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От всей души поздравляем Вас с 15-летием журнала «Политравма»! За время своего существования издание заняло уникальную нишу в обширном информационном поле медицинских изданий. Публикации журнала весьма востребованы специалистами Минздрава, ФМБА, МЧС, Минобороны России, принимающими участие в организации оказания медицинской помощи пострадавшим с политравмой при чрезвычайных ситуациях. Высокий научно-практический статус журнала подчеркнут его включением в перечень ведущих научных рецензируемых журналов ВАК Минобрнауки России и международную реферативную базу данных Scopus. Многоплановость публикаций, освещающих экспериментальные и практические научные работы, исследования молодых ученых по ключевым проблемам хирургии, травматологии и ортопедии, анестезиологии и реаниматологии, нейрохирургии, делает журнал незаменимым помощником медиков и вестником новаций.

Мы высоко оцениваем труд редакционной коллегии, рецензентов и редакции и искренне желаем Вам дальнейшей плодотворной деятельности, интересных и содержательных статей, роста тиража, числа авторов и читателей. Надеемся на долговременное сотрудничество в сфере редакционно-издательской деятельности!

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TO THE ANNIVERSARY OF GREAT VICTORY К ГОДОВЩИНЕ ВЕЛИКОЙ ПОБЕДЫ

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Review article
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CHIEF EPIDEMIOLOGS OF FRONTS AND FLOTS IN GREAT PATRIOTIC WAR 1941-1945

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Abstract. Activities of a number of military epidemiologists of the country during the Great Patriotic War of 1941-1945 are considered. It is highlighted that the skillful work of the chief epidemiologists of fronts and fleets, who were at the head of large teams of sanitary doctors, greatly contributed to the successful anti-epidemic support of the personnel of the troops and of the navy during the war.

Keywords: chief epidemiologists of fronts and fleets, chief epidemiologist of navy, chief epidemiologists of the Red Army, Great Patriotic War 1941-1945, military epidemiology

Conflict of interest. The authors declare no conflict of interest

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ГЛАВНЫЕ ЭПИДЕМИОЛОГИ ФРОНТОВ И ФЛОТОВ В ГОДЫ ВЕЛИКОЙ ОТЕЧЕСТВЕННОЙ ВОЙНЫ 1941–1945 гг.

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Резюме. Представлена многогранная деятельность ряда военных эпидемиологов страны в годы Великой Отечественной войны 1941–1945 гг.

Отмечено, что успешному решению задач по противоэпидемическому обеспечению личного состава войск и флота в период войны во многом способствовала умелая работа главных эпидемиологов фронтов и флотов, стоявших во главе больших коллективов санитарных врачей.

Ключевые слова: Великая Отечественная война 1941–1945 гг., военная эпидемиология, главный эпидемиолог Военно-морского флота, главные эпидемиологи Красной Армии, главные эпидемиологи фронтов и флотов

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A significant date — the 75th anniversary of the Great Victory over Nazi Germany — encourages us to turn again and again to the events of those unforgettable years. The noble work of a huge army of medical workers, including a large detachment of epidemiologists, occupies a worthy place in the great feat of that war.

In the Great Patriotic War, unprecedented in scale, accompanied by devastation of territories, by robbery of the population in the occupied regions, by mass migration of civilians, a certain epidemic well-being was preserved. The successful anti-epidemic support of troops and navy during the war was largely facilitated by work of the chief epidemiologists of fronts and fleets, who were at the head of large teams of sanitary doctors.

The Institute of Chief Epidemiologists of Fronts was created by the Order of the People's Commissar of Defense of the USSR dated May 9, 1941. Prominent scientists occupied this responsible post during the war: the chief epidemiologists of the Red Army I.D. Ionin (1941-1943) and T.E. Boldyrev (1943- 1947) and the main epidemiologists of fronts I.F. Akimikhin, K.F. Akinfiyev, M.L. Bezprozvanny, E.S. Benyaminson, V.M. Berman, S.V. Viskovsky, B.S. Grabovsky, L.V. Gromashevsky, N.L. Dankovsky, V.G. Diligensky, I.I. Yolkin, M.V. Zemskov, G.A. Znamensky, K.T. Katsitadze, V.M. Krakov, V.D. Krasnov, A.S. Kuzminsky, M.V. Kuris, M.M. Lebedev, A.M. Levitov, B.P. Pervushin, T.T. Pozvyay, V.L. Portnykh, S.M. Radunsky, G. Ya.Sinai, V.O. Kholodovsky, G.I. Khomenko.

Later, by the Order of the People's Commissar of the Navy of the USSR of September 1, 1942, the institute of chief epidemiologists of fleets was introduced. During the Great Patriotic War, A.Ya. Alymov was the chief epidemiologist of the Navy, and the chief epidemiologists of fleets were Ya.K. Gimmelfarb, V.I. Ioffe, A.S. Kaplan, N.N. Spassky.

The heads of the anti-epidemic service of fronts and fleets were faced with numerous tasks: continuous study of the sanitary state of the territories, of epidemic state of troops and fleets, of population, as well as of enemy troops; analysis of morbidity; forecasting and planning of anti-epidemic support of troops and fleets; maneuvering anti-epidemic forces and means; systematic control and generalization of experience; development of new methods of anti-epidemic work.

We will limit our essay to a brief description of activities of some prominent organizers of military epidemiology.

The post of the chief epidemiologist of the Red Army from 1941 to 1943 was occupied by the Honored Scientist of the Ukrainian SSR, Doctor of Medical Sciences, Professor, Major General of Medical Service, Ivan Dmitrievich Ionin (1895-1945). At all stages of the Great Patriotic War, his multifaceted activity was appreciated by the leadership of the medical service. During the war, one of his attestations noted: "Comrade I.D. Ionin is a qualified specialist, doctor with a wide outlook, who knows his job well. Specially trained, skillfully applies theoretical knowledge in practice. Works a lot on himself. Solves issues seriously and deliberately. Initiative and observant" [1].

I.D. Ionin died at the age of 50. A remarkable epidemiologist and clinician, talented organizer and teacher, a man of great personal charm, Ivan Dmitrievich lived a short but a bright life, which was completely devoted to medicine.

In 1943-1947 the chief epidemiologist of the Red Army was a well-known Russian scientist, major public health organizer, one of the founders of military epidemiology, corresponding member of the USSR Academy of Medical Sciences, professor, major general of medical service, Tikhon Efimovich Boldyrev (1900-1984). During the war years, he headed the anti-epidemic department of the Main Military

Sanitary Directorate (1941-1943), and then became the chief epidemiologist of the Red Army (1943-1947). With the direct participation of T.E. Boldyrev, a new organizational and staff structure of anti-epidemic institutions in the army was created, the features of its functioning at wartime were determined. T.E. Boldyrev developed a doctrine on spreading infectious diseases in the troops, proposed measures to prevent and to combat them. He repeatedly went to the troops, personally took part in the elimination of epidemic foci and outbreaks (Kalinin region, Belarus, Pomerania) — [2]. Much organizational work was carried out by him to eliminate the typhoid epidemic among Polish and German population (1945). In 1945-1947 Tikhon Efimovich headed the entire system of sanitary and anti-epidemic control during the mass repatriation of the population moved to the West. Based on materials of the war years, he wrote a number of original works. Here are some of them: "Protection against epidemic diseases in wartime", "Basic conditions for the success of anti-epidemic work in an offensive operation", "Anti-epidemic protection of troops", etc.

Among the main epidemiologists of fronts, a worthy place belongs to the prominent domestic microbiologist and epidemiologist, doctor of medical sciences, professor, colonel of medical service Viktor Mikhailovich Berman (1897-1969). During the Soviet-Finnish War, he was a consultant to the sanitary service of the North-Western Front, and during the Great Patriotic War — the chief epidemiologist of the Northern Front. He devoted all his strength, knowledge and experience to the organization of anti-epidemic measures in the troops, which made it possible to avoid massive outbreaks of infectious diseases among the personnel. In the certification papers of V.M. Berman it was emphasized: "Professor V.M. Berman is a highly qualified microbiologist and epidemiologist and a good practitioner of anti-epidemic support of troops, a prominent scientist. He actively helps the sanitary service of the Red Army and civilian health authorities in the field of his specialty, as he is constantly involved in consultative work" [3]. V.M. Berman wrote about 100 scientific works on microbiology, immunology and epidemiology of intestinal infections, tuberculosis, on specific prevention of infectious diseases, on barrier function of the lymphatic system, etc.

The main epidemiologist of the Leningrad Front was the Honored Scientist of the RSFSR, professor, colonel of medical service, Stefan Valerianovich Viskovsky (1882-1953). From the first days of the war, he was appointed chief epidemiologist of the Leningrad Front. S.V. Viskovsky published a large number of scientific works, the main of which are devoted to the clinic and epidemiology of dysentery, parasitic typhus and some tropical diseases. Back in 1924, he was the first to detect the presence of mosquito fever in Central Asia.

A bright page in the life of Stefan Valerianovich was his work during the Great Patriotic War. As the chief epidemiologist of the Leningrad Front (1941-1945), S.V. Viskovsky put all his strength and energy into creating a clear and orderly system of anti-epidemic support for troops and population. The epidemic well-being of the troops of the Leningrad Front and of the population of besieged Leningrad owes much to his energetic activities [4].

In the cohort of leading military epidemiologists of the war period, one of the first places belongs to an outstanding domestic scientist, major healthcare organizer, talented teacher, academician of the USSR Academy of Medical Sciences, Honored Scientist of the Ukrainian SSR, professor, military doctor of the 1st rank Lev Vasilyevich Gromashevsky (1887-1980).

During the Great Patriotic War, L.V. Gromashevsky was the chief epidemiologist of the Transcaucasian Front, and later — of Moscow Military District. When the war began, Lev Vasilievich was 54 years old. It would seem that age could, to a certain extent, affect his performance. But that was not the case. He energetically and skillfully supervised the work of front-line epidemiologists, and often traveled to the location of active forces in order to help in organizing of anti-epidemic work. During this period, he devoted all his experience and knowledge to the creation of an effective system of anti-epidemic protection of troops [5].

L.V. Gromashevsky published about 250 scientific works devoted to general epidemiology and to epidemiology of a number of infectious diseases — typhus and typhoid fever, cholera, dysentery, viral hepatitis, including (together with G.M. Vindrakh) a textbook of general epidemiology. His works deserve special mention: "On epidemiology of cholera", "On frequency of recurrent typhus infections" (together with I.R. Stepanov), "Principle of classification of infectious diseases", "Private epidemiology", "General epidemiology", "Intestinal infections", "On the evolution of viruses and viral diseases" (together with V.L. Vasilyeva) and others. Lev Vasilyevich developed the doctrine of mechanism of transmission of infection and the classification of infectious diseases.

Among the creators of domestic epidemiology, one of the first places is occupied by a prominent scientist of our country, talented organizer of health care, Honored Scientist of the Uzbek SSR, professor, lieutenant colonel of medical service, Ivan Ivanovich Yolkin (1903-1982). Exceptional personal qualities, as well as scientific works in various areas of epidemiology have earned him universal respect and recognition in wide circles of the country's medical community. From the first days of the war I.I. Yolkin served in the army: as a head of the sanitary-epidemiological detachment laboratory, as army epidemiologist of the 52nd army, from March 1942 until the end of the war — as the chief epidemiologist of the North-Western, Kalinin and 1st Baltic fronts. During those difficult years, under his leadership and with his direct participation, medical service of the armies and fronts successfully carried out anti-epidemic work in difficult conditions of hostilities [6].

I.I. Yolkin wrote about 200 scientific works: "Guide for practical training in epidemiology", "Essays on the theory of epidemiology", "Epidemiology", "General and specialised epidemiology", "Dysentery (epidemiology, prevention)", etc. He is the editor of the manual "Course of Epidemiology", as well as of the 5th volume of the "Manual of Microbiology, Clinic and Epidemiology of Infectious Diseases." His scientific works are devoted to general and military epidemiology. A number of his studies, which are important for anti-epidemic work in military collectives, are devoted to the epidemiology of tularemia, typhus, dysentery, as well as to epidemiological geography.

The chief epidemiologist of the Southwestern and 1st Ukrainian fronts during the Great Patriotic War was doctor of medical sciences, professor, lieutenant colonel of the medical service, Mikhail Vasilyevich Zemskov (1908-1998). From the first days of the war, he was in the active army: first as an army epidemiologist of the 29th and of the 3rd guards armies, later as the chief epidemiologist of the aforementioned fronts. During the war years, his activities were constantly receiving high marks: "Erudite, experienced specialist-epidemiologist. He is doing well with the duties assigned to the front epidemiologist. All issues related to anti-epidemic support of troops are solved correctly, promptly and clearly. Strong-willed qualities are well developed. Energetic, ini-

tiative and disciplined. The position of the chief epidemiologist of the front is quite consistent" [7].

M.V. Zemskov is the author of over 200 scientific works, including a number of monographs and two textbooks on general and specialised microbiology. His main scientific research is devoted to the problem of human and animal leptospirosis and nonspecific stimulation of immunity.

In the galaxy of major domestic epidemiologists, a worthy place is occupied by the chief epidemiologist of the Navy during the Great Patriotic War. In the postwar period he was the chief epidemiologist of the USSR Armed Forces, corresponding member of the USSR Academy of Medical Sciences, professor, major general of the medical service. His name is Andrei Yakovlevich Alymov (1893– 1965). In 1942 A.Ya. Alymov was appointed the chief epidemiologist of the Navy. He played an important role in the formation of a coherent system for organizing anti-epidemic support on ships and in parts of the fleet. Having experience in training naval doctors, A.Ya. Alymov paid special attention to special training of naval epidemiologists. During the war, Andrei Yakovlevich spent most of the time in the fleets, where he was involved in organizing anti-epidemic measures, providing practical assistance to naval epidemiologists on the ground. In besieged Leningrad, he conducted classes in epidemiology and microbiology at advanced training courses for doctors of the Red-Banner Baltic Fleet.

His work during the Great Patriotic War, as well as on peaceful days, was always positively assessed by the command: "Professor A.Ya. Alymov is one of the most prominent scientists of our country. Being a well-educated, versatile specialist, he constantly pays great attention to the correct organization of anti-epidemic support of fleets. In his work, he shows great perseverance and dedication. Perfectly prepared theoretically. Has high organizational skills. As the chief epidemiologist of the USSR Armed Forces, he was involved by the Main Military Medical Directorate of the USSR Ministry of Defense and the USSR Ministry of Health to address topical issues of organizing anti-epidemic service in peacetime and wartime. He has a well-deserved authority" [8].

A.Ya. Alymov published more than 100 scientific works on topical problems of infectious pathology: "Persian relapsing fever", "Spontaneous complications of experimental tick-borne recurrence and their influence on the course of spirochetosis", "Fundamentals of diagnosis and prevention of parasitic typhus and fevers", etc. His main research is devoted to the study of infectious diseases with natural foci. Another direction of Andrei Yakovlevich's work is the study of the role of nervous system in the development of infectious diseases and in the formation of immunity to them. He organized and personally participated in scientific expeditions to study tick-borne relapsing fever in Kyrgyzstan, Pappatachi fever and Marseilles fever in the Crimea, endemic rat typhus in Batumi, etc. In the initial period of the war, A.Ya. Alymov, while in the besieged Leningrad, studied biological products proposed by him for the treatment of infected wounds. In experiments on self-infection with pathogens of mosquito fever and brucellosis, he clarified the questions of the pathogenesis and of the duration of the incubation period of these infections. He also developed means for specific prevention of anaerobic infections.

An outstanding Russian scientist, academician of the USSR Academy of Medical Sciences, professor, colonel of medical service Vladimir Ilyich Ioffe (1898-1979) made a huge contribution to the management of the activities of a large detachment of sanitary doctors of the Red-Banner Baltic Fleet during the Great Patriotic War. Since the be-

gining of the war, Vladimir Ilyich was in the active army as a consultant epidemiologist of the Red Baltic Fleet. In November 1942 he was appointed chief epidemiologist of the Baltic Fleet, in which he worked until March 1946. During these years, he personally supervised anti-epidemic measures on ships and in units of the fleet in the conditions of besieged Leningrad, in Kronstadt fortress, on Ladoga military flotilla.

The archival documents contain the final certification of V.I. Ioffe for the entire period of his tenure as the chief epidemiologist of the Red-Banner Baltic Fleet. Here are a few lines from this document: "Huge erudition in the epidemiology of infectious diseases, personal rich experience in practical issues of anti-epidemic measures, brilliant theoretical and scientific training have strengthened professor V. Ioffe's well-deserved authority not only in the Baltic Sea, but also far beyond. The research work carried out by Professor V.I. Ioffe at the Red-Banner Baltic Fleet during the war years was always distinguished by a great practical value. He personally took part in the fight against outbreaks of dysentery, typhus and other infections in the Red-Banner Baltic Fleet, which largely prevented the spread of infectious diseases in the fleet "[9].

In science V.I. Ioffe is known as a talented researcher-experimenter who blazed new paths in domestic medicine. He published over 200 scientific works on microbiology, epidemiology and immunology, including 10 monographs and collections. The following works deserve special mention: "On one new principle in the study of viral infections", "Scarlet fever", "Towards immunological study of malignant tumors", "Some results of the study of general immunological reactivity of organism in clinic and epidemiology", etc. V.I. Ioffe gave a serological characterization of hemolytic streptococci. In the study of childhood infections, especially if the scarlet fever, Vladimir Ilyich developed a method for comparative assessment of the size of a microbial focus, of the dynamics of its development and extinction. He studied microbiology and immunology of whooping cough, and proposed a method for its early diagnosis in the incubation and prodromal periods. During the war, he published a number of works on microbiology and immunology of intestinal infections, in particular on the so-called blockade dysentery. Some of his works are devoted to the problem of nonspecific resistance to infection.

The anti-epidemic service of the Black Sea Fleet during the Great Patriotic War was headed by doctor of medical sciences, professor, colonel of medical service, Yakov Klimentievich Gimmelfarb (1896-1975). From December 1942 until the end of the war, Ya.K. Gimmelfarb was the chief epidemiologist of the Black Sea Fleet. During these years, he actively contributed to maintaining a stable epidemiological state in the Black Sea Fleet and led the generalization of the experience of anti-epidemic support of this fleet during the war years.

The head of the medical and sanitary department of the Black Sea Fleet, major general of medical service, A.N. Zotov, in attestation of the Chief Epidemiologist of the Fleet, noted: "Professor Ya.K. Gimmelfarb took an active part in the work on establishing the entire organization of anti-epidemic support of the fleet. With his direct participation, epidemiologists, bacteriologists and laboratory assistants were selected and trained. Repeatedly traveled to naval bases, including to the forward sections of our theater (Kerch, Taman, Novorossiysk), where he provided practical assistance to medical specialists of sanitary profile. He often visited individual units and ships, summarizing the experience of combating dysentery in the navy during the war years, di-

recting the sanitary service. For the work done on the anti-epidemic support of the fleet he deserves a presentation for a government award "[10].

Ya.K. Gimmelfarb wrote more than 100 scientific works in microbiology, virology and epidemiology. Particularly famous were his works on microbiology of plague, pseudotuberculosis of rodents, and of anaerobic microflora of canned food. He is a renowned specialist in the field of virology and epidemiology of Botkin's disease.

The post of the chief epidemiologist of the Northern Fleet during the Great Patriotic War was held by doctor of medical sciences, professor, colonel of medical service, Nikolai Nikolayevich Spassky (1896-1974). As the chief epidemiologist of the Northern Fleet, he was directly involved in the war in the Arctic. N.N. Spassky made every effort to ensure the efficient work of anti-epidemic service in the war, when there were plenty of prerequisites for the emergence of various epidemics.

The command of the Northern Fleet in the combat characteristics of N.N. Spassky noted: "Comrade N.N. Spassky showed great initiative in his work, as well as the necessary efficiency in the fight against outbreaks of dysentery, acute gastrointestinal diseases and toxic infections. In any situation, he went to the Northern defensive area, to its front edge, in the ground defense of the Air Force and in the Solovetsky garrison, where he resolutely and persistently carried out well-thought-out sanitary and epidemiological measures, which achieved quick results in stopping outbreaks of acute intestinal infections. Seriously approaches his duties as a flagship epidemiologist. He persistently teaches the medical staff at all training sessions of the formations, especially on anti-epidemic support for the personnel of the fleet. Along with his service activity, he showed high comradely qualities, which earned him authority and respect among medical officers "[11].

N.N. Spassky's scientific research has both theoretical and practical value. He made a great contribution to the study of anthrax, yellow typhoid, in the etiology of staphylococcal, streptococcal, intestinal and other infections.

The chief epidemiologist of the Pacific Fleet during the Great Patriotic War and during the war with Japan (August 9 - September 2, 1945) was doctor of medical sciences, associate professor, colonel of medical service, Alexander Sergeevich Kaplan (1910-1995). Head of the Medical and Sanitary Department of the Pacific Fleet, major general of medical service, M.N. Kravchenko, highly appreciated his activities in this post: "Having arrived at the fleet in mid-1945, he quickly got used to the situation and to the work of the flagship epidemiologist. An energetic, decisive and proactive officer. He possesses courage and composure shown by him in the landing operation, for which he was presented with a government award. He is a highly erudite epidemiologist who is well versed in various sanitary and epidemiological conditions and takes right decisions. He took an active part in the fight against infectious diseases, went directly to the field to organize anti-epidemic support of personnel. The position held is quite consistent "[12].

A.S. Kaplan is the author of about 100 scientific papers on microbiology and virology. Here are some of them: "A case of actinomycotic sepsis", "Prevention with a dysentery bacteriophage in the USSR", "Macroscopic method of staging Weill's reaction", "On the question of the specificity of prevention of typhus", "Serological and allergic reactions in people in a brucellosis farm", "Typhoid fever on the ships of the Navy during the Great Patriotic War" and others (Fig. 1-12).

CHIEF EPIDEMIOLOGISTS OF FRONTS

IONIN Ivan Dmitrievich (1895-1945). Honored scientist of the Ukrainian SSR, professor, major general of medical service, chief epidemiologist of the Red Army in 1941-1943.

BOLDYREV Tikhon Efimovich (1900-1984). Corresponding member of the USSR Academy of Medical Sciences, professor, major general of the medical service, chief epidemiologist of the Red Army in 1943-1947.

AKIMIKHIN Ivan Fedotovich (1895-1962). Candidate of medical sciences, colonel of medical service, chief epidemiologist of the North-Western Front.

AKINFIEV Konstantin Fedorovich (1893-1955). Associate professor, major general of medical service, chief epidemiologist of the Southern and North Caucasian Fronts.

BEZPROZVANNY Matvey Lvovich (1900-1978). Associate professor, colonel of medical service, chief epidemiologist of the 2nd Ukrainian Front.

BENYAMINSON Evgeny Sergeevich (1890-1977). Associate professor, colonel of medical service, chief epidemiologist of the Reserve, Voronezh and 1st Ukrainian fronts.

BERMAN Victor Mikhailovich (1897-1969). Professor, colonel of medical service, chief epidemiologist of the Northern Front.

VISKOVSKY Stefan Valerianovich (1892-1953). Honored scientist of the RSFSR, professor, colonel of medical service, chief epidemiologist of the Leningrad Front.

GRABOVSKY Boris Stefanovich (1907-1984). Colonel of medical service, chief epidemiologist of the 2nd Baltic Front.

GROMASHEVSKY Lev Vasilevich (1887-1980). Academician of the USSR Academy of Medical Sciences, honored scientist of the Ukrainian SSR, 1st rank military doctor, chief epidemiologist of the Transcaucasian Front.



Рис. 1. Главный эпидемиолог Красной Армии в 1941-1943 гг. И.Д.Ионин
Fig. 1. Chief Epidemiologist of the Red Army in 1941-1943, I.D. Ionin



Рис. 2. Главный эпидемиолог Красной Армии в 1943-1947 гг. Т.Е.Болдырев
Fig. 2. Chief Epidemiologist of the Red Army in 1943-1947, T.E. Boldyrev



Рис. 3. Главный эпидемиолог Северного фронта В.М.Берман
Fig. 3. Chief Epidemiologist of the Northern Front, V.M. Berman



Рис. 4. Главный эпидемиолог Ленинградского фронта С.В.Висковский
Fig. 4. Chief Epidemiologist of the Leningrad Front, S.V. Viskovskiy



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Рис. 12. Главный эпидемиолог Тихоокеанского флота А.С.Каплан
Fig. 12. Chief Epidemiologist of the Pacific Fleet, A.S. Kaplan

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KEY INDICATORS OF HEALTH AND MORBIDITY STRUCTURE OF INCIDENCE
OF POLICE OFFICERS, FIREMEN AND SERVICEMEN OF THE RUSSIAN FEDERATION

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Abstract. *The purpose of the study* is to assess the main indicators of health status as well as the structure of overall morbidity of employees of the Ministry of Internal Affairs of Russia in 2015–2019 on the basis of long-term data. Authors compare them with the corresponding indicators of the employees of the Federal Fire Service of the State Fire Service of the EMERCOM of Russia and of the contract servicemen, including officers, of the Armed Forces of the Russian Federation.

Materials and research methods. The materials of medical reports on the health status of police officers were analyzed, which contained generalized medical and statistical data on the overall morbidity of all police officers who served in 2015–2019. The comparison of these indicators with the indicators of the employees of the State Fire Service of the Ministry of EMERCOM of Russia and of military personnel under the contract, including officers, of the Armed Forces of the Russian Federation, is made.

Research results and their analysis. Analysis of health indicators of police officers for 2014–2019 showed that the effectiveness of preventive measures was quite high: about 90% of employees were classified as "healthy" and "practically healthy"; almost every police officer applied for medical help every year.

It was noted that the indicators of the health status of the police officers were similar to those of the military personnel of the Armed Forces and the employees of the State Fire Service of the EMERCOM of Russia. At the same time, the level of general morbidity and mortality was significantly lower among the police officers, in comparison with the military personnel of the Armed Forces, but there were more cases and days of temporary disability. In comparison with the employees of the State Fire Service of the Ministry of EMERCOM of Russia, the police officers had significantly lower "primary access to disability", etc.

It is concluded that data on the health status of police officers can serve as a starting point in the work on further improving the system of medical support for police officers.

Key words: *Armed Forces of the Russian Federation, disability, dispensary registration groups, employees, general morbidity, health status, military personnel, Ministry of Internal Affairs of Russia, mortality, State Fire Service of the EMERCOM of Russia, temporary disability*

Conflict of interest. The authors declare no conflict of interest

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ОСНОВНЫЕ ПОКАЗАТЕЛИ СОСТОЯНИЯ ЗДОРОВЬЯ И СТРУКТУРА ЗАБОЛЕВАЕМОСТИ
СОТРУДНИКОВ ОРГАНОВ ВНУТРЕННИХ ДЕЛ, ФЕДЕРАЛЬНОЙ ПРОТИВОПОЖАРНОЙ
СЛУЖБЫ ГОСУДАРСТВЕННОЙ ПРОТИВОПОЖАРНОЙ СЛУЖБЫ МЧС РОССИИ
И ВОЕННОСЛУЖАЩИХ ВООРУЖЕННЫХ СИЛ РОССИЙСКОЙ ФЕДЕРАЦИИ

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Резюме. *Цель исследования* – на основе многолетних данных оценить основные показатели состояния здоровья и структуру общей заболеваемости сотрудников органов внутренних дел (ОВД) МВД России за 2015–2019 гг. и сравнить их с соответствующими показателями сотрудников Федеральной противопожарной службы Государственной противопожарной

службы (ФПС ГПС) МЧС России и военнослужащих по контракту, в том числе офицеров, Вооруженных Сил (ВС) Российской Федерации (Вооруженные Силы).

Материалы и методы исследования. Проанализированы материалы медицинских отчетов о состоянии здоровья сотрудников ОВД, в которых содержались обобщенные медико-статистические данные об общей заболеваемости всех сотрудников ОВД, проходивших службу в 2015–2019 гг. Выполнено сравнение указанных показателей с показателями сотрудников ФПС ГПС МЧС России и военнослужащих по контракту, в том числе офицеров, ВС Российской Федерации.

Результаты исследования и их анализ. Анализ показателей состояния здоровья сотрудников ОВД за 2014–2019 гг. показал, что эффективность профилактических мероприятий, проводившихся среди данного контингента, была достаточно высокой: около 90% сотрудников относились к группам диспансерного учета «здоровые» и «практически здоровые»; за медицинской помощью ежегодно обращался почти каждый сотрудник ОВД.

Отмечено, что показатели состояния здоровья сотрудников ОВД имели сходство с аналогичными показателями военнослужащих Вооруженных Сил и сотрудников ФПС ГПС МЧС России. В то же время у сотрудников ОВД, по сравнению с военнослужащими ВС, был достоверно ниже уровень общей заболеваемости и смертности, но было больше случаев и дней временной утраты трудоспособности. При этом, по сравнению с сотрудниками ФПС ГПС МЧС России, у сотрудников ОВД был достоверно ниже «первичный выход на инвалидность» и др.

Сделан вывод, что данные о состоянии здоровья сотрудников ОВД могут стать отправной точкой в работе по дальнейшему совершенствованию системы медицинского обеспечения сотрудников органов внутренних дел МВД России.

Ключевые слова: военнослужащие, Вооруженные Силы Российской Федерации, временная нетрудоспособность, группы диспансерного учета, инвалидизация, общая заболеваемость, органы внутренних дел МВД России, смертность, состояние здоровья, сотрудники, Федеральная противопожарная служба Государственной противопожарной службы МЧС России

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Service and professional activities of police officers to ensure public safety, law enforcement and fight against crime take place in extreme conditions and are linked to many stress factors that adversely affect their health [1]. Irregular working hours, constant threat to life and health, occupational stress and a number of other factors contribute to stress and depletion of the body's functional reserves, which inevitably leads to the development of diseases, disability and even to death [1, 2].

The monograph by V. I. Evdokimov, S. S. Aleksanin and E. V. Bobrinev presents the results of a comparative medical and statistical analysis of health indicators, including morbidity, of employees of the State Fire Service (FFS) in 1996–2015 as well as of the military personnel — officers and servicemen under contract: privates, sergeants, foremen — of the Armed Forces. The authors made conclusion about the influence of the professional activity of the indicated contingents on their health, on the formation of somatic pathology, on the structure of morbidity, labor loss and mortality [3].

However, there is no systematic data on similar indicators for police officers.

A number of works present data on the peculiarities of mental maladjustment of police officers, on risk factors for diseases, as well as on the results of assessing their psychological status and prenosological mental pathology [2]. However, there is no detailed analysis of the health status of police officers.

It should be emphasized that the data on the main indicators of the state of health and on the structure of morbidity of police officers need to be generalized and are the basis for further improvement of the system of medical support for police officers.

The purpose of the study is to assess the main indicators of health status and the structure of morbidity among Russian police officers in 2015–2019 on the basis of long-term data.

Materials and research methods. We analysed the data of annual medical reports on the health status of police officers, which provided generalized statistical information (more than 3 million observations) on the health status of all police officers who served in 2015–2019. Generalized medical and statistical indexes were calculated. They characterize the main indicators of health status: coverage with preventive medical examinations, level and structure of morbidity, primary disability, labor losses (cases and duration) and mortality among police officers. The calculation of the incidence rate (per 1,000 employees or per thousand) and the morbidity structure (as a percentage of the total number of diseases for each year and in general) was carried out according to the classes of diseases of the International Classification of Diseases and Related Health Problems, 10th revision — ICD-10.

The long-term indicators of the health status of police officers is represented by the arithmetic mean values and their standard errors, which were compared using Student's t-test, as well as Spearman's rank correlation.

Research results and their analysis. The main indicators of the health status of police officers in 2015–2019 are presented in Table 1.

The main indicators of the health status of police officers in 2014–2019 represent the following:

- effectiveness (based on the evaluation of the volume of services) of preventive measures is quite high — "coverage by preventive medical examinations" is $(96.27 \pm 0.10)\%$;
- majority of employees have a fairly high level of health status — groups I and II of dispensary registration — "healthy"

and "practically healthy" — include (88.27 ± 0.10)% of employees;

- level of general morbidity for 5 years was (907.80 ± 10.1) ‰, i.e. almost each police officer applied for medical help every year;

- level of disability is quite high — annually more than 700 employees leave the service for health reasons and receive a primary disability group;

- cases of labor losses among employees averaged (54.92 ± 0.13)%, i.e. every second employee got a certificate of temporary incapacity for work ("sick leave") due to illness within each year. Average duration of temporary disability was (12.66 ± 0.1) days;

- mortality rate among police officers is also high and amounts to 0.78 ‰, i.e. more than 500 employees die every year, including more than 100 in the line of duty.

It seems relevant to compare the main indicators of the health status of police officers with the available data on servicemen (officers and servicemen under contract): privates, sergeants, foremen of the Armed Forces and employees of the State Fire Service of the Ministry of Emergency Situations of Russia, who also perform professional activities in extreme conditions. However, their tasks and conditions of their implementation differ from those of police officers (Table 2).

As can be seen from the data in the Table 2, the main indicators of the health status of the three compared contingents of "law enforcement agencies" do not differ significantly, with the exception of three indicators: "morbidity" (the level of general morbidity) and "mortality" among police officers are significantly lower compared to military personnel of the Armed Forces, and "the number of days of temporary disability"— significantly higher in comparison with military personnel and employees of the State Fire Service.

Application of the Spearman rank correlation method showed the identity of three rows of medical and statistical indicators of the health status of police officers, military personnel of the Ministry of Defense and employees of the State Fire Service of the Russian Emergencies Ministry, $p < 0.01$.

Consequently, the health indicators of police officers (data for 2015–2019) are similar to those of military personnel of the Armed Forces (data for 2003–2015) and employees of the State Fire Service of the Russian Emergencies Ministry (data for 1996–2015 and 2010–2017) — [3–6].

However, police officers have significantly lower levels of general morbidity and mortality compared to military personnel, but the number of cases and days of temporary disability is higher. At the same time, in comparison with the employees of the State Fire Service of the Ministry of Emergency

Таблица 1/ Table No. 1

Основные показатели состояния здоровья сотрудников ОВД в 2015–2019 гг.

Main indicators of the health status of employees of internal affairs institutions (OVD) 2015–2019

Показатель состояния здоровья Health indicator	2015	2016	2017	2018	2019	$\bar{x} \pm m$
Охват сотрудников профилактическими медицинскими осмотрами, % Coverage of employees with preventive medical examinations, %	96,59	95,9	96,1	96,54	96,21	96,27±0,10
Отнесены к I и II группам диспансерного учета – «здоровые» и «практически здоровые», %/Attributed to groups I and II of dispensary registration – "healthy" and "practically healthy", %	87,61	87,89	88,29	88,59	89,00	88,27±0,10
Общая заболеваемость, ‰/General morbidity, ‰	1004,44	910,37	880,34	872,59	871,27	907,80±10,1
Первичный выход на инвалидность, ‰/Primary disability, ‰	1,38	1,24	1,09	0,91	0,84	1,09±0,06
Число случаев ВУТ*, на 100 чел./Number of temporary loss of working capacity cases, per 100 people	60,27	54,42	50,66	54,41	54,83	54,92±0,13
Число дней ВУТ, на 100 чел./Number of days of temporary loss of working capacity, per 100 people	762,05	688,75	638,93	694,98	694,54	695,85±5,01
Средняя продолжительность ВУТ, сут./Average duration of temporary loss of working capacity, days	12,58	12,66	12,61	12,77	12,67	12,66±0,1
Смертность, ‰/Mortality, ‰	0,93	0,77	0,77	0,74	0,71	0,78±0,01

* ВУТ – временная утрата трудоспособности /Temporary loss of working capacity cases

Таблица 2/ Table No. 2

Основные показатели состояния здоровья сотрудников ОВД, военнослужащих Минобороны России и сотрудников ФПС ГПС МЧС России

Main indicators of health status of police officers, of military personnel of the Russian Ministry of Defense and of employees of the State Fire Service of the EMERCOM of Russia

Показатель состояния здоровья Health indicator	Сотрудники ОВД – группа 1 Police officers – group No. 1	Военнослужащие [4] – группа 2 Military personnel – group No. 2	Сотрудники ФПС ГПС [3, 5, 6] – группа 3 Employees of the State Fire Service of the EMERCOM of Russia – group No. 3	Достоверность различий между группами, P< The reliability of differences between groups, P<		
				gr.1/gr.2	gr.1/gr.3	gr.2/gr.3
Заболеваемость, ‰/Morbidity, ‰	907,80±50,1	1152,0±63,9	1067,0±56,1	0,01	0,05	–
Первичный выход на инвалидность, ‰/Primary disability, ‰	1,09±0,06	ДО /NA*	1,69±0,07	–	0,01	–
Число случаев ВУТ, ‰/Number of temporary loss of working capacity cases, ‰	549,2±31,3	499,6±30,7	419,3±28,3	–	0,01	0,05
Число дней ВУТ, ‰/Number of days of temporary loss of working capacity, ‰	6958,5±30,1	4150±30,7	5259±34,5	0,001	0,001	0,001
Соотношение день/случай ВУТ, абс./Correlation of day/case of temporary loss of working capacity	12,65±0,28	8,53±0,35	12,55±0,17	0,01	–	0,01
Смертность, ‰/Mortality, ‰	0,78±0,05	1,21±0,06	1,096±0,06	0,001	0,01	0,05

* ДО – данные отсутствуют / NA – no data available

Situations of Russia, the police officers have significantly lower level "primary disability".

