways to improve the medical evacuation system using technical means.
Research results and their analysis. Based on the experience of eliminating the medical and sanitary consequences of known emergencies, it is shown that insufficient attention was paid to the organization and conduct of medical evacuation of victims, taking into account the principles of routing and creating a three–level system of medical care.
Transfer from the hearth of emergencies to nearby hospitals, the lack of monitoring of victims, unproper routing, lack of medical air transport, weak medico-technical equipment of vehicles, lack of training and a number of other circumstances have led to a growing number of different complications and increased fatality rate among the victims in an emergency.
It is concluded that the organization and conduct of medical evacuation of victims in emergencies require: high – quality application of information technologies that allow predicting routing and monitoring of victims, including using telemedicine systems; development and use of new modular kits and other medical equipment, primarily for sanitary aviation evacuation.

Key words: *emergency situations, medical evacuation measures, medical evacuation, monitoring, routing, sanitary aviation evacuation, sanitary transport, telemedicine*

Conflict of interest. The authors declare no conflict of interest

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Оригинальная статья

СОВРЕМЕННОЕ СОСТОЯНИЕ ПРОБЛЕМЫ ОРГАНИЗАЦИИ И ПРОВЕДЕНИЯ МЕДИЦИНСКОЙ ЭВАКУАЦИИ ПОСТРАДАВШИХ В ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЯХ

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Резюме. *Актуальность исследования.* Рост количества природных и техногенных чрезвычайных ситуаций (ЧС), террористических актов, социальных и вооруженных конфликтов приводит к увеличению числа жертв и пострадавших, дефициту медицинского персонала, медикаментов и оборудования, к задержке оказания медицинской помощи в условиях выхода из строя лечебных медицинских организаций (ЛМО).
Каждая катастрофа носит, как правило, пролонгированный характер, представляет опасность для социальной инфраструктуры и требует организованного проведения лечебно-эвакуационных мероприятий.

Актуальность проблемы повышения качества и эффективности оказания медицинской помощи и проведения медицинской эвакуации пострадавших в ЧС подтверждается данными государственных докладов «О состоянии защиты населения и территорий от ЧС природного и техногенного характера...» за 2018–2019 гг.
Цель исследования – проанализировать организацию и проведение медицинской эвакуации пострадавших в ЧС в современных условиях.
Материалы и методы исследования. На основе анализа опыта организации и проведения лечебно-эвакуационных мероприятий в ЧС, анализа результатов научных исследований различных аспектов медицинской эвакуации больных и пострадавших при стихийных бедствиях, техногенных авариях, террористических актах и в вооруженных конфликтах, материалов по применению цифровых технологий, многолетнего собственного опыта – проведен информационный поиск направлений совершенствования системы медицинской эвакуации с использованием технических средств.
Результаты исследования и их анализ. На примерах опыта ликвидации медико-санитарных последствий известных ЧС показано, что вопросам организации и проведения медицинской эвакуации пострадавших с учетом принципов маршрутизации и создания трехуровневой системы оказания медицинской помощи – уделялось недостаточное внимание.
Доставка из очага ЧС в ближайшие больницы, отсутствие мониторинга пострадавших, несоблюдение должной маршрутизации, недостаток медицинского авиационного транспорта, слабое медико-техническое оснащение транспортных средств, недостаточный уровень подготовки специалистов и ряд других обстоятельств приводили к росту количества различных осложнений и увеличению уровня летальности среди пострадавших в ЧС.
Сделаны выводы, что организация и проведение медицинской эвакуации пострадавших в ЧС требуют: качественного применения информационных технологий, позволяющих прогнозировать маршрутизацию и осуществлять мониторинг пострадавших, в том числе с применением телемедицинских систем; развития и применения новых модульных комплектов и другого медицинского оснащения, в первую очередь – для проведения санитарно-авиационной эвакуации.

Ключевые слова: *лечебно-эвакуационные мероприятия, маршрутизация, медицинская эвакуация, мониторинг, санитарно-авиационная эвакуация, санитарный транспорт, телемедицина, чрезвычайные ситуации*

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The issues of protecting life and preserving health of the population in disasters have a planetary scale, enormous socio-economic significance and deep humanitarian content. To solve it means to ensure the readiness of society, state, structures and systems specially designed for this purpose for a prompt response to emergency situations (ChS).