It should be noted that among men of working age, citizens of the Russian Federation, the mortality rate is significantly higher. It reached $(10.41 \pm 4.68) \%$ in 2003-2015 [3].

Apparently, this is due to the high health requirements of candidates for service in the Ministry of Internal Affairs, in the Armed Forces and in the Ministry of Emergency Situations of Russia, as well as to a developed system of their medical support, focused on maintaining their health.

Table 3 shows data on the structure of the general morbidity of the police officers in 2015–2019. Data is presented separately for each year. Also there is an averaged data for the specified period, as well as rank significance and rank place (R) for each group of diseases.

As can be seen from these data, the following diseases dominate in the structure of the general morbidity of the police officers: "respiratory diseases" (J00-J98, R = 1); "diseases of the musculoskeletal system and connective tissue" (M00-M99, R = 2); "diseases of the circulatory system" (I00-I99, R = 3); "diseases of the digestive system" (K00-K93, R = 4); "injuries, poisoning and some other consequences of external causes" (S00-S93, R = 5), the share of which in the overall structure of disease groups was about 70%.

This information is consistent with the data of V.I. Evdokimov et al., who analyzed the state of health of the Armed Forces officers and noted that in 2003–2015 in the structure

of the general morbidity of officers, "respiratory diseases" (J00-J98, R = 1), "diseases of the musculoskeletal system and connective tissue" (M00-M99, R = 2), "diseases of the circulatory system" (I00-I99, R = 3), "diseases of the digestive system" (K00-K93, R = 4), "diseases of the skin and subcutaneous tissue" (L00-L99, R = 5) dominated. The share of them also amounted to about 70% in the structure of morbidity of the officers [4].

Consequently, the structure of the main classes of diseases in police officers and in Armed Forces officers has pronounced similarities. The difference lies in the high significance of the 19th class of diseases among the police officers. "Injuries, poisoning and some other consequences of external causes" (S00-S93, R = 5) have the 5th rank significance for them. While among the officers of the Armed Forces it has the 8th rank significance in the structure of general morbidity. In our opinion, this is due to a high importance in the daily service and professional activities of police officers of the factor of forceful counteraction to criminals and violators of law and order who injure police officers.

Conclusion

1. Service and professional activities of police officers take place in extreme conditions that have an adverse effect on their health. The results of the assessment of the main indicators of the state of health and of the structure of the general morbidity of police officers made it possible to note some similarities and a number of differences in comparison with the

Таблица 3/ Table 3

Структура общей заболеваемости сотрудников ОВД в 2015–2019 гг., %
Structure of police officers' general morbidity 2015–2019, %

Наименование заболевания Classes of diseases	Шифр по МКБ-10-го пересмотра ICD Code - 10th revision	2015	2016	2017	2018	2019	$\bar{x} \pm m$	R
Некоторые инфекционные и паразитарные болезни Some infectious and parasitic diseases	A00-B99	2,22	2,23	2,20	2,28	2,13	2,21±0,02	12
Новообразования / Neoplasms	C00-D48	1,99	2,03	2,25	2,29	2,19	2,15±0,06	11
Болезни крови, кроветворных органов и отдельные нарушения, вовлекающие иммунный механизм Diseases of the blood, hematopoietic organs and individual disorders involving the immune mechanism	D50-D89	0,36	0,39	0,43	0,47	0,50	0,43±0,03	16
Болезни эндокринной системы, расстройства питания и нарушения обмена веществ Diseases of the endocrine system, eating disorders and metabolic disorders	E00-E89	4,05	4,03	3,7	3,54	3,80	3,82±0,10	8
Психические расстройства и расстройства поведения Mental and behavioural disorders	F00-F99	0,74	0,7	0,64	0,61	0,71	0,68±0,02	14
Болезни нервной системы Diseases of the nervous system	G00-G98	2,30	2,4	2,3	2,39	2,60	2,40±0,06	10
Болезни глаза и его придаточного аппарата Diseases of the eye and its appendage	H00-H59	7,84	6,67	5,54	4,97	4,96	6,00±0,56	7
Болезни уха и сосцевидного отростка Ear and mastoid diseases	H60-H95	1,88	2,03	1,94	2,07	1,94	1,97±0,03	13
Болезни системы кровообращения Diseases of the circulatory system	I00-I99	8,82	9,02	9,33	9,58	9,36	9,22±0,12	3
Болезни органов дыхания /Respiratory diseases	J00-J98	32,00	32,5	32,57	32,04	32,21	32,26±0,12	1
Болезни органов пищеварения / Digestive diseases	K00-K92	8,06	8,06	8,19	8,45	8,55	8,26±0,10	4
Болезни кожи и подкожной клетчатки Diseases of skin and subcutaneous tissue	L00-L98	3,05	3,14	3,16	3,29	3,21	3,17±0,04	9
Болезни костно-мышечной системы и соединительной ткани Musculoskeletal and connective tissue diseases	M00-M99	11,26	11,3	12,13	12,08	11,73	11,7±0,19	2
Болезни мочеполовой системы / Urogenital diseases	N00-N99	6,09	6,0	6,15	6,49	6,47	6,24±0,10	6
Травмы, отравления и некоторые другие последствия воздействия внешних причин Injuries, poisoning and some other consequences of external causes	S00-T98	7,64	7,7	7,86	7,6	7,53	7,67±0,06	5
Прочие / Other	–	1,40	0,6	0,34	0,56	0,62	0,70±0,18	15
Всего / Total	A00-T98	100,0	100,0	100,0	100,0	100,0	100,0	1-16

military personnel of the Ministry of Defense of Russia and employees of the state fire service of the EMERCOM of Russia.

2. The main indicators of the health status of police officers, military personnel of the Armed Forces and employees of the State Fire Service of the Russian Emergencies Ministry are practically the same, which, in our opinion, is explained by the high health requirements of candidates for service in the Ministry of Internal Affairs, in the Armed Forces and in the Ministry of Emergency Situations of Russia, as well as by a fairly developed system of their medical support, focused on the preservation and maintenance of their health.

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MEDICAL SAFETY ASSESSMENT AT SKI RESORTS OF THE RUSSIAN FEDERATION

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Abstract. Within recent years, the number of ski tourists in the world has been growing. Taking into account the barriers to abroad tourism in 2020–2021, in the coming years, a significant increase in the flow of ski tourists to ski resorts of Russia should be expected. At the same time, it should be emphasized that the level of injuries at Russian ski resorts remains quite high, one of the reasons for which is an insufficiently developed regulatory and legal framework for medical safety of ski resorts.

The aim of the study is to classify ski resorts in Russia by level of their medical safety based on the developed criteria.

Materials and research methods. A survey of 271 employees and visitors of ski resorts was carried out. According to its results and taking into account their own experience, the authors identified 20 criteria that affect medical safety of ski resorts. The specified criteria were divided into 5 groups: "Facility design", "Administration of ski resort", "Maintenance of routes", "Rescue service", "Medical assistance and medical evacuation".

Research results and their analysis. A point scale for assessing medical safety of ski resorts is proposed with the cumulative final results defined as: "insufficient level", "minimum sufficient level", "moderate level", "maximum level".

According to these criteria, an assessment was made of 21 ski resorts in Russia and in the neighboring countries, as a result of which only 4 ski resorts (19%) corresponded to the maximum level of medical safety; to the moderate -- 16 ski resorts (76.2%). These results generally coincided with the opinion of the expert community, which supports the effectiveness of the developed classification.

Conclusions are made about the need to introduce this classification into the system of assessment and of certification of ski resorts and about the necessity to widely communicate the results of the assessment to visitors of ski resorts.

Key words: classification, criteria, medical safety, point score, Russian Federation, ski resorts

Conflict of interest. The authors declare no conflict of interest

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ОЦЕНКА МЕДИЦИНСКОЙ БЕЗОПАСНОСТИ НА ГОРНОЛЫЖНЫХ КОМПЛЕКСАХ РОССИЙСКОЙ ФЕДЕРАЦИИ

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Резюме. В последние годы в мире растет число горнолыжных туристов. С учетом сложностей зарубежного туризма в 2020–2021 гг., в ближайшие годы следует ожидать существенного увеличения потока горнолыжных туристов на горнолыжные комплексы (ГК) России. При этом следует подчеркнуть, что уровень травматизма на ГК России остается довольно высоким. Одна из причин этого – недостаточно развитая нормативно-правовая база медицинской безопасности горнолыжных комплексов.

Цель исследования – классификация горнолыжных комплексов России по уровню их медицинской безопасности на основе разработанных критериев.

Материалы и методы исследования. Проведено анкетирование 271 сотрудника и посетителя ГК, по результатам анкетирования и с учётом собственного опыта автора определены 20 критериев, в наибольшей степени влияющих на медицинскую безопасность ГК. Указанные критерии были разделены на 5 групп: «Проектирование объекта», «Администрирование ГК», «Обслуживание трасс», «Спасательная служба», «Медицинская помощь и медицинская эвакуация».

Результаты исследования и их анализ. Предложена балльная шкала оценки медицинской безопасности ГК с вариантами итогового результата по соблюдению условий их медицинской безопасности: «недостаточный уровень», «минимально достаточный уровень», «умеренный уровень», «максимальный уровень».

По этим критериям дана оценка 21 ГК в России и ближнем зарубежье, в результате которой максимальному уровню медицинской безопасности соответствовали только 4 ГК (19%); умеренному – 16 ГК (76,2%). Эти результаты в целом совпали с мнением экспертного сообщества, что свидетельствует об эффективности разработанной классификации.

Сделаны выводы о необходимости внедрения данной классификации в систему оценки и сертификации горнолыжных комплексов с широким информированием посетителей ГК о полученных результатах.

Ключевые слова: горнолыжные комплексы, классификация, критерии, медицинская безопасность, оценка в баллах, Российская Федерация

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Globally, the level of injuries among fans of ski tourism ranges from 0.6 to 4.1 cases per 1,000 visits [1-3]. There is no centralized collection of ski injury data in the Russian Federation. According to the internal reporting documentation, at the largest ski resorts of the country — Rosa Khutor, Sorochany, Mountain Air and others, this figure ranges from 1.5 to 2.5 incidents per 1,000 visits.

According to the Federal Tourism Agency, for the ski seasons 2015–2017, tourist flow at Russian resorts and recreation centers amounted to more than 6 million people per year [4]. Even if we estimate very roughly the frequency of visits to ski resorts by each tourist of 1-2 times per season, we can predict up to 30 thousand traumatic incidents.

Such an "additional" flow of patients increases the load on the territorial medical infrastructure in the regions where the ski resorts operate, and requires creation of a system for providing medical assistance to victims from the moment of injury to discharge from the hospital.

Unfortunately, in the Russian standards for the design of industrial facilities, the concept of a ski track as a sports building structure is absent. Therefore, not a single SNIP and SANPiN contains safety requirements that are mandatory for the design of such facilities.

In the ski industry, despite the adoption of a number of normative legal acts, there is still a deficit in the legislative framework for the safety requirements for ski tourism. To date, there are no normatively fixed criteria for a comprehensive assessment of medical safety at ski resorts. In the existing regulations, the issues of ensuring the medical safety of skiers are covered fragmentarily, in a number of cases — in a contradictory way^{1,2,3}. None of these regulations contain a comprehensive assessment methodology that would allow potential visitors to make an independent conclusion about the safety of the services provided at the ski resort. Also, they do not provide the specialists of the ski resort with a comprehensive approach to the organization of a system for preventing medical incidents and effective assistance to potential victims.

The aim of the study is to classify the ski resorts in Russia according to the levels of their medical safety based on the developed criteria.

Materials and research methods. At the first stage, a survey was conducted, which included 271 employees and visitors of the ski resort, as well as employees of emergency rescue teams and other operational services involved in providing assistance to victims on the ski slopes. Based on the results of this survey, it was decided to divide the ski resort into 3 safety levels: minimum sufficient, moderate and maximum. The division is based on the 20 most significant, in our opinion, criteria that allow us to assess the peculiarities of the functioning of the ski resort from the point of view of the medical safety of skiers and visitors. These 20 indi-

¹ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts"

² GOST 57279-2016 "Assessment of the services of ski resorts"

³ On the approval of the procedure for the classification of objects of the tourism industry, including hotels and other accommodation facilities, ski slopes and beaches, carried out by accredited organizations: order of the Ministry of Culture of Russia dated July 11, 2014 No. 1215, Appendix 19

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cators characterizing the effectiveness and conditions of providing assistance to victims on the territory of the ski resort were combined into 5 groups.

Research results and their analysis.**The first group — object design**

1.1. *The presence of tracks of "red"⁴ and "black"⁵ levels of difficulty in accordance with the classification of GOST R 55881-2016⁶.*

This indicator was adopted by us in view of an objective increase in risk when descending on the tracks of the "red" and "black" level. According to marketers, among the visitors of the ski resort, the slopes of the "blue" level of difficulty are most in demand, despite the fact that they are considered to be tracks for beginners. Even experienced skiers, who are aware of the complexity of the "red" and "black" slopes and adequately assess their strength, rarely spend the whole day on such slopes, preferring to alternate them with more gentle "blue" slopes. An increased risk of skiing on "red" and "black" slopes is associated with: their steeper slope and, therefore, with a higher kinetic energy of a likely fall or collision of skiers; a smaller width and less space for maneuvering when avoiding a collision; higher altitude and more severe climatic conditions (wind). In addition, due to the steepness of their slopes, the snow cover on "black" slopes is often not processed or is not properly processed by snow plowing machines, creating additional difficulties when maneuvering during downhill skiing.

1.2. *Availability of engineering protection of routes and supports of chairlifts from avalanches in potentially dangerous places.*

The most common threats to the normal operation of the gondola, chairlift and funicular-type suspended roads are avalanches and strong winds. The emergency automation of modern ropeways is configured to stop functioning independently when the wind load on the supports is higher than the maximum permissible value. This is done to prevent breakage of cabins and seats, as well as to prevent their dangerous rocking and grazing on the supports. However, such a stop of a cableway cabins leads to a temporary blocking of passengers in the seats and cabins of the road, which, in conditions of low temperatures and low mobility until the moment of unblocking, can lead to dangerous consequences for health.

The threat of damage of cableroad supports from avalanches is leveled by a whole range of measures, including forecasting avalanche formation, engineering structures, observation and active impact on avalanche-prone slope areas. Some of the most commonly used engineering structures include avalanche-diverting dams, avalanche breakers in front of cable car pylons, and snow-retaining nets in avalanche-prone areas.

Measures to eliminate the consequences of such situations should be spelled out in detail in a document called "Emergency Response Plan", drawn up individually for each specific facility.

⁴ "Red" track — a track of an average difficulty level

⁵ "Black" track — a track of a high level of difficulty

⁶ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts", Appendix D

1.3. *The nature of the road surface and the width of the road bed along the entire route to the nearest medical organization corresponding to the level III trauma center.*

The speed of medical evacuation of the victim from the territory of the ski resort to the hospital depends on the quality of the road. Many ski resorts being situated outside the boundaries of municipalities, in hard-to-reach areas, are forced to independently build a section of access roads and clean to it from snow. Sometimes it is a one- or two-lane dirt road, the sides of which on weekends, during a massive visit to the object, are filled with spontaneously parked cars, turning into an insurmountable obstacle for an ambulance car. Even 300-500 m of such a road can nullify the speed effect from a wide and cleaned track bed, passing not far from the main complex.

1.4. *Availability of a helipad or of a platform suitable for receiving helicopters at the facility.*

In global practice, ambulance helicopters remain the most prompt and effective means of medical evacuation of an injured person from the territory of the ski resort. Despite the low availability of this service in Russia and the ban on helicopter flights in the mountains at night, the possibility of a helicopter landing on the territory of the ski resort is a significant criterion for ensuring the medical safety of its visitors. A small number of ski resorts in Russia have a helicopter on their territory or on the sites next to it. In European countries, where the experience of organizing ski resorts is much bigger, the use of an ambulance helicopter to evacuate an injured skier is a routine event.

The second group is the administration of the ski complex

2.1. *Availability at the facility of a comprehensive plan for the elimination of consequences of possible emergencies.*

The creation of such a plan is the responsibility of the administration of a particularly dangerous facility. According to the law, almost all types of chairlifts represent such a facility. This document should serve as a basis for conducting regular trainings with employees and representatives of operational services to eliminate the consequences of possible emergencies. Therefore, this document must be adapted to the specific conditions of the facility. For example, when planning the actions of employees in the event of an emergency stop of the cable car and of blocking people in the cabins or on the seats, it is necessary to work out the most probable ways of unblocking and of lowering them, depending on the distance to the ground, ways of providing heating and protection from the wind, of providing the supply of drinking water while carrying out emergency work, taking into account the specifics of this facility.

2.2. *Possibility of calling the rescue service by the visitors of the ski resort; coverage of the track area with a stable radio signal for the rescue service.*

It is difficult to overestimate the importance of operational communication during rescue operations. Visitors should be able to call for help from anywhere in the ski resort and rescuers should be able to contact each other as well as the control and rescue point or the control room of the ski resort. In the case when this rule is not observed — such situations are not uncommon in conditions of a rough terrain — there is a threat of leaving the victim without any help at all, or there can be difficulties in obtaining assistance in the required amount. The issues of covering "dead zones" with a cellular or radio signal are solved by installing additional equipment for signal retransmission.

2.3. *Availability of staff responsible for the operation, maintenance and emergency response on the chair lifts.*

According to the current regulations, the administration of the ski resort must conclude an agreement for its maintenance with a professional emergency rescue team or create and certify such a formation in the structure of the ski resort. However, in the case of an agreement with a third-party professional rescue team and of an extraterritorial deployment of its employees, a prompt response to an emergency situation is not always possible. In addition, cable road, like any complex mechanism, requires timely maintenance and repair. The presence of ski resort employees responsible for this work makes it possible to make this segment of security more manageable, including by improving the qualifications of these employees in the company that manufactures ropeway equipment.

2.4. *Deadline for bringing the access road into working condition after snowfall in winter.*

The importance of the quality and accessibility of access roads has already been discussed. Prompt response to the condition of the roadway in case of a snowfall is one of the key tasks for ensuring the accessibility of the territory of the ski resort and, in particular, for a timely medical evacuation of the victim. The variability of the weather and the likelihood of heavy snowfalls, especially in mountainous areas, may require the involvement of considerable forces to solve this problem. A vivid illustration of this is the situation in the mountainous region of Valais and in the vicinity of the resort of Zermatt (Switzerland), where in January 2019, due to heavy snowfalls and avalanches, traffic on roads and railways was repeatedly stopped, blocking 9-13 thousand people for several days in villages and resorts [5-7].

The third group — maintenance of tracks

3.1. *The quality of the snow cover on the ski slopes according to GOST R 55881-2016⁷.*

The quality of the snow cover on the slope directly depends on the efforts applied to control the projectile — skis or snowboard, as well as the predictability of the trajectory of the skier during the descent. The presence of ice build-up, bare soil, bumps or holes on a slope greatly increases the likelihood of losing control of your ski or snowboard and a subsequent fall or collision. It should be noted that the importance of this factor for the safety and quality of skiing is indicated by all specialists and visitors who took part in the survey. However, due to the high cost of snow compacting machines, there is a shortage of this equipment on many of the Russian ski resorts.

3.2. *Marking of ski slopes and directions of movement in accordance with GOST R 55881-2016 8. Provision of slopes with safety equipment, marking and placement of information on ski slopes and slopes in accordance with GOST R 55881-2016⁹.*

High-quality, intuitive and clearly distinguishable track markings are one of the cornerstones of ensuring the safety of skiers. When descending, in conditions of frequently changing slope and direction of the track, it is critical for the skier and snowboarder to choose an appropriate direction and speed of movement and to unambiguously interpret the warning signs. Carefully fencing off dangerous areas, installing restraining nets at the edge of the track, and securing mats around obstacles can prevent a significant amount of injury while riding. At the same time, according to the

⁷ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts", Appendix B

⁸ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts", Appendix D

⁹ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts", Appendix E

opinion of employees and visitors, only a few of the ski resorts surveyed by us had a sufficient number of such security equipment.

3.3. *Regular monitoring and research of the snow cover for the presence of the danger of avalanches and taking measures for artificial avalanches in especially dangerous areas; use of the international scale for marking the avalanche danger of slopes with the provision of relevant information to visitors.*

Avalanches are one of the few natural disasters in mountainous areas that are permanent. Despite the fairly good knowledge of this phenomenon, no specialist will fully guarantee protection from avalanches in the mountains. Nevertheless, the constant monitoring of the state of the snow cover by specialists, forecasting the processes of crystallization of snow, construction of special engineering structures and possibility of actively influence on the slope, as well as artificial avalanches are important measures to protect skiers from this threat. The administration of the minor part of ski resorts surveyed by us pays sufficient attention to this aspect of security. For the sake of objectivity, it should be noted that not all ski resorts have a problem of avalanche danger on slopes — on hilly or flat terrain with man-made slopes, avalanche formation processes are excluded. Nevertheless, even the ski resorts in mountainous areas often does not have their own avalanche safety service. The observations of their respective specialists are carried out "by eye", without using the necessary measurements and methods. One of the options for solving this problem is the use of information from the avalanche service of the entire mountainous region in which the ski resorts are located, which does not take into account the individual conditions of the relief and microclimate of a particular ski resort and greatly reduces the effectiveness of anti-avalanche measures.

3.4. *Closing of routes in accordance with the working hours of employees serving the routes and cable cars, depending on weather conditions and on the danger of avalanches.*

Timely removal of skiers from a potentially dangerous track reflects the level of organization of the rescue service at a particular ski resort. Ideally, after several announcements on the loudspeaker about the closure of the route and the stopping of the cable car, the rescue service personnel, together with the employees of the route service, descend from the top point of the route and visually monitor the slope, helping those who cannot go down on their own, and setting signs prohibiting entry to the track. However, on some of the ski resorts, the process is limited only to announcements over the loudspeaker or even only to the stop of the cable car. It is easy to guess that there is a high probability of leaving an injured or lost skier on the track.

The fourth group — rescue service

4.1. *The presence of a specialized control and rescue service (ski patrol) with the necessary equipment at the facility.*

This is one of the key elements of ensuring the safety of the skiers on the slope. The functionality of the service employees is very diverse: control over the behavior of visitors; suppression of dangerous, aggressive skiing; help for those who are lost or tired; providing first aid to victims with their subsequent transportation to the place of meeting with the ambulance brigade; monitoring the state of the route, of its marking and of the safety of protective structures in hazardous areas, etc. But the main condition for the effective functioning of this service is the deployment of its employees on the territory of the ski resort and thus the possibility of a prompt response to emerging situations. When the admin-

istration of the ski resort uses the emergency services of the nearest municipality (NSR station, city rescue service, territorial search and rescue squad, etc.), the response time to an incident becomes poorly predictable.

4.2. *The established mode of operation of the object's rescue service.*

The rational use of human and material resources and the promptness of response to situations largely depend on the competent location of the employees of the control and rescue service of the ski resort and on the mode of their work. In the general case, it is optimal to locate control and rescue points with service personnel at the top points of the cable cars, so that all places of probable incidents are located down the slope. This makes it possible for service personnel to arrive at the scene of the incident with a minimum waste of time. An important addition to this scheme is the mode of constant patrolling of the slope by the service personnel: while one rescuer is going down the slope, the second is waiting for his return at the upper station of the cable car. Such a patrol scheme assumes a quick descent of the rescuer to any point on the slope in response to a call. The rest of the personnel with evacuation equipment stay in the control and rescue point, ready to move on command to the scene. With a large length of the main routes, such a scheme of the functioning of the rescue service makes it possible to minimize the time to detect the victim and to arrive to him.

However, such a scheme is not the only effective one. For example, with a short slope length and its good visualization, the control and rescue point can be located at the lowest point, near the base of the snowmobile equipment. This will allow rescuers to arrive quickly to any point on the slope.

4.3. *The rescue service employees have documents on training in the subject / topic / discipline "First aid" in the amount of at least 16 academic hours; regularity of their repeated training.*

Regular training in providing first aid to injured people on the slope allows to maintain the necessary skills, to develop muscle memory, which is important in stressful situations, and to develop soft skills — communication skills, self-organization, etc. A global trend in the development of first aid skills is to conduct repeated trainings every six months using simulation training equipment.

4.4. *Estimated time of arrival of the rescue service personnel to the victim.*

As the best indicator for this criterion, we took an interval of up to 10 minutes. Considering the fact that injuries prevail in the statistics of incidents on the slope, rescuers must be prepared to respond quickly to an incident and to provide assistance in case of profuse external bleeding, of shock trauma and of manifestations of shock in the victim. The time of arrival of rescuers depends on the area of the patrolled territory of the ski resort and on the adequate number of employees of the control and rescue service available. The standards set out in GOST R 55881-2016 — 3 rescuers per 10 hectares of surface¹⁰ — often need adjustments.

4.5. *Scheme and planned time of delivery of the victim to the medical center or evacuation site.*

In the chain of relief and life-saving of the victim, the time of transporting the victim from the slope is summed up with other time intervals. Based on the severity of the victim's con-

¹⁰ GOST R 55881-2016 "Tourist services. General requirements for the activities of ski resorts", Appendix E, clause 9.3

¹¹ On approval of the Procedure for the provision of ambulance, including specialized ambulance, medical care: order of the Ministry of Health of Russia dated June 20, 2013 No. 388n, Appendix 2, clause 6

dition, the time of his/her delivery to a medical institution should be shortened as much as possible. The value of the time interval largely characterizes the efficiency of the security system and the provision of assistance at a particular ski resort.

The fifth group — medical assistance and medical evacuation

5.1. Estimated time of arrival of the ambulance team.

According to the Procedure for the provision of ambulance, including specialized ambulance, medical care, the time of arrival of the ambulance brigade to the victim should not exceed 20 minutes¹¹. However, given the remoteness of ski resorts from the borders of the municipality, difficulties in approaching the territory of the ski resort, workload of the NSR stations with current calls and a number of other reasons, the time of arrival of the NSR brigade to the territory of the ski resort when called from the city can significantly increase. The optimal, but expensive solution to this problem may be the organization of a medical center on the territory of the facility or the involvement of ambulance teams under the contract.

The presence of medical workers on the territory of the ski resort to provide assistance to the injured is one of the main wishes of the employees of the ASF and other operational services involved in providing assistance to the injured on the ski slopes.

5.2. Estimated time of evacuation to a medical organization corresponding to a level III trauma center.

Focusing on the severity of the victim's condition, we conventionally adopted the concept of the "golden hour" as a starting point for calculating the optimal time intervals in the rescue chain, realizing that the time from the moment of injury or of development of an emergency to the start of surgery should be as short as possible. The interval of 10 minutes established by us as the optimal for this criterion can be implemented in practice in the case of the proximity of a medical hospital to the territory of the ski resort or when using an ambulance helicopter for medical evacuation of the victim.

5.3. Provision of medical care on the territory of the ski resort.

The availability of emergency medical care for an injured person on a ski slope is an ambiguous criterion. On one hand, the data of the survey of employees and visitors of the ski resort indicate the need for the presence of medical workers at the foot of the slope as one of the most important indicators of the safety of skiers. On the other hand, the organization of such medical support, as a rule, requires considerable financial expenses from the administration of the ski resort to obtain a license to provide medical care or to conclude an agreement with a third-party medical organization for the duty of a medical team on the territory of the ski resort during the operation of the facility. Other options are also possible. So, on the territory of the Russian Federation there are many ski resorts, the administration of which includes personnel with medical education in the rescue service of the facility. However, with this option, the provision of medical care without an appropriate license becomes unauthorized.

Evaluation of criteria in points

After the formulation and selection of criteria, each of them can be evaluated in points — 0, 1, 2. In case of non-compliance or minimum fulfillment of the requirements of the criterion, the examined ski resort is given 0 points; in case of incomplete fulfillment of the requirements, it is assigned 1 point; with full fulfillment of the requirements of the criterion — 2 points. The maximum possible amount for all sections is 40 points (see Table).

The sum of the indicators of the evaluated criteria gives us a new complex indicator — the index of medical safety of the ski resort. In our opinion, this index most fully reflects the expected effectiveness of rendering assistance to a visitor of the ski resort when he/she gets an injury or develops an emergency.

At the second stage of the study, we conducted a survey according to the selected criteria with an assessment of the results in points and with the assignment of the ski resort to one of the conditional levels of medical safety:

Insufficient level — less than 7 points — in our opinion, in such cases, visitors cannot be admitted to the ski resort.

The minimum sufficient level is 7-15 points.

Moderate level — 16-32 points.

The maximum level is 33-40 points.

The calculation of points was carried out on the basis of:

- publicly available data contained in publications about the ski resort;
- results of the questionnaire survey of employees and management of the ski resort;
- own observations.

For the survey, we selected ski resorts that comply with the mandatory norms of the current legislation. For example, the operation, the system of quick evacuation of passengers from any point of the cable cars, as well as all stages of the life cycle of the cable cars at the facility had to comply with the Safety Rules for passenger cable cars and funiculars¹².

We also introduced special conditions according to the criteria:

1.2. Availability of engineering protection of routes and supports of chairlifts from avalanches in potentially dangerous places.

2.4. Deadline for bringing the access road into working condition after snowfall in winter.

3.3. Regular monitoring and research of the snow cover for the presence of the danger of avalanches and taking measures for their artificial descent in especially dangerous areas; use of the international scale for marking the avalanche danger of slopes with the provision of relevant information to visitors.

According to the specified criteria, the ski resort score should have been at least 1 point for each criterion. If at least one of the criteria is assessed at 0 points, the operation of the ski resort, in our opinion, should be prohibited. Such conditions were introduced due to their importance for ensuring the safety of the cable car users, to combat the avalanche threat as the most probable natural emergency factor at the ski resort and to ensure unhindered medical evacuation of the victim from the territory of the ski resort.

In accordance with the developed criteria, an assessment of 21 ski resorts in Russia and neighboring countries was given. As a result, the following 4 objects (19.0%) were classified with the maximum level of medical safety:

- Rosa Khutor ski resort (33 points), which confirms the opinion of most experts and skiers about it as the leading ski resort in Russia;

- sports complex "Kant", located within the city of Moscow (33 points);

- Alpine skiing center "Abzakovo" (34 points) — a large all-season sports complex in the Republic of Bashkortostan;

¹² On approval of federal norms and rules in the field of industrial safety. Safety rules for passenger cable cars and funiculars: order of the Federal Service for Environmental, Technological and Nuclear Supervision dated 06.02.2014 No. 42

Оценка горнолыжных комплексов по критериям безопасности
Evaluation of ski resorts according to safety criteria

Группа / Group	Критерий / Criterion	Оценка, баллы / Assessment, points		
		0	1	2
1. Проектирование объекта Designing an object	Наличие трасс черного и красного уровня сложности в соответствии с классификацией Приложения Г ГОСТ Р 55881-2016 Presence of black and red level trails in accordance with the classification listed in Appendix G GOST R 55881-2016	Да, черные трассы – диапазон уклонов – >22° / > 40% Yes, black slopes – slope range – > 22° / > 40%	Да, красные трассы – диапазон уклонов трассы от 16 до 22° – от 25% до 40% Yes, red slopes – slope range 16 to 22° – 25% to 40%	Нет / No
	Инженерная защита трасс и опор канатных дорог от лавин в потенциально опасных местах Engineering protection of routes and ropeway supports from avalanches in potentially dangerous places	Нет / No	Да, по мнению проектировщиков Yes, according to designers	Предусмотрено при проектировании и обеспечено при строительстве Foreseen during design stage and provided during construction stage
	Характер дорожного покрытия и ширина полотна дороги на всем маршруте до ближайшей ЛМО, соответствующей травмоцентру III уровня Nature of road surface and road bed width along the entire route to the nearest medical organisation corresponding to the level III trauma center	Однополосная грунтовая Single-lane unpaved	Двухполосная грунтовая или однополосная с твердым покрытием Two-lane unpaved or single-lane paved	Двухполосная и шире с твердым покрытием Two-lane and wider paved
	Наличие на объекте вертолетной площадки или площадки, пригодной для приема вертолетов Availability of a helipad or of a platform suitable for receiving helicopters at the facility	Нет / No	Да – в дневное время Yes – in daytime	Да – пригодна к работе и в ночное время Yes – suitable for work at night
2. Администрирование ГК Administration of ski resort	Наличие на объекте комплексного плана ликвидации аварийных и чрезвычайных ситуаций Availability of a comprehensive emergency response plan at the facility	Нет / No	Да / Yes	Да – проведение тренировок с персоналом не реже одного раза в полгода Yes – training with personnel at least once every six months
	Возможность вызова спасательной службы посетителями ГК, покрытие площади трасс устойчивым радиосигналом для аварийной службы Possibility of calling the rescue service by the visitors of the ski resort, covering of the track area with a stable radio signal for the emergency service	Нет / No	Не по всей площади трасс Not over the entire trail area	Обеспечивается по всей площади трасс Provided over the entire trail area
	Наличие на объекте сотрудников, ответственных за функционирование, обслуживание и действия при аварийных ситуациях на ККД Availability of employees responsible for the operation, maintenance and actions in emergency situations at the chairlift	Да, но сотрудники не имеют специальной подготовки Yes, but employees have no special training	Да – специалисты проходят регулярную аттестацию в области промышленной безопасности Yes – specialists are regularly certified in the field of industrial safety	Да – специалисты проходят регулярную аттестацию в области промышленной безопасности, что подтверждается сертификатом официального производителя о прохождении обучения Yes – specialists undergo regular certification in the field of industrial safety, which is confirmed by a certificate of the official training centre
	Срок приведения подъездной дороги в рабочее состояние после снегопада в зимнее время, ч Time for bringing the access road into working condition after snowfall in winter	12 и более 12 hours and more	Менее 12 Less than 12 hours	Оперативное реагирование на текущее состояние подъездных путей Prompt response to the current state of access roads
3. Обслуживание трасс / Tracks maintenance	Качество снежного покрытия на горнолыжных трассах в соответствии с Приложением В ГОСТ Р 55881-2016 Quality of the snow cover on the ski slopes in accordance with Appendix B of GOST R 55881-2016	1-й вариант – ледяной склон, доля обработанных участков трассы – до 30% Option 1 – ice slope, share of processed route sections – up to 30%	Снег естественный или искусственный, подготовленный с помощью снегоуплотнительных машин (СУМ) на плотном грунте Snow, natural or artificial, prepared with snow compacting machines on dense ground	Снег плотный – естественный или искусственный – подготовленный с помощью СУМ, на плотном грунте без выбоин, бугров, ям и жестких комьев. Обнаженных участков – нет. Доля льдистых участков трассы – менее 10%

Группа / Group	Критерий / Criterion	Оценка, баллы / Assessment, points		
		0	1	2
		2-й вариант – снег на всем склоне не обработан снегоуплотнительной машиной, с большим количеством выбоин, бугров и ям. Доля обнаженных и льдистых участков – до 30% Option 2 – snow on the entire slope has not been processed by a snow compacting machine, with a large number of potholes, bumps and holes. Share of bare and icy areas – up to 30%	Наличие небольшого количества выбоин, бугров и ям. Доля льдистых участков трассы – до 30%. Обнаженные участки или мокрый снег – менее 10% трассы Presence of a small number of potholes, bumps and holes. Share of icy sections on the route is up to 30%. Bare sections or wet snow – less than 10% of the trail	Snow – natural or artificial – is dense, prepared with snow compacting machines, on dense ground, without potholes, bumps, pits and hard lumps. There are no exposed areas. Share of icy sections of the route is less than 10%
	Разметка горнолыжных трасс и направлений движения в соответствии с Приложением Д ГОСТ Р 55881-2016. Обеспеченность трасс средствами безопасности, маркировка и размещение информации на горнолыжных трассах и склонах в соответствии с Приложением Е ГОСТ Р 55881-2016 Marking of ski slopes and directions of movement in accordance with Appendix D GOST R 55881-2016. Security of the slopes with safety equipment, marking and placement of information on ski slopes in accordance with Appendix E of GOST R 55881-2016	Нет / No	Частично соответствует Partially compliant	Соответствует Compliant
	Регулярное наблюдение и исследование снежного покрова на предмет наличия опасности схода лавин и принятие мер для искусственного схода лавин на особо опасных участках. Использование международной шкалы маркировки лавиноопасности склонов с предоставлением информации посетителям Regular monitoring and examination of the snow cover looking for the presence of danger of avalanches and taking measures for making artificial avalanches in especially dangerous areas Use of the international scale for marking the avalanche hazard of slopes with the provision of information to visitors	Нет / No	Да / Yes	Да – наличие на объекте постоянной снеголавинной службы. Или отсутствие опасности схода лавин ввиду рельефа местности Yes – there is a permanent avalanche service at the facility. Or absence of danger of avalanches due to the terrain specifics
	Закрытие трасс в соответствии со временем работы обслуживающих трассы канатных дорог, а также ввиду погодных условий и существующей опасности схода лавин Closing slopes in accordance with operating hours of cable cars serving the trails, as well as due to weather conditions and existing danger of avalanches	Нет / No	Да, формальное с объявлением по громкой связи или на стендах Yes, formal, with an announcement over speakerphone or at stands	Да, с проверкой трасс после их закрытия силами сотрудников объекта Yes, with an inspection of tracks after they have been closed by facility staff
4. Спасательная служба / Rescue service	Присутствие на объекте специализированной контрольно-спасательной службы (лыжный патруль) с необходимым оборудованием в случае, когда трасса открыта Presence of a specialized control and rescue service (ski patrol) with all the necessary equipment, when track is open	Оказание помощи – не организовано First aid provision – not organized	Обслуживающий персонал объекта обучен приемам и обладает навыками оказания первой помощи Facility maintenance personnel are trained in techniques and first aid skills	В штате объекта собственная спасательная служба с необходимым снаряжением Facility has its own rescue service with all the necessary equipment
	Установлен режим функционирования спасательной службы объекта Operating mode of the object's rescue service has been established	Нет / No	Отправка лыжного патруля при поступлении сигнала о происшествии на трассе Ski patrol dispatch upon receipt of a signal about an incident on the track	Бесперебойное патрулирование трасс сотрудниками Trouble-proof patrolling of the tracks by employees
	Наличие у сотрудников спасательного формирования документов об обучении по предмету / теме / дисциплине «Оказание первой помощи» в объеме не менее 16 академических часов; регулярность повторного обучения Rescue team personnel have documents certifying their training in "First aid" discipline within at least 16 academic hours; regularity of retraining	Нет / No	Да. Повторное обучение реже одного раза за сезон. Re-training less than once a season.	Да. Повторное обучение не реже одного раза за сезон Re-training at least once a season

Группа / Group	Критерий / Criterion	Оценка, баллы / Assessment, points		
		0	1	2
	Расчетное время прибытия сотрудников спасательной службы к пострадавшему Estimated time of arrival of rescue service personnel to a victim	Нет службы или >30 мин No service or more than 30 min	11–30 мин 11–30 min	В пределах 10 мин Within 10 min
	Схема и планируемое время доставки пострадавшего до медицинского пункта или эвакуационной площадки Scheme and planned time of delivery of the victim to medical center or evacuation site	В порядке само- и взаимопомощи или более 30 мин Self-help and mutual help or more than 30 minutes	Силами спасательной службы в пределах 20 – 30 мин By rescue service within 20-30 minutes	Силами спасательной службы в пределах 20 мин By rescue service within 20 minutes
5. Медицинская помощь и медицинская эвакуация / Medical assistance and medical evacuation	Расчетное время прибытия бригады СМП Estimated time of arrival of ambulance team	Прибытие бригады СМП в срок свыше 20 мин после обращения или эвакуация попутным транспортом Arrival of ambulance team within 20 minutes after a call or evacuation by passing transport	Прибытие бригады СМП в течение 20 мин после обращения Arrival of ambulance team within 20 minutes after a call	Дежурство бригады СМП с транспортом в период нахождения на территории посетителей или прибытие бригады СМП в течение 5 мин после обращения Duty of an ambulance team with transport on the ski complex territory while visitors are there or arrival of ambulance team within 5 minutes after a call
	Расчетное время медицинской эвакуации до ЛМО, соответствующей травмоцентру III уровня Estimated duration of medical evacuation to medical organisation corresponding to the level III trauma center	Более 20 мин More than 20 min	В течение 11–20 мин Within 11-20 min	10 мин и менее 10 min or less
	Обеспеченность медицинской помощью на территории ГК Provision of medical care on the territory of ski resort	Нет / No	Присутствие на территории объекта медицинского работника при отсутствии у ГК лицензии на оказание медпомощи Presence of a medical worker on the territory of the facility if the ski resort does not have a license to provide medical care	Лицензированный медпункт в структуре объекта или дежурство бригады СМП/медработника в медпункте по договору во время работы подъемников Licensed first-aid post in the facility structure or contractual duty of ambulance team / paramedic in first-aid post during operation of ski elevators

- Sorochany ski resort (35 points) — the largest ski resort in the Moscow region.