The world lives in an era of accidents and disasters. Any catastrophe, as a rule, is of a prolonged nature, thus it poses a danger to social infrastructure and requires organization of emergency medical assistance (EMP) and medical evacuation of victims.

Since the beginning of this century, the number of natural emergencies has been growing. For example, in the Philippines, in just 4 months, there were 3 disasters, including an earthquake in October 2013, typhoons in November 2013 and January 2014. Such disasters, as a rule, are accompanied by epidemics, and imply a long recovery of medical and social infrastructure. Since 1990, in the world, the number of people affected by disasters has exceeded 200 million annually. [12].

In addition to natural disasters, the number of man-made disasters is growing. Large industrial enterprises, nuclear power plants, oil and gas pipelines, hydraulic structures, etc are at risk of such emergencies.

A large number of social catastrophes are associated with the movement of refugees, the number of which currently exceeds 65 million people. Practically all of them are deprived of a necessary medical support and are potential sources of epidemics. This trend requires a restructuring of health systems taking into account migration processes, including the development and adjustment of technologies for medical support of migrants, including the provision of EMP, treatment in hospitals and adherence to the principles of routing when planning and conducting medical evacuation [3].

The nature of military and local armed conflicts (LVK) has also undergone a number of significant changes associated with the withdrawal from classical hostilities and the recourse to covert sabotage operations on the home front, to pinpoint strikes against civilian infrastructure, to cyber attacks, to the use of psychological and biological weapons (" hybrid wars "). In this regard, it is necessary to revise and clarify the models and schemes of medical support in military and local armed conflicts, to unite efforts of military and civilian health care in order to provide comprehensive medical care, including timely medical evacuation, to the affected[4, 5].

One of the features of modern crisis situations (CS) is CS caused by terrorist acts, in which, in addition to explosions and taking hostages, radioactive, chemical and biological substances can be used. A number of studies advocate the need to increase the level of preparedness of ambulance brigades (SMP), emergency response teams (BER), specialized medical care teams (BSMP), aviation medical teams (AMBr), medical organizations (LMO) to work in crisis situations, caused by terrorist acts. When eliminating medical and sanitary consequences of emergencies, terrorist acts, military and local armed conflicts, medical evacuation becomes an integral part of the process. Here the principle “which is well organized remains effective” is essential. In this regard, the upcoming trend of different nations to develop international, including civil-military, cooperation (VGS) and to create a system of medical and evacuation support at the national level, is becoming decisive [6, 7].

Thus, to eliminate medical and sanitary consequences of emergencies at the international level, a "temporary" three-level system of medical and evacuation measures is being created,

consisting of various types of International Medical Emergency Response Teams (MMBrChR, EMT) arrived in the emergency area, which corresponds to the ideology of staged medical care that exists in civil health care in most countries of the world. At the same time, it should be noted that up to now the issues of medical evacuation are not represented in the Blue Book of the World Health Organization (WHO) and the issues of medical evacuation are not regulated – the availability and equipment of field, including aviation medical, teams, ambulance vehicles and air transport, routing of medical evacuation of victims.

The heads of EMT of various countries spoke about the need to solve the problems of medical evacuation of victims of emergencies at the international level after analyzing their experience in 2018 in a number of countries: in the Democratic Republic of Congo (Ebola fever); Costa Rica, Ecuador, Argentina, Palestine, Israel (local armed conflicts); Bangladesh (diphtheria outbreak); Indonesia and Papua New Guinea (earthquakes); in the Philippines (typhoon), etc.

Discussions took place within the framework of the Global Meeting to discuss this WHO initiative, which took place on June 12-14, 2019 in Bangkok (Thailand) with the active participation of employees of the All-Russian Center for Disaster Medicine "Zashchita" (VCMK "Zashchita").

As a WHO Collaborating Center, the specialists of VCMK "Zashchita" made a great contribution to the further development of the WHO initiative on the work of EMT. In particular, they were included in the working group on the development of standards for EMT work in the context of military and local armed conflicts at the international level. Proposals of our specialists, including one of the authors of this article, on the organization and routing of medical evacuation of victims are included as a section to the WHO Red Book [8].

It should be emphasized that civil-military cooperation during the elimination of medical and sanitary consequences of various emergencies has its own specific characteristics when organizing medical and evacuation support. In particular, in the organization of medical support for participants in military and local armed conflicts, the issues of attracting specialists from the military medical service to provide medical care to the affected civilian population; of the deployment of special purpose medical units (MOSN) and of military field hospitals; of providing humanitarian aid to residents of territories affected by military operations ("hybrid war") are of particular importance. At the same time, it should be noted that the issues of organizing medical evacuation of civilian victims often are not the subject for discussion on specialized discussion platforms and, as a rule, are not included in cooperation agreements.

As the modern practice of eliminating the consequences of emergencies of a different nature shows, the determining factor in organizing the medical evacuation of the affected civilian population is the creation of a system of medical and evacuation support at the national level in each state.

To date, significant experience has been gathered and analyzed in the organization of medical evacuation in various emergencies. So, for example, when working in the mode of daily activities, it is necessary to assess the readiness of medical forces and means to solve suddenly arising problems, to respond to disasters, terrorist acts, LVK, having specially trained personnel, all the necessary material and technical equipment, being in a state of readiness and mobility.

When eliminating medical and sanitary consequences of emergencies in Russia, medical forces and means were used in cases where there was a need for emergency medical care and medical evacuation. A number of subsequent organizational and clinical decisions, including one on the fulfilment of medical evacuation, were based on the study of the experience of the military medical service during the war in Afghanistan, in the elimination of the consequences of a number of major emergencies, including the earthquake in Armenia (1988), Ulu -Telyakskaya railway accident near the city of Ufa (1989), etc.

Specialists of the military medical service have gained considerable experience in organizing medical evacuation of the wounded and sick in the course of medical and evacuation support for our troops in Afghanistan in 1979-1989. In the prehospital period, the type of transport used for medical evacuation in each specific case mainly depended on the evacuation characteristics of the wounded, on the location of medical units and on a number of other circumstances - the presence of helipads, airfields, etc.

During the hospital period, the wounded and sick who needed long-term treatment in institutions providing specialized medical care were evacuated from the 40th Army to medical institutions of the Turkestan Military District. In addition, medical evacuation was used to unload army hospitals. More than 78 thousand patients were evacuated by air, of which 25.7% were surgical wounded; 74.3% are sick. The wounded with the most complex and severe pathology - damage to the brain and spinal cord, internal organs of the abdominal cavity and chest, fractures of long bones, polytrauma, etc were evacuated.

In fact, when selecting the wounded and sick for medical evacuation, the decision makers adhered to the provisions that were subsequently included in the draft Guidelines for the evacuation of the wounded and sick from the front's hospital bases to the territorial hospitals of the USSR Ministry of Health (TGMZ). There were practically no medical contraindications to inter-hospital evacuation by air, since they were limited to conditions requiring urgent surgical interventions.

Outside the Turkestan Military District in 1980-1988 more than 9 thousand people were evacuated, including 99.9% of the wounded. Particular attention was paid to early medical evacuation in order to provide high-tech medical care to the wounded of neurosurgical, ophthalmological and thoracoabdominal profile. During the medical evacuation, emergency medical assistance was provided in 98.3% of cases, deterioration was noted in 3.1% of evacuees.

An analysis of the system of medical evacuation of the wounded and sick that existed during the war in Afghanistan shows that the widespread use of aircraft was planned. However, it should be noted that during its organization, mistakes were made, including the late deployment of evacuation receivers and of specially designated rooms (places) for temporary waiting for evacuation at airfields [9].

In Armenia, the first to arrive in the area of the earthquake (1988) were medical and nursing brigades (VSB) from military hospitals and medical military units located within a radius of about 300 km. Later-on medical specialists of the district military hospital arrived. At the airport of Leninakan, an evacuation center was deployed, medical triage of the victims was organized, followed by sanitary and aviation evacuation to medical and preventive institutions in Yerevan, Tbilisi, Moscow, Leningrad. In the earthquake zone, the coordination of actions

of all medical forces and means, as well as the interaction of military medicine with the USSR Ministry of Health and the Armenian SSR Ministry of Health, was carried out by the operational group of the Main Military Medical Directorate (GVMU) of the USSR Ministry of Defense, headed by the chief surgeon of the USSR Ministry of Defense E.A. Nechaev.

In addition to military medical specialists, employees of the emergency medicine institute named after Sklifosovsky and of other Moscow clinics were sent to the disaster scene. As a result of VGS, emergency medical care was provided to about 6 thousand victims, about 5 thousand people were evacuated to medical institutions, including about 500 transported for treatment to Moscow and Leningrad. At the same time, in the first 5 days, the main efforts to eliminate the health consequences of the earthquake were aimed at organizing medical and evacuation support and medical evacuation routing [10].