Sixteen ski resorts (76.2%) were classified with a moderate level of medical safety. This category includes such popular ski resorts as the all-season resort Okhta Park in the Leningrad Region, the Sheregesh tourist center in the Kemerovo Region, the Bolshoi Vudayavr ski resort in the Murmansk Region, the Kholdomi mountain resort in the Khabarovsk Territory, the all-season tourist recreational complex "Arkhyz" in the Karachay-Cherkess Republic, the all-season "resort town" "Krasnaya Polyana" (formerly "Gorki Gorod" of the Krasnodar Territory), the ski resort "Mountain Air" in the Sakhalin Region, etc.

The tourist complex "Azish-Tau" (11 points) in the Republic of Adygea fell into the category of the minimum acceptable level of medical safety.

The data we have obtained coincide with the results of many unofficial surveys conducted on Internet forums, and with the conclusions of the experts of the ski industry on the quality and safety of services provided at the ski resorts of Russia [8–10].

It should be emphasized that the analysis of the conditions for the functioning of the ski resorts according to the selected criteria and an attempt to distribute them into conditional levels does not mean their division into good and bad. The proposed methodology makes it possible to identify risk factors and possibilities of providing assistance to victims at ski resorts. The presented classification of ski resorts can help the administration of individual ski resorts to form and to concretise development plans, as well as to create healthy competition to attract clients.

Conclusion

1. The proposed method for assessing the level of medical safety of ski resorts has demonstrated its viability. The results of its application coincide with expert assessments and can be used for inspection and certification of ski resorts.

2. The level of medical safety assigned to ski resorts should be included in their mandatory characteristics, and all consumers of services should be able to familiarize themselves with them.

3. Improving the level of medical safety will be a significant incentive for the further work of the administration of the ski resorts to improve the quality of service for ski tourists.

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ROAD TRANSPORTATION INJURIES ON THE FEDERAL HIGHWAY IN THE REGION WITH A LOW POPULATION DENSITY: RELEVANCE OF THE PROBLEM AND WAYS OF ITS SOLUTION

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Abstract. The purpose of the study is to use the example of the Arkhangelsk region to identify conditions affecting the organization of medical care for victims of road accidents on the federal highway in a region with a low population density, and to determine the main directions of its improvement.

Materials and research methods. Using the method of comparative analysis, the following review was carried out: review of the authors' studies, the subject of which was the features of road traffic injuries on the federal highway M-8 "Kholmogory" within the Arkhangelsk region; review of domestic and foreign scientific research, review of regulatory documents on the provision of medical assistance to victims of road accidents. Scientific literature search was performed in eLibrary, PubMed, Scopus systems by keywords. Scientific articles published in 1990–2020 were selected for analysis. Using the method of an organizational experiment, a scientific substantiation of a set of measures to improve the efficiency of the provision of medical care in prehospital and hospital periods to victims of road traffic accidents at federal highway in regions of the Russian Federation with a low population density was carried out. Applying the method of system analysis, on the basis of the results of this study, conceptual provisions for a systemic register of health consequences of road accidents in the Russian Federation have been developed and scientifically substantiated.

Research results and their analysis. The article describes road traffic injuries on the federal highway M-8 "Kholmogory" in the Arkhangelsk region. The factors that determine the effectiveness of the provision of medical care in prehospital and hospital periods to victims of road traffic accidents are considered. The ways of improving the provision of medical care to victims of road traffic accidents at federal highway in a region with a low population density are formulated and substantiated.

Key words: ambulance teams, Arkhangelsk region, federal highway M-8 "Kholmogory", hospital period, prehospital period, regions with low population density, road traffic accidents, road traffic injuries, victims

Conflict of interest. The authors declare no conflict of interest

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ДОРОЖНО-ТРАНСПОРТНЫЙ ТРАВМАТИЗМ НА ФЕДЕРАЛЬНОЙ АВТОДОРОГЕ В РЕГИОНЕ С НИЗКОЙ ПЛОТНОСТЬЮ НАСЕЛЕНИЯ: АКТУАЛЬНОСТЬ ПРОБЛЕМЫ И ПУТИ ЕЕ РЕШЕНИЯ

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Резюме. Цель исследования – на примере Архангельской области выявить условия, влияющие на организацию оказания медицинской помощи пострадавшим в дорожно-транспортных происшествиях (ДТП) на федеральной автодороге (ФАД) в регионе с низкой плотностью населения, и определить основные направления ее совершенствования.

Материалы и методы исследования. С использованием метода компаративного анализа выполнен обзор: результатов исследований авторов, предметом которых явились особенности дорожно-транспортного травматизма (ДТТ) на ФАД М-8 «Холмогоры» в пределах Архангельской области; результатов отечественных и зарубежных научных исследований, а также анализ нормативных документов по вопросам оказания медицинской помощи пострадавшим в ДТП. Поиск научной литературы выполнен в системах eLibrary, PubMed, Scopus по ключевым словам. Для анализа были отобраны научные статьи, опубликованные в 1990–2020 гг. С использованием метода организационного эксперимента выполнено научное обоснование проведения комплекса мероприятий по повышению эффективности и оптимизации оказания медицинской помощи в догоспитальном и госпитальном периодах пострадавшим в ДТП на ФАД в регионах Российской Федерации с низкой плотностью населения. Применяя метод системного анализа, на основе результатов настоящего исследования разработаны и научно обоснованы основные концептуальные положения системного регистра медико-санитарных последствий ДТП в Российской Федерации.

Результаты исследования и их анализ. Охарактеризован дорожно-транспортный травматизм на федеральной автодороге М-8 «Холмогоры» в Архангельской области. Рассмотрены факторы, определяющие результативность оказания медицинской помощи в догоспитальном и госпитальном периодах пострадавшим в ДТП. Сформулированы и обоснованы пути совершенствования оказания медицинской помощи пострадавшим в дорожно-транспортных происшествиях на ФАД в регионе с низкой плотностью населения.

Ключевые слова: Архангельская область, бригады скорой медицинской помощи, госпитальный период, догоспитальный период, дорожно-транспортные происшествия, дорожно-транспортный травматизм, пострадавшие, регионы с низкой плотностью населения, федеральная автодорога М-8 «Холмогоры»

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Introduction. Road traffic injuries remain one of the major problems in the organization of healthcare, disaster medicine, traumatology, emergency medical care and surgery [1-3]. Russian experts gave a comprehensive description of road traffic injuries, substantiated general principles of providing medical assistance to victims of road traffic accidents. At the same time, in the northern and eastern "marginal" regions of the country, characterized by a low population density and by significant distances between settlements and between medical organizations road traffic injuries have certain features that necessitate the use of different methods of medical support for victims of road accidents. These regions include the Arkhangelsk region, the area of which, together with the Nenets Autonomous Okrug, is comparable to the area of Spain and France, and the population density is less than 2 people per 1 square kilometre.

The leading motor transport artery of the Arkhangelsk region is the federal highway M-8 "Kholmogory" (hereinafter – M-8), which has the following features inherent in most northern routes: significant total length – more than 500 km; large spans – sections of the road between the nearest settlements and, accordingly, between the nearest medical organisations; tough road conditions – frequent fogs, low visibility in the autumn-winter and spring periods, strong side winds, frequent icing of the roadway. These factors significantly increase the risk of road traffic accidents with medical and sanitary consequences and negatively affect the timeliness of medical assistance to victims [4, 5].

Until now, the factors that determine the characteristics of road traffic trauma in a region with a low population density have not been comprehensively studied; in general, the problem of developing new methods of providing victims of such road accidents with timely and high-quality medical care remains unresolved.

The purpose of the study is to identify and to analyze the features of road traffic injuries on the federal highway M-8 "Kholmogory" in the Arkhangelsk region (the region with a low population density) and to determine the main ways of improving the provision of medical care to victims of road accidents.

Materials and research methods. An overview of the author's research results, the subject of which was the features of road traffic injuries at federal highway M-8 within the Arkhangelsk region, results of domestic and foreign scientific research, as well as analysis of regulatory documents on the problems of providing medical care to victims of road accidents is presented. Scientific literature search was performed in eLibrary, PubMed, Scopus systems by keywords. Scientific articles published in 1990–2020 were selected for analysis.

The study was conducted in accordance with the ethical standards set out in the Declaration of Helsinki. The research protocol was approved by the expert council on biomedical ethics of the Northern State Medical University, Arkhangelsk, protocol No. 08 / 11-17 of November 29, 2017.

Research results and their analysis. At the beginning of the XXI century in the Russian Federation, public attention is drawn to the problems of the Arctic. The fact of turning to the original Russian northern territories is associated with global climate change, with possibilities of long-term navigation and extraction of minerals, as well as with the need to strengthen national security. The strategic importance of northern and arctic regions is great for strengthening the economic and military power of Russia, for protecting and promoting Russian arctic interests [6–8]. The Russian Arctic includes large territories: the Murmansk Region, the Nenets, Yamalo-Nenets and Chukotka Autonomous Districts (AO), the northern regions of the Arkhangelsk and Magadan Regions, the Krasnoyarsk Territory, the Republics of Sakha (Yakutia), Karelia, Komi and others. It should be noted that these territories account for more than two-thirds of the area of our country.

As of January 1, 2020, average population density in the Russian Federation is 8.57 people per 1 km², and in the studied subjects of the Russian Federation (hereinafter – subjects) it varies from 2 to 1 person per 1 km², sometimes reaching values of less than 0.1 person per 1 km². Such a low population density in these regions developed historically and is due to the social foundations and customs of indigenous population. Underdeveloped road infrastructure, tough climatic, geographic and weather conditions and a high level of alcoholization in areas with low population density predetermine the specific features of both the occurrence of road traffic injuries with medical and sanitary consequences and the organization of medical care for victims in the prehospital and hospital periods [9, 10].

Number of road traffic injuries in these regions do not tend to decrease, and the results of treatment of victims with polytrauma on federal highways, in rural areas or in remote areas of these regions are usually unsatisfactory, which can be considered as a characteristic feature of Russian regions with low population density [11, 12].

Federal highways provide connection between these regions and with the rest of the territory of Russia, but the provision of medical assistance to victims of road accidents on these routes encounters significant difficulties [13–16].

At present, considering the provision of emergency medical care to victims of road accidents on the federal highway in the Arkhangelsk region, it can be concluded that despite the division of the region's territory into medical districts, there

is an extreme unevenness in the distribution of ambulance teams, as well as a clear lack of their number — so, in three large districts of the region: Kholmogorsky, Vinogradovskiy and Shenkurskiy (total length - about 380 km), through which the federal highway passes, emergency medical care is provided only by 8 ambulance teams that are not assigned to the highway, but serve calls from the districts of the Arkhangelsk region. Also, on the investigated federal highway there are no separate emergency response teams assigned to certain sections of it, and no route points to provide medical care to victims of road accidents [17].

A big problem for small central district hospitals located on federal highways in regions with a low population density is the arrival of more than two road accident victims — such a situation simply "paralyzes" the medical organization. Thus, in most of the small central district hospitals located at the federal highway in the Arkhangelsk Region, there is only one surgeon and one anesthesiologist-resuscitator; traumatologists-orthopedists, neurosurgeons, thoracic and abdominal surgeons, functional diagnosticians are almost completely absent, and the existing doctors are forced to combine several specialties, which affects the quality of the specialized medical care they provide. In many central district hospitals located on the federal highway, the medical equipment necessary for high-quality medical care in the hospital period to victims with severe multiple and concomitant injuries sustained in road accidents is obsolete.

Taking into account the territorial and geographical features of the regions of the Russian Federation, the organization of the sanitary aviation evacuation of victims of road accidents, especially from remote and hard-to-reach areas, is one of the highest priority measures to save lives and to preserve the health of victims. In a number of subjects of the Russian Federation (hereinafter referred to as the subject), the provision of emergency medical care is generally impossible without the use of medical aviation — Khanty-Mansi Autonomous Okrug, the Republic of Sakha (Yakutia), Chukotka Autonomous Okrug, the Komi Republic, Yamalo-Nenets Autonomous Okrug, Krasnoyarsk Territory and other regions of the Arctic, The Far North and equivalent territories [18–21].

Medical evacuation of victims of road accidents at M-8 federal highway is one of the most important components of the complex of treatment and evacuation measures in the system of their medical support in a region with a low population density. Currently, all victims who need medical evacuation are sent, in accordance with the routing approved by the Ministry of Health of the Arkhangelsk Region, to the level I trauma center "Arkhangelsk Regional Clinical Hospital".

The total number of medical evacuations of severe victims at federal highway is growing annually, amounting to about 500-600 departures per year, however, due to the long distance, as well as to tough climatic conditions (bad weather, strong winds, high clouds), delivery of the victim to the level I trauma center can be delayed for 1 day or more, which cannot but affect the patient's condition. In view of this, there is a need to revise and to change the routing of victims of road accidents on the M-8 federal highway in the southern districts of the Arkhangelsk region as they are the most remote from the regional center.

To reduce the volume of medical and sanitary consequences of road accidents; to achieve the target indicators determined by the Decrees of the President and the Decrees of the Government of the Russian Federation; to improve the technologies for providing medical care to victims

of road accidents at all stages, as well as to adapt them to the regional characteristics of subjects with special climatic and geographical conditions and to develop a mechanism for interaction between medical organizations performing the functions of trauma centers — it is necessary to build a system of information exchange among trauma centers and to organize monitoring of the health consequences of road accidents. Currently, the best solution for this is provided by the use of population registers, which are developed and successfully operate in many areas of medicine [22–24]. We propose to introduce a register, of distributed database type, which would allow: to generate and to store data on the diagnosis and treatment of victims of road accidents in the prehospital and hospital periods; to dynamically monitor their condition; to analyze in detail the lethality at all stages, as well as to assess the scale of road accidents both in the subject and in Russia as a whole. This register will assist in the development and adjustment of the routing of victims and will allow assessing the need for the regional health care system in material resources and in planning of its activities.

Conclusion

As forces and means of medical organizations available on the federal highway M-8 "Kholmogory" in the Arkhangelsk region are clearly not enough to provide a full-fledged medical care to victims of road accidents in the prehospital and hospital periods, it is necessary to justify and to develop a comprehensive system for providing the region with medical care. In our opinion, it is necessary:

1. To create emergency response teams with their attachment to a certain area of the M-8 federal highway for constant duty in order to provide emergency medical assistance to victims of road accidents. Each team should include 1 doctor and 1 paramedic or 2 qualified paramedics who have undergone mandatory training in providing emergency medical care to victims with severe multiple and concomitant injuries, as well as to victims of road accidents with more than two injured, including a driver. We consider it expedient and sufficient to create on the site for round-the-clock duty:

- one emergency response team — as part of the Severodvinsk emergency health care station;

- two emergency response teams — as part of the Arkhangelsk Regional Clinical Station of the emergency health care;

- one emergency response team as part of the Kholmogorsk Central Regional Hospital;

- one emergency response team — as part of Vinogradovskaya, Shenkurskaya and Velskaya central regional hospitals.

2. To re-equip the Yemetskaya regional hospital — a branch of the Kholmogorsk central district hospital — to the level III trauma center in order to eliminate more than 200-km gap on the M-8 federal highway, with an obligatory involvement of general surgeon, traumatologist-orthopedist and anesthesiologist-resuscitator, as well as with the purchase of all necessary equipment.

3. Equip a helipad, purchase a helicopter and organize the routing of victims of road accidents at the federal highway in the Shenkur and Velskiy districts to the level II trauma center — Velskaya central district hospital;

4. Create a systemic register of the medical and sanitary consequences of road traffic accidents in the Russian Federation and to manage it on a permanent basis in the Arkhangelsk region.

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SAFETY IN EMERGENCY ENVIRONMENT БЕЗОПАСНОСТЬ В ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЯХ

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SOME ISSUES OF OPTIMIZING MANAGEMENT ACTIVITIES IN ORGANIZING PROVISION OF MEDICAL CARE TO VICTIMS OF TERRORIST ACTS

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Abstract. *The purpose of the study is to develop and to substantiate proposals for optimizing management activities for organizing the provision of medical care and medical evacuation of victims of terrorist attacks with the use of explosive devices and conventional weapons.*

Materials and research methods. Research materials: normative and methodological documents regulating the procedure for management activities in the medical provision of the population affected in emergency situations; data of expert assessment maps on the research topic; scientific works and publications devoted to topical issues of management activities in the framework of the issue under study.

In the course of the study, the following scientific methods were used: methods of content analysis and expert assessment, statistical method, method of logical and information modeling, analytical method.

Research results and their analysis. The results of the study showed that one of the organizational issues in the system of countering terrorism and of organizing the elimination of medical and sanitary consequences of terrorist attacks is the presence of a coordinating management body, on which it is advisable to assign the appropriate functions to coordinate the activities of medical forces and means. In the course of the study, the rank value of each medical brigade and medical unit participating in the elimination of medical and sanitary consequences of terrorist attacks was determined; quality of methodological support for predicting medical and sanitary consequences of terrorist attacks and for planning the organization of medical assistance to victims of terrorist attacks has been studied; main methodological approaches that should be taken into account when planning the organization of medical care and medical evacuation of victims of terrorist attacks in each constituent entity of the Russian Federation were formulated; a list of most effective measures has been identified, which make it possible to increase the readiness of health authorities, medical units and organizations to work to save lives and to preserve the health of victims of terrorist attacks, etc.

Key words: *basic methodological approaches, forecasting, management activities, medical care, medical evacuation, medical teams and formations, methodological support, optimization, planning, rank value, standard measures, terrorist acts, victims*

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НЕКОТОРЫЕ ВОПРОСЫ ОПТИМИЗАЦИИ УПРАВЛЕНЧЕСКОЙ ДЕЯТЕЛЬНОСТИ ПРИ ОРГАНИЗАЦИИ ОКАЗАНИЯ МЕДИЦИНСКОЙ ПОМОЩИ ПОСТРАДАВШИМ В РЕЗУЛЬТАТЕ ТЕРРОРИСТИЧЕСКИХ АКТОВ *

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Резюме. *Цель исследования – разработать и обосновать предложения по оптимизации управленческой деятельности при организации оказания медицинской помощи и проведения медицинской эвакуации пострадавших при террористических актах с применением взрывных устройств и обычных средств поражения.*

Материалы и методы исследования. Материалы исследования: нормативные и методические документы, регламентирующие порядок управленческой деятельности при медицинском обеспечении населения, пострадавшего в чрезвычайных ситуациях (ЧС); данные карт экспертной оценки по теме исследования; научные работы и публикации, посвященные актуальным вопросам управленческой деятельности в рамках изучаемого вопроса.

В ходе проведения исследования применялись следующие научные методы: методы контент-анализа и экспертной оценки, статистический метод, метод логического и информационного моделирования, аналитический метод.

Результаты исследования и их анализ. Результаты исследования показали, что одним из организационных вопросов в системе противодействия терроризму и организации ликвидации медико-санитарных последствий терактов является наличие координационного органа управления, на который целесообразно возлагать соответствующие функции (полномочия) по координации деятельности медицинских сил и средств как при работе в режиме повседневной деятельности, так и при ликвидации медико-санитарных последствий терактов. В процессе исследования было определено ранговое значение каждой медицинской бригады и медицинского формирования, принимающих участие в ликвидации медико-санитарных последствий терактов; изучено качество методического сопровождения прогнозирования медико-санитарных последствий терактов и планирования организации оказания медицинской помощи пострадавшим при терактах; сформулированы основные методические подходы, которые следует учитывать при планировании организации оказания медицинской помощи и проведения медицинской эвакуации пострадавших при терактах в каждом субъекте Российской Федерации; выявлен перечень типовых наиболее результативных мероприятий, позволяющих повысить готовность органов управления здравоохранением, медицинских формирований и организаций к работе по спасению жизни и сохранению здоровья пострадавших при терактах и др.

Ключевые слова: медицинская помощь, медицинская эвакуация, медицинские бригады и формирования, методическое сопровождение, оптимизация, основные методические подходы, планирование, пострадавшие, прогнозирование, ранговое значение, террористические акты, типовые мероприятия, управленческая деятельность

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In the health sector of the country, a large range of program measures is being implemented, aimed at further development of the system of providing medical care, while ensuring an increase in its availability and quality. These measures include the creation of medical districts, of inter-municipal medical centers in the regions, as well as, on the basis of the integration of ambulance stations and territorial centers of disaster medicine — if unified regional centers of emergency and disaster medicine^{1,2} – [1, 2].

An important step here is to improve the management of the industry in general as well as the management of medical organizations and their activities in particular. There is no doubt that this direction should be developed in the system of medical support for the population affected in various emergency situations, including those caused by terrorist acts³ [3].

The results of studying the current regulatory and methodological documents of the Ministry of Health of Russia indicate that healthcare, including the Disaster Medicine Service of the Ministry of Health of Russia, taking an active part in eliminating the consequences of terrorist attacks, is not yet sufficiently “equipped” with comprehensively developed recommendations for the management. Some issues have to be addressed, in “improvisation” mode.

It should be noted that until now, on this problematic issue, there are only a few scientific works and methodological

documents concerning mainly the basics of managing medical forces and means when organizing provision of medical care and carrying out medical evacuation of victims in emergencies of natural and man-made character. As for terrorist acts, there are practically no such works and related documents [4–7].

Perhaps this is one of the reasons for a certain imperfection of the management activities of the Disaster Medicine Service of the regions related to this problem. This was confirmed by the results of scheduled inspections, exercises and trainings carried out by specialists from the All-Russian Center for Disaster Medicine “Zashchita”, as well as by the experience in eliminating medical and sanitary consequences of terrorist attacks [1, 2].

In modern times, when terrorist activity is growing, accumulated experience in eliminating medical and sanitary consequences of terrorist attacks requires comprehension and development on a scientific platform of proposals for optimization of management activities, both in preparing health care for responding to terrorist attacks, and in medical treatment and evacuation measures in such emergencies.

The purpose of the study is to develop and to substantiate proposals for optimizing management activities for organizing provision of medical care and medical evacuation of victims of terrorist attacks with the use of explosive devices and conventional weapons.

Materials and research methods.

research materials: normative and methodological documents regulating the procedure for management activities in medical provision of the population affected by emergencies; data of expert assessment maps on the research topic; scientific works and publications devoted to topical issues of management activities in the framework of the issue under study.

In the course of the study, the following scientific methods were used: methods of content analysis and expert assessment, statistical method, method of logical and information modeling, analytical method.

* In this article, the issues of management activities are considered in relation to terrorist acts with the use of conventional weapons. Conventional means of destruction are weapons that are based on the use of the energy of explosives and of incendiary mixtures — artillery, missile and aviation ammunition, small arms, mines, incendiary ammunition and fire mixtures, as well as edged weapons and non-standard explosive devices.

¹ National Project “Healthcare”: Approved by the Presidium of the Council under the President of the Russian Federation for strategic development and national projects, minutes of December 24, 2018 No. 16.

² Improving emergency medical care and the All-Russian Service for Disaster Medicine: Order of the Ministry of Health of Russia dated October 2, 2019 No. 827.

³ On the unified state information system in the field of health care: Resolution of the Government of the Russian Federation dated May 5, 2018 No. 555.

Research results and their analysis. The results of the study showed that one of the issues in the system of countering terrorism and of organizing elimination of medical and sanitary consequences of terrorist attacks is the presence of a coordinating management body (commission, headquarters, working group, etc.), which, depending on the level of the health care system and on specific conditions, should be assigned with appropriate functions (powers) to coordinate the activities of medical forces and means both when working in the mode of daily activities and when eliminating medical and sanitary consequences of terrorist attacks.

It is known that at the federal level in the field of healthcare, such a governing body is the Commission of the Ministry of Health of Russia for the prevention and elimination of emergencies and for fire safety (hereinafter referred to as Commission). The regulations on the Commission and its composition are approved by the order of the Ministry of Health of Russia. However, in the executive body of a constituent entity of the Russian Federation (hereinafter referred to as the subject) in the field of public health protection, creation and functioning of such a governing body is not framed by regulatory or methodological documents^{4,5}.

This situation required — in relation to the problem of countering terrorism — a study using the method of expert assessments of the feasibility of creating a collegial coordinating governing body as part of a governing body in the field of protecting the health of citizens of the subject.

In the course of the study, it was found that the question of the need for the mentioned non-staff management body in any organizational form in the composition of the specified regional health management body, the tasks of which would be to develop and to adjust measures to counter terrorism, to coordinate the activities of the health care system in its preparation for response and work on eliminating the consequences of terrorist attacks — 81.5% of experts gave a positive answer; 8.8 — believed that there was no need to create such a body; 9.7% of experts — could not (found it difficult to) give any answer. In addition, 83.3% of experts agreed that such a management body should be created in advance and should function constantly. 16.7% of experts indicated that such a body should be created upon the occurrence of a terrorist act and elimination of its medical and sanitary consequences.

Based on these data, the following conclusion can be drawn: the question of the need to create such a governing body should be decided depending on the characteristics of the region, the risks and likelihood of terrorist attacks on its territory, as well as on the state of the healthcare infrastructure, including the Disaster Medicine Service. At the same time, the relevant medical specialists of the region — first of all, from among the main freelance specialists — are obliged to actively participate in the development of measures to counter terrorism, to maintain health care in a state of high readiness to work to eliminate medical and sanitary consequences of terrorist attacks.

The study of the experience of liquidating medical and sanitary consequences of terrorist attacks showed that in order

to provide medical assistance to victims outside medical center (in the prehospital period), various medical teams and formations had to be involved — mobile ambulance teams, emergency response teams of the Disaster Medicine Service, Field Multidisciplinary Hospital and others. When looking for ways to optimize organizational and management activities, concerning, first of all, planning the organization of medical assistance to victims of terrorist attacks, creation and equipment of these teams and formations, organization of professional training of medical specialists and other issues, it is necessary to determine the rank value of each brigade and formation taking part in the elimination of medical and sanitary consequences of terrorist attacks.

This task was also solved with the help of experts. Analysing expert opinions, it was found that the greatest role in the elimination of medical and sanitary consequences of terrorist attacks is played by mobile ambulance teams (24.02%), specialized ambulance teams (18.83%) and emergency response teams of territorial disaster medicine centers (17.65%). According to experts, teams of specialized medical care for the surgical profile of the Disaster Medicine Service (15.4%) and mobile medical teams of the Disaster Medicine Service (11.55%) play a less significant role. According to the experts' conclusions, the penultimate place in this row was given to the Field Multidisciplinary Hospital of the Disaster Medicine Service (8.2%), the last — to the mobile paramedic brigade of the Emergency Medical Service (4.35%).

When considering the data obtained, one may think that the role of mobile medical units and of the field multidisciplinary hospital of the Disaster Medicine Service in providing medical assistance to victims of terrorist attacks may be unjustified. But here attention should be paid to the fact that the results of the experts' assessment on the issue under study have the following objective prerequisites:

1. In the total number of emergencies caused by terrorist acts committed during the study period, the share of local and municipal emergencies was, according to the data of the territorial disaster medicine centers, about 75.0% [8]. In the prehospital period, medical and sanitary consequences of such emergencies were mainly eliminated by medical specialists of ambulance teams.

2. When determining the rank value of one or another medical structural unit — of a brigade or formation that provides medical assistance to victims in the prehospital period — the experts took into account mainly the practical experience of eliminating medical and sanitary consequences of terrorist attacks.

3. The experience of eliminating medical and sanitary consequences of terrorist attacks convincingly testifies that the Field Multidisciplinary Hospital and the mobile medical unit of the Disaster Medicine Service of the Ministry of Health of Russia were used to provide medical assistance to victims of terrorist attacks in isolated cases. For example, during elimination of medical and sanitary consequences of a large-scale terrorist attack in the city of Beslan (2004), the Field Multiprofile Hospital was promptly delivered from Moscow by air and deployed to provide assistance to the injured children.

The results of the study highlighted the need to consider in more detail the issues of the readiness of medical specialists of the governing bodies and, first of all, of the Regional Centers for emergency and disaster medicine and of Terri Centers for disaster medicine, as well as of the providers of

⁴ Regulations on the Unified State System for the Prevention and Response to Emergency Situations: Resolution of the Government of the Russian Federation dated December 30, 2003 No. 794.

⁵ On the creation of a commission of the Ministry of Health of the Russian Federation for the prevention and elimination of emergencies and for fire safety: order of the Ministry of Health of Russia dated March 15, 2013 No. 140.

medical care and medical evacuation in the prehospital period — specialists of ambulance teams and of emergency response teams — to work in the conditions of liquidation of the consequences of terrorist acts, as well as the issues of improving their specialized and targeted professional training.

It is known that one of the fundamental organizational and managerial measures, the high-quality implementation of which makes it possible to significantly increase the readiness of health care to respond to and to act in emergencies, including those caused by terrorist attacks, is the advance planning of the organization of medical assistance to victims, carried out in each region, as a rule, by the specialists of regional centers for emergency and disaster medicine and of territorial disaster medicine centers. The result of this activity is the emergency medical plan for the population of the region — the key management document.

Given this circumstance, it became necessary to study the state of the quality of methodological support for predicting medical and sanitary consequences of terrorist attacks and for planning the organization of medical assistance to victims of terrorist attacks. So, the question of whether methodological support currently allows forecasting and planning, 12.2% of experts answered — “fully allows”; 76.5% of experts — “partially allows”. 11.3% of experts found it difficult to answer the question. Consequently, the results of expert assessments indicate that the relevant health authorities and the Disaster Medicine Service do not have developed recommendations (methods) for planning the organization of medical care and of medical evacuation of victims of terrorist attacks in compliance with the routing principles.

In addition, scientific publications devoted to topical issues of medical support to victims of terrorist attacks, as well as other works that consider some areas of improving management activities in the Disaster Medicine Service, do not contain comprehensive data on the procedure for planning the organization of medical care for victims of terrorist attacks [6, 7].

Apparently, this testifies to the imperfection of planning the organization of treatment and medical evacuation in the elimination of the medical and sanitary consequences of terrorist attacks.

The study showed that for an early identification and development of adequate measures to organize the provision of medical care and medical evacuation of victims of terrorist attacks, there is often not enough initial specific information, i.e. data on the predicted medico-tactical situation in places of possible terrorist attacks. Therefore, the task of predicting the locations of terrorist acts is difficult to solve, and in some cases, impossible. We paid attention to this in the previous article [9].

The article noted that with regard to specific objects (hydroelectric power plants, railway stations, airports, hospitals, schools, universities, shopping centers, stadiums, etc.), the degree of probability of terrorist attacks on which is the highest, there is a need and certain opportunities to plan in advance the measures to organize the provision of medical care and medical evacuation of victims. 81.3% of experts agreed with this conclusion; 8.1 — considered that it was inappropriate to do this; 10.6% of experts could not assess this proposal.

It should be noted that these recommendations have already been implemented, in particular, during the Winter Olympic Games (Sochi, 2014), the FIFA World Cup (Russia, 2018) and are currently being implemented in many public events.

During the study, it was found that there is no need to develop in advance a separate management document — a plan for organizing medical care and medical evacuation of victims of terrorist attacks on the territory of a particular region. In order to improve planning and to create conditions for increasing the preparedness of the region's health care to respond and to take actions in the elimination of medical and sanitary consequences of terrorist attacks, it is recommended to additionally include in the structure of medical support for the population of the region in emergencies a separate section containing appropriate measures to counter terrorism. It allows to maintain the officially adopted general structure of the plan.

This approach to planning was approved by the majority (87.5%) of experts, a small number (6.3%) of experts did not agree with the proposed option, but did not give their recommendations on this issue either. In addition, 7.2% of the experts experienced difficulties in assessing the specified organizational solution.

Taking into account the above, this section of the plan should contain measures to organize the provision of medical care and medical evacuation from the emergency center to the appointed medical facilities. And it should include interaction procedures of the regional health management body, regional center for emergency and disaster medicine medical services and territorial disaster medicine center with territorial governing bodies and organizations*, while counteracting terrorism in case of predicted terrorist attacks throughout the region, in individual cities and at potentially dangerous facilities.

The algorithm for the development of planned measures to counter terrorism should be the same as in the development of the plan of medical support for the population of the region in emergencies of natural and man-made character [4, 5].

When planning the organization of medical assistance to victims and their medical evacuation in the context of terrorist attacks, it is necessary to envisage not only average, but also most severe medical and sanitary consequences.