Positive experience of joint work of military and civilian medical specialists was gained during the elimination of the consequences of the Ulu-Telyak railway disaster near the city of Ufa (1989). The ignition of a cloud of hydrocarbons led to an explosion and fire in the surrounding area and in train passenger cars, as a result of which 1,264 people were injured, 408 died. During the liquidation of the consequences of the disaster, medical evacuation by automotive road was difficult to fulfil due to the lack of access roads - it was mainly carried out by helicopters and railway transport. As a result of the joint work of military and civilian specialists, all the victims were hospitalized in the nearest medical institutions within 8-10 hours. However, triage errors led to a violation of routing principles. As a result, a large number of victims with severe burns were sent to non-core medical facilities, which led to a shortage of medicines, medical devices and equipment and significantly complicated the medical evacuation process.Subsequently, inter-hospital medical evacuation was carried out on Il-76, Il-62 aircraft , Tu-154, An-26 to medical institutions in Moscow, Leningrad, Kuibyshev, Sverdlovsk, Chelyabinsk [11].

The experience of carrying out emergency rescue operations during the earthquake in Armenia (1988) and the explosion of passenger trains on the Ulu-Telyak stretch in Bashkiria (1989) showed that medical evacuation by motor transport was ineffective under these conditions. Timely medical evacuation of victims could only be carried out using air transport.

In most large-scale emergencies, the impossibility of conducting sanitary evacuation dramatically reduces the effectiveness of work to rescue victims and increases the number of deaths [12].

The earthquake in the village of Neftegorsk (Sakhalin, 1995) became a test for the system of the All-Russian Service of Disaster Medicine (VSMK). It proved to be one of the most destructive in the XX century. During the earthquake, more than 1.8 thousand people died at once, the village was completely destroyed, all infrastructure facilities, including hospitals, were destructed, 30 medical specialists of the village hospital perished. Thanks to timely measures taken, it was possible to organise work in the prehospital period and to evacuate those in need of specialized medical care.

With the active assistance of the administration of the Sakhalin Region, of Khabarovsk and Primorskiy Territories, specialists of the territorial centers of disaster medicine (TCMK), of the Field Multiprofile Hospital (PMH) of VCMK "Zashchita" provided assistance to 510 victims, organized and carried out medical evacuation of victims to medical institutions in Okha - 203 people, Khabarovsk - 98, Vladivostok - 43, Yuzhno-Sakhalinsk - 40 people. [13].

In subsequent years, the experience of using the forces and means of VSMK in Russia and abroad was enriched in the course of organizing medical support for the population in emergencies: in the Chechen Republic and the Republic of Ingushetia (1994-2002), Budennovsk (1995), Kaspiysk (1996), in Colombia (1999), Turkey (1999), Lensk (2001), Iran (2003), Beslan (2004), in Perm - “Lame Horse” nightclub (2009), at 284th km of the railway section Aleshinka - Uglovka on the border of the Novgorod and Tver regions - the train "Nevsky Express" (2009), etc.

The medical evacuation of victims of local armed conflicts was practiced during the counter-terrorist operation on the territory of the Chechen Republic in 1995-1996 and 1998-2002, as well as during the operation to force the aggressor to peace in South Ossetia in 2008.

When organizing medical support for the population of the Chechen Republic, helicopters and airplanes of the Ministry of Emergency Situations, of the Ministry of Internal Affairs and of the Ministry of Defense of Russia were used for the sanitary and aviation evacuation. The interaction of specialists from several departments facilitated timely medical evacuation for the provision of emergency specialized medical care to various categories of the wounded and sick.

During the preparatory period of the operation on the territory of the Chechen Republic in 1995-1996 the specialists of VCMK "Zashchita" have developed plans-schemes with evacuation routes, locations of deployment of medical centers and stages of medical care. The scheme of carrying out medical and evacuation measures included: first aid in the form of self- and mutual assistance or provided by non-staff orderlies; moving of the wounded to shelters; evacuation of the wounded in armored carriers to the united first-aid post (medrota), where emergency medical assistance was provided; evacuation of the wounded with the help of MTLB, AS-66, UAZ-452 to the MOSN, where they were provided with qualified medical care with elements of specialized medical care.

The evacuation of the wounded and sick from the MOSN of the first echelon was carried out by ambulance and transport helicopters to the basic hospitals of the North Caucasus Military District and of the central regions of Russia. For this purpose, 2 ambulance aircrafts were used - An-73 and Il-76 "Scalpel", as well as transport aircrafts. In total, 7267 military and civilian casualties were evacuated to the hospitals of the North Caucasian Military District, of other military districts and of the central district [14].

An important role in the implementation of the system of medical and evacuation support for victims in the zone of the Georgian-South Ossetian armed conflict (2008) was played by the forces and means of the Disaster Medicine Service (DMS) of the Republic of North Ossetia - Alania, the Kabardino-Balkarian Republic, the Stavropol Territory, etc.

With the beginning of hostilities in South Ossetia, the brigade of the PMG of VCMK "Zashchita", consisting of 25 people. - doctors of the surgical, trauma, anesthesiology and resuscitation profile, nurses, engineering and technical personnel - flew to Vladikavkaz and then to Tskhinval.

Analyzing the organization of medical and evacuation support for the victims, carried out during the Georgian-South

Ossetian armed conflict, the effectiveness of the tactics of bringing medical assistance to the source of the disaster by moving mobile medical units - PMG of VCMK "Zashchita" of the Ministry of Health of Russia and of "Centrospas" detachment of the EMERCOM of Russia should be highlighted.

The experience of eliminating medical and sanitary consequences of the tragedy in Beslan, when the terrorists took hostage at school more than 1,000 people, half of which were children of different ages, also formed the basis for the development of a system of medical and evacuation support in complicated emergencies. As a result of the explosion at the school on September 3, 2004 and of the subsequent operation to free the hostages, an overwhelming majority of hostages, more than 300 people, who got injuries of varying severity, died [15].

Specialists of PMG of VCMK "Zashchita" and of the air-mobile hospital of the Ministry of Emergencies of Russia (children's surgeons, traumatologists, anesthesiologists-resuscitators, otolaryngologist, pediatrician, nurses - only 46 people), deployed the Field Pediatric Hospital on the territory of the city of Beslan on the border of the alleged focus of the disaster.

The medical-tactical situation was complicated by the lack of reliable data on the exact number of hostages, by the unpredictability of the course of events, by the difficulty of predicting the nature of the lesions and the structure of sanitary losses, by the limited bed availability in Beslan, and by the lack of children's surgical beds in the city's medical institutions. All this required a medical evacuation.

After the explosion at the school, medical evacuation of more than 530 injured people, including 311 children, was carried out by ambulance cars and by private vehicles.

On the first day, more than 300 children were transported to Vladikavkaz hospitals by ambulance, the majority (68%) of them were children of primary and secondary school age. On the same day, 6 children in serious condition were evacuated to hospitals in Moscow. The location of the medical hospital on the border of the outbreak made it possible to reduce the total number of stages of medical evacuation and to significantly reduce the risk of prolonged medical evacuation of seriously wounded children. It is necessary to note the high speed of taking evacuation measures - during the first few days, 146 injured people were evacuated to clinics in Moscow and Rostov, air ambulance evacuation of the most severe patients was carried out in resuscitation vehicles loaded into a transport plane [16].

The experience of medical specialists of VCMK "Zashchita" in the elimination of medical and sanitary consequences of events in the North Caucasus revealed the need for revision, scientific substantiation and adaptation to changing conditions of the existing system of medical and evacuation measures.

The need to develop special medical modules with the ability to accommodate patients and medical equipment for aircraft (VS) during mass air medical evacuation was confirmed. Such developments were initiated in 2004, by 2009 final tests were carried out and medical aircraft and helicopter modules - MMC and MMB [17] were put into operation.

As an example of organizing and conducting a mass air sanitary evacuation using MMS, the experience of liquidating medical and sanitary consequences of a fire in the "Lame Horse" nightclub in Perm on the night of December 4-5, 2009, when 238 people were injured, can be used.

The ambulance and TCMK teams evacuated 78 victims to medical institutions. 53 patients were transported by passing vehicles. Most of the hospitalized (62 people - 79.5%) were in an extremely serious condition and had associated lesions - extensive skin burns, thermal inhalation trauma and poisoning by combustion products [18].