In accordance with the opinions of experts, it was determined that in the text part of the first section of the model plan of medical provision of the population of the region in an emergency (brief geographical, socio-economic and medico-tactical characteristics of the region, assessment of possible medical and sanitary situation arising in an emergency on its territory) it is advisable to include the following information: a list of objects on which terrorist attacks are most likely to occur entailing numerous sanitary losses (a large number of victims); data on probable number of victims and on their medical and evacuation characteristics (in the form of tables); need for mobile medical teams and for medical units involved in the prehospital period, as well as for ambulance vehicles for medical evacuation of victims; need for hospital beds, taking into account their profile for the provision of medical care and treatment of victims in the conditions of hospitals; routes of medical evacuation of victims from the emergency site to the pre-assigned medical organizations — in the form of tables.

* In accordance with the legislation of the Russian Federation, the subjects directly involved in countering terrorism are: Federal Security Service, Ministry of Internal Affairs of Russia, Foreign Intelligence Service, Federal Security Service, Federal Border Service, Federal Service of National Guard, Ministry of Defense of Russia — On countering terrorism: Federal Law of the Russian Federation dated March 6, 2006 No. 35-FZ.

In the second section of the textual part of the plan, in the subsection "In the event of a threat of major emergencies" (high alert mode), standard measures should be supplemented with the procedure for interaction and information exchange with relevant territorial bodies and structures of the FSB, of the Federal Service of the National Guard and — if necessary — with other subjects of countering terrorism.

In the subsection "In the event of major emergencies", in addition to the outlined typical measures, it is required to present possible schemes for organizing provision of medical care and medical evacuation routing of victims of terrorist attacks in relation to the most likely targets of a terrorist attack.

When developing a subsection of the Plan "Management of medical provision of the population in an emergency", it is necessary to pay special attention to the organization of communication in the emergency zone, since during terrorist attacks in the emergency zone, cellular communication and open radio communication channels usually do not function. In view of this, specialists of medical operational group, who manage and coordinate the activities of medical forces and means involved in eliminating the consequences of a terrorist attack, as well as specialists of mobile medical teams and units, must be equipped with radio communications and should establish a procedure for their use.

As for a map of possible medical and sanitary situation, attached to the Plan, it is necessary to additionally draw on it: the most probable targets of a terrorist attack; medical units, hospitals and, if necessary, other medical facilities that can be involved in the elimination of medical and sanitary consequences of terrorist attacks; a reserve of forces and means of health care, including the emergency medical service and the Disaster Medicine Service.

On the map, other data reflecting the characteristics of the terrorist attack, the Disaster Medicine Service and health care in general, as well as reference and calculation tables can be put as well.

The results of the study made it possible to formulate the main methodological approaches that should be taken into account when planning the organization of medical care and medical evacuation of victims of terrorist attacks in each constituent entity of the Russian Federation. These include: development of planned medical and evacuation measures — carried out in accordance with the competence of health authorities; determination of the goal and objectives of the planned medical and evacuation measures — linked to the periods of liquidation of medical and sanitary consequences of the terrorist attack, taking into account the grouping of forces and means of health care being created — resources necessary for carrying out medical and evacuation measures are allocated respectively; when planning medical care and evacuation, taking into account the strengths and weaknesses of the existing system of organizing the provision of medical care and medical evacuation in the terrorist attack zone, on the territory of municipal administrative formations and in the region as a whole, taking into account the presence of medical districts, intermunicipal medical centers, trauma centers, etc.

The development and implementation of a complex of medical and evacuation measures in the elimination of medical and sanitary consequences of terrorist attacks is a complex and diverse process of management activities. Consequently, if we proceed from this provision, then it is quite natural that in the activities of countering terrorism by health authorities, by medical organizations and formations, and, above all, by the Emergency Medicine Service and by the Disaster Medicine Service, there should be key standard measures to be implemented by both the governing bodies and by relevant medical organizations. The implementation of such measures contributes to a more effective response of the health care system, mainly at the regional level, to terrorist attacks and to an effective minimization of their health consequences.

Taking this into account, using the method of expert assessments, a study was carried out, during which 2 tasks were solved: the first was to identify a list of the most effective measures that would increase the readiness of health authorities, medical units and organizations to work to save lives and to preserve health of victims during terrorist attacks; the second was to determine the significance (rank value) of a particular event in their general list.

It turned out that the number of such events is, as a rule, no more than 10 (Table).

As can be seen from the table, the third, seventh and eighth activities have the highest significance coefficient. For each of these activities, it is equal to 0.1272, 0.1237 and 0.1228, respectively, and the overall coefficient of their significance is 0.3737. Attention is drawn to the fact that the difference in the coefficients of significance of the typical activities indicated in the table is not very large.

Consequently, on the basis of these results of the study, it can be argued that in order to increase the readiness of health care of the region, for a prompt response and adequate actions in case of terrorist attacks, all measures must be implemented in a comprehensive manner.

Conclusion

1. The results of the research testify to the multifaceted management activities carried out in the preparation of the health care system, including medical organizations and the Disaster Medicine Service units, to work in the conditions of terrorist attacks and in the course of eliminating their health consequences.

2. Analysis of the data obtained using expert assessments indicates the need to increase the level of methodological support for forecasting, planning and organizing of the provision of medical care and medical evacuation of victims of terrorist attacks, which confirms the importance of scientific research on management activities in the system of the All-Russian Service for Disaster Medicine.

3. When implementing the proposed approaches to planning the organization of medical assistance to victims of terrorist attacks at the regional level, specific conditions can be created for a more rapid response and for adequate actions in the elimination of medical and sanitary consequences of terrorist attacks.

Основные мероприятия, реализация которых обеспечивает повышение готовности здравоохранения к реагированию на теракты и к работе по ликвидации их медико-санитарных последствий
 Main measures, implementation of which ensures an increase in the preparedness of health care for terrorist attack response and for work to eliminate their medical and sanitary consequences

№ пп No.	Мероприятие Measure	Коэффициент значимости дан- ного мероприятия (ранговое значение мероприятия) Coefficient of significance of the measure (rank value of the measure)
1.	Повышение качества прогнозирования и планирования медицинского обеспечения населения при терактах Improving quality of forecasting and planning of medical support during terrorist attacks	0,1185 (4)
2.	Улучшение межведомственного взаимодействия между структурами, в т.ч. здравоохранения, предназначенными (привлекаемыми) для ликвидации последствий терактов Improving interagency interaction between structures, including health care institutions, intended (involved) to eliminate the consequences of terrorist attacks	0,1115 (5)
3.	Повышение квалификации медицинских кадров по медицине катастроф Advanced training of medical personnel in disaster medicine	0,1272 (1)
4.	Теоретическая разработка основ медицинского обеспечения населения при терактах Theoretical development of foundations of population medical support during terrorist attacks	0,0897 (8)
5.	Создание и совершенствования нормативной и методической базы по вопросам медицинского обеспечения населения при терактах Creation and improvement of regulatory and methodological base of population medical support during terrorist attacks	0,0958 (7)
6.	Повышение уровня технического оснащения здравоохранения, в т.ч. санитарным транспортом Raising the level of technical equipment of health care, including its equipment with ambulance cars	0,1054 (6)
7.	Повышение уровня оснащения медицинских формирований, предназначенных (привлекаемых) для ликвидации медико-санитарных последствий терактов Improving the level of equipment of medical units intended (involved) to eliminate medical and sanitary consequences of terrorist attacks	0,1237 (2)
8.	Проведение с органами управления здравоохранением, медицинскими формированиями и учреждениями специальных учений и тренировок по тематике противодействия терроризму Organization of special exercises and trainings on countering terrorism with health authorities, medical units, institutions	0,1228 (3)
9.	Повышение требовательности к руководящему составу (руководителям) органов управления здравоохранением, медицинских учреждений и формирований по их подготовке к работе по ликвидации последствий терактов Raising requirements for management staff (heads) of healthcare management bodies, medical institutions and formations for their preparation for work on eliminating the consequences of terrorist attacks	0,1054 (6)

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CLINICAL ASPECTS OF DISASTER MEDICINE КЛИНИЧЕСКИЕ АСПЕКТЫ МЕДИЦИНЫ КАТАСТРОФ

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MEDICAL SUPPORT OF MASS EVENTS DURING THE COVID-19 PANDEMIC: PROBLEMS AND POSSIBLE WAYS OF THEIR SOLUTION

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Abstract. *The purpose of the study is to summarize the experience of organizing and implementing medical support for mass events by the specialists of the medical teams of the All-Russian Center for Disaster Medicine "Zashchita" in 2008–2019; to analyze and to assess the organization of medical support for the Tavrida Forum and Festival, as well as for the Final of the "Big Change" ("Bolshaya Peremena") competition in the Republic of Crimea in 2020 in the face of the threat of the new coronavirus infection COVID-19 spread. Materials and research methods.* We analyzed the data of medical reports of specialists of the Field Multidisciplinary Hospital of the All-Russian Center for Disaster Medicine "Zashchita", who participated in the medical support of mass events held in 2008–2020. The regulatory documents, scientific and methodological publications on the organization of medical support for public events, climatic and geographic conditions in the places of the Hospital's deployment, legal and medical documentation on the prevention, diagnosis and treatment of COVID-19 were studied.

Research results and their analysis. A brief description of the medical support of mass events by the specialists of the Field Multidisciplinary Hospital of the All-Russian Center for Disaster Medicine "Zashchita" in 2008–2019 is given. The organization and implementation of medical support for mass events held in 2020 in the Republic of Crimea in the context of the COVID-19 pandemic are presented. The work of the Consolidated Medical Unit of the FMBA of Russia with the participation of specialists from the All-Russian Center for Disaster Medicine "Zashchita" is analyzed.

Key words: All-Russian Center for Disaster Medicine "Zashchita", anti-epidemic measures, comprehensive medical support, consolidated medical unit of the FMBA of Russia, COVID-19 pandemic, field multidisciplinary hospital, isolation, mass events, medical evacuation, observation, Republic of Crimea, routing

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МЕДИЦИНСКОЕ ОБЕСПЕЧЕНИЕ МАССОВЫХ МЕРОПРИЯТИЙ В ПЕРИОД ПАНДЕМИИ COVID-19: ПРОБЛЕМЫ И ВОЗМОЖНЫЕ ПУТИ ИХ РЕШЕНИЯ

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Резюме. *Цель исследования – обобщить опыт организации и осуществления медицинского обеспечения массовых мероприятий силами специалистов медицинских бригад Всероссийского центра медицины катастроф «Защита» (ВЦМК «Защита») в 2008–2019 гг.; проанализировать и дать оценку организации медицинского обеспечения Форума и Фестиваля «Таврида», а также Финала конкурса «Большая перемена» в Республике Крым в 2020 г. в условиях угрозы распространения новой коронавирусной инфекции COVID-19.*

Материалы и методы исследования. Проанализированы данные медицинских отчетов специалистов Полевого многопрофильного госпиталя ВЦМК «Защита» (ПМГ, Госпиталь), участвовавших в медицинском обеспечении массовых мероприятий, проводившихся в 2008–2020 гг. Изучены нормативные документы, научные и методические публикации по организации медицинского обеспечения массовых мероприятий, климатогеографические условия в местах развертывания Госпиталя, правовая и медицинская документация по профилактике, диагностике и лечению COVID-19.

Результаты исследования и их анализ. Дана краткая характеристика медицинского обеспечения массовых мероприятий силами специалистов ПМГ ВЦМК «Защита» в 2008–2019 гг. Представлены организация и осуществление медицинского обеспечения массовых мероприятий, проводившихся в 2020 г. в Республике Крым в условиях пандемии COVID-19. Проанализирована работа Сводного медицинского отряда (СМО) ФМБА России с участием специалистов ВЦМК «Защита».

Ключевые слова: ВЦМК «Защита», изоляция, комплексное медицинское обеспечение, маршрутизация, массовые мероприятия, медицинская эвакуация, обсервация, пандемия COVID-19, Полевой многопрофильный госпиталь, противоэпидемические мероприятия, Республика Крым, Сводный медицинский отряд ФМБА России

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Introduction

Holding mass events with a large concentration of people in a limited space often brings a threat of injury and illness to their participants. In addition, in places where mass events are held, various crisis situations may arise due to man-made accidents and disasters, antisocial actions, terrorist acts, etc. [1–4].

Over the past decade, a lot has been done to develop the system of organizing medical support of public events. Specialists of the Field Multidisciplinary Hospital of the All-Russian Centre for Disaster Medicine "Zashchita" got a significant experience in organizing medical support for mass events of various duration and scale: car races and other sports competitions, archaeological and geographical expeditions, military parades, festivals, international and interdepartmental exercises, concert tours and performances of children's choirs, youth forums, rock festivals, etc. In 2008–2019 with the involvement of specialists from the Center for Sanitary Aviation the All-Russian Centre for Disaster Medicine "Zashchita", in cooperation with other medical organizations (LMO), medical support was organized for more than 80 mass events, medical assistance was provided to over 18 thousands of their participants and guests.

In addition, over the years, concepts have been developed for the organisation of medical support for various mass events by medical units of "Zashchita" Center with eventual involvement of specialists from other medical entities, taking into account possibility of occurrence of various crisis situations upon their implementation.

In 2020, due to the COVID-19 pandemic, most public events were suspended. At the same time, in the Republic of Crimea, restrictive measures were eased and a possibility of holding a number of cultural events within the framework of the Presidential and State programs appeared.

The epidemiological situation made significant adjustments to the organization of medical support for mass events — it was necessary to take additional tough anti-epidemic measures. At the time of elaboration of options for medical support of mass events in the Republic of Crimea in the context of the COVID-19 pandemic, medical units and organisations did not have relevant prior experience. The elaboration of the issue was complicated by the lack of understanding by the organizers of these events of the need to take enhanced anti-epidemic measures, which required an increase in human and financial resources.

All this contributed to further complication of the organizational and clinical background and negatively influenced the process of preparation, organization and implementation of medical support.

The relevance of research. Mass events require careful preparation and continuous medical support during the entire period of their holding[5–7]. Each event has its own specifics related to the place of its holding, to the composition of its participants, to the attitude of the organizers to the restrictive events. As a rule, the structure of medical care requests depends on the topic of the event, its focus and the contingent of its participants. For example, at music festivals

injuries, poisoning with alcohol and its surrogates, infectious diseases and disorders of psychosomatic state prevail, while at sports events there are mostly injuries, etc. [5–8]. In view of this, the medical support of mass events requires a deep preliminary study in order to form an adequate composition of medical teams and to equip them with appropriate equipment [8–14].

In 2020, FMBA of Russia and, in particular, All-Russian Centre for Disaster Medicine "Zashchita" were entrusted with the task of comprehensive medical support for participants, guests, staff and organizers of Tavrida Forum and Festival (hereinafter referred to as Forum, Festival), as well as of the Final of "Big Change" ("Bolshaya Peremena") competition (hereinafter — Final of the Competition). A distinctive feature of the medical support in 2020 is the work in a difficult epidemic situation, due to the threat of a spread of the new coronavirus infection COVID-19. The experience of preparation and implementation of medical support for the Forum, the Festival and the Final of the competition, the analysis of the activities of the medical units of the All-Russian Centre for Disaster Medicine "Zashchita" and of the Consolidated Medical Unit of the FMBA of Russia determined the relevance of this study.

The aim of the study is to analyze the experience of medical support for mass events with a large number of participants within an unfavorable epidemiological situation.

Research objectives:

- to summarize the experience of organizing medical support of mass events, carried out by the medical teams of the All-Russian Center for Disaster Medicine "Zashchita" in 2008–2019;

- to assess the organization of medical support for Tavrida Forum and Festival, as well as for the Final of the "Big Change" competition in 2020 in the face of the threat of the spread of the new coronavirus infection COVID-19;

- to study scientific and methodological publications on the organization of medical support for public events, legal and medical documentation on the prevention, diagnosis and treatment of COVID-19.

Materials and research methods. The data of medical reports of specialists of the field multiprofile hospital of the All-Russian Centre for Disaster Medicine "Zashchita", who participated in the medical support of mass events in 2008–2020, have been analyzed. The regulatory documents, scientific and methodological publications on the organization of medical support for mass events, climatic and geographic characteristics of the places of the Hospital's deployment in 2020, legal and medical documentation on the prevention, diagnosis and treatment of COVID-19 were studied.

Research results and their analysis.

Brief description of medical support for mass events held in 2008–2019.

Specialists of the field multiprofile hospital of "Zashchita" Centre have significant experience in organizing and implementing medical support for mass events of various duration and scale.

As already noted, in 2008–2019, more than 80 mass events were provided with medical support. Within 11 years, more than 18 thousand people have applied for medical help, including 600 children.

Experience shows that successful implementation of medical support for mass events depends, among other things, on its preliminary preparation. In all cases, at the stage of preparation, the employees of field multiprofile hospital took part in the meetings of the event organizers, where the details of the participation of medical teams were agreed and the following points were specified: approximate number, contingent, age categories of participants and guests of the event; its duration; location of event facilities and evacuation routes. The tiniest details were agreed, including the requirements for the site for the deployment of field multiprofile hospital units, energy and water supply, communications.

Depending on the format of the event, medical support was provided in various formats: deployment on the basis of pneumatic and metal frame modules, in premises provided by the organizers, on ambulances, as well as using combined and mixed options.

The demand for medical care depended not only on the number of participants in the event, but also on its duration. So, if the event lasts for up to 5 days (the rock festival "Invasion" ("Nashestvie"), performances of the children's choir, car racing), the demand for medical care was 1–2% of the total number of the event's participants. However, with long-term medical support (archaeological and geographic expeditions), the turnover increased to 60% or more. So, for example, within the medical support of archaeological excavations in the Krasnoyarsk Territory and in the Republic of Tyva, the appealability even exceeded the number of participants, which was associated with their repeated appeals, as well as with the significant remoteness of the only medical facility of the 1st level. Since level 2 medical facilities were located at a distance of 100–300 km, and level 3 medical facilities were at an even greater distance from the excavation site, only the field multiprofile hospital specialists provided medical assistance. In exceptional cases — if it was necessary to provide specialized medical care — a medical evacuation was carried out using medical transport or transport provided by the organizers of the event.

During excavations, the average daily load on medical specialists was 30–100 people / day.

Characteristics of medical support for public events held in 2020

The main difference between the medical support of mass events held in 2020 is work in the context of the COVID-19 pandemic.

In 2020, mass events — in order to avoid a simultaneous large gathering of people — were held in "closed" territories and were of a prolonged nature. The number of participants, guests and staff also varied (Table 1).

Medical support of the Forum of young workers of culture and arts "Tavrida" and of the Festival "Tavrida-Art".

In preparation for the medical support of mass events in June 2020 in Simferopol and Sudak, working meetings were held with the participation of the heads of the Council of Ministers of the Republic of Crimea, All-Russian Centre for Disaster Medicine "Zashchita" of the FMBA of Russia, the Ministry of Health of the Republic of Crimea, the Crimean Republican Center for Emergency and Disaster Medicine, the Interregional Administration of Rospotrebnadzor in the Republic of Crimea and in the federal city of Sevastopol, the State Committee for Youth Policy of the Republic of Crimea and the Federal Agency for Youth Affairs, as well as the organizers of Tavrida Forum and Festival.

During the meetings, the main issues of medical support were discussed; measures to prevent the emergence and spread of infectious diseases among guests, participants and organizers of events; issues of interagency interaction and patient routing during the Forum and the Festival. The following issues were considered in detail: the minimum number of participants and employees, their remote placement; a schedule of periodic testing and collection of biological material, followed by laboratory PCR tests; the availability of a sufficient number of personal protective equipment, disinfectants, rapid tests for antibodies and COVID-19 antigen; observance of the mask regime, social distancing and separate nutrition; uninterrupted water supply with guaranteed quality of drinking water; cleaning and sanitizing of the territory; mandatory availability of the necessary medical documentation for participants and employees, including a confirmed negative laboratory PCR test result for COVID-19.

Таблица 1 /Table No. 1

Характеристика массовых мероприятий, проводившихся в 2020 г.

Description of mass public events held in 2020

Массовое мероприятие Mass event	Место проведения Location	Даты – продолжительность – мед. обеспечения Dates – duration of medical support	Число участников, гостей и персонала Number of participants, guests and staff	Особенности проведения Features
Форум молодых деятелей культуры и искусства «Таврида» "Tavrida" Forum of young culture and arts workers	Бухта Капсель, г.о. Судак, Республика Крым Kapsel bay, Sudak urban district, Republic of Crimea	03.07–13.10.2020 – 3,5 мес 03.07–13.10.2020 – 3.5 months	2,5 тыс. чел. – 10 смен, в среднем – 200 чел. в смену 2.5 thousand people: 10 shifts, on average – 200 people per shift	Частые заезды смен, длительность мероприятия Frequent arrivals of shifts, event duration
Фестиваль «Таврида-Арт» – проведение в рамках Форума "Tavrida-Art" festival – held within the framework of "Tavrida" Forum	Бухта Капсель, г.о. Судак, Республика Крым Kapsel bay, Sudak urban district, Republic of Crimea	31.08–07.09.2020 – 8 сут 31.08–07.09.2020 – 8 days	До 7 тыс. чел. Up to 7 thousand people	Одновременный заезд большого числа участников и гостей Simultaneous arrival of a large number of participants and guests
Финал конкурса «Большая перемена» Final of "Big Change" ("Bolshaya Peremena") competition	Международный детский центр «Артек», пгт. Гурзуф, Республика Крым International Children's Center "Artek", Gurzuf settlement, Republic of Crimea	26.10–07.11.2020 – 12 сут 26.10–07.11.2020 – 12 days	До 3 тыс. чел., в том числе 1,2 тыс. – дети Up to 3 thousand people, including 1.2 thousand children	Детское мероприятие – одновременный заезд большого числа участников и гостей, среди участников – дети-инвалиды и дети с хроническими заболеваниями Children's event – simultaneous arrival of a large number of participants and guests, disabled children and children with chronic diseases among the participants

A reconnaissance of the event territory was carried out. Together with the organizers, the issues of the deployment of the Hospital in the conditions of the infrastructure of the living quarters of the Forum and the Festival were resolved, additional premises for medical purposes were identified, including a separate temporary isolation ward for patients suspected of COVID-19, as well as the accommodation of specialists. Routing of reanimobiles across the territory was outlined. At meetings with the leadership of the nearest medical centers, the possibility of eventual hospitalization of sick and injured was discussed.

The Forum and the Festival were held on an area of over 50 hectares. Taking into account the epidemiological situation, the arrival of the participants was divided into shifts, the duration of one shift was 1 week. The number of participants, teachers (experts) and guests — 18–35 years old — was up to 200 people per shift. Forum and Festival participants lived in double stationary houses and tourist tents, they ate in the canteen and on the territory of the field kitchen. All drinking water was consumed in bottled form. A sufficient number of sanitary zones were organized on the territory of the Forum. Showers, toilets, and a bath and laundry plant functioned. The total daily number of staff and coordinators was no more than 350 people.

The first combined medical unit of FMBA of Russia was formed at the beginning of July 2020 from the specialists of the All-Russian Center for Disaster Medicine "Zashchita" and of the Clinical Hospital No. 85 of the FMBA of Russia.

Taking into account the duration of the medical support, a schedule was drawn up for the shifts of the health care specialists (1st shift: July – August; 2nd - August – September; 3rd shift - September – October).

The hospital was fully deployed, equipped and operational on July 5, 2020 (Figure 1).

Hospital structure:

1. Receiving and sorting department.
2. Control module.
3. Surgical department.
4. Department of intensive care.
5. Day hospital.
6. Diagnostic department (X-ray).
7. Pharmacy.
8. Module for disinfection treatment.
9. Isolator for patients with intestinal infection.
10. Isolator for patients with airborne infection.
11. Isolation unit for patients with suspected COVID-19.
12. Special transport area — 2 reanimobiles.

A mobile telemedicine complex of secure satellite communications was deployed in the control unit of the coordination and technical center of the All-Russian Center for Disaster Medicine "Zashchita". The complex allowed to access the Internet, to communicate via video conferencing through the on-call service of "Zashchita" Centre with 36 National Medical Research Centers and with 26 leading consulting medical organizations for organising telemedicine consultations in emergency, urgent and planned forms, and also made it possible — in case of emergencies — to contact the duty services of the National Center for Crisis Management of EMERCOM of Russia and of the National Center for Defense Management of the Russian Federation.

Organization of field work. At the arrival of each new shift, combined medical unit specialists carried out express testing for COVID-19, as well as the thermometry and medical records of all Forum participants at the airport of Simferopol. The same control was carried out at railway stations in case of arrival of organized groups by rail. Participants with positive results of rapid testing for COVID-19 and with signs of acute respiratory viral infections were transferred to the

team of the Territorial Center for Emergency and Disaster Medicine and then were hospitalized in infectious diseases hospitals. Thus, the risks of the spread of infections in buses on the route from the airport to the closed territory of the Forum and the Festival were minimized.

In parallel with the work of the combined medical units, at the airport and at the railway station the specialists of the Territorial Centre for Emergency and Disaster Medicine carried out a selection of biomaterials for COVID-19 from all participants, including those who had the necessary medical documentation and had no complaints. The materials were transferred to the laboratories of the Center for Hygiene and Epidemiology and the Anti-Plague Station of the Republic of Crimea of Rospotrebnadzor in the Republic of Crimea and in the city of Sevastopol for PCR research. The research results were provided no earlier than a day later. In case of receiving information about a positive laboratory test for the SARS-CoV-2 virus, the participant and persons from among his close contacts were promptly isolated. The representative of Rospotrebnadzor conducted an epidemiological investigation, wrote out decrees and orders. Subsequently, the sick were hospitalized in infectious diseases hospitals, and the contact persons of the medical teams of the Territorial Centre for Emergency and Disaster Medicine were isolated in observators. Before entering the event site, all participants and guests underwent thermometry.

When seeking medical help, thermometry, pulse oximetry, examination of the throat, collection of anamnesis and clarification of complaints were performed.

In the premises on the territory of the event, the mask regime and social distance were observed. Dispensers with antiseptics and air recirculators were installed in places of mass gatherings. In order to maintain social distance, all Forum premises were marked with lines. At the entrance to the dining room and the Big Educational Tent, the volunteer corps carried out constant thermometry putting the data into an electronic journal. Meals for the Forum staff and participants were provided using only disposable tableware. Between shifts of the Forum — within a break of 1 to 3 days — employees of the management company carried out preventive disinfection of all residential and industrial premises. Entry to and exit from the territory of employees and participants of the Forum and the Festival were strictly limited.

On August 30, 2020, during the Tavrida-Art Festival, an additional group of forces and means of the FMBA of Russia was formed. In the immediate vicinity of the tent camp of the participants, at a distance of 1.3 km from the field multiprofile hospital (Hospital-1), the 2nd mobile hospital (Hospital-2) was deployed, and reanimobiles were dispersed throughout the territory of the Festival (Fig. 2).

Subdivisions of Hospital-2, deployed on the basis of medical trucks with all-terrain vehicles of the Rapid Response Brigade:

1. Rapid Response Brigade "Bandaging Station".
2. Rapid Response Brigade "Reanimation".
3. Rapid Response Brigade "Surgery Station".
4. Rapid Response Brigade "Headquarters Dispatching".
5. Cargo van for the toxicology team.
6. Special transport platform — 4 reanimobiles (Fig. 3).

In preparation for the medical support of the Festival on September 1, 2020, after the deployment of Hospital-2, special tactical exercises were held to eliminate the medical and sanitary consequences of a simulated fire on the central stage of the festival. During the exercise, the effectiveness of passing information about the fire to the headquarters of the Combined Medical Unit of the FMBA of Russia and the Unified Duty Dispatch Services was checked, as well as the interaction of the services involved in the elimination of the

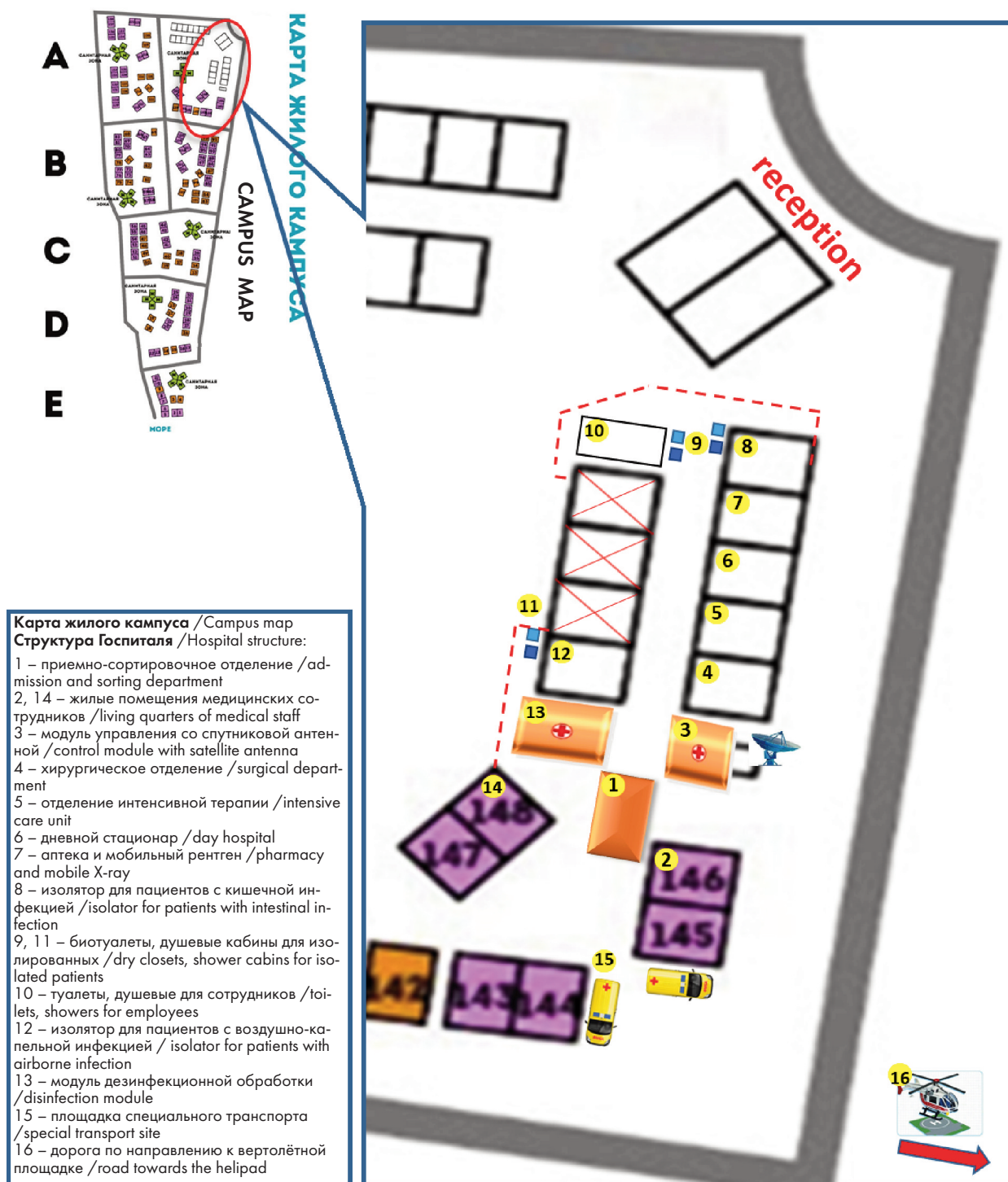


Рис. 1. Развертывание Полевого многопрофильного госпиталя ВЦМК «Защита» (Госпиталь-1) в составе Сводного медицинского отряда (СМО) Федерального медико-биологического агентства (ФМБА России) в жилой зоне Форума и Фестиваля «Таврида 2020»

Fig. 1. Deployment of the Field Multiprofile Hospital of the All-Russian Centre for Disaster Medicine "Zashchita" (Hospital-1) as part of the Consolidated Medical Unit of the Federal Medical and Biological Agency (FMBA) of Russia in the residential area of "Tavrida" Forum and Festival

consequences of the fire was checked (Fig. 4).

On September 2, 2020, specialists from the FMBA of Russia began to provide medical support for the participants and guests of the Festival.

Considering that the estimated total number of participants will be up to 7 thousand people, as well as the fact that buses with organized groups of 1-2 thousand people will arrive every day, at the checkpoint of the event combined medical units specialists of FMBA of Russia and of the Crimean Regional Center for Emergency and Disaster Medicine de-

ployed a sanitary checkpoint – an inlet filter. The main forces of the combined medical units were involved in the work on the inlet filter for the entire period of the event. Each arriving person was examined by a combined medical unit specialist, express testing for COVID-19, thermometry, collection of anamnesis and complaints as well as medical records were carried out. Thanks to the experience gained by the combined medical units specialists in the previous 2 months, the strengthening of anti-epidemic measures, the well-coordinated interaction of all security services, during the Festi-

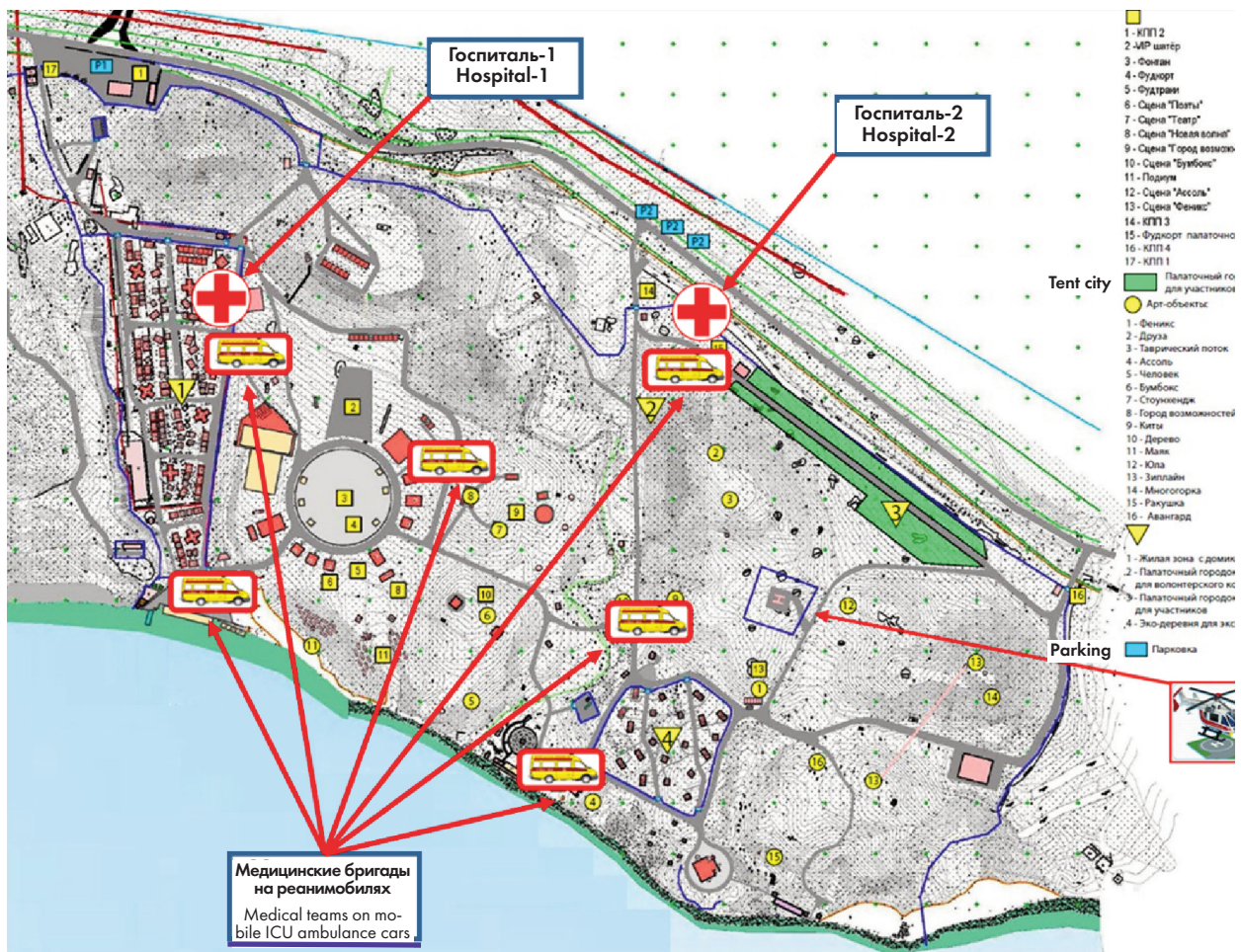


Рис. 2. Расположение сил и средств СМО ФМБА России на Фестивале «Таврида-Арт», 02–06.09.2020 г.