Medical consultations and subsequent support during the sanitary-aviation evacuation of the victims were carried out by toxicologists, specialists in extracorporeal detoxification, endoscopists, resuscitators, surgeons, pulmonologists and other specialists from LMOs of Moscow, of the republics of Bashkortostan and Tatarstan, of Chelyabinsk, Sverdlovsk and Nizhny Novgorod regions. Aviation medical brigades and emergency response brigades of the All-Russian Center for Disaster Medicine "Zashchita" of the Ministry of Health of Russia and of "Centrospas" of the Ministry of Emergencies of Russia were involved [19, 20].

Aviation sanitary evacuation of the victims was carried out to the LMO of Moscow, St. Petersburg, Chelyabinsk by aircraft: Il-76 with five MMS for 20 seats, Yak-42 and Be-200 of EMERCOM of Russia, as well as An-74 of FMBA of Russia.

This first positive experience of using MMS laid the foundation for further developments in this area.

Another tragedy that proved the need for use of helicopter aviation for medical purposes was the railway disaster that occurred on November 27, 2009 in the Bologovsky district of Tver region on the Aleshinka - Uglovka stretch of Oktyabrskaya railway - 283 km from St. Petersburg. As a result of an explosion (terrorist attack), 3 passenger carriages of the high-speed train "Nevsky Express", en route from Moscow to St. Petersburg, went off the rails. 95 victims were evacuated for hospitalization in the LMOs of Moscow, St. Petersburg, Tver, Veliky Novgorod and other cities.

The main problems in carrying out emergency rescue operations and providing medical assistance were: lack of access roads, swampy terrain, long distance to medical institutions from the crash site, etc. To evacuate 23 victims, 7 medical modules helicopter flights were performed [21].

Analyzing the experience of medical evacuation during the elimination of medical and sanitary consequences of various emergencies, including military and local armed conflicts, one can note a variety of organizational solutions: for carrying out medical triage prior to medical evacuation; for the provision of emergency medical assistance in the process of medical evacuation; for the quantitative and qualitative composition of the forces and means used, including personnel, material and technical support and the transport. All organizational decisions were made depending on the nature of an emergency, on terrain characteristics, on the availability of access roads, on the remoteness of medical institutions from the location of the emergency, on the possibility of using air transport. At the same time, the lack of uniform principles for organizing medical evacuation of victims in an emergency including their routing resulted in a number of cases in an underestimation of the severity of condition of victims, in a shortage of medical personnel and necessary transport, in hospitalization of victims to the nearest hospital facilities and other shortcomings, which significantly reduced the quality of medical care to victims of emergencies.

The volume of medical evacuation of victims, carried out in

the prehospital period in the constituent entities of the Russian Federation (hereinafter referred to as the constituent entities), is presented in Table 1 - from form 55.

Every year, VSMK specialists take part in the elimination of medical and sanitary consequences of a large number of different emergencies - from 1,681 emergencies in 2017 to 15,500 emergencies - in 2012, providing medical assistance to an average of about 35 thousand victims, while the proportion of victims who are in grave and extremely grave condition, averages 23.0%, and the proportion of evacuees is 40.0% or more.

In total, 2012–2018 medical evacuation of 133,242 victims was carried out by the field medical units of the subjects, including the proportion of those evacuated by air of 58.0% (Table 2).

Information on the volume of medical evacuation of patients and injured at the federal level is presented in table. 3.

From the presented data it can be seen that compared to 2015–2016 in 2017–2019 the number of victims evacuated by air decreased by almost 1.5 times. This is due to a decrease in the number of victims in the LVK in the South-East of Ukraine. At the same time, there is an increase of approximately 1.5 times in the number of evacuees by land transport. Meanwhile, the total volume of medical evacuation at the federal level remains stable - approximately 1,000 people annually.

It is known that various types of transport were used for medical evacuation of victims in emergencies, but the most effective is the use of aircraft, which reduces the number of stages of medical evacuation and is most consistent with the main principle of routing - timely delivery of victims to their destination in specialized medical centers.

In modern conditions, taking into account the development of material and technical forces and means of medical evacuation, including a widespread use of air vehicles, as well as the improvement of portable medical equipment and other factors, medical evacuation of victims in most cases is no longer a "forced measure". It becomes an integral planned component of the complex of medical and evacuation measures within the process of elimination of medical and sanitary consequences of emergencies.

In most cases, in the event of an emergency, forces and resources of medical institutions located near the scene of emergency turn out to be insufficient.

The problem of medical support for victims of emergencies dictates the need to: create special medical units with an appropriate organizational and staff structure; develop and improve technical means of medical evacuation; train medical personnel, taking into account the technologies of their delivery together with medical equipment to the emergency scene and of medical evacuation of victims to appropriate medical institutions.

We have worked out and analyzed the issues of studying various aspects of medical evacuation, which were raised in a number of scientific studies conducted over the past 20 years.

The problems of organizing and conducting medical evac-

Таблица 1/Table 1

Основные данные о ЧС, произошедших на территории Российской Федерации в 2010–2019 гг.

Basic data on emergencies that occurred on the territory of the Russian Federation in 2010-2019

Год Year	Кол-во ЧС, абс. Number of emergencies	Число пострадавших, чел., всего Number of victims, people, total	Характеристика пострадавших по степени тяжести поражения Characteristics of victims according to the severity of the lesion				Число эвакуированных с места ЧС, чел. Number of evacuees from the emergency site, people
			крайне тяжелая extremely severe	тяжелая severe	средняя medium	легкая light	
2010	14232	38869	1408	4200	9403	14286	17584
2011	15105	38205	1373	3990	9279	13451	16603
2012	15500	45596	1372	3262	10373	20837	15797
2013	7172	26231	1263	2705	6516	8587	9056
2014	5887	23373	911	2415	5934	8116	8755
2015	2528	17015	446	1410	4098	6370	6839
2016	2087	14862	366	1105	4549	5112	8030
2017	1681	10051	292	1109	2885	2667	5478
2018	2566	14999	410	1610	4168	4175	8278
2019	2894	14602	442	1733	4742	3179	8091

Таблица 2/Table 2

Работа отделений экстренной консультативной медицинской помощи по проведению медицинской эвакуации в 2012–2019 гг.

Activitiy of emergency medical consultative departments on medical evacuation in 2012-2019

Показатель Indicator	Проведена медицинская эвакуация Medical evacuation was carried out							
	2012	2013	2014	2015	2016	2017	2018	2019
Число эвакуированных, чел. всего, из них: Total number of evacuees, including	16864	24487	23456	18496	15683	21082	13174	16670
авиационным транспортом by air	12170	12200	10316	11420	10491	11473	9161	7650
санитарным автотранспортом by ambulance	4669	12275	13119	7060	5173	9596	3995	8999
другим транспортом by other transport	–	–	21	16	19	13	18	21

uation were studied from the standpoint of: providing medical care to patients with various nosologies at the stages of medical evacuation in the prehospital period; medical triage, on which the further sequence of medical evacuation depends; studying possible composition of teams of medical specialists for medical evacuation and issues of their training; transportability of patients with varying severity of condition; peculiarities of using different types of transport for medical evacuation; development of a regulatory legal framework as the basis for the organization and conduct of medical evacuation of patients and victims in emergencies.

Special attention in scientific research was paid to the study of issues of interdepartmental interaction in the organization of medical evacuation, to the development of various material and technical means and of equipment lists for medical vehicles, including various types of aircraft, for medical evacuation of patients and injured with various nosologies, etc. ...

In a number of works, attention is paid to the role and importance of triage in preparing victims for medical evacuation, while in the studies of some authors, triage issues were studied inappropriately, as a component of a single process of providing emergency medical care and medical evacuation of victims in various emergencies including armed conflicts [22-24].

In our opinion, triage issues are of great importance for organizing and conducting medical evacuation of victims and require further scientific study when creating an effective routing system for medical evacuation of victims from the emergency site to medical organizations, where they will be provided with comprehensive medical assistance.

Studies by a number of authors have shown features of use of various types of transport for medical evacuation [18, 25-28].

At present, one of the main conditions for the effectiveness of the medical evacuation system is information exchange between medical organizations. The decision on the possibility of medical evacuation is made by medical specialists of the field team when examining the patient and studying the medical documentation. At the same time, at the preliminary stage, even before leaving, it is advisable to remotely obtain and study as much information as possible about the patient's health status in order to choose a method for medical evacuation, a vehicle, a composition of a medical team, specialized medical equipment and medicines. Telemedicine plays the most important role in information exchange [29–31].

The use of telemedicine technologies in the elimination of medical and sanitary consequences of emergencies is associated with the need to: increase the efficiency of solving issues of providing emergency medical care to victims, address a number of other organizational issues, including assessing the severity of the medical and sanitary consequences of emergencies, organizing forces and means, determining the degree of transportability of victims, choosing the routing of medical evacuation of each individual victim.