Fig. 2. Location of forces and means of consolidated medical unit of the FMBA of Russia at "Tavrida-Art" Festival, 02-06.09.2020

val, the spread of the new coronavirus infection COVID-19 was avoided.

The main problem in organizing medical support for the Forum and the Festival was the absence of laboratories, observers, infectious diseases hospitals and converted "covid" hospitals in the immediate vicinity of the territory of their holding. In this regard, from the moment of isolation of an infectious patient or of a contact to the moment of his hospitalization isolation in the observatory, it could take up to 12 hours.

During the Forum "Tavrida" and the Festival "Tavrida-Art" 2439 people applied for medical help; 1846 COVID-19 rapid tests were performed; 44 people were sent for hospitalization and examination at the medical organisations of the Republic of Crimea, of whom 26 were hospitalized, including 16 people with COVID-19; 31 COVID-19 contact persons were sent to Observatory. The structure of the appealability: surgical and traumatological profile — 37.15%; therapeutic profile, including infection — 62.85%.

At the same time, if we take into account the preliminary examination of the participants and guests of the event at the arrival of each shift, as well as multiple repeated requests for medical assistance by the personnel who lived almost without leaving the event territory, at different times the number of requests was from 20 to 60%, which was due to both the event duration, and to the need for taking anti-epidemic measures.

Taking into account thermometry, additional express testing for COVID-19 and verification of the submitted medical documentation, the total workload on combined medical units specialists ranged from 200 to 2 thousand people / day.

Medical support of the final of the All-Russian competition "Big Change"

Work on preparation for medical support of the final of the All-Russian competition "Big Change", held in October-November 2020 on the basis of the International Children's Center "Artek" — Republic of Crimea, Gurzuf, was carried out remotely and was based on the successful experience of medical support for Tavrida Forum and Festival. In addition to remote meetings, preliminary working meetings were held with the participation of the organizers of the event, the medical and sanitary unit of "Artek", the Crimean Regional Center for Emergency and Disaster Medicine and Rospotrebnadzor in the Republic of Crimea and in the city of Sevastopol.

Taking into account the existing experience, the presence of a number of problems in the medical provision of the Tavrida Forum, anti-epidemic measures were strengthened and adjusted. The participants, who arrived from different regions in Simferopol, settled in the Base — the hotel "Artek" (evacuation base), where they lived for 1-3 days immediately before visiting "Artek". The specialists of the Medical Unit of the Artek Medical Center carried out medical examinations and control of the medical records of the children-participants. In case of suspicion of an infectious disease, biomaterials were taken for COVID-19, and then transferred to the reference laboratory of Simferopol. While waiting for the results of the PCR study, the participants were isolated in separate rooms of the evacuation base. In case of a negative result, children were taken to the event territory by buses.

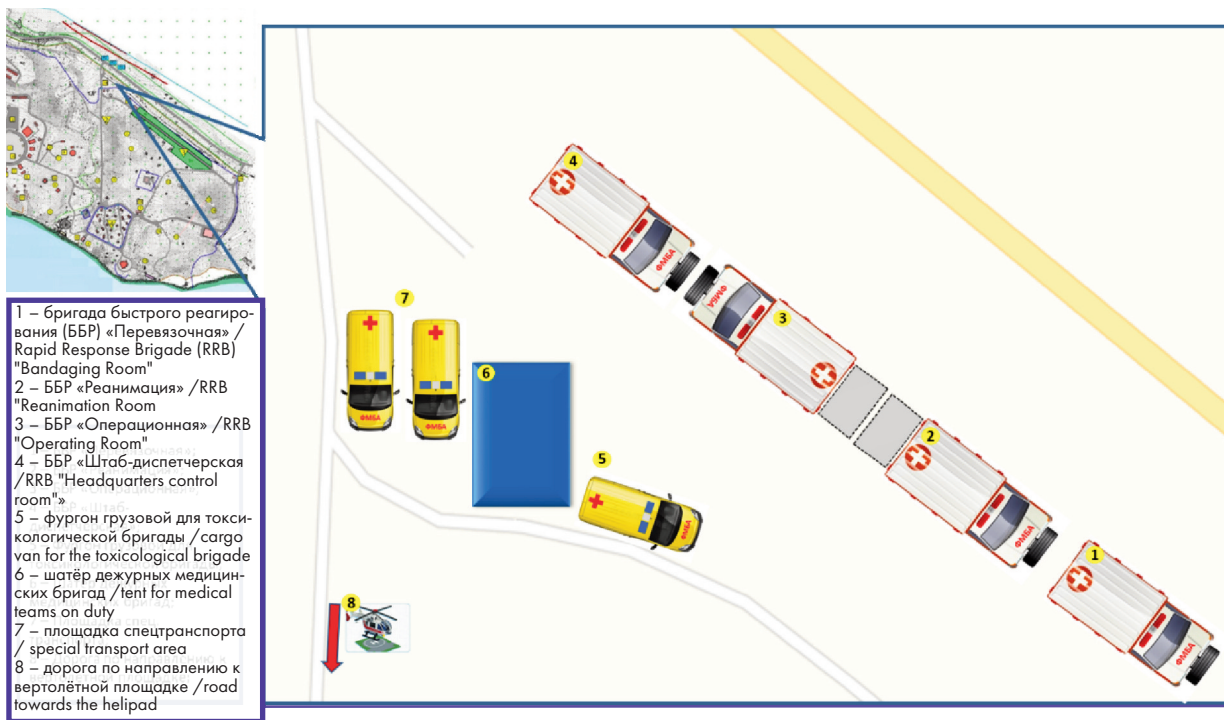


Рис. 3. Развертывание на базе медицинских грузовых автомобилей повышенной проходимости Госпиталей-2 в составе СМО ФМБА России в палаточном городке Фестиваля «Таврида-Арт»

Fig. 3. Deployment on the basis of Hospital-2 off-road medical trucks as a part of consolidated medical unit of the FMBA of Russia in the tent city of "Tavrida-Art" Festival

Most of the guests, experts and involved personnel lived in a sanatorium-resort complex 30 km away from the event site and were daily delivered to its territory by buses. Upon arrival, everyone, without exception, underwent the procedure of inspection and express testing in the sanitary checkpoint (entrance filter) of the FMBA of Russia, which was deployed before entering "Artek".

Thus, due to the enhanced anti-epidemic measures at the time of the Competition Final, the territory of the Artek ICC was a "green zone".

Medical support was carried out by the combined medical units of FMBA of Russia — specialists from All-Russian Centre for Disaster Medicine "Zashchita", Clinical Hospital No. 85, Central Children's Clinical Hospital, Federal Scientific and Clinical Center — together with the staff of the Medical Center of "Artek". The management of the FMBA of Russia set several tasks for the specialists of the medical organization: participation in medical support for the Final of the competition; express testing for a new coronavirus infection of the organizers, service personnel and participants of the event; individual medical support for children diagnosed with diabetes mellitus; consultation of infectious disease doctor within the analysis of medical records on the input filter.

Taking into account the need to simultaneously solve several tasks, the forces and means of the combined medical unit were concentrated at two points on the territory of the event:

1. *Sanitary checkpoint — inlet filter.* Deployed on the basis of frame modules and stationary premises in front of the checkpoint on the territory of "Artek" administrative and economic zone. It included: an admission and diagnostic department — express testing for COVID-19, if necessary — selection of biomaterials, PCR testing for COVID-19 and an infectious disease doctor's advisory office — analysis of the submitted medical documentation, issuance of an admission / refusal opinion for event.

2. *Medical center — emergency response brigade.* Deployed in stationary premises converted for medical purposes on the territory of the Rechnoy children's camp of the "Artek" in the building where children-participants with chronic diseases, including those diagnosed with diabetes mellitus, lived. Its structure includes: a medical center — consultative assistance and monitoring of glycemia by an endocrinologist, on duty of pediatric medical and nursing teams; special transport platform — on duty of medical and paramedic brigades on reanimation vehicles.

During the event, 64 people applied for medical help, including 61 children. In addition, 154 consultations of an infectious profile were conducted on the basis of submitted medical documents. 1344 COVID-19 tests performed. Denied for medical reasons in admission to the event — 31 people. The structure of appealability: surgical and traumatological profile — 15.7%; therapeutic profile, including diabetes mellitus — 84.3%. Children with diabetes were constantly monitored for glycemia.

Combined medical unit specialists: surgeons, pediatric surgeons, traumatologists, anesthesiologists-resuscitators, toxicologists, emergency doctors, infectious disease specialists, endocrinologists, therapists, pediatricians, paramedics, operating nurses, nurses-anesthetists, laboratory assistants (engineers, non-medical specialists)

Such an expanded staff of specialists was necessary to organize and conduct events for the prevention of COVID-19 for participants, guests and employees of the support services of the events (Table 2).

Medical evacuation routing for medical support of mass events in 2020

In case of the need for hospitalization of patients and injured in the medical facilities of the Republic of Crimea, medical evacuation was carried out in accordance with the developed routing (Table 3, 4; Fig. 5, 6).

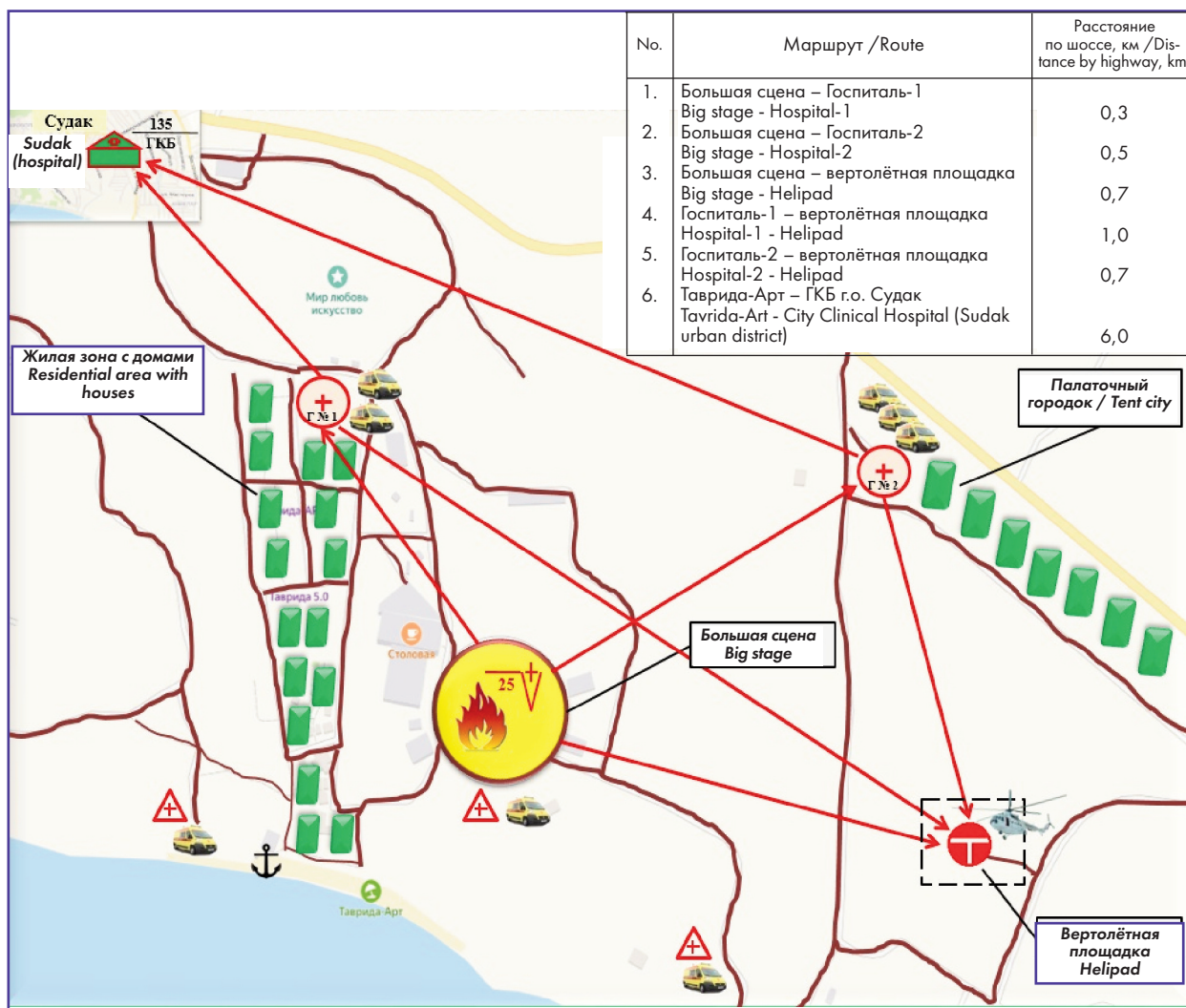


Рис. 4. Тактико-специальные учения / Fig. 4. Special tactical exercises

Considering the large shoulder of the evacuation to the medical facilities, it was decided that the medical evacuation of the sick and injured is carried out: at a distance of up to 60 km — by the teams of the Emergency Department of the Federal Medical and Biological Agency of Russia, more than 60 km — by the brigades of the Territorial Centre for Emergency and Disaster Medicine.

Helipads were created on the territory of the events, which were located 1.0–1.5 km from the base of the combined medical unit. The medical helicopter "Ansar" of the Territorial Centre for Emergency and Disaster Medicine was permanently based at the Simferopol airport, its estimated time of arrival was 20 minutes. During the events, the medical helicopter was not used.

If we analyze the demand for medical care in medical support of mass events in 2020, then on average it amounted to 20% of the total number of participants and guests of events. An increase in the number of people in circulation compared to previous years by 1–2% is due to the need to carry out anti-epidemic measures. At the same time, when holding prolonged mass events, this is due to the large number of repeated appeals. Since, in comparison with previous years, the number of combined medical unit staff has increased, the workload on medical specialists has remained the same — about 30 people / day.

Conclusion

The experience of organisation of medical support for mass events in the context of the COVID-19 pandemic made it possible to draw a number of conclusions that should be taken into account in the future:

1. The area where the event is held must be closed.
2. It is obligatory to organize a sanitary checkpoint (inlet filter), the work of which is aimed to prevent attending the event by: persons with suspected infectious disease; persons who do not have a certificate of a negative PCR test for COVID-19, as well as persons with such a certificate, after the issuance of which more than 72 hours have passed.
3. When holding mass events in a closed area with a long stay, the following measures should be taken: check medical documentation — a certificate of epidemiological well-being, vaccinations; organise thermometry in places of mass stay of people; carry out PCR testing every 5-7 days; limit as much as possible temporary exit from the territory of the event.
4. Not allowed: accommodation of guests, experts and staff outside the territory of the event; failure to perform thermometry; non-observance of the mask regime and social distance in the premises on the territory of the event.
5. If an infectious disease is suspected, it is necessary to: isolate a sick person in a specially equipped room; notify the ter-

Постоянный состав СМО ФМБА России и число обратившихся за медицинской помощью при осуществлении медицинского обеспечения массовых мероприятий в Крыму в 2020 г.

Permanent composition of the Consolidated Medical Unit of the Federal Medical and Biological Agency (FMBA) of Russia and number of requests within the framework of the implementation of medical support for mass events in Crimea in 2020

Мероприятие Event	Даты – продолжительность мед. обеспечения Dates – duration of medical support	Подведомственные организации, участвовавшие в мед. обеспечении Subordinate organizations involved in medical support	Число привлеченных специалистов Number of involved specialists	Число обратившихся, чел. Number of requests, people
Форум молодых деятелей культуры и искусства «Таврида» "Tavrida" Forum of young culture and arts workers	03.07–13.10.2020 – 3,5 мес 03.07–13.10.2020 – 3.5 months	ВЦМК «Защита» / All-Russian Centre for Disaster Medicine "Zashchita"; КБ №85 / Clinical Hospital No. 85	48 чел. за 3 смены – 18 врачей, 15 медсестер/фельдшеров, 15 немедиков* 48 people in 3 shifts – 18 doctors, 15 nurses / paramedics, 15 non-physicians*	1640
Фестиваль «Таврида-Арт» – проведение в рамках Форума "Tavrida-Art" festival – held within the framework of "Tavrida" Forum	31.08–07.09.2020 – 8 сут 31.08–07.09.2020 – 8 days	Центральный аппарат ФМБА России / Central office of FMBA of Russia; ВЦМК «Защита» / All-Russian Centre for Disaster Medicine "Zashchita"; ФКЦ ВМТ / Federal Clinical Centre of High Medical Technologies; ФНКЦ / Federal Research and Clinical Centre; ГНЦ ФМБЦ им. А.И.Бурназяна / A.I. Burnazyan Federal Medical Biophysical Centre; КБ №85 / Clinical Hospital No. 85; ФНКЦ ФХМ / Federal Research and Clinical Centre for Physical and Chemical Medicine; КБ №101 ФГБУ СКФНКЦ / Clinical Hospital №101 of North Caucasian Federal Research and Clinical Centre; НКЦ / Research and Clinical Centre; ЮОМЦ / South District Medical Centre; КДЦ ФКЦ ВМТ / Clinical Diagnostic Centre of the Federal Clinical Centre of High Medical Technologie	56 чел. – 27 врачей, 15 медсестер / фельдшеров, 14 немедиков* 56 people: 18 – doctors, 15 – nurses / paramedics, 15 – non-physicians*	799
Финал конкурса «Большая перемена» Final of "Big Change" ("Bolshaya Peremena") competition	26.10–07.11.2020 – 12 сут 26.10–07.11.2020 – 12 days	Центральный аппарат ФМБА России / Central office of FMBA of Russia; ВЦМК «Защита» / All-Russian Centre for Disaster Medicine "Zashchita"; КБ № 85 / Clinical Hospital No. 85; ФНКЦ детей и подростков / Federal Research and Clinical Centre for Children and Adolescents; ФНКЦ / Federal Research and Clinical Centre	28 чел. – 7 врачей, 14 медсестер/фельдшеров, 7 немедиков* 28 people: 7 - doctors, 14 - nurses / paramedics, 7 - non-physicians*	64, в том числе детей - 61 64, from them children - 61
Всего / Total			132 чел. – 52 врача, 44 медсестры/фельдшера, 36 немедиков* 132 people: 52 - doctors, 44 - nurses / paramedics, 36 - non-physicians*	2503, в том числе детей - 61 2503, from them children - 61

* Инженеры, водители, IT-специалисты; привлечены 24 единицы спецтехники
* Engineers, drivers, IT specialists; number of special technik - 24

ritorial department of Rospotrebnadzor; carry out medical evacuation to a specialized medical facility; identify contact persons with their subsequent evacuation to the observatory.

6. Dispensers with antiseptics and air recirculators must be installed in the premises on the territory of the event.

7. In preparation for a mass event, together with the heads of local government bodies, medical and other services responsible for protecting life and health of the population, it is necessary to work out in detail the routing for the medical evacuation of patients with various pathologies to medical organisations of the region, paying special attention to patients with infectious diseases.

8. During the period of the spread of infectious diseases, comprehensive medical support for mass events, including all anti-epidemic measures, is possible after organising a shift arrival of organized groups of participants and after ensuring a strict compliance with the above mentioned conditions of passage to the closed area.

9. An effective epidemiological measure is the organization of medical examinations, control of medical records of participants on the territory of the evacuation base, where those arriving at the event live for 1-3 days before attending the event.

10. While organising medical support for mass events during the spread of infectious diseases, it is required to increase the staffing of mobile teams, as well as to equip them with medical, engineering and technical equipment, medicines and consumables.

11. The experience of participation in the medical support of large-scale mass events has shown that the problem of medical safety of its participants can be solved only with a comprehensive preparation and concerted actions of the event organizers, heads of local health authorities, medical and other services responsible for protecting life and health of the population.

Маршрутизация медицинской эвакуации при медицинском обеспечении массовых мероприятий в 2020 г.

Medical evacuation routing for medical support of mass events in 2020

Начальный пункт медицинской эвакуации Beginning of medical evacuation	Расстояние до конечного пункта медицинской эвакуации, км Distance to the final point of medical evacuation, km				
	Судакская ГБ Sudak City Hospital	Филиал ФНКЦ ФМБА России в Крыму, г.Ялта Branch of Federal Research and Clinical Centre of FMBA of Russia in Crimea, Yalta	Алуштинская ЦГБ* Alushta Central City Hospital	ЛМО 3-го уровня, г.Симферополь Medical organization of the 3rd level, Simferopol	Бахчисарайская ЦРБ** Bakhchisarai Central District Hospital
Форум и Фестиваль «Таврида», Бухта Капсель, г.о. Судак "Tavrida" Forum and festival, Kapsel bay, Sudak urban district	5	130	86	130	150
Финал конкурса «Большая перемена», МДЦ «Артек», пгт. Гурзуф Final of "Big Change" ("Bolshaya Peremena"), International Children's Center "Artek", Gurzuf settlement	170	25	22	90	110

* ЦГБ – центральная городская больница / Central City Hospital; ** ЦРБ – центральная районная больница / Central District Hospital

Маршрутизация медицинской эвакуации при медицинском обеспечении массовых мероприятий в 2020 г.

Medical evacuation routing for medical support of mass events in 2020

Начальный пункт медицинской эвакуации Beginning of medical evacuation	Расстояние до конечного пункта медицинской эвакуации, км Distance to the final point of medical evacuation, km			
	Феодосийская инфекционная больница Feodosia Infectious Diseases Hospita	Симферопольская ГКБ* №7 Simferopol City Clinical Hospital №7	Евпаторийская инфекционная больница Evpatoria Infectious Diseases Hospital	Обсерваторы санаторного комплекса «Здравница», г.Евпатория Evpatoria Infectious Diseases Hospital
Форум и Фестиваль «Таврида», Бухта Капсель, г.о. Судак "Tavrida" Forum and festival, Kapsel bay, Sudak urban district	55	130	200	200
Финал конкурса «Большая перемена», МДЦ «Артек», пгт. Гурзуф Final of "Big Change" ("Bolshaya Peremena"), International Children's Center "Artek", Gurzuf settlement	180	90	160	160

* ГКБ – городская клиническая больница / City Clinical Hospital



Рис. 5. Маршрутизация медицинской эвакуации при проведении Форума и Фестиваля «Таврида», г.о. Судак
Fig. 5. Routing of medical evacuation during "Tavrida" Forum and Festival, Sudak urban district

СХЕМА ЛЕЧЕБНО-ЭВАКУАЦИОННЫХ МЕРОПРИЯТИЙ
Финал конкурса «Большая перемена», МДЦ «Артек», пгт. Гурзуф

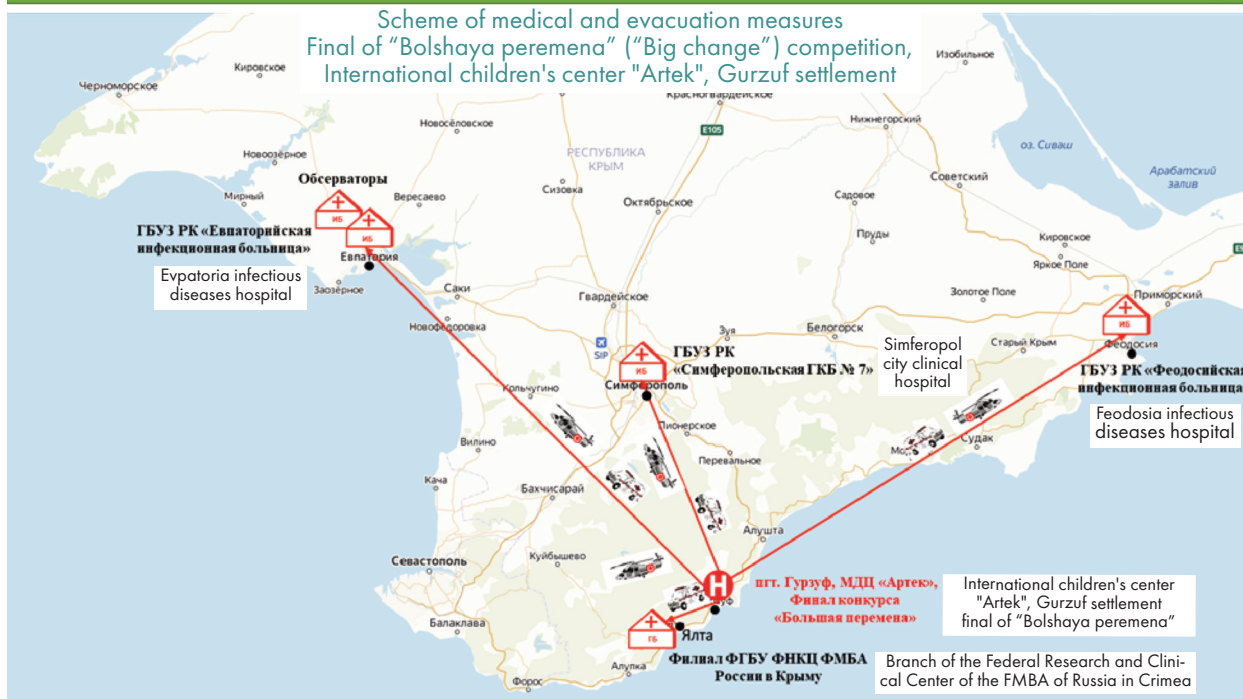


Рис. 6. Маршрутизация медицинской эвакуации при проведении финала конкурса «Большая перемена», Международный детский центр (МДЦ) «Артек», пгт. Гурзуф

Fig. 6. Routing of medical evacuation during the final of “Bolshaya peremena” (“Big change”) competition, International children's center “Artek”, Gurzuf settlement

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ORGANIZATION OF STAGE MEDICAL CARE TO PATIENTS WITH SUSPECTED AND CONFIRMED NEW CORONAVIRUS INFECTION COVID-19 IN THE VORONEZH REGION

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Abstract. The purpose of the study is to analyze the results of the work of the territorial center for disaster medicine of the Voronezh region to improve the organization of medical care for patients with suspected and confirmed new coronavirus infection COVID-19 in 2020.

Materials and research methods. The study was based on: data on the provision of medical care to patients with community-acquired pneumonia of unknown infectious etiology and with a confirmed new coronavirus infection COVID-19, who were hospitalized in medical organizations of the Voronezh region; information about the routing of patients to medical organisations; data on monitoring bed fund and equipment, as well as information on the continuity and outcomes of treatment in patients of these categories.

Research results and their analysis. Analysis of the research results showed:

- creation in the Voronezh region of the system of staged medical care for patients with suspected and confirmed new coronavirus infection COVID-19 and a three-level system of medical care for this category of patients contributed to their early detection and effective treatment;
- monitoring system for patients with COVID-19 allows to determine optimal routing for each patient in order to provide timely specialized, including high-tech, medical care;
- change in the routing of patients with COVID-19 in the region in order to provide high-tech medical care to as many patients as possible fully justifies the use of helicopter with a resuscitation module and a transport isolation box combined with it.

Key words: COVID-19 pandemic, interhospital evacuation, medical care, medical districts, medical evacuation, medical organizations, monitoring, patients, routing, stages of medical care, telemedicine consultations, transport isolation box, Voronezh region

Conflict of interest. The authors declare no conflict of interest

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ОРГАНИЗАЦИЯ ЭТАПНОГО ОКАЗАНИЯ МЕДИЦИНСКОЙ ПОМОЩИ ПАЦИЕНТАМ С ПОДОЗРЕНИЕМ И С ПОДТВЕРЖДЕННОЙ НОВОЙ КОРОНАВИРУСНОЙ ИНФЕКЦИЕЙ COVID-19 В ВОРОНЕЖСКОЙ ОБЛАСТИ

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Резюме. Цель исследования – проанализировать результаты работы территориального центра медицины катастроф (ТЦМК, Центр) Воронежской области по совершенствованию организации оказания медицинской помощи пациентам с подозрением и с подтвержденной новой коронавирусной инфекцией COVID-19 в 2020 г.

Материалы и методы исследования. В основу исследования были положены: данные об оказании медицинской помощи пациентам с внебольничными пневмониями неизвестной инфекционной этиологии и с подтвержденной новой коронавирусной инфекцией COVID-19, находившимся на стационарном лечении в лечебных медицинских организациях (ЛМО) Воронежской области; сведения о маршрутизации пациентов в ЛМО; данные о мониторинге коечного фонда и оборудования, а также сведения о преемственности и исходах лечения у пациентов указанных категорий.

Результаты исследования и их анализ. Анализ результатов исследования показал:

- создание в Воронежской области на базе ЛМО медицинских округов системы этапного оказания медицинской помощи пациентам с подозрением и с подтвержденной новой коронавирусной инфекцией COVID-19 и трёхуровневой системы оказания медицинской помощи данной категории пациентов – способствовало их раннему выявлению и эффективному лечению;
- система мониторинга пациентов с COVID-19 позволяет определить оптимальную маршрутизацию каждого больного с целью оказания ему своевременной специализированной, в том числе высокотехнологичной, медицинской помощи;
- изменение в регионе маршрутизации пациентов с COVID-19 с целью оказания высокотехнологичной медицинской помощи как можно большему числу больных полностью оправдывает применение вертолётной техники с реанимационным модулем и с совмещенным с ним транспортировочным изолирующим боксом.

Ключевые слова: Воронежская область, лечебные медицинские организации, маршрутизация, медицинская эвакуация, медицинские округа, межбольничная эвакуация, мониторинг, оказание медицинской помощи, пандемия COVID-19, пациенты, телемедицинские консультации, транспортировочный изолирующий бокс, этапы медицинской помощи

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The purpose of the study is to analyze the results of the activities of the territorial center of disaster medicine of the Voronezh region to improve the organization of medical care for patients with suspected and confirmed new coronavirus infection COVID-19 in 2020.

Materials and research methods. The study was based on: data on the provision of medical care to patients with community-acquired pneumonia of unknown infectious etiology and with a confirmed new coronavirus infection COVID-19, who were hospitalized in medical organizations of the Voronezh region; information about the routing of patients in medical organizations; data on monitoring the bed fund and equipment, as well as information on the continuity and outcomes of treatment in patients of these categories.

Research results and their analysis. In the Voronezh region, the fight against COVID-19 began in January 2020, when the first medical evacuation of a patient suspected of COVID-19 from the regional infectious diseases hospital to the infectious diagnostic (Melzerovka) box of the Voronezh Regional Children's Clinical Hospital No. 2 was carried out. Medical evacuation using the Lamsystems transport isolation box, acquired in preparation for the 2018 FIFA World Cup, was carried out by the team of the territorial disaster medicine center, whose personnel received the necessary skills to operate the box during exercises and trainings. At the beginning of the first wave of COVID-19 pandemic, the main efforts of the region's Department of Health were aimed at reducing risk of spread of the new coronavirus infection.

The center organized medical support for the reception of passengers arriving from countries with an unfavorable epidemiological situation for COVID-19 at the Voronezh International Airport named after Peter The Great. In total, medical support was organized for four flights. For medical support of each flight, up to six ambulance teams, a bus and a minibus of the Territorial Center for Disaster Medicine were involved. On board the aircraft, all arriving passengers underwent thermometry by the personnel of the airport medical and quarantine points. Employees of Rospotrebnadzor kept a record of arrivals, issued instructions on compliance with quarantine measures at the place of residence. The passengers with fever were evacuated to the COVID departments of medical organizations in Voronezh. Passengers from neighboring regions, for whom the vehicles did not arrive, were sent to the observatory on the Territorial Disaster Medicine Center bus for isolation. The rest of the passengers on the buses, accompanied by the traffic police, were taken to their homes.

In the Ramonsky district, at the recreation center "German Sloboda" by the forces of the Ramon regional hospital, an observatory for 90 people was deployed. The observatory was provided with the necessary forces and means and is

ready to receive citizens from April 29, 2020. The main categories of persons in need of observation are citizens who arrived from an epidemically unfavorable territory for COVID-19, as well as contacts with patients with coronavirus infection who cannot be isolated at their place of residence. The work of the observatory was organized in accordance with the Temporary Recommendations for organizing the work of the observatory for persons arriving from an epidemically unfavorable territory for a new coronavirus infection. The observation period is 14 days from the moment of arrival / contact with a patient with a new coronavirus infection. In total, during the operation of the observatory — from April 29 to July 1, 2020 — 118 people underwent observation. All patients were examined for a new coronavirus infection in accordance with existing requirements. Over the entire observation period, 6 persons with a positive result for COVID-19 were identified. These patients were transferred by the Territorial Disaster Medicine Center teams to the COVID departments of Voronezh medical organizations.

At the start of the first wave, all COVID-19 patients were hospitalized. In the future, in accordance with the recommendations of the Russian Ministry of Health, patients with COVID-19, including those with community-acquired pneumonia in mild or moderate form, were treated at home. The exceptions were made for persons from the risk group — over 65 years old, as well as for those suffering from chronic diseases of bronchopulmonary, cardiovascular and endocrine systems and for pregnant women.

The dynamics of the deployment of hospital beds in the region was in direct proportion to the epidemiological situation. Minimum number of beds — 1069, including 807 — with oxygen supply, of which 190 — in intensive care units, was deployed on the basis of 12 medical organizations in mid-August. As of December 1, 2020, 4550 beds were deployed on the basis of 37 medical organizations, including 2139 with oxygen supply, of which 1515 were in the intensive care units. The estimated standard of bed capacity for the Voronezh region is 1686 beds.

The dynamics of hospitalization of patients has a wave-like character. The peak of hospitalizations of the first wave of cases was in the beginning of June, the second wave — in mid-October.

On the basis of the medical districts created in the region, the stages of providing medical care to patients with COVID-19 were organized. A three-level system of medical care was created for patients with community-acquired pneumonia of unknown infectious etiology and with a confirmed new coronavirus infection.

The 1st stage included the medical organizations of the districts of Voronezh, Clinical Hospital No. 33 of the FMBA of Russia, 27 district hospitals; the 2nd stage included

5 large regional hospitals — medical organisations of the 2nd level; the 3rd stage — ambulance hospitals No. 1, 8, 10 and Voronezh Regional Clinical Hospital No. 1 — medical organisation of the 3rd level. Medical organisations of the 2nd stage ensured interaction with attached medical organisations to manage patient routing.

The primary diagnosis "community-acquired pneumonia" was made at the 1st stage in the medical organisation at the place of attachment of the patient. After that the patient was evacuated to the medical organisation of the 2nd stage. Medical evacuation was carried out — depending on the severity of the patient's condition — either by means of the 1st stage medical organisation transport, or by the ambulance team.

The final diagnosis of "new coronavirus infection" or its exclusion was determined in the medical organisation of the 2nd stage.

At all stages, until the patient has been diagnosed with a new coronavirus infection, medical assistance to a patient with community-acquired pneumonia is provided in accordance with the temporary orders and instructions regulated by the order of the Ministry of Health of Russia "On the temporary procedure for organizing the work of medical organizations in order to implement measures to prevent and reduce the risk of the spread of new coronavirus infection COVID-19" dated March 19, 2020 No. 198n.

The transfer of a patient from the district hospitals of the 2nd stage — Bobrovskaya, Pavlovskaya, Rossoshanskaya, Borisoglebskaya and Liskinskaya — to the 3rd stage is carried out after a telemedicine consultation with specialists of the Voronezh Regional Clinical Hospital No. 1, taking into account the severity of the patient's condition, by transport of the medical organisation of the 2nd stage or by the Territorial Disaster Medicine Center brigade. Before the medical evacuation, a telemedicine consultation is held with the specialists of the Territorial Disaster Medicine Center to clarify the level of the patient's transportability and his preparation for medical evacuation.

Patients with community-acquired pneumonia in extremely serious condition are hospitalized in specially allocated ICU beds of medical organizations at the place of treatment in compliance with the rules provided for by the order of the Ministry of Health of Russia dated March 19, 2020 No. 198n.

If it is impossible, due to the severity of the patient's condition, to transfer him/her to medical organisation in accordance with the established routing procedure, after a telemedicine consultation, if necessary, the specialists of the Territorial Center for Disaster Medicine are sent out with the involvement of specialists from the Voronezh Regional Clinical Hospital No. 1.

Patients whose diagnosis of community-acquired pneumonia is not confirmed, depending on the profile of the identified disease, are evacuated in accordance with the approved routing.

Interaction of Voronezh medical organisations in the treatment of patients with COVID-19. For a more effective use of specialized beds at the stage of recovery, patients are transferred for further treatment from the medical center of the 3rd level to the so-called "aftercare hospitals". And, conversely, when the condition of patients in aftercare hospitals becomes worse, they are transferred to the medical organisations of the 3rd level. Inter-hospital medical evacuation is carried out by the Territorial Disaster Medicine Centers teams.

Between the first and the second waves of COVID-19 diseases, there was a negative trend in the severity of the patient's condition during hospitalization:

— on saturation — in June 2020, 3% of patients with saturation below 90% were admitted, in November 2020 — 16%;

— on computed tomography (CT), 5% of patients with CT 3–4 were admitted in June 2020, in November 2020 — 19%.

In accordance with the order of the Ministry of Health of Russia dated March 19, 2020 No. 198n, the following remote regional advisory centers of anesthesiology and resuscitation for the diagnosis and treatment of new coronavirus infection COVID-19 and pneumonia were created:

— Remote regional advisory Center for adults — on the basis of the regional coordination center of the Territorial Disaster Medicine Center;

— Remote regional advisory Center for children — on the basis of the regional coordination center of the Regional Children's Clinical Hospital No. 2;

— Remote regional advisory Center for pregnant women — on the basis of the obstetric remote consulting center of the Voronezh Regional Clinical Hospital No. 1.

A total of 480 telemedicine consultations were held with the Federal remote regional advisory Center for adults. There were no problems during the telemedicine consultations. The protocols of telemedicine consultations were provided in a timely manner (Fig. 1).

An information resource has been created on the basis of the Territorial Disaster Medicine Center for the monitoring of: deployed and occupied beds; patients with pneumonia, including those on artificial lung ventilation, who are hospitalized; medical equipment. Medical organizations enter this program on a daily basis and fill in the appropriate tables. The summary information is presented daily to the Governor and to the Government of the Voronezh Region, to the Main Directorate of the Ministry of Emergency Situations of Russia and to the Main Directorate of the Ministry of Internal Affairs of Russia in the Voronezh Region, to the Russian Guard, to Rosreestr, and to the media.

In addition, 3 times a day in a specially created chat medical organizations provide operational information about free beds, including those with oxygen support and mechanical ventilation. That allows for point routing of patients with COVID-19.

Interhospital medical evacuation of patients with COVID-19 in a state of moderate severity is carried out by the emergency medical teams, patients in severe condition are

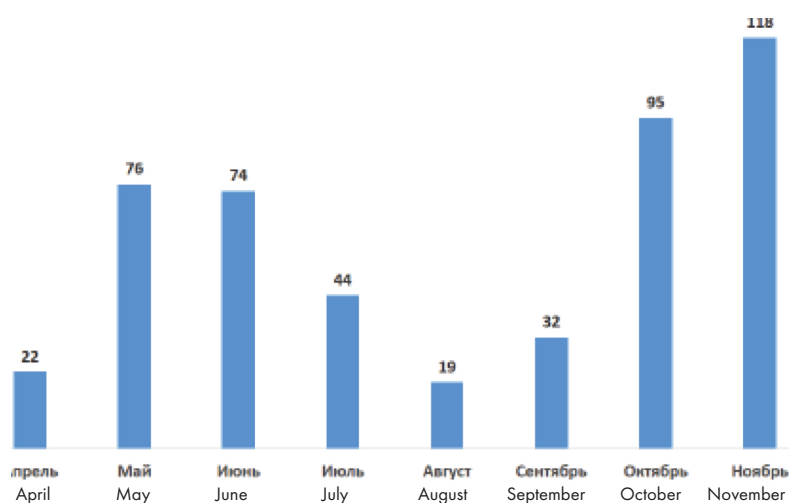


Рис. 1. Динамика количества телемедицинских консультаций, проведенных с федеральным региональным консультативным центром для взрослых в апреле – ноябре 2020 г., абс.

Fig. 1. Dynamics of the number of telemedicine consultations conducted with the federal regional advisory center for adults in April – November 2020

evacuated by the resuscitation teams of the Territorial Disaster Medicine Center (Fig. 2).

Territorial Disaster Medicine Center specialists have experience in conducting air ambulance evacuation of patients with COVID-19. At present, the Ansat ambulance helicopter with a resuscitation module is used for these purposes in the region. Air evacuation of patients with COVID-19 is carried out in a transport isolation box, in which the patient can be ventilated during the flight. A preliminary study was made of the possibility of placing the transport isolation box in the helicopter cabin and of combining it with the equipment of the resuscitation module. Specialists of the medical team in protective clothing enter the "red zone" of COVID compartment, transfer the patient to the isolation box, connect the tracking equipment and respiratory support, and close the box hermetically. When leaving the "red zone", the protective clothing of the team members and the outer surface of the box are completely disinfected, protective clothing is removed. The box is installed in the helicopter cabin. Due to the complete tightness of the box, the helicopter crew is not exposed to the risk of infection. The helicopter pilot does not wear personal protective equipment, but only uses a three-layer medical mask. During the flight, the specialists of the resuscitation team, using chamber gloves, provide the patient with all the necessary assistance, including respiratory support.

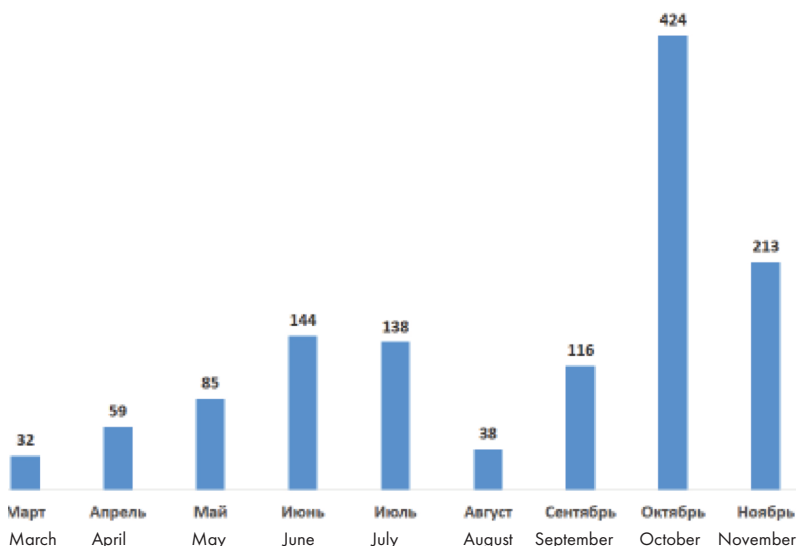


Рис. 2. Динамика межбольничной медицинской эвакуации пациентов с COVID-19 бригадами территориального центра медицины катастроф в марте–ноябре 2020 г., чел.

Fig. 2. Dynamics of interhospital medical evacuation of patients by teams of territorial center of disaster medicine in March – November 2020, people

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For the final disinfection of ambulances and of a transport box, a special box is equipped in the garage of the Territorial Disaster Medicine Centre. A paramedic in personal protective equipment disinfects with 6% hydrogen peroxide using a Nocospray aerosol disinfection apparatus and then uses an open-type ultraviolet irradiator in the passenger compartment.

During 2020, the material and technical base of medical facilities providing medical care to patients with COVID-19 was strengthened. The fleet of ambulances was significantly updated. In accordance with the Orders of the Government of the Russian Federation dated April 18 and July 11, 2020, 39 ambulances were delivered to the region, including 24 — of class "C"; in the Territorial Disaster Medicine Center — 10 reanimobiles. Currently, the Territorial Disaster Medicine Center park has 23 ambulances, including 19 reanimobiles, 70% of which are ambulances with a service life of up to 5 years.

At the expense of the reserve fund (2.37 million rubles), the Government of the Voronezh Region purchased personal protective equipment for the respiratory and skin organs, antiseptics, consumables for sampling, antiviral drugs, and equipment for carrying out disinfection measures. For these purposes, Territorial Disaster Medicine Centre made purchases for a total amount of 3.13 million rubles. Strengthening the material and technical base of medical organizations made it possible to organize the provision of medical care to patients with COVID-19 in accordance with the requirements of guidelines [1-5].

Conclusion

1. The creation in the Voronezh region on the medical organisations basis of medical districts of a system of staged medical care for patients with suspected and confirmed new coronavirus infection COVID-19 as well as the creation of a three-level system of medical care for this category of patients contributed to their early detection and effective treatment.

2. The monitoring system for patients with COVID-19 allows to determine the optimal routing of each patient in order to provide him/her with timely specialized, including high-tech, medical care.

3. The change in the routing of patients with COVID-19 in the region in order to provide high-tech medical care to as many patients with a new coronavirus infection as possible fully justifies the use of helicopter technology with a resuscitation module and with a transport isolation box.

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PECULIARITIES OF TROPHOLOGICAL STATUS IN VICTIMS OF EMERGENCIES WITH LONG CONSCIOUSNESS IMPAIRMENT DUE TO CRANIOCEREBRAL INJURY

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Abstract. The aim of the study was to investigate peculiarities of trophological status, to identify prevalence, severity and types of trophological insufficiency and to analyze the effect of infectious complications on the severity of protein-energy malnutrition in victims of emergency situations with long-term impairment of consciousness due to traumatic brain injury.

Materials and research methods. The study involved 126 victims of various age groups, who underwent primary screening using NRS-2002 scale, indicators of trophological status and the effect of infectious complications on the severity of protein-energy malnutrition were assessed.

Research results and their analysis. Screening showed a high risk of malnutrition in all patients. Indicators of trophological status were less than the reference values. In all age groups, both men and women, moderate protein-energy malnutrition prevailed (82.5%). For young patients, marasmus (64.6%) and marasmic kwashiorkor (34.3%) were most typical. The trophological status of the victims – regardless of the severity and in more than half of the cases – was represented by marasmus and, less often, by kwashiorkor. Patients with infectious complications had a high risk of moderate and severe protein-energy malnutrition development, $p < 0.001$.

Key words: emergency situations, long-term impairment of consciousness, nutritional support, PEM, protein-energy malnutrition, traumatic brain injury, trophological status

Conflict of interest. The authors declare no conflict of interest

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ОСОБЕННОСТИ ТРОФОЛОГИЧЕСКОГО СТАТУСА У ПОСТРАДАВШИХ В ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЯХ С ДЛИТЕЛЬНЫМИ НАРУШЕНИЯМИ СОЗНАНИЯ ВСЛЕДСТВИЕ ЧЕРЕПНО-МОЗГОВОЙ ТРАВМЫ

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Резюме. Цель исследования – изучить особенности трофологического статуса, выявить распространенность, выраженность, типы трофологической недостаточности и проанализировать влияние инфекционных осложнений на степень тяжести белково-энергетической недостаточности (БЭН) у пострадавших в чрезвычайных ситуациях (ЧС) с длительными нарушениями сознания вследствие черепно-мозговой травмы (ЧМТ).

Материалы и методы исследования. В исследовании участвовали 126 пострадавших различных возрастных групп. Проводился первичный скрининг с использованием шкалы NRS-2002, оценены показатели трофологического статуса и влияние инфекционных осложнений на степень тяжести БЭН.

Результаты исследования и их анализ. Проведенный скрининг показал высокий риск развития недостаточности питания у всех пациентов. Показатели трофологического статуса были меньше референсных значений. Во всех возрастных группах – как у мужчин, так и у женщин – преобладала (82,5%) БЭН средней степени тяжести. Для пациентов молодого возраста были наиболее характерны маразм (64,6%) и маразматический квашиоркор (34,3%). Трофологический статус у пострадавших – вне зависимости от степени тяжести и больше чем в половине случаев – был представлен маразмом и реже – квашиоркором. У пациентов с инфекционными осложнениями имелся высокий риск развития БЭН средней и тяжелой степени тяжести, $p < 0,001$.

Ключевые слова: белково-энергетическая недостаточность, длительное нарушение сознания, нутриционная поддержка, трофологический статус, черепно-мозговая травма, чрезвычайные ситуации

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Introduction

Traumatic brain injury (TBI) is the most important medical and social problem due to its high prevalence, high mortality and disability rates, as well as to economic costs of treatment and rehabilitation of victims with TBI [1]. In recent years, the world sees an increase in number of natural disasters, man-made disasters, road traffic accidents, terrorism and military conflicts accompanied by traumatic injuries, especially those of the brain. The proportion of injuries to skull and brain is more than 1/3 in the total number of all injuries, and number of such injuries is growing by an average of 2% per year [2]. According to the World Health Organization (WHO), in the world every year 1.5 million people die from TBI and 2.4 million people become disabled.

The most severe neurological manifestations of TBI are bulbar and pseudobulbar syndromes, manifested by neurogenic dysphagia, in which the transport of food from oral cavity to esophagus suffers. This negatively affects the quality of life, increases risk of aspiration pneumonia, dehydration, energy metabolism disorders, leading to cachexia. In such cases, a mandatory component of modern approaches to treatment is nutritional support based on various mixtures for enteral nutrition.

Severe TBI refers to a group of pathological conditions occurring with pronounced symptoms of hypermetabolism – hypercatabolism syndrome. Metabolic stress and the subsequent cascade of catabolic events with the development of severe malnutrition have a significant impact both on survival of victims with severe TBI and on the level of neurological deficit in its outcome [3]. For example, in an acute period of severe TBI, the severity of metabolic disorders depends on the volume and nature of brain damage. Protein deficiency can reach 180-200 g / day, which corresponds to a loss of 750 g of muscle mass [4]. Untimely correction of emerging protein-energy malnutrition (PEM) in TBI patients leads to depletion of the body and to a decrease in adaptive reserves, to development of infectious complications and to multiple organ fail. This not only lengthens the period of hospital stay, but also increases mortality [5].

Infectious complications in patients, who are in prolonged unconsciousness, are primarily a consequence of the peculiarities of their immune status. The main mechanisms of the immunopathological process in them are: decrease in T-lymphocytes, IgG, phagocytic activity of leukocytes; violation of the relationship of immunoregulatory cells; autoneurosensitization and “autoaggressive” nature of immune responses [6]. Chronic infectious processes intensify the manifestations of trophological insufficiency.

Due to the fact that in patients with long-term impairment of consciousness after TBI, adequate correction of the trophological status is an obligatory component of rehabilitation process, an urgent task in managing such patients is the optimization of nutritional support.

The aim of the study was to explore the features of trophological status, to reveal the prevalence, severity, types of trophological insufficiency and to analyze the influence of infectious complications on the severity of PEM in victims of emergencies with long-term impairment of consciousness due to TBI.

Materials and research methods.

The study prospectively included 126 victims of emergencies (hereinafter referred to as patients) with long-term impairment of consciousness due to TBI, which took place in 2016–2020. They underwent a course of medical rehabilitation on the basis of the medical rehabilitation department of the All-Russian Center for Emergency and Radiation Medicine named after A.M. Nikiforov of EMERCOM of Russia. The age of the patients is 18–87 years old; the average age is (35.1 ± 1.28) years. In the total number of patients there were 102 men, aged 18–87, average age (36.3 ± 1.44) years; women – 24, aged 18–66, average age – (29.9 ± 2.57) years. In accordance with the WHO age classification, the group of young patients (18-44 years old) included 99 people; middle age (45–59 years old) – 20; elderly (60 – 74 years old) – 4; senile age (75–90 years old) – 3 people. Thus, young people predominated among the patients.

Inclusion criteria for the study: TBI duration - more than 1 month; level of consciousness - vegetative state or the state of minimal consciousness; signs of trophological insufficiency requiring correction at the time of admission; age – over 18 years old; duration of the inpatient medical rehabilitation course – 28 days. Patients excluded from the study: with a burdened history and concomitant urgent pathology, with unstable hemodynamics, with febrile syndrome, with systemic inflammatory reaction, with intestinal dysfunction (digestive disorder), with diseases of internal organs in the stage of decompensation.

Upon the initial examination anamnesis, clinical examination and determination of the level of consciousness were carried out. When examining and evaluating patients with chronic impairment of consciousness, a standardized integrated approach was applied using a protocol for managing patients in vegetative state and in a state of minimal consciousness of traumatic and nontraumatic genesis as well as a revised Coma Recovery Scale-Revised (CRS-R), and since 2018 year – Russified version of the revised scale of recovery after coma (Coma Recovery Scale-Revised - CRS-R) - [7, 8].

Chronic disturbances of consciousness were presented: in the form of a vegetative state – in 17 patients (men – 13, women – 4); in the form of a state of minimal consciousness – in 109 patients (men – 89, women – 20). Thus, among the surveyed, patients with a state of minimal consciousness prevailed (86.5%).

Clinical assessment of violations of trophological status requires an integrated approach for a correct interpretation of signs of trophological insufficiency. In accordance with the study design, after assessing the level of consciousness, all patients underwent step-by-step diagnostics in order to correctly and accurately identify impairment of their nutritional status. According to the recommendations of the European Society for Clinical Nutrition and Metabolism, screening was performed using the Nottingham Nutritional Risk Assessment Scale (NRS 2002) - [9]. The screening algorithm for early detection of malnutrition was simple and fast.

For a more detailed assessment of nutritional status, we used a set of somatometric and laboratory indicators, which can be used to determine the PEM degree [5]. Somatometric criteria (somatic protein pool) included body mass index (BMI), thickness of the skin-fat fold over the triceps, shoulder circumference, shoulder muscle circumference, percent deviation of actual body weight from the recommended one. Laboratory criteria (visceral protein pool) were represented by total serum protein, albumin and absolute lymphocyte count. To identify the type of malnutrition — marasmus, kwashiorkor, marasmic kwashiorkor — the recommended differential diagnostic criteria were applied [5].

All patients showed signs of neurogenic dysphagia. Therefore, a nutritional support was carried out using the method of tube feeding through a nasogastric tube ($n = 56$) and through a gastrostomy tube ($n = 70$). Thus, tube feeding was carried out through a gastrostomy tube by 11.2% more often than through a nasogastric tube. This was primarily due to the limitation period of TBI and to the international standards, according to which, if the need for tube feeding persists for more than 4 weeks, stoma is indicated [9, 10].

Statistical analysis methods. Statistical analysis was carried out using the StatTech v. 0 and Microsoft Excel spreadsheet resources. The probability of error (p) was considered statistically significant at $p = 0.05$.

Research results and their analysis.

Features of the trophological status of victims of emergencies with long-term impairment of consciousness due to TBI

During physical examination, patients showed characteristic early signs of a violation of the trophological status in the form of the hairline breach (sparse, thin hair, alopecia), skin (dryness, peeling, follicular lesions and decreased turgor), nails (fragility and stratification) and mucous membranes (stomatitis, cracks on the lips) impairment, edema of lower extremities, decrease in subcutaneous fat and muscle mass (muscle wasting, protruding bones of the skeleton, sunken abdomen, cachexia).

Further, when screening using the NRS-2002 scale, in all patients, due to the initial presence of TBI, a high risk of malnutrition was diagnosed, which required further assessment of their trophological status and an active correction of nutrition. BMI indicators - 13.1-23.1 kg / m², average - (18.2 ± 0.17) - testified to low nutrition and malnutrition. The deviation of factual body mass from recommended body mass was in the range of 52.9–96.9%, the average was (74.4 ± 0.71), which confirmed a significant progressive loss of body weight since the onset of the disease. Determination of shoulder circumference, thickness of the skin-fat fold over the triceps and shoulder muscles circumference made it possible to assess the state of the somatic protein pool: shoulder circumference — 18-29.5 cm, average — (21.8 ± 0.15); thickness of the skin-fat fold over the triceps — 2–12 mm, average — (5.41 ± 0.22); shoulder muscle circumference — 17.1–26.4 cm, average — (20.1 ± 0.12). The listed indicators confirmed a decrease in both the fat depot and the muscle mass as well as a violation of the trophological status.

Laboratory results made it possible to assess the state of the visceral pool of protein and immunity. The obtained indicators of the level of total blood serum protein — 47-83 g / l, average — (64.9 ± 0.59) and albumin — 17.1-45.6 g / l, average — (32.8 ± 0.43) — showed a decrease in the visceral protein pool. Along with this, the absolute number of lymphocytes — 0.6-4.8 thousand, average — (2.04 ± 0.07) indirectly indicated the severity of suppression of the immune system.

When analyzing the indicators of trophological status depending on gender, it was not possible to establish statistically significant differences. When comparing BMI, deviation of factual body mass from recommended body mass, depending on the level of consciousness, statistically significant differences were found, $p < 0.05$. For patients in the vegetative state the most characteristic features were a decrease in BMI and a deviation of factual body weight from recommended body weight. The analysis of the visceral protein pool, depending on the level of consciousness, did not show statistically significant differences.

Thus, in the study group of patients, the trophological status indicators were less than the reference values, which indicated the presence of signs of PEM of varying severity in victims of emergencies with long-term impairment of consciousness due to TBI.

Prevalence, severity and types of trophological insufficiency in victims of emergencies with long-term impairment of consciousness due to TBI

The study of the obtained data on the nutritional status of victims of emergencies with long-term impairment of consciousness due to TBI made it possible to conduct a clinical and epidemiological analysis of trophological insufficiency in patients of this group. Among victims in emergencies with long-term impairment of consciousness due to TBI, the severity of trophological insufficiency was presented as mild ($n = 12$), moderate ($n = 104$) and severe ($n = 10$). Thus, in the study group (82.5%) PEM of moderate severity prevailed.

To assess the prevalence of trophological insufficiency, we analyzed the severity of PEM depending on demographic parameters. In the study group, both men ($n = 85 - 83.3\%$) and women ($n = 19 - 79.2\%$) in all age groups most often suffered from trophological insufficiency of moderate severity. Among young patients, there were different degrees of severity of PEM, while for old age only moderate severity was characteristic — $n = 3 - 100\%$. In elderly patients, in one case (25%) it was mild, in 3 cases (75%) it was moderate. Severe PEM was found only in young ($n = 8 - 8.1\%$) and middle-aged ($n = 2 - 10\%$) patients. Thus, when comparing the severity of PEM depending on gender and age, we were unable to establish statistically significant differences — $p = 0.386$ and $p = 0.566$, respectively.

All patients with long-term impairment of consciousness had signs of oropharyngeal dysphagia, and therefore, nutrition was carried out using a gastrostomy tube and a nasogastric tube. An assessment was made of the influence of nutritional delivery methods on the severity of trophological insufficiency from the moment of TBI till the moment of inclusion in the study (Table 1)

Table 1 shows that when assessing the influence of the feeding method on the severity of PEM, statistically significant differences were found, $p < 0.05$. Mild PEM was more common with nasogastric tube feeding, while moderate PEM was common with both tube feeding methods. Trophological status was presented by severe PEM only in the case of gastrostomy.

In the study group, trophological insufficiency was also assessed on the basis of objective data and diagnostic criteria — body weight, fat storage, somatic and visceral protein pool. Analysis of the data obtained made it possible to identify the main types of PEM in victims of emergencies with long-term impairment of consciousness due to TBI. Most often, were registered: PEM of marasmus type (55.6%) and of mixed type — marasmic kwashiorkor (41.3%), less often — kwashiorkor (3.2%). In men, marasmus ($n = 53 - 52\%$) and marasmus kwashiorkor ($n = 46 - 45.1\%$) occurrence were almost equal, while marasmus was more common in women

Таблица 1/Table No 1

Распределение пациентов по степени тяжести белково-энергетической недостаточности (БЭН) в зависимости от метода введения питания, чел./%

Distribution of patients in accordance with severity of protein-energy malnutrition (PEM) depending on feeding method, per./%

Метод введения питания Feed introduction method	Степень тяжести БЭН Severity of protein-energy malnutrition			P
	легкая light	средняя medium	тяжелая severe	
Гастростома Gastrostomy	4/5,71	57/81,43	9/12,86	0,024*
Назогастральный зонд Nasogastric tube	8/14,29	47/83,93	1/1,79	

* Здесь и в табл. 2-4 – различия показателей статистически значимы, $p < 0,05$
* Here and in Tables No. 2-4 – differences in indicators are statistically significant, $p < 0,05$

($n = 17 - 70.8\%$). Kwashiorkor-type malnutrition was less common in patients of both sexes. For young patients, marasmus ($n = 64 - 64.6\%$) and marasmus kwashiorkor ($n = 34 - 34.3\%$) were most typical – the latter was more often observed in middle-aged ($n = 15 - 75\%$) and in elderly ($n = 2 - 66.7\%$) (Table 2).

When comparing the distribution of patients by PEM type depending on age, statistically significant differences were found, $p < 0.001$. When comparing the distribution of patients by PEM type depending on gender, no significant differences were found, $p = 0.124$.

To identify the prevalence of trophological deficiency, the nutritional status was analyzed depending on the level of consciousness of the patients. For patients who were in a state of minimal consciousness and in a vegetative state, the most characteristic was an average degree of malnutrition – ($n = 90 - 82.6\%$) and ($n = 14 - 82.4\%$), respectively. In patients in both groups, marasmus was more common – ($n = 61 - 56\%$) and ($n = 19 - 52.9\%$), respectively, and marasmic kwashiorkor – ($n = 46 - 42.2\%$) and ($n = 16 - 35, 3\%$), respectively. When analyzing the influence of the level of consciousness on the severity and type of PEM, no statistically significant differences were found – $p = 0.117$ and $p = 0.13$, respectively.

To obtain a general idea of trophological insufficiency in patients with long-term impairment of consciousness due to TBI got in emergency, the type of protein-energy deficiency was analyzed depending on the severity of PEM (Table 3).

According to Table 3, when comparing the type of PEM depending on the severity of PEM, significant differences were found, $p < 0.05$.

In patients of the study group, regardless of the severity of PEM, in more than half of the cases, the type of PEM was represented by marasmus and, less often, by kwashiorkor, which is characteristic primarily of severe PEM.

Influence of infectious complications on the severity of PEM in victims of emergencies with long-term impairment of consciousness due to TBI

Concomitant infectious complications of various localization were detected in 109 patients (86.5%). In 17 patients (13.5%)

there were no complications. The most typical localizations: bronchopulmonary infections – 82% of cases; urinary tract infections – 61%; infected bedsores – 27% of cases. Considering the high prevalence of infectious complications among patients, we analyzed their effect on the degree of trophological insufficiency (Table 4).

From the data of Table 4, analyzing the severity of PEM, depending on the presence or absence of infectious complications, we revealed statistically significant differences, $p < 0.001$. The incidence of moderate and severe trophological insufficiency was higher in the presence of infectious complications – 9.2 and 88.1%, respectively.

Conclusion

1. In victims of emergencies with long-term impairment of consciousness due to TBI, during the initial screening, high risks of developing a rapidly progressing malnutrition are determined. The trophological status is manifested by deficiency of the somatic (decrease in fat depot, muscle mass) and visceral (violation of the protein-synthetic function of the liver, state of hematopoietic organs and of immune system) protein pools.

2. The trophological status of victims of emergencies with long-term impairment of consciousness due to TBI – regardless of the severity of PEM – in more than half of the cases was represented by marasmus and, less often, by kwashiorkor. In all age groups, PEM of moderate severity prevailed in both men and women, while a severe degree was found only in middle-aged and young patients. Marasmus and senile kwashiorkor as types of PEM were more common than kwashiorkor. At the same time, marasmus and marasmus kwashiorkor were almost equally met in men, while in women PEM predominated in the form of marasmus. For a young age, the most characteristic PEM type was marasmus, for the elderly it was kwashiorkor.

3. Patients with infectious complications have a high risk of developing moderate and severe PEM, which requires additional screening and timely sanitation of foci of chronic infection.

4. The identified features require further study and assessment of the impact of timely and adequate nutritional support on the trophological status in these patients.

Таблица 2/Table No 2

Распределение пациентов по типам БЭН в зависимости от их пола и возраста, чел./%

Distribution of patients by protein-energy malnutrition type depending on their gender and age, per. %

Группировка пациентов по полу и возрасту Patients groups by gender and age	Тип БЭН /Protein-energy malnutrition type			P
	маразм marasmus	квашиоркор kwashiorkor	маразматический квашиоркор marasmic kwashiorkor	
Женщины Women	17/70,83	1/4,17	6/25,0	0,124
Мужчины Man	53/51,96	3/2,94	46/45,1	
Молодой возраст Young age	64/64,65	1/1,01	34/34,34	$< 0,001^*$ $P_{\text{Молодой возраст} - \text{Средний возраст}} = 0,004^*$ $P_{\text{Young age} - \text{Average age}} = 0,004^*$
Средний возраст Average age	4/20,0	1/5,0	15/75,0	
Пожилый возраст Elderly age	2/50,0	1/25,0	1/25,0	$P_{\text{Молодой возраст} - \text{Пожилый возраст}} = 0,012^*$ $P_{\text{Young age} - \text{Elderly age}} = 0,012^*$ $P_{\text{Молодой возраст} - \text{Старческий возраст}} < 0,001^*$ $P_{\text{Young age} - \text{Old age}} < 0,001^*$
Старческий возраст Old age	-	1/33,33	2/66,67	

Таблица 3/Table No 3

**Распределение пациентов по типам
белково-энергетической недостаточности
в зависимости от степени её тяжести, чел./%**

Distribution of patients by protein-energy malnutrition type depending on the severity of protein-energy malnutrition, per./%

Степень тяжести БЭН Severity of protein-energy malnutrition	Тип БЭН / Protein-energy malnutrition type			P
	маразм marasmus	квашиоркор kwashiorkor	маразматический квашиоркор marasmic kwashiorkor	
Легкая Light	11/91,67	–	1/8,33	0,046*
Средняя Medium	55/52,88	3/2,88	46/44,23	
Тяжелая Severe	4/40,0	1/10,0	5/50,0	

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Таблица 4/Table No 4

**Распределение пациентов по степени тяжести БЭН
в зависимости от отсутствия или наличия
инфекционных осложнений, чел./%**

Distribution of patients by severity of protein-energy malnutrition depending on the presence or absence of infectious complications, per./%

Инфекционные осложнения Infectious complications	Степень тяжести БЭН Severity of protein-energy malnutrition			P
	легкая light	средняя medium	тяжелая severe	
Отсутствие Absence	9/52,94	8/47,06	–	0,001*
Наличие Presence	3/2,75	96/88,07	10/9,17	

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PREVENTION AND TREATMENT OF ALTITUDE DISEASE

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Abstract. *The aim of the study is to determine the tactics of effective prevention and treatment of altitude sickness in the conditions of medium and high mountains.*

Materials and research methods. Domestic and foreign literature on altitude sickness are analyzed. The search was carried out using the electronic databases MEDLINE, Embase, Scopus, Web of Science, eLIBRARY for the period from 2013 to 2021. The following keywords and their combinations were used for the search: altitude sickness, treatment, prevention.

Research results and their analysis. The features of the development of altitude sickness, risk factors, modern approaches to the treatment of this pathology, as well as the possibilities of pharmacological and non-pharmacological methods of prevention are considered. It is noted that the key method of preventing altitude sickness is a gradual ascent to great heights, and a promising method for its prevention can be an early implementation of interval hypoxic training. If one needs to quickly climb to heights of over 2.5 thousand meters, it is possible to use drugs such as acetazolamide and dexamethasone. In case of ineffectiveness of prevention and of development of any form of altitude sickness, the most effective treatment is an immediate descent to lower altitudes. If the descent is impossible, the use of oxygen and pharmacotherapy is justified, it is also possible to use hyperbaric chambers.

Key words: *acute mountain sickness, altitude sickness, athletes, high-altitude cerebral edema, high-altitude pulmonary edema, prevention, treatment*

Conflict of interest. The authors declare no conflict of interest

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ПРОФИЛАКТИКА И ЛЕЧЕНИЕ ВЫСОТНОЙ БОЛЕЗНИ

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Резюме. *Цель исследования – определение тактики эффективной профилактики и лечения высотной болезни в условиях средне- и высокогорья.*

Материалы и методы исследования. Проанализированы данные отечественной и зарубежной литературы о высотной болезни. Поиск проводился с использованием электронных баз данных MEDLINE, Embase, Scopus, Web of Science, eLIBRARY за период с 2013 г. по 2021 г. Для поиска использовались следующие ключевые слова и их сочетания: высотная болезнь, лечение, профилактика.

Результаты исследования и их анализ. Рассмотрены особенности развития высотной болезни, факторы риска, современные подходы к лечению данной патологии, а также возможности фармакологических и нефармакологических методов профилактики. Отмечено, что ключевой метод профилактики высотной болезни – постепенное восхождение на большие высоты, а перспективным методом её профилактики может быть заблаговременное проведение интервальных гипоксических тренировок. При необходимости быстрого подъема на высоты свыше 2,5 тыс. м возможно применение таких препаратов, как ацетазоламид и дексаметазон. В случае неэффективности профилактики и развития любой из форм высотной болезни самое эффективное средство лечения – незамедлительный спуск на более низкие высоты. При невозможности спуска оправдано применение кислородо- и фармакотерапии, возможно также использование гипербарических камер.

Ключевые слова: *высокогорный отек легких, высокогорный отек мозга, высотная болезнь, острая горная болезнь, спортсмены*

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here are many activities associated with the need to climb mountains up to great heights. These include sports (mountaineering, alpine skiing, etc.), military operations, scientific expeditions, tourism, rescue operations, etc. As one climbs to a great height, one faces many negative environmental factors: decrease in temperature and humidity, strong winds, increase in ultraviolet radiation and, most importantly, decrease in atmospheric pressure and oxygen partial pressure. It has been established that atmospheric pressure at an altitude of over 5 thousand m can decrease till 370 mm Hg and below, and partial pressure of oxygen (normal range is 90-100 mm Hg) — till 50 mm Hg and below [1, 2]. The combination of the above-mentioned unfavorable factors with hypoxia can provoke the development of the so-called "altitude sickness".

Altitude sickness has 3 forms: acute mountain sickness, high-altitude cerebral edema and high-altitude pulmonary edema. Acute mountain sickness most often develops with a rapid ascent to an altitude of 2.5 thousand meters and above. To determine the severity of acute mountain sickness, the Lake Louise test questionnaire is used, which is based on a quantitative assessment of the four most characteristic symptoms: headache, dizziness, impaired activity of the gastrointestinal tract and fatigue. On the basis of the total score, 3 degrees of severity of acute mountain sickness are distinguished: mild degree — 3-5 points; moderate degree — 6-9 points; severe degree — 10-12 points [3]. With the development of cerebral edema, neurological manifestations are added to the aforementioned symptoms: impaired consciousness and ataxia [4]. In case of pulmonary edema, the symptoms of respiratory system damage come to the fore: dry cough, tachypnea. The condition deteriorates sharply, tachycardia, wet cough, cyanosis, coma appear [5]. This syndrome is the most dangerous form of altitude sickness. It is important to note that high-altitude cerebral edema can be considered as a more severe degree of acute mountain sickness, while high-altitude pulmonary edema due to differences in pathogenesis, clinical manifestations and, as a result, in approaches to treatment, should be considered separately [6].

These conditions, especially pulmonary and cerebral edema, in certain situations endanger the health and life of not only the patient himself, but also of those persons around him. Therefore, the issue of preventing the aforementioned conditions, the effectiveness of certain methods and drugs used to treat altitude sickness is very important.

Current views on the pathophysiology of altitude sickness

When climbing to a height of 2.5 thousand meters and above, adaptive mechanisms are subjected to significant stress. Low atmospheric pressure makes it difficult for oxygen to flow through the alveolar wall by diffusion, which causes a decrease in the partial pressure of oxygen and in the level of saturation in the blood. The resulting hypoxia triggers a cascade of physiological reactions: hyperventilation develops, leading to respiratory alkalosis, hematocrit increases, erythrocyte aggregation processes accelerate, blood flow velocity in all organs and tissues (especially in the brain and lungs) increases, heart rate and hydrostatic pressure in capillary bed grow [7]. Increased pressure in the lungs microcirculation system and increased perfusion cause interstitial pulmonary edema, which further disrupts gas exchange in alveoli and aggravates hypoxia. Through the same mechanism, interstitial cerebral edema develops, which occurs mainly in the white matter and causes an increase in intracranial pressure and irritation of the sensitive fibers of the trigeminal ganglia. This process causes severe headache. The connection of sensory fibers with the autonomic centers of the brain stem explains the frequent occurrence of nausea and vomiting together with severe

headache. It should be emphasized that in altitude sickness intracranial pressure at rest does not differ from normal. Its increase is observed with exercising and with an increase in intrathoracic pressure caused by coughing, vomiting, etc. [8]. Recent evidence suggests a significant role for the venous system in the pathogenesis of altitude sickness. The study showed that even a small cerebral edema if there is an individual predisposition can significantly impede venous outflow due to compression of small veins and thereby aggravate the symptoms of this condition [9]. In addition to the structural features of small veins, individual differences in the structure of the transverse sinus, the compensatory capabilities of the cerebrospinal fluid pathways and subarachnoid space, the tone of the autonomic nervous system (ANS) and the level of vascular endothelial growth factor expression can have a great influence on the development of the disease [8].

Pulmonary hypertension is a key link in the pathogenesis of high-altitude pulmonary edema. It is believed that in susceptible people, hypoxia causes localized pulmonary hypertension, which may be accompanied by an increased blood flow in certain areas of the lungs and by penetration of fluid from capillary bed into alveoli. Apparently, increased activity of the sympathetic nervous system and impaired absorption of sodium and fluid in the alveoli are involved in the pathogenesis of pulmonary edema [10]. Hypoxia reduces sodium transport by reducing the expression of epithelial sodium channels and sodium-potassium-dependent adenosine triphosphatase. Perhaps this effect is due to dysfunction of β_2 -adrenergic receptors [8]. In recent years, researchers have paid more and more attention to the role of endothelium and its production of substances such as nitrous oxide (NO) and endothelin-1. It was found that in patients with high-altitude pulmonary edema the level of NO in the exhaled air is lower than in healthy people, and the level of endothelin in their blood is higher [11].