A number of scientific articles present the results of studying the features of medical evacuation of patients with various pathologies [26, 27, 32, 33].

At present, the issues of development and usage of technical means for medical evacuation, including the use of MMC, MMB, and extracorporeal membrane oxygenation (ECMO), have been sufficiently studied. The possibility of medical evacuation with minimal impact on the condition of patients and victims has been found [17, 34–36].

A number of problematic issues of medical evacuation of patients with infectious diseases are being actively studied in connection with the Covid-19 pandemic. Of particular interest is the experience of carrying out mass and long-term sanitary and aviation evacuations of such patients [37–40].

The issues of regulatory legal support of medical evacuation are especially relevant in today's changing conditions. In particular, the development of ideology of a three-level health care system dictates the need for planning medical evacuation, taking into account the creation of medical districts. The unification of regional SMP and TCMK stations with the creation of unified regional information system for management of emergency response services will allow the use of common forces and means, including for medical evacuation, both in daily activities and in an emergency mode. These transformations dictate the need to study and to analyze the existing algorithms for medical evacuation, their refinement and consolidation at the legislative level [41].

Based on the analysis of various aspects of the organization and conduct of medical evacuation of victims in emergencies, it can be noted that there is no scientific research entirely devoted to all aspects of medical evacuation. Basically, scientific research is carried out on the provision of emergency medical care to victims with various pathologies at the stages of medical evacuation. In various scientific works, medical evacuation is studied from the standpoint of the main research topic and only some of its aspects are highlighted: organization of medical evacuation; evacuation medical triage of victims at the scene; issues of informatization during medical evacuation; some aspects of routing of patients with certain nosologies and types of lesions; use of medical equipment and the composition of medical tools; particular issues of the tactics of providing medical care during medical evacuation, etc.

At the same time, the organization and conduct of medical evacuation of victims in emergencies requires unified approaches that take into account the type and scale of emergencies, the effect of damaging factors, medical and evacuation characteristics of victims, etc. It is obvious that it is necessary to conduct comprehensive scientific research on the unexplored issues of organizing and conducting medical evacuation including justification of all necessary measures carried out by specialists of mobile medical teams in the prehospital and hospital periods. The creation and improvement of medical evacuation system for victims of emergencies on the basis of their constant monitoring will allow to ensure their correct routing, which ultimately will increase the quality of measures taken.

Таблица 3/Table 3

Медицинская эвакуация на федеральном уровне в 2015-2019 гг., чел.

Medical evacuation at the Federal level 2015-2019, people

Год Year	Число эвакуированных, всего Number of evacuees, total	Из них / From them		
		воздушным транспортом by air	санитарным автотранспортом by ambulance	другими видами транспорта by other transport
2015	1113	444	664	5
2016	1117	368	747	2
2017	988	265	712	11
2018	983	230	746	7
2019	1129	258	861	10

Conclusion

The existing system of medical and evacuation support generally meets the needs of practical health care in the elimination of the medical and sanitary consequences of emergencies. At the same time, scale and severity of recent accidents, disasters, terrorist acts and armed conflicts dictate the need to revise a number of positions in order to create and further improve the modern system of medical evacuation of victims of emergencies. The conditions in which medical and evacuation measures are carried out have changed, new, primarily technical and informational, opportunities have appeared, the availability of air transport has increased, and other factors that must be taken into account when creating a system for medical evacuation of victims of emergencies appeared.

The digitalization of healthcare, the formation of a united information space at the regional and federal levels, the use of modern medical equipment allow real-time monitoring of the medical evacuation of patients with the possibility of timely correction of organizational and clinical decisions.

A patient-centered approach as the basis for the provision of medical care requires an increase in the effectiveness of medical and evacuation measures with the development of criteria for assessing the quality of medical evacuation of victims in an emergency.

The need to use more modern medical equipment for medical evacuation with the ability to remotely transmit data about the patient's condition and with a system to support the adoption and execution of clinical decisions led to the development of mobile modular complexes "Angel", "Afalina" and "Belukha" [42].

The technology of using the ECMO method requires further study, including its application for medical evacuation of Covid-19 patients in serious condition.

In connection with the above, it is obvious that it is necessary to analyze new conditions, factors and possibilities for medical evacuation within the framework of a comprehensive scientific study to substantiate and develop the main provisions of the system of medical evacuation of victims in emergencies.

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