Thus, the pathophysiology of altitude sickness is complex and multifaceted. It can be noted that the genetic characteristics of a particular person are of great importance in the development of the disease.

Risk factors for altitude sickness

The strongest risk factor for altitude sickness is a rapid ascent to a great height: the body does not have time to adapt to a progressive decrease in atmospheric pressure. With an intense physical activity symptoms of altitude sickness can appear even at relatively low altitudes. The nature of the area where the person permanently resides is of great importance. People living in lowlands are at increased risk of altitude sickness compared to those who live permanently above 900 m above sea level [12]. A previous history of altitude sickness is also a fairly important risk factor, especially if there have been cases of cerebral and pulmonary edema, regardless of how long ago they occurred. Moreover, up to 60% of people with a history of altitude sickness fall ill again when they return to the same altitude [2]. Recent studies have shown that gender and physical fitness — unlike age — do not directly affect morbidity [12]. It has been shown that people over the age of 40-60, as well as children and adolescents, are less susceptible to the development of altitude sickness, but the exact mechanisms of the development of resistance of these groups to the disease have not yet been identified. It is believed that the presence of bad habits (alcohol and smoking) does not affect the incidence of altitude sickness. However, in a recent study, it was found that people who smoke are still more likely to suffer from this pathology [13].

In the last decade, researchers have paid more and more attention to the role of genetics in the pathogenesis of altitude sickness. For example, the genetic variability of many

genes may be associated with a predisposition to this condition. The strongest link was found with genes that encode angiotensin converting enzyme (ACE) and nitric oxide synthase (NO synthase) — [10]. This fact suggests that in the future it will be possible to assess the risks of altitude sickness by studying the genotype and to take the necessary measures in a timely manner before the ascent.

Prevention of altitude sickness

Preventing the development of altitude sickness should be a priority before climbing. Although the prevention strategy in most cases gives a good result, its effectiveness cannot be unequivocally guaranteed in all cases, since the response of an individual to the height can be unpredictable and depends on many individual characteristics. Gradual ascent is the best prevention tactics for all forms of altitude sickness, since applying it a person gives necessary time to his body to develop high-altitude acclimatization. If you plan to climb to an altitude of more than 2.5 thousand m, then before continuing the hike, it is recommended to spend 6-7 days at a moderate altitude — 2.2 thousand - 3 thousand m. It is also recommended at an altitude of 3 thousand not to exceed the daily climb by more than 500 m per day and to stop for rest every 3-4 days [5]. If symptoms of altitude sickness develop, the ascent should be stopped. Additionally, it should be noted that on the eve of climbing to a height, one should stop drinking alcohol, taking narcotic analgesics and avoid hard physical exertion [8]. Throughout the entire ascent, it is necessary to observe a drinking regime, since in conditions of low humidity at altitude and physical exertion, the risk of dehydration increases, which serves as an additional aggravating factor.

The tactics of preliminary hypoxic preparation for the prevention of altitude sickness is very interesting. A large number of studies have been carried out studying the effects of exposure to hypo- or normobaric hypoxia for some time before climbing. It was concluded that 15-60 min courses of hypoxia taken a few days before the ascent did not contribute to a more rapid acclimatization to the conditions of medium and high mountains. At the same time, longer courses — of more than 8 hours a day for 7 days before the ascent — are more likely to facilitate quick adaptation. Moreover, hypobaric hypoxia is more effective than normobaric hypoxia [14].

Prophylactic medication is not recommended for persons with a low risk of developing altitude sickness — climbing to an altitude below 2.5 thousand meters, with no symptoms of the disease in the anamnesis. In other cases, taking medications may be justified. The carbonic anhydrase inhibitor acetazolamide is the main drug for the prevention of acute mountain sickness and high-altitude cerebral edema. It accelerates natural mechanisms of adaptation to high mountains, reduces the severity of neurological disorders at altitude, increases physical performance under conditions of hypobaric hypoxia. At the same time, there is no data on the advantage of taking acetazolamide in a daily dose of 1000 mg compared to a daily dose of 250 mg [15]. In view of this, acetazolamide is recommended to be taken the day before the ascent at a dosage of 125 mg every 12 hours — 250 mg per day and 2.5 mg / kg - for children - until the start of the descent from the maximum reached altitude of the route [16].

If acetazolamide is intolerant, dexamethasone may be an effective prophylaxis for altitude sickness. The preferred dosage for this drug is 2 mg every 6 hours or 4 mg every 12 hours [2]. Taking dexamethasone should be discontinued after the start of descent from a height and should not last more than 7 days, since in this case there is a risk of suppression of adrenal function. Some authors recommend combination therapy with acetazolamide and dexametha-

sone during military and rescue operations, when there is a need for rapid ascent to an altitude of more than 3.5 thousand m [9]. Ibuprofen is also considered an alternative means of preventing altitude sickness, which has been shown to be more effective than placebo, but less effective than acetazolamide [17]. Given the fact that ibuprofen can cause gastrointestinal bleeding, this drug is recommended only if acetazolamide and dexamethasone are intolerant.

As for high-altitude pulmonary edema, the routine prophylactic use of drugs is not recommended. The only indication is a history of single or multiple cases of the disease. Among the drugs used to prevent the disease are nifedipine, tadalafil and dexamethasone. The calcium channel blocker nifedipine is the most effective drug for preventing pulmonary edema. It has been shown that this drug effectively reduces the pressure in the pulmonary vessels without development of significant systemic hypotension [18]. Prophylaxis should be started 24 hours before rising, the recommended dose is 20 mg of the slow-release drug every 8 hours. Tadalafil and dexamethasone are used only if nifedipine is intolerant.

Altitude sickness treatment

As mentioned above, when climbing to an altitude of over 2.5 thousand meters, it is necessary to prevent altitude sickness. If, despite the preventive measures taken, the disease has developed, the most effective strategy is to immediately descend to lower altitudes — an average of 300–1000 m. This is especially important if symptoms of cerebral and pulmonary edema are present. Other medical and pharmacological measures should be considered as a priority only when immediate descent is not possible.

Most patients with mild symptoms of acute mountain sickness can be cured by giving them enough time to rest. You can also use symptomatic drugs: non-opioid analgesics — for headaches; antiemetics — for nausea and vomiting. It is recommended to take ibuprofen (600 mg) and acetaminophen (650–1000 mg) as analgesics, metoclopramide (10 mg) as an antiemetic [19]. In case of ineffectiveness of symptomatic drugs when they are taken for 1-2 days or the progression of symptoms of the disease, it is recommended to use acetazolamide at a dosage of 250 mg 2 times a day or dexamethasone at a dosage of 4 mg every 6 hours with a preliminary loading dose of 8 mg [5].

With further aggravation of the symptoms of altitude sickness and the appearance of signs of high-altitude cerebral edema, urgent evacuation is necessary. If it is impossible, it is necessary to carry out oxygen treatment under the control of saturation, the target level of which is more than 90% [2]. It is also possible to use hyperbaric chambers, but in this case there is a high probability of repeated deterioration after the procedure. The use of CPAP-therapy (Constant Positive Airway Pressure), which has become widespread in the treatment of obstructive sleep apnea syndrome, is very promising [20]. When using this method, the pressure on the alveolar walls increases, which is accompanied by an increase in the alveolar volume, an improvement in the ventilation-perfusion ratio and, as a consequence, in gas exchange. However, due to the lack of full-fledged studies of the application of this method in mountain sickness, CPAP therapy is recommended to be used only when standard oxygen therapy did not give the desired effect.

If high-altitude pulmonary edema develops, it is also necessary to either take immediate descent measures, or to conduct oxygen therapy until the target saturation values are reached. In the absence of oxygen, it is recommended to take nifedipine at a dosage of 30 mg 2 times a day. It is possible to use inhibitors of phosphodiesterase-5, dexamethasone and beta-agonists. It should be noted that all types of pharmacological drugs used in high-altitude pulmonary

edema should be used in the absence of the possibility of oxygen therapy, since the equal efficiency of using oxygen and its combination with drugs has been proven [9].

Currently, active research is underway on the possibility of using for the prevention and treatment of altitude sickness of such drugs as endothelin receptor antagonists type A (sitaxentan, ambrisentan), interleukin-10 activators (gabapentin), Rho-kinase inhibitors, stimulants of soluble guanylate cyclase and inducers of glutathione S- transferase [21].

Thus, altitude sickness is a dangerous condition that can cause significant harm to human health and, in some cases, even lead to death. Prevention of this disease should be carried out when climbing mountains to an altitude of more than 2.5 thousand meters, and in some cases to lower

heights. This is especially true for people permanently living in flat areas or with a history of altitude sickness. Prevention of altitude sickness includes a gradual ascent to significant heights, elimination of smoking, alcohol and intense physical activity on the eve of the ascent. If you need to quickly climb to a great height, it is possible to use drugs such as acetazolamide and dexamethasone. It is also very promising to use the method of interval hypoxic training at least a week before the ascent. In case of ineffectiveness of prevention, if any form of altitude sickness develops, the most effective treatment is an immediate descent to lower altitudes. Only when it is impossible to descend, the use of oxygen therapy, pharmacotherapy, hyperbaric chambers, etc. is justified.

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NEW PROFESSIONAL COMPETENCES OF INPATIENT EMERGENCY DEPARTMENT STAFF

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Abstract. The purpose of the study is to determine the professional competencies that are in demand among emergency medical personnel when they provide medical care in an inpatient department.

Materials and research methods. We compared the impersonal reports on the work done by 20 doctors of specialized substations of the emergency medical service in St. Petersburg for 2015–2017 with the information about work in the mode of daily activities in 2017 of 10 doctors in the intensive care unit of the inpatient department of the Emergency Medical Service of the First St. Petersburg State Medical University named after academician I.I. Pavlov, stored in the qMS medical information system of the University. The volume of instrumental examination of patients who sought medical help, received it in the required volume and were discharged in a satisfactory condition within the first day, was assessed. We compared the results of ultrasound diagnostics performed by the emergency doctors in the screening mode using portable equipment with the results of the work of a consultant-specialist. 701 medical records of inpatients from among those admitted to the Medical University were analyzed. By studying 4573 medical records, possibility and effectiveness of independent primary triage of the incoming patients by the nursing staff was determined. In addition, with the help of the FlexSim HealthCare program, which allows to effectively predict and to simulate changes in work processes within medical institutions, computer simulation of the department's work was carried out in the conditions of autonomous work of an emergency doctor.

Statistical comparison was performed using the Mann-Whitney test, Student's t-test for unrelated values, and analysis of four-field tables using the χ -square test.

Research results and their analysis. Analysis of the research results showed:

- fundamental principles of work of the staff of inpatient department – multidisciplinary, multitasking, autonomy. An ambulance doctor working in a stationary environment must be able to independently diagnose, to treat patients with various pathologies, and to simultaneously supervise several patients;
- having the level of practical and theoretical training specified in the professional standard, the emergency doctor can effectively provide resuscitation care in the volume of I – II levels, which is especially important, given the short time spent by patients in the department;
- professional standard of the emergency doctors requires to master ultrasound diagnostics to identify gross pathological conditions and to perform a number of manipulations;
- nursing staff working in the inpatient department must be able to work in an autonomous environment. Triage by nurses is effective and allows to identify patients who need an immediate examination by an EMS doctor. The use of a three-level sorting algorithm does not contradict basic principles of medical triage used in world practice.

Key words: doctors, computer simulation, emergency medical care, inpatient department, nurses, professional competence, three-level triage algorithm, triage, ultrasound screening.

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НОВОЕ В ПРОФЕССИОНАЛЬНЫХ КОМПЕТЕНЦИЯХ ПЕРСОНАЛА СТАЦИОНАРНОГО ОТДЕЛЕНИЯ СКОРОЙ МЕДИЦИНСКОЙ ПОМОЩИ

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Резюме. Цель исследования – определение профессиональных компетенций, востребованных у сотрудников скорой медицинской помощи (СМП) при оказании ими медицинской помощи в условиях стационарного отделения (отделение). **Материалы и методы исследования.** Сравнивались обезличенные отчеты о проделанной работе 20 врачей специализированных подстанций СМП г. Санкт-Петербурга за 2015–2017 гг. с информацией о работе в режиме повседневной деятельности в 2017 г. 10 врачей в палате реанимации и интенсивной терапии (ПРИТ) стационарного отделения СМП Первого Санкт-Петербургского государственного медицинского университета им. акад. И.П. Павлова (Медицинский университет, Университет), хранящейся в медицинской информационной системе (МИС) qMS Университета. Оценивался объем инструментального обследования пациентов, которые обратились за медицинской помощью, получили её в необходимом объеме и в течение первых суток были выписаны в удовлетворительном состоянии. Сравнивались результаты выполнения врачом СМП самостоятельной ультразвуковой диагностики в режиме скрининга с использованием портативной аппаратуры с результатами работы консультанта-специалиста. Была проанализирована 701 медицинская карта стационарного больного из числа поступивших в Медицинский университет. Путем изучения 4573 медицинских карт определяли возможность и эффективность проведения силами среднего медицинского персонала самостоятельной первичной медицинской сортировки поступивших пациентов. Кроме того, с помощью программы FlexSim HealthCare – программа позволяет эффективно прогнозировать и моделировать изменение рабочих процессов внутри медицинских учреждений – осуществлялось компьютерное имитационное моделирование работы отделения в условиях автономной работы врача СМП.

Статистическое сравнение осуществлялось с помощью критерия Манна-Уитни, t-критерия Стьюдента для несвязанных величин и анализа четырехпольных таблиц с использованием критерия χ^2 -квadrat.

Результаты исследования и их анализ. Анализ результатов исследования показал:

- основополагающие принципы работы сотрудника стационарного отделения – мультидисциплинарность, многозадачность, автономность. Врач СМП, работающий в стационарных условиях, должен уметь самостоятельно ставить диагноз, лечить пациентов с различной патологией, одновременно курировать несколько больных;
- имея уровень практической и теоретической подготовки, указанный в профессиональном стандарте, врач СМП может эффективно оказывать реаниматологическую помощь в объеме I–II уровня, что особенно важно, учитывая краткие сроки нахождения пациентов в отделении;
- профессиональный стандарт врача СМП требует от него владения ультразвуковой диагностикой для выявления грубых патологических состояний и выполнения ряда манипуляций;
- средний медицинский персонал, работающий в стационарном отделении, должен уметь работать в условиях автономной деятельности. Медицинская сортировка, проводимая медицинскими сестрами – эффективна и позволяет выделять пациентов, нуждающихся в немедленном осмотре врачом СМП. Применение трехуровневого сортировочного алгоритма не противоречит основным принципам медицинской сортировки, используемым в мировой практике.

Ключевые слова: врачи, компьютерное имитационное моделирование, медицинская сортировка, медицинские сестры, профессиональные компетенции, скорая медицинская помощь, стационарное отделение, трехуровневый сортировочный алгоритм, УЗ-скрининг

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Introduction

At the beginning of the XXI century one of the key events for the ambulance service was the order of the Ministry of Health of Russia dated June 20, 2013 No. 388n, which approved the Procedure for the provision of ambulance, including specialized ambulance, medical care¹. The order legalized the stationary stage of the provision of emergency medical care. The new working conditions resulted in the creation of a professional standard for emergency doctors – approved by order of the Ministry of Labor of Russia dated March 14, 2018 No. 133n. The standard presents a generalized function "Provision of ambulance, including specialized ambulance, medical care outside medical organization, as well

as on an outpatient and inpatient basis"². Changing the professional standard requires a revision of educational programs, for which it is necessary to compare competencies which are necessary in prehospital and hospital (inpatient) periods. As a long-term experience of functioning of inpatient emergency departments shows, an emergency doctor should be able to make decisions without involving related specialists, to understand a wide range of pathological conditions and to simultaneously supervise several patients. In emergency situations department staff may be assigned the task of admitting and of triaging a large number of patients. In this case it is extremely important to make right decisions quickly and – often – to implement them independently.

¹ On approval of the Procedure for the provision of ambulance, including specialized ambulance, medical care: order of the Ministry of Health of Russia dated June 20, 2013 No. 388n

² Professional standard of an ambulance doctor: Approved by order of the Ministry of Labor of Russia dated March 14, 2018 No. 133n

Work in an emergency room for nursing staff: rotation between the department zones, work in the anti-shock ward, triage process — all this requires expanding professional competencies of a nurse. The nurse often has to combine the skills of a bandage room, ward, procedural nurse, anesthetist [1]. In her work, a nurse deals with a syndromic approach to a patient, with monitoring, artificial lung ventilation, with catheterization of great vessels, with drainage of cavities, etc. At the same time, since patients are in the department for a fairly short time, long-term care skills are less in demand. While treatment tasks and clinical situations are familiar, to one degree or another, to the nursing staff, their active involvement to the triage process has practically not been considered so far.

The purpose of the study is to determine professional competencies which are in demand among ambulance workers when they provide medical care in inpatient conditions.

Research objectives

In the course of the study, skills and knowledge used by emergency doctors in prehospital and hospital periods were compared. A possibility of independent work of a doctor in intensive care unit (ICU) and of performing ultrasound diagnostics by him was assessed. We analyzed the results of independent triage performed by nurses in inpatient department of a university clinic while working in the mode of daily activities.

Materials and research methods. The impersonal reports on the work done by 20 doctors of substations of emergency medical service in St. Petersburg for 2015–2017 were compared with information about work in the mode of daily activities in 2017 of 10 doctors in the intensive care unit of the inpatient department of the emergency room of the First Saint Petersburg State Medical University named after academician I.P. Pavlov (hereinafter — Medical University, University), stored in the medical information system qMS of the University. The volume of instrumental examination of patients who sought medical help, received it in the required volume and were discharged in a satisfactory condition within the first day was assessed. We compared the results of ultrasound diagnostics performed by the emergency doctor in the screening mode using portable equipment with the results of the work of a consultant-specialist. 701 medical records of inpatients from among those admitted to the Medical University were analyzed. By studying 4573 medical records, possibility and effectiveness of independent primary triage of incoming patients by the nursing staff was determined. In addition, using the FlexSim HealthCare program — which allows to effectively predict and to simulate changes in work processes within medical institutions — computer simulation of the department's work was carried out under the conditions of autonomous work of an emergency doctor [2, 3].

Statistical comparison was performed using the Mann-Whitney test, Student's t-test for unrelated values, and analysis of four-field tables using the χ -square test.

Research results and their analysis. Comparison of the workload and comparison of the professional skills of anesthesiologists-resuscitators of a specialized emergency medical station and of an inpatient hospital department showed that in the prehospital period, emergency medical personnel were less likely to encounter patients who needed auxiliary or artificial lung ventilation, i.e. a significant part of patients and victims did not have pronounced disorders of vital functions (Table 1). This was confirmed by a significant difference in the frequency of central venous catheterization. The result was no surprise, since the decision to call a specialized brigade is made remotely, i.e. on the basis of insufficient information, and is interpreted in favor of the person seeking emergency medical care. At the same time, comparing the

groups of doctors, there was a significant difference in frequency of puncture / drainage of pleural cavity, of electrical impulse therapy, of ultrasound diagnostics; in the studied reports, there was no ultrasound data in the prehospital period — most likely due to the fact that equipping the stations with a portable ultrasound diagnostic apparatus is optional.

The study of medical records of patients discharged from the department during the first day showed that they underwent, on average, (2.82 ± 0.06) instrumental examinations. Some of them were performed or interpreted independently by emergency doctor, and some were recommended by consultants — doctors of "narrow" specialization — urologists, neurologists, surgeons, etc. The latter significantly more often prescribed additional examination methods to patients (Table 2). Since these patients did not undergo major surgical interventions and did not require long-term hospitalization, we can say that involvement of "narrow" specialists was excessive. Unfortunately, current clinical guidelines for emergency medical care and procedures for providing care for various conditions often oblige the emergency doctor to engage doctors of other specialties.

The volume of resuscitation and anesthesiological care in intensive care unit usually does not exceed level II — the minimum volume of specialized resuscitation care — according to the classification proposed by Yu.S. Polushin et al. [4]. Patients stay in intensive care units for a fairly short period of time, and the tasks solved by doctors include instrumental examination with simultaneous correction of life-threatening conditions — complex therapy of acute respiratory disorders, infusion-transfusion therapy, correction of acute circulatory failure by simple measures, etc.

Таблица 1/ Table No. 1

Применение профессиональных навыков врачами специализированных реанимационных бригад станций СМП и врачами ПРИТ стационарного отделения

Use of professional skills by doctors of specialized resuscitation teams of ambulance stations and by doctors of resuscitation and intensive care unit of the inpatient emergency department

Показатель Indicator	Врачи реанимационных бригад Resuscitation team doctors, n=4	Врачи ПРИТ отделения Inpatient department resuscitation and intensive care unit doctors, n=3
Число пациентов, пролеченных за год, чел., (M±m) Number of patients treated per year, people, (M±m)	772,3±9,5	238±4,7*
Частота случаев катетеризации центральных вен, % Incidence of central venous catheterization, %	2,8±0,2	5,5±0,8*
Частота случаев ВВЛ ¹ /ИВЛ ² , % Incidence of assisted ventilation ¹ /artificial lung ventilation ² , %	4,2±0,5	8,9±1,1*
Частота случаев ЭИТ ³ /дефибрилляции, % Electric impulse therapy ³ /defibrillation incidence, %	2,3±0,2	7,8±1,9*
Частота случаев пункции/дренирования плевральной полости, % Incidence of puncture / drainage of pleural cavity, %	0,08±0,01	0,67±0,03*
Частота случаев самостоятельного выполнения УЗИ, % Frequency of cases of self-performed ultrasound, %	0	34,4±4,2*

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

¹ ВВЛ — вспомогательная вентиляция лёгких /assisted ventilation

² ИВЛ — искусственная вентиляция лёгких /artificial lung ventilation

³ ЭИТ — электроимпульсная терапия /Electric impulse therapy

Таблица 2/Table No. 2

Частота применения в стационарном отделении инструментальных методов обследования в зависимости от привлечения или не привлечения консультанта

Frequency of application of instrumental examination methods in the inpatient department, depending on whether or not a consultant is involved

Показатель Indicator	Консультант /Consultant	
	привлекался involved	не привлекался not involved
Число пациентов, чел. Number of patients, people	365	336
Количество инструментальных методов обследования пациента, абс., (M±m): Number of instrumental methods of patient examination, abs.:		
- выполнены врачом или м/с СтОСМП - performed by a doctor or by a nurse of the inpatient emergency department	1,31±0,04	1,38±0,05
- выполнены специалистом - performed by a specialist	1,67±0,07*	1,28±0,07
Всего /Total	2,98±0,08	2,67±0,07

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

The authors also assessed the performance of 7 doctors who worked in the intensive care unit of the emergency room of the university clinic: they compared the results of the work of four anesthesiologists-resuscitators and of three emergency doctors who had experience working in specialized intensive care teams in the prehospital period. All 7 specialists had the same monthly workload. A retrospective analysis of 272 medical records of patients admitted to the emergency room of the emergency department was carried out.

Anesthesiologists-resuscitators (group 1) provided medical care to 178 patients, including 95 men and 83 women; an average age of patients is (66.4±7.04) years; emergency doctors (group 2) – 94 patients; of them, men – 48, women – 46; an average age of the patients was (69.1±10.09) years. All patients met the red stream triage criteria. Analysis of the performance of therapeutic manipulations showed that frequency of tracheal intubation and of mechanical ventilation was the same, and differences were observed during catheterization of the great vessels (Table 3). As a result of these procedures, no cases of complications were observed. Also, in both groups of doctors, there were no significant differences in length of stay in the department, in the duration of hospitalization of patients and in the level of hospital mortality.

The autonomy of the work of emergency doctors in the inpatient department should be manifested both in the treatment and in the diagnostic process. In foreign practice, such a specialist actively uses ultrasound examination methods, without involving a specialist in radiation diagnostics. To perform screening in an inpatient emergency department, it is optimal to use portable scanners. The protocols developed in recent years make it possible to reduce the time spent for this and at the same time to obtain the most reliable amount of information. Using a "pocket" scanner, one can quickly identify a life-threatening condition and focus on significant findings. At the same time, this does not exclude the involvement of a specialist consultant to perform a full-fledged ultrasound examination to confirm the preliminary diagnosis in a complex clinical situation. The professional standard of emergency doctor, approved in 2018, presupposes ability to use ultrasound monitoring for the recognition of free fluid in the pericardium, pleural and abdominal cavities, pneumothorax, as

well as to perform puncture and catheterization of peripheral and central veins using ultrasound navigation [5–8].

For more than 5 years, the routine examination of patients seeking medical help at the inpatient department of the Medical University included a screening ultrasound study by doctors on duty. All of them are pre-trained in an 8-hour theoretical course on ultrasound diagnostics, after which together with the specialist on duty, they practiced the skills for a month. The authors analyzed the medical records of 405 surgical and therapeutic patients who were admitted to the department on an emergency basis. Upon admission, the department doctor performed screening ultrasound examination of chest and abdominal cavity organs using a portable apparatus for all patients. Immediately after the screening, a certified physician performed a full examination using a stationary apparatus.

The results obtained were compared, and the frequency of erroneous conclusions of emergency doctors was determined, which could or could not affect the treatment and diagnostic tactics. A detailed analysis of errors showed that only in 16 cases – 3.95% of the total number – an incorrect conclusion could have an impact on the course of treatment and diagnostic process (Table 4).

In addition to diagnostics in ultrasound screening mode, department staff actively used a portable device for ultrasound navigation when performing diagnostic and therapeutic punctures, as well as during catheterization of great vessels. In 2017, in the inpatient department, emergency doctors independently performed: 47 pleural punctures for hydrothorax, 2 times – puncture of tense ascites, 3 times – suprapubic punctures of bladder, and no complications were observed. The implementation of the procedures without involvement of other specialists significantly reduced the treatment time, which had a beneficial effect on the patient's condition. Currently, the department also uses portable devices for diagnosis of pulmonary embolism – expansion of the inferior vena cava, presence of floating blood clots in the veins of the lower extremities.

The authors carried out an experiment with a computer model of inpatient emergency department, made using the FlexSim HC program [9]. The emergency doctor was provided with greater autonomy in comparison to the real data obtained

Таблица 3/Table No. 3

Сравнение результатов, полученных в исследуемых группах врачей

Comparison of results obtained in the studied groups of doctors

Показатель Indicator	Группа 1/ Group No.1, n=4	Группа 2 / Group No.2, n=3
Госпитальная летальность среди пролеченных пациентов, % Hospital mortality among treated patients, %	16,85	17,02
Длительность пребывания в СтОСМП, ч Duration of stay in the inpatient emergency department, h	5,1±0,76	5,2±1,04
Длительность пребывания в клинике, сут Length of stay in the clinic, days	16,5±1,8	15,1±2,2
Частота выполнения ЦВК ¹ , % Frequency of central venous catheterization, %	34,8±2,5	23,4±2,1*
Частота выполнения ИВЛ, % Artificial lung ventilation frequency, %	8,9±1,2	8,5±1,3

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

¹ЦВК – катетеризация центральных вен /central venous catheterization

after the analysis of the qMs medical information system data. In addition, the frequency of ultrasound examinations and consultations performed by third-party specialists was reduced – they were independently performed by a virtual emergency doctor. In the model, the frequency was empirically established: ultrasound studies – 0.15 instead of actual 0.7; consultations – 0.15 instead of 0.8 per patient with 75 admissions per day (Table 5).

As a result of the experiment, time spent by patients in yellow and green zones significantly decreased, and there was also a decrease in the load on the medical staff due to the absence of repeated examinations and of additional transportation of patients.

Ultrasound lung screening was used by the department's doctors while working in the context of the COVID-19 pandemic. Patients in stable condition, who did not have gross bilateral changes during ultrasound examination of the chest cavity, underwent computed tomography of the chest organs on the first day, not in urgency mode. This allowed us to optimize work of radiological service.

At present, in the inpatient department of the Medical University, all emergency nurses carry out triage using a simple three-level algorithm developed at the Emergency medical care research institute named after I.I. Dzhanlidze [10-15]. We studied 4,753 medical records of patients admitted to the department during the first half of 2018.

Таблица 4/Table No.4

Ошибочные заключения при выполнении УЗИ-скрининга

Erroneous conclusions when performing ultrasound screening

Не выявленная/ошибочно выявленная патология Unidentified / mistakenly identified pathology	Количество случаев, абс. Number of cases, abs.
Признаки острого холецистита – абсцесс, инфильтрат, крупный конкремент, расслоение стенки желчного пузыря Signs of acute cholecystitis – abscess, infiltration, large calculus, dissection of the gallbladder wall	5
Пневмония/Pneumonia	3
Гидроторакс /Hydrothorax	1
Гидроперикард /Hydropericardium	1
Аневризма брюшной аорты /Abdominal aortic aneurysm	1
Объемное образование органов брюшной полости /Volumetric formation of the abdominal organs	1
Поражение почек – гидронефроз, крупные кисты/Kidney damage – hydronephrosis, large cysts	4

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

Таблица 5/Table No. 5

Результаты эксперимента с расширением обязанностей врача стационарного отделения

Results of the experiment with expanding the duties of an inpatient doctor

Показатель Indicator	До эксперимента Before experiment	После эксперимента After experiment
Длительность пребывания в зонах отделения, мин, (Т±t): Duration of stay in the areas of the department, min		
- красная зона/red zone	108,5±10,1	103,9±11,8
- желтая зона/yellow zone	219,6±13,2	179,2±12,5*
- зеленая зона/green zone	288,9±13,4	239,1±12,9*

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

It was decided, using the available data, to retrospectively compare the triage of patients using a three-level scale with the RETTS scale widely used in Scandinavian countries (Table 6). Comparison with RETTS was due to the fact that the scales have a related origin and common parameters used to assess the patient's condition. The analysis showed that the time frames for starting treatment of patients were fully complied with regardless of the characteristics of a particular scale. The time from the moment of admission to the medical examination of the "red" and "green" streams did not differ significantly, the "yellow" stream was examined almost 2.5 min faster, which is significantly better compared to that for the RETTS scale, and the distribution of the "orange" stream between the "red" and "yellow" streams did not harm the patient, since the time did not exceed the required 15 minutes. In the proposed scale, a significantly larger (more than 3 times) number of patients of the "red" stream was due to the redistribution of the "orange" stream into it, as well as the requirements of the Procedures for rendering assistance to patients with a cardiological and neurological profile, according to which the examination of patients with suspected acute coronary syndrome and acute cerebrovascular accident are carried out in conditions of the intensive care unit.

In our opinion, reducing the number of groups simplified the decision-making process for nurses, which is essential for the introduction of nursing triage. The triage performed by nursing staff made it possible to ensure a competent distribution of forces and means, and attention was paid primarily to more severe patients.

The experience of triage in the admission department of an infectious hospital during COVID-19 pandemic had its own specifics, which is associated with the massiveness of admissions and with the peculiarities of working with incoming stream. The vast majority of admissions had an incoming diagnosis of U07.1 or U07.2, confirmed clinically, instrumentally or by a laboratory. Primary triage was carried out directly in the process or before the preparation of medical records. The triage nurse's attention was primarily focused on arterial blood SpO₂, as patients often had severe hypoxemia with relative external well-being, which required immediate placement in a follow-up room or to intensive care to start respiratory support.

Таблица 6/Table No 6

Результаты проведения медицинской сортировки пациентов с применением сортировочных шкал RETTS и медицинского университета и время до их врачебного осмотра

Results of triage of patients using RETTS and medical university triage scales and time to their medical examination

Показатель Indicator	Шкала RETTS/RETTS Scale		Шкала медицинского университета Scale of medical university	
	число пациентов, чел./number of patients, people	расчетное время, мин./time, min	число пациентов, чел./number of patients, people	расчетное время, мин./time, min
Сортировочный поток: Sorting stream:				
- красный/red	442	0	1407	0
- оранжевый/orange	1111	1,64±0,13	Не выделяется/Not identified	
- желтый/yellow	1548	17,3±0,6	1522	14,8±0,3*
- зеленый/green	1652	35,9±3,3	1824	34,7±4,3

* различия статистически значимы, $p < 0,05$ /group differences are statistically significant

Conclusion

1. Fundamental principles of work of an inpatient emergency department employee — multidisciplinary, multitasking, autonomy. An ambulance doctor working in a stationary environment must be able to independently diagnose, to treat patients with various pathologies, and to simultaneously supervise several patients.

2. Having the level of practical and theoretical training specified in the professional standard, an emergency doctor can effectively provide intensive care in the volume of I – II levels, which is especially important given the short time spent by patients at the inpatient emergency department stage. With the emergence of inpatient departments in a large number of multidisciplinary hospitals, the ability to work as an ambulance doctor in the intensive care

unit will reduce the shortage of anesthesiologists and resuscitators [16, 17].

3. The professional standard of an ambulance doctor requires proficiency in ultrasound diagnostics to identify gross pathological conditions and to perform a number of manipulations. The use of portable scanners in daily work ensures optimization of the workflow both when working in the mode of daily activities and in emergencies of biological and social nature.

4. The nursing staff working in inpatient emergency department must be able to work in conditions of autonomous activity. The triage performed by nurses is effective and allows to identify patients in need of immediate examination by an ambulance doctor. The use of a three-level sorting algorithm does not contradict the basic principles of medical triage used in world practice.

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ORGANIZATIONAL ASPECTS OF PROVIDING EMERGENCY CARE TO VICTIMS IN ROAD TRANSPORTATION ACCIDENTS WITH DAMAGE TO THE FACIAL SKELETON

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Abstract. *The aim of the study is to investigate the organizational aspects of providing emergency medical care to victims of road traffic accidents with injuries of the facial skeleton.*

Materials and research methods. The study included 75 victims of road accidents that occurred in the city of Saratov in 2010–2019. In the total number of injured men – 42 (56.0%), women – 33 (44.0%). The age of the victims is 18–70 years, the average age is (37.5 ± 6.0) years. The study did not include: victims under the age of 18; victims with neck trauma, damage to the cerebral section of the skull and to other parts of the body. All the victims got medical assistance from the personnel of the ambulance brigades. Covering sheets, outpatient cards and medical records were used as primary documentation.

Study criteria: time during which the ambulance was provided; who provided emergency medical care; correctness of its rendering.

Research results and their analysis. Analysis of injuries to the facial skeleton showed:

- injuries of the facial skeleton are an actual pathology in victims of road traffic accidents in Saratov;
- victims of road accidents got open and closed injuries of the facial skeleton. With closed injuries, moderate and severe injuries were found in 23 (30.7%) victims, with open injuries – in 19 (23.3%) victims;
- majority (90.7%) of victims of road accidents got high-quality emergency medical aid in a timely manner. In 9.3% of cases, the quality of care was insufficient due to an incorrect assessment of severity of the victims' condition and, as a consequence, due to non-fulfillment of anti-shock measures;
- scope of the provision of emergency medical care to victims of road accidents included temporary hemostasis, treatment of wounds and anti-shock measures;
- from the accident site were evacuated: to level III trauma centers – 24.0% of victims; to level II – 48.0%; to level I trauma centers – 28.0% of victims;
- complications in the form of purulent-septic processes were observed in 16.0% of victims;
- competent and timely implementation of anti-shock measures determined an insignificant mortality rate – 4.0%.

Key words: ambulance teams, injured, injuries of the facial skeleton, organizational aspects, road traffic accidents

Conflict of interest. The authors declare no conflict of interest

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ОРГАНИЗАЦИОННЫЕ АСПЕКТЫ ОКАЗАНИЯ СКОРОЙ МЕДИЦИНСКОЙ ПОМОЩИ ПОСТРАДАВШИМ В ДОРОЖНО-ТРАНСПОРТНЫХ ПРОИСШЕСТВИЯХ С ПОВРЕЖДЕНИЯМИ ЛИЦЕВОГО СКЕЛЕТА

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Резюме. *Цель исследования – изучить организационные аспекты оказания скорой медицинской помощи (СМП) пострадавшим в дорожно-транспортных происшествиях (ДТП) с повреждениями лицевого скелета.*

Материалы и методы исследования. В исследование были включены 75 пострадавших в ДТП, произошедших в г.Саратове в 2010–2019 гг. В общем числе пострадавших мужчин – 42 (56,0%), женщин – 33 (44,0%). Возраст пострадавших – 18–70 лет, средний возраст – (37,5±6,0) лет. В исследование не включали: пострадавших, не достигших 18-летнего возраста; пострадавших с травмой шеи, повреждением мозгового отдела черепа и других частей тела. Всем пострадавшим медицинскую помощь оказывал персонал бригад СМП. В качестве первичной документации использовались сопроводительные листы, амбулаторные карты и истории болезни.

Критерии исследования: время, в течение которого была оказана скорая медицинская помощь; кто оказывал скорую медицинскую помощь; правильность ее оказания.

Результаты исследования и их анализ. Анализ травм лицевого скелета показал:

- травмы лицевого скелета являются актуальной патологией у пострадавших в ДТП в г.Саратове;
- у пострадавших в ДТП выявлены закрытые и открытые повреждения лицевого скелета. При закрытых травмах средние и тяжёлые повреждения выявлены у 30,7% пострадавших, при открытых – у 23,3% пострадавших;
- большинству (90,7%) пострадавших в ДТП скорая медицинская помощь была оказана своевременно и качественно. В 9,3% случаев она была оказана недостаточно квалифицированно из-за неправильной оценки тяжести состояния пострадавших и, как следствие, из-за невыполнения противошоковых мероприятий;
- объем оказания скорой медицинской помощи пострадавшим в ДТП включал в себя выполнение временного гемостаза, обработку ран и проведение противошоковых мероприятий;
- с места ДТП были эвакуированы: в травмоцентры III уровня – 24,0% пострадавших; II уровня – 48,0; в травмоцентры I уровня – 28,0% пострадавших;
- осложнения в виде гнойно-септических процессов наблюдались у 16,0% пострадавших;
- грамотное и своевременное выполнение противошоковых мероприятий определило незначительную летальность – 4,0%.

Ключевые слова: бригады скорой медицинской помощи, дорожно-транспортные происшествия, организационные аспекты, повреждения лицевого скелета, пострадавшие

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Relevance of research. In the Russian Federation, the problem of road traffic accidents remains actual. According to a number of authors, in our country the dynamics of the number of road accidents and mortality in them has a wave-like character [1]. The proportion of victims with injuries to the facial and cerebral parts of the skull is 23.9% [2, 3]. Maxillofacial injuries are often combined with damage to vital organs, including the organs of vision [4–6]. In addition, fractures of the lower and upper jaw are often [7]. Severe injuries are accompanied by the development of traumatic shock in the victims, which requires urgent emergency medical care. Such assistance is provided by medical and paramedic teams of the ambulance service [8]. One of the reasons for the high mortality rate in road accidents is the low literacy of road users who do not have or have insufficient skills in providing first aid to victims [9–12]. Much attention is paid to the organizational aspects of providing medical care to victims of road accidents, however, this problem is far from being solved and requires further research [13–15].

The aim of the study is to examine the organizational aspects of providing emergency medical care to victims of road traffic accidents with injuries of the facial skeleton.

Materials and research methods. The study included 75 victims of road accidents that occurred in the city of Saratov in 2010–2019. In the total number of injured men – 42 men (56.0%), 33 (44.0%) – women. The age of the victims is 18–70 years, the average age is (37.5 ± 6.0) years. The study did not include: victims under the age of 18; victims with neck trauma, damage to the cerebral section of the skull and to other parts of the body. All the victims received medical assistance from the personnel of the ambulance brigades. Covering sheets, outpatient cards and medical records were used as primary documentation.

Study criteria: time during which the emergency medical care was provided; who provided emergency medical care; correctness of its rendering.

The following criteria were used to characterize the damage:

– minor injuries: isolated (tangential, through, blind); limited damage to soft tissues of the face without their true defect and without damage to organs – tongue, salivary glands, nerve trunks,

etc.; isolated damage to alveolar ridges of the jaw or to individual teeth without disrupting continuity of the jaw; damage that does not penetrate into natural cavities of the maxillofacial region; single or multiple blind injuries to soft tissues of the face with standard shrapnel elements (balls, arrows, etc.); bruises and abrasions to the face;

– damage of moderate severity: isolated extensive damage to soft tissues of the face without their true defect or accompanied by damage to individual anatomical structures of the maxillofacial region – tongue, salivary glands and their ducts, eyelids, wings of the nose, auricles, etc.; damage to bones of the facial skeleton in violation of their continuity or penetrating into natural cavities; small blind wounds with localization of foreign bodies (fragments) near vital anatomical structures, organs and large vessels;

– severe injuries: isolated soft tissue injuries, accompanied by extensive defects or loss of small, but functionally and cosmetically important fragments of the external nose, eyelids, lips, ears, tongue, soft palate, etc.; damage to upper or lower jaw, accompanied by a bone defect; wounds that penetrate the oral cavity with damage to the hard palate, or that penetrate the nasal cavity and paranasal sinuses; multiple, multi-splintered fractures of bones of the facial skull; damage to large nerve trunks and branches of trigeminal and facial nerves, large vessels and venous plexuses; presence of foreign bodies – fragments, secondary wounding elements near vital and functionally important anatomical formations of the maxillofacial region.

Research results and their analysis. The analysis showed that closed injuries were observed in 45 victims (60.0%), open injuries - in 30 victims (40.0%). Signs of fractures of bones of the facial skull were absent in 50 victims (66.7%), in 25 victims (33.3%) - fractures of bones of the facial skeleton were registered: displacement of bone fragments, manifested by deformation, first of all, of the nose; inability to open the jaw; crepitus of bone fragments.

In the group of victims with closed injuries, light injuries were registered in 22 victims (29.3%); medium – in 18 (24.0%); severe – in 5 victims (6.7%). In victims with open injuries, minor injuries were found in 10 people. (13.3%); medium – in 11 (14.7%); severe – in 9 people. (12.0%).

In 60 cases (80.0%), emergency medical care was provided by doctors, in 15 cases (20.0%) — by paramedic teams of the ambulance.

The average time for an ambulance brigade to reach the victims is (15 ± 4) minutes. During the triage at the scene of the accident, it was found that 15 victims (20.0%) did not need emergency medical care having minor bruises of the soft tissues of the face and no signs of traumatic brain injury (TBI); the remaining 60 victims (80.0%) got emergency medical assistance at the accident site, and they were evacuated to medical organizations. Delivery time to medical organisation — (35 ± 12) min.

At the time of the provision of medical assistance at the accident scene, 42 victims (56.0%) were clearly conscious; in stupor — 25 (33.3%); in coma — 8 victims (10.7%).

The next aspect of the study was to analyze the correctness of provision of emergency medical care at the scene of an accident. In 68 cases (90.7%) the volume of emergency medical care was satisfactory, in 7 cases (9.3%) the gravity of victims condition was underestimated and anti-shock measures were carried out inadequately.

Treatment of wounds and imposition of aseptic dressings were performed in 30 cases (40.0%); temporary hemostasis — in 27 (36.0%); anti-shock measures — in 43 cases (57.3%).

In patients with open injuries, temporary hemostasis was used, in 15 victims (20.0%) pressure bandage was used; in 8 (10.7%) — wound tamponade; in 4 victims (5.3%) — hemostatic clamp.

The following anti-shock measures were taken: infusion therapy — in 36 victims (48.0%); anesthesia with non-narcotic analgesics (analgin 50% 2 ml) — in 25 (33.3%); narcotic analgesics — in 18 victims (24.0%), of which: 1% promedol 1 ml — in 12 victims (16.0%) and morphine — in 6 victims (8.0%).

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The ambulance teams delivered: 18 victims (24.0%) to level III trauma centers; 36 (48.0%) — to level II trauma centers; 12 victims (28%) — to level I trauma centers.

In the postoperative period, various complications were recorded in 12 cases (16.0%), lethal outcome — in 3 cases (4.0%). Complications were mainly associated with the development of purulent-septic processes, which most often manifested themselves as wound suppuration — 9 victims (12.0%). The main cause of death is hemorrhagic shock.

Conclusion

1. Injuries to the facial skeleton are an actual pathology in victims of road traffic accidents in Saratov.

2. Victims of road accidents got open and closed injuries of facial skeleton. Among closed injuries, moderate and severe injuries were found in 23 victims (30.7%), among open injuries — in 19 victims (23.3%).

3. The majority of victims of road accidents (90.7%) got high quality emergency medical aid in a timely manner. In 9.3% of cases, it was insufficiently qualified due to an incorrect assessment of the severity of the condition and, as a consequence, due to non-implementation of anti-shock measures.

4. The scope of the provision of emergency medical care to victims of road accidents included the implementation of temporary hemostasis, treatment of wounds and anti-shock measures.

5. The following number of victims were evacuated from the accident scene to trauma centers: Level III — 24.0% of victims; Level II — 48.0%; Level I — 28.0% of victims.

6. Complications in the form of purulent-septic processes were observed in 16.0% of victims.

7. Competent and timely implementation of anti-shock measures determined an insignificant mortality rate — 4.0%.

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ACTUAL PROBLEMS OF MEDICAL EVACUATION АКТУАЛЬНЫЕ ПРОБЛЕМЫ МЕДИЦИНСКОЙ ЭВАКУАЦИИ

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ROUTING PROBLEMS DURING MEDICAL EVACUATION OF VICTIMS IN EMERGENCY SITUATIONS: RESULTS OF SWOT ANALYSIS OF SOLUTIONS OF SITUATION TASKS IN SUBURBAN AND REMOTE AREAS. MESSAGE 2

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Abstract. The purpose of the study is to analyze and to evaluate the decisions of specialists of the Disaster Medicine Service of the regions on the application of routing principles during medical evacuation of victims in emergency situations and to identify ways to improve the quality and efficiency of medical evacuation measures in emergencies with a large number of victims arisen in suburban – up to 50 km from the city – zone and in remote – more than 50 km from the city – area.

Materials and research methods. The materials of the study were 85 variants of solutions to the situational task "100 affected". The task had different structure of lesions in their localization and severity, different proportion of adults and children and variants of the place of occurrence of emergency situations. The tasks solutions were analyzed using case study technology and SWOT analysis method.

Research results and their analysis. Medical specialists who took part in solving situational tasks-cases and experts from the Headquarters of the All-Russian Disaster Medicine Service revealed a fairly large number of factors affecting the quality of medical evacuation measures in emergencies. These factors in relation to SWOT analysis can be structured into "internal" (strengths and weaknesses) and "external" – enlarging opportunities for high-quality medical evacuation measures and reducing their risks. Analysis of the identified factors in relation to medical evacuations in emergencies revealed strengths and weaknesses of each option:

- prevalence of "internal" strengths during medical evacuation in an emergency in the city, and the presence of certain risks – see Message 1 – option No. 1;

- similar positions are determined during medical evacuation in a suburban area, but with a number of differences affecting routing – Message 2 – option No. 2;

- in an emergency in a remote area, a large number of "internal" weaknesses and "external" risks are compensated by available opportunities – Message 2 – option No. 2.

For all emergency conditions, a weighted score of factors is given.

As a result, the goal of the SWOT analysis was achieved – ways to improve treatment and evacuation measures were identified to develop strategies for "breakthrough", "development", "defense" and "containment" in each scenario of emergencies.

Key words: case method, emergencies, medical evacuation, remote area, routing, suburban area, SWOT analysis, victims

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ПРОБЛЕМЫ МАРШРУТИЗАЦИИ ПРИ ПРОВЕДЕНИИ МЕДИЦИНСКОЙ ЭВАКУАЦИИ ПОСТРАДАВШИХ В ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЯХ: РЕЗУЛЬТАТЫ SWOT-АНАЛИЗА РЕШЕНИЙ СИТУАЦИОННЫХ ЗАДАЧ В УСЛОВИЯХ ПРИГОРОДНОЙ ЗОНЫ И ОТДАЛЕННОГО ОТ ГОРОДА РАЙОНА. СООБЩЕНИЕ 2

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Резюме. Цель исследования – проанализировать и оценить решения специалистов Службы медицины катастроф (СМК) регионов по применению принципов маршрутизации при проведении медицинской эвакуации пострадавших в чрезвычайных ситуациях (ЧС) и выявить пути повышения качества и эффективности проведения лечебно-эвакуационных мероприятий (ЛЭМ) в ЧС с большим числом пострадавших, возникших в пригородной – до 50 км от города – зоне и в отдаленном – более 50 км от города – районе (далее – отдаленный район).

Материалы и методы исследования. Материалами исследования были 85 вариантов решений актуальной задачи «100 поражённых» с различной структурой поражений по их локализации, степени тяжести, доле взрослых и детей и по вариантам места возникновения ЧС с применением технологии кейс-метода (Case study) и проведением SWOT-анализа ЛЭМ при ликвидации медико-санитарных последствий ЧС.

Результаты исследования и их анализ. Медицинские специалисты, принимавшие участие в решении ситуационных задач кейсов, и эксперты Штаба Всероссийской службы медицины катастроф (ВСМК) выявили достаточно большое количество факторов, влияющих на качество ЛЭМ, проводимых в ЧС. Указанные факторы применительно к SWOT-анализу можно структурировать на «внутренние» (сильные и слабые) и «внешние» – повышающие возможности качественного проведения ЛЭМ и снижающие их риски.

Анализ выявленных факторов применительно к проведению медицинских эвакуаций в ЧС выявил сильные и слабые стороны каждого варианта:

- превалирование сильных «внутренних» сторон при проведении медицинской эвакуации в ЧС, возникшей в городской черте, и наличие при этом определенных рисков – см. Сообщение 1 – вариант №1;
- аналогичные позиции определены при проведении медицинской эвакуации в ЧС, возникшей в пригородной зоне, но с рядом отличий, влияющих на маршрутизацию – Сообщение 2 – вариант №2;
- в ЧС, возникшей в отдаленном районе, большое количество слабых «внутренних» факторов и «внешних» рисков компенсируется имеющимися возможностями – Сообщение 2 – вариант №3.

Во всех условиях возникновения ЧС дана взвешенная оценка факторов.

В результате достигнута цель SWOT-анализа – выявлены направления совершенствования лечебно-эвакуационных мероприятий для разработки стратегий «прорыва», «развития», «обороны» и «сдерживания» в каждом варианте возникновения ЧС.

Ключевые слова: SWOT-анализ, кейс-метод, маршрутизация, медицинская эвакуация, отдаленный район, пострадавшие, пригородная зона, чрезвычайные ситуации

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The purpose of the study is to analyze and to evaluate the decisions of specialists of the Disaster Medicine Service of regions on the application of routing principles during medical evacuation of victims in emergency situations and to identify ways to improve quality and efficiency of medical evacuation measures in emergencies with a large number of victims in a suburban – up to 50 km from city – zone and in a remote – more than 50 km from city – area (hereinafter referred to as a remote area).

Materials and research methods. When organizing medical evacuation while liquidating medical and sanitary consequences of emergency with a large number of victims, in order to focus on the principles of routing during medical evacuation, we used the case study technology.

As a part of improving the organization of medical evacuation, heads of territorial centers of disaster medicine and of united regional centers of emergency and disaster medicine and of other institutions of Disaster Medicine Service were asked, having input data (case), to form a problem and to find optimal ways to solve it, working in teams with their own staff.

When compiling the cases, the following input data were presented:

- number of victims – 100 people;
- pathology profiles of the victims: neurosurgery, thoracoabdominal trauma, burn trauma, skeletal polytrauma and others – 5–10 options;
- structure of the contingent of victims according to the severity of the condition: severe, moderate, light – 3-7 options;
- options for the proportion of adults and children in the total number of victims – 3-5 options;
- options for the emergency location: in the city; in a suburban area – up to 50 km from the city; in a remote area – more than 50 km from the city.

In addition, when modeling the cases, real infrastructural and natural objects of the regions were mentioned. It

was proposed to take into account season, time of day and weather conditions corresponding to the date of the event specified in the case. When solving the problem, leaders themselves had to determine a possibility of attracting forces and means available in the region, including a possibility of deploying such mobile medical units as emergency response teams, mobile medical teams, field multidisciplinary hospitals (as evacuation receivers in the emergency zone).

The cases were handed over to each manager on electronic media; 7-10 days were allocated for development of solutions and for their submission for evaluation by the specialists-experts of the Headquarters of the All-Russian Service for Disaster Medicine.

In search for a solution to a problem situation specified in the case, each leader took into account from the real conditions in his region:

- personnel, material and technical support;
- number and possibilities of usage of ambulance vehicles and air transport;
- remoteness of medical organizations of the 1st, 2nd, 3rd level, their bed capacity and other characteristics;
- system of information exchange on emergencies available in the region;
- existing schemes of interagency interaction at the regional and interregional levels, etc.

When solving each case, it was necessary:

1. To assess capabilities of available medical forces and means to rescue victims within one day: provision of emergency medical assistance; organization and conduct of medical evacuation from emergency center to medical facilities of the 1st, 2nd, 3rd level, further interhospital medical evacuation.

2. To develop a schedule for carrying out available medical forces and means of medical evacuation in medical facilities of the 1st - 3rd level.

3. To calculate in the table the data reflecting the dynamics of the inflow of victims in each medical organisation for every hour with a cumulative total.

4. To calculate dynamics of medical care, taking into account hourly workload in each medical facility of the 1st - 3rd level, as well as the real data on the number of specialist doctors, operating tables, intensive care units available.

5. To calculate the required volume of interhospital medical evacuation.

6. To calculate the proportion of evacuees for each routing option that was applied.

The solutions to the case were evaluated by the specialists-experts of the Disaster Medicine Service Headquarters.

A total of 85 decisions were presented and analyzed, of which 16 decisions related to an emergency that occurred in a city; 41 — in a suburban area; 28 solutions — to an emergency that occurred in a remote area.

In Message 1, medical and evacuation measures in the elimination of medical and sanitary consequences of emergencies in the city were analysed — Option No. 1; Message 2 presents options for solving cases under the conditions of a suburban area and a remote area — Options No. 2, 3.

Research results and their analysis. The main factors that were analyzed were the remoteness of medical organisations from the emergency site and the duration of medical

evacuation (Tables 1, 2). In almost every federal district, regardless of population density and other conditions, there is a proportional distance from medical organisations of various levels from the emergency location — in a city, in a suburban area and in a remote area.

The dependence of the duration of medical evacuation on the distance between medical organisation and the place of emergency (see Tables 1, 2), as well as other factors affecting the quality of medical evacuation conducted in an emergency, and their grouping into "internal" and "external" types were presented in the Message 1.

Cases for the conditions of a suburban area and a remote area — Options No. 2, 3.

The organization of medical evacuation in an emergency in a suburban area — up to 50 km from the city — is in many ways similar to those in the event of an emergency in a city. At the same time, there are a number of differences:

- forces and means to eliminate medical and sanitary consequences of emergencies in a suburban area are mainly attracted from different regional medical facilities and their branches. They are usually located at a great distance from the place of emergency. That is why the time of arrival of medical teams at the emergency place in a suburban area is longer than in a city. Also, there is often a shortage of medical personnel;

Таблица 1/ Table No 1

Удаленность места ЧС от ЛМО 1-го, 2-го, 3-го уровня, среднее значение, км
Distance of the emergency site from the medical organization (LMO) of the 1st, 2nd, 3rd level, average value, km

Федеральный округ Federal District	В городе/In the city			В пригородной зоне/In the suburbs			В отдалённом районе/Outside the city		
	1-й уровень 1st level	2-й уровень 2nd level	3-й уровень 3rd level	1-й уровень 1st level	2-й уровень 2nd level	3-й уровень 3rd level	1-й уровень 1st level	2-й уровень 2nd level	3-й уровень 3rd level
Центральный/Central	59	96	110	79	43	68	76	173	175
Северо-Западный/Nord-West	35	35	57	70	330	330	172	140	470
Южный/South	33	41	47	41	39	49	80	96	330
Северокавказский*/North-Caucasian*	5	125	124	40	46	224	—	—	—
Приволжский/Volga	5	5	20	110	150	170	67	98	170
Уральский/Uralsky	63	120	380	27	48	136	120	120	386
Сибирский/Siberian	5	100	107	46	15	170	314	191	198
Дальневосточный/Far Eastern	18	32	44	60	75	400	42	1100	1100
Среднее значение/Average	27,8	65,7	111,1	59,1	93,2	193,4	124,4	274,0	404,1

* Специалисты СКФО не принимали участия в решении кейсов, по условиям которых ЧС произошла в отдалённом районе

* Specialists of the NCFD did not participate in solving cases in which an emergency occurred outside the city

Таблица 2/ Table No 2*

Продолжительность медицинской эвакуации с места ЧС до ЛМО 1-го, 2-го, 3-го уровня, среднее значение, ч
Duration of medical evacuation from the emergency site to the medical organization (LMO) of the 1st, 2nd, 3rd level, average values, hour

Федеральный округ Indicator	Медицинская эвакуация/Medical evacuation					
	санитарным автотранспортом by ambulance vehicles			воздушным транспортом** by air transport**		
	1-й уровень 1st level	2-й уровень 2nd level	3-й уровень 3rd level	1-й уровень 1st level	2-й уровень 2nd level	3-й уровень 3rd level
Центральный/Central	1,7	2,1	2,2	—	—	1,2
Северо-Западный/Nord-West	2,8	5,1	3,9	—	—	3,5
Южный/South	1,6	1,8	2,9	—	—	1,1
Северокавказский/North-Caucasian	2,8	3,3	3,6	—	—	2,0
Приволжский/Volga	1,9	2,2	3,5	—	—	3,3
Уральский/Uralsky	1,6	2,3	2,9	—	—	1,5
Сибирский/Siberian	1,2	1,5	2,1	—	—	1,7
Дальневосточный/Far Eastern	1,3	2,3	3,6	—	1,7	2,1
Среднее значение/Average	1,9	2,6	3,1	—	1,7	2,1

* В печатной версии журнала при публикации табл. 2 в Сообщении 1 (Медицина катастроф. 2021. №1. С.60) по вине редакции была допущена ошибка: в табл. 2 содержались неверные данные. Редакция приносит свои извинения автору статьи и читателям журнала

* In the printed version of the journal in Message 1, due to the fault of the editorial board, an error was made: a discrepancy between the name and content of the Table 2. The editorial board apologises for that.

** Санитарные вертолеты/Ambulance helicopters

- distance to medical organisations of the 2nd and 3rd levels depends on the length of medical district: in the event of an emergency in a city, an average distance to the medical organisation of the 2nd and 3rd levels is 65 and 111 km, respectively, in a suburban area — 93 and 193 km, respectively (see Table 1);

- in case of an emergency in a suburban area, in some cases it is advisable to involve the mobile medical units to work at the emergency site as an evacuation receiver;

- in 30.0% of cases of emergencies in a suburban area, helicopters are used for organizing and conducting medical evacuation, which is expedient;

- quality of telephone communication outside cities often does not contribute to a timely information exchange during medical evacuation — this must be borne in mind.

To develop strategies to improve the efficiency and quality of medical evacuation in the event of an emergency in a suburban area, we assigned a weighted score to the factors (Table 3):

Вариант №2/Variant No.2

Схема проведения SWOT-анализа ЛЭМ для ЧС, возникшей в пригородной зоне
Scheme of SWOT analysis of medical and evacuation measures (LEM) for an emergency in the suburban area

Сильные стороны – S/ Strengths – S	Слабые стороны – W /Weaknesses – W
Достаточная численность медицинского персонала – S1 Sufficient number of medical personnel – S1	Фельдшерские бригады W2 /Paramedic teams, W2
Высокая мотивация медицинского и немедицинского (водители) персонала к работе – S5 High work motivation of medical and non-medical (drivers) personnel – S5	Недоступность телемедицинских технологий, W3 Unavailability of telemedicine technologies, W3
Достаточное количество санитарного автотранспорта – S6 Sufficient number of sanitary vehicles – S6	Отсутствие системы трассовых пунктов, W4/Lack of a system of highway points, W4
Наличие санитарных вертолетов – S7 Availability of ambulance helicopters – S7	Несвоевременность информационного обмена, W9 Absence of timeliness of information exchange, W9
Наличие мобильных медицинских формирований –ММО, БЭР, ПМГ* – S8 Availability of flexible medical units – MMF, MMO, REM, PMG* – S8	Отсутствие ЕДДС** догоспитального и госпитального периодов, W10 Absence of EDDS** of pre-hospital and hospital periods, W10
Хорошая материально-техническая база – S11 Good material and technical base – S11	–
Возможности – O/ Opportunities	Риски – T /Threats – T
Развитие интернета, улучшение покрытия сотовой связью, 3G, 4G, в перспективе – 5G – O1 Development of Internet, improvement of cellular coverage, 3G, 4G, in future – 5G – O1	Бездорожье – T2 Off-road – T2
Обеспечение транспортных, в том числе немедицинских, средств системой Глонасс – O2 Provision of transport facilities, including non-medical, with the Glonass system – O2	Водные препятствия – островные территории и др. – T3 Water obstacles – island territories, etc. – T3
Проведение регулярных учений и тренингов медицинского персонала, в том числе межведомственных учений и др. – O4 Conducting regular exercises, training of medical personnel etc including on interdepartmental level – O4	Перегруженность ближайших больниц – T4 Capacity overload of nearby hospitals – T4
Разработка регламентов межведомственного взаимодействия на региональном и межрегиональном уровнях – O5 Development of regulations for interagency cooperation at the regional and interregional levels – O5	Ошибки при проведении эвакуотранспортной медицинской сортировки – T5 Mistakes during aviatransport medical triage – T5
Развитие системы дистанционного обучения – доступность образования – O6 Development of the distance learning system-accessibility of education – O6	Неблагоприятные погодные условия и время суток – T6 Adverse weather conditions and time of day – T6
Развитие системы менеджмента качества и безопасности медицинской деятельности при выездных формах работы – O7 Development of the quality and safety management system for medical activities in field-work environmen – O7	Сложности при определении: точного числа пострадавших и их местонахождения – завалы и др.; лечебно-эвакуационной характеристики пострадавших – профиль патологии, тяжесть состояния – T7 Difficulties in determining the exact number of victims and their location – blockages, etc.; difficulty in medical and evacuation characteristics of victims-pathology profile, severity of the condition – T7
Объединение ТЦМК и СМП и создание РЦ СМП и МК позволяет объединить организационные, кадровые и материально-технические ресурсы для проведения более эффективных ЛЭМ – O9 Merger of Territorial Centres for Disaster Medicine with Emergency Medicine Centers and creation of Regional Centers for Emergency and Disaster Medicine allows to combine organizational, human, material and technical resources for more efficient medical evacuation measures – O9	Отсутствие/недостаточное развитие нормативной базы для создания мобильных медицинских формирований в субъектах РФ*** – T9 Lack / insufficient development of regulatory framework for creation of mobile units in regions of Russia*** – T9
Развитие проекта по использованию санитарных вертолетов в регионах – O10 Development of the project for the use of medical helicopters in the regions – O10	–
Возможность использования железнодорожного и водного транспорта для проведения медицинской эвакуации – O11 Possibility of using rail and water transport for medical evacuation – O11	–
Развитие идеологии трехуровневой системы здравоохранения и др. – O12 Development of a three-tier health care system ideology, etc. – O12	–

* ММО – мобильный медицинский отряд, БЭР – бригада экстренного реагирования, ПМГ – полевой многопрофильный госпиталь / ММО – mobile medical detachment, REM – emergency response team, PMG – field multidisciplinary hospital

** ЕДДС – Единая дежурно-диспетчерская служба / EDDS – Unified Duty Dispatch Service

*** Субъекты РФ – далее – субъекты / Regions of Russia – regions

Based on the results of the analysis of "external" and "internal" factors affecting the medical provision of victims of emergencies in a suburban area, it is possible to formulate the following strategies for improving medical evacuation.

1. Strategy for improving the quality of medical evacuation, based on the development of internal strengths using external opportunities (S + O). According to the analysis, the main strengths are: sufficient number of medical personnel, availability of well-equipped ambulance vehicles and ability to use ambulance helicopters in most constituent entities of the Russian Federation (hereinafter referred to as the constituent entities) and deployment of mobile medical units

in the emergency zone. The task of the leader is to use the available opportunities for the rational and effective use of the available forces and means. Thus, regular exercises and trainings of medical personnel and management personnel, including with the involvement of interdepartmental forces and means, as well as the development of regulations for interdepartmental interaction will make it possible to competently use personnel, material, technical and other resources of the region and to send the required amount of forces and funds to the site of emergency in a timely manner. The formation of the united regional centers of emergency and disaster medicine and the development of the ideology

Вариант №3/Variant No.3

Схема проведения SWOT-анализа ЛЭМ для ЧС, возникшей в отдаленном от города районе
Scheme of SWOT analysis of medical and evacuation measures (LEM) for an emergency in a remote area from the city

Сильные стороны – S/ Strengths – S	Слабые стороны – W /Weaknesses – W
Наличие системы трассовых пунктов – S4 Availability of a system of highway points – S4	Недостаток медицинского персонала – W1 Lack of medical staff – W1
Наличие санитарных вертолетов – S7 Availability of ambulance helicopters – S7	Фельдшерские бригады – W2 Paramedic teams – W2
Наличие мобильных медицинских формирований –ММО, БЭР, ПМГ – S8 Availability of flexible medical units – MMF, MMO, REM, PMG* – S8	Недоступность телемедицинских технологий – W3 Unavailability of telemedicine technologies – W3
Наличие ЕДДС догоспитального и госпитального периодов – S10 The presence of EDDS of the prehospital and hospital periods – S10	Низкая мотивация медицинского и немедицинского (водители) персонала к работе –W5 Low work motivation of medical and non-medical (drivers) personnel – W5
Хорошая материально-техническая база – S11 Good material and technical base – S11	Недостаточное количество санитарного автотранспорта – W6 Insufficient number of sanitary vehicles – W6
–	Несвоевременность информационного обмена – W9 Absence of timeliness of information exchange – W9
–	Отсутствие ЕДДС догоспитального и госпитального периодов – W10 Absence of EDDS of pre-hospital and hospital periods – W10
Возможности – O/ Opportunities	Риски – T /Threats – T
Обеспечение транспортных, в том числе немедицинских, средств системой Глонасс – O2 Provision of transport facilities, including non-medical, with the Glonass system – O2	Бездорожье – T2 Off-road – T2
Наличие новых медицинских технологий (оборудования), позволяющих снизить численность медицинского персонала – O3 Availability of new medical technologies (equipment), allowing to reduce the number of medical personnel – O3	Водные препятствия – островные территории и др. – T3 Water obstacles – island territories, etc. – T3
Проведение регулярных учений и тренировок медицинского персонала, в том числе межведомственных учений и др. – O4 Conducting regular exercises, training of medical personnel etc including on interdepartmental level – O4	Перегруженность ближайших больниц – T4 Capacity overload of nearby hospitals – T4
Разработка регламентов межведомственного взаимодействия на региональном и межрегиональном уровнях – O5 Development of regulations for interagency cooperation at the regional and interregional levels – O5	Ошибки при проведении эвакуотранспортной медицинской сортировки – T5 Mistakes during aviatransport medical triage – T5
Развитие системы дистанционного обучения – доступность образования – O6 Development of the distance learning system-accessibility of education – O6	Неблагоприятные погодные условия и время суток – T6 Adverse weather conditions and time of day – T6
Развитие системы менеджмента качества и безопасности медицинской деятельности при выездных формах работы – O7 Development of the quality and safety management system for medical activities in field-work environmen – O7	Сложности при определении: точного числа пострадавших и их местонахождения – завалы и др.; лечебно-эвакуационной характеристики пострадавших – профиль патологии, тяжесть состояния – T7 Difficulties in determining the exact number of victims and their location – blockages, etc.; difficulty in medical and evacuation characteristics of victims-pathology profile, severity of the condition – T7
Объединение ТЦМК и СМП и создание РЦ СМП и МК позволяет объединить организационные, кадровые и материально-технические ресурсы для проведения более эффективных ЛЭМ – O9 Merger of Territorial Centres for Disaster Medicine with Emergency Medicine Centers and creation of Regional Centers for Emergency and Disaster Medicine allows to combine organizational, human, material and technical resources for more efficient medical evacuation measures – O9	Низкая заинтересованность органов исполнительной власти в развитии СМК субъектов – T8 Low interest of executive authorities in the development of Disaster Medicine Service of constituent entities – T8
Развитие проекта по использованию санитарных вертолетов в регионе – O10 Development of the project for the use of medical helicopters in the regions – O10	Отсутствие/недостаточное развитие нормативной базы для создания мобильных медицинских формирований в субъекте – T9 Lack / insufficient development of regulatory framework for creation of mobile units in region – T9
Возможность использования железнодорожного и водного транспорта для проведения медицинской эвакуации – O11 Possibility of using rail and water transport for medical evacuation – O11	Слабая нормативная база для проведения госпитализации пациентов на межрегиональном уровне – при близости очага ЧС к больницам соседнего субъекта – T10 Weak regulatory framework for hospitalization of patients at interregional level – when an emergency is close to hospitals of a neighboring subject – T10
Развитие идеологии трехуровневой системы здравоохранения – O13 Development of a three-tier health care system ideology – O13	Межведомственные разногласия при организации ЛЭМ – T11 Interdepartmental differences in the organization of LEM – T11

of a three-tier health care system will allow combining the potential of different medical facilities, creating a united duty dispatch service of the region for timely information exchange both in pre-hospital and in hospital periods, etc.

2. Strategy of "development" (W + O) - increasing the efficiency of medical evacuation in the elimination of med-

ical and sanitary consequences of emergencies in a suburban area — can be aimed at training field medical personnel, mainly paramedics for acquiring competencies in carrying out evacuation triage, at increasing their general level of knowledge, including by means of distance learning. Hindered information exchange, lack of a single infor-

Таблица 3/Table No 3

Значимость факторов и их оценка (баллы) при возникновении ЧС в пригородной зоне
Significance of factors and their assessment (points) in emergency in the suburban area

Фактор Factor	Значимость Significance	Оценка Evaluation	Взвешенная оценка Weighted estimation of the factor	Уд. вес фактора- Specific weight of the factor
Сильные стороны – S /Strengths – S				
Достаточная численность медицинского персонала – S1 Sufficient number of medical personnel – S1	5	3	15	0,25
Высокая мотивация медицинского и немедицинского (водители) персонала к работе – S5 High work motivation of medical and non-medical (drivers) personnel – S5	5	2	10	0,16
Достаточное количество санитарного автотранспорта – S6 Sufficient number of sanitary vehicles – S6	5	3	15	0,25
Наличие санитарных вертолетов – S7 Availability of ambulance helicopters – S7	4	2	8	0,13
Наличие мобильных медицинских формирований – ММО, БЭР, ПМГ – S8 Availability of flexible medical units – MMF, MMO, REM, PMG* – S8	3	1	3	0,05
Хорошая материально-техническая база – S11 Good material and technical base – S11	5	2	10	0,16
Всего/Total	–	–	61	1,0
Слабые стороны – W /Weaknesses – W				
Фельдшерские бригады W2 /Paramedic teams, W2	4	4	16	0,23
Недоступность телемедицинских технологий, W3 Unavailability of telemedicine technologies, W3	4	3	12	0,17
Отсутствие системы трассовых пунктов, W4/Lack of a system of highway points, W4	3	2	6	0,09
Несвоевременность информационного обмена, W9 Absence of timeliness of information exchange, W9	5	3	15	0,22
Отсутствие ЕДДС догоспитального и госпитального периодов, W10 Absence of EDDS** of pre-hospital and hospital periods, W10	5	4	20	0,29
Всего/Total	–	–	69	1,0
Возможности – O /Opportunities – O				
Развитие интернета, улучшение покрытия сотовой связью, 3G, 4G, в перспективе – 5G – O1 Development of Internet, improvement of cellular coverage, 3G, 4G, in future – 5G – O1	5	2	10	0,08
Обеспечение транспортных, в том числе немедицинских, средств системой Глонасс – O2 Provision of transport facilities, including non-medical, with the Glonass system – O2	4	5	20	0,15
Проведение регулярных учений и тренировок медицинского персонала, в том числе межведомственных учений и др. – O4 Conducting regular exercises, training of medical personnel etc including on interdepartmental level – O4	5	3	15	0,11
Разработка регламентов межведомственного взаимодействия на региональном и межрегиональном уровнях – O5 Development of regulations for interagency cooperation at the regional and interregional levels – O5	4	2	8	0,07
Развитие системы дистанционного обучения – доступность образования – O6 Development of the distance learning system-accessibility of education – O6	3	4	12	0,09
Развитие системы менеджмента качества и безопасности медицинской деятельности при выездных формах работы – O7 Development of the quality and safety management system for medical activities in field-work environment – O7	5	2	10	0,08
Объединение ТЦМК и СМП и создание РЦ СМП и МК позволяет объединить организационные, кадровые и материально-технические ресурсы для проведения более эффективных ЛЭМ – O9 Merger of Territorial Centres for Disaster Medicine with Emergency Medicine Centers and creation of Regional Centers for Emergency and Disaster Medicine allows to combine organizational, human, material and technical resources for more efficient medical evacuation measures – O9	5	3	15	0,11
Развитие проекта использования санитарных вертолетов в регионах – O10 Development of the project for the use of medical helicopters in the regions – O10	5	3	15	0,11
Возможность использования железнодорожного и водного транспорта для проведения медицинской эвакуации – O11 Possibility of using rail and water transport for medical evacuation – O11	3	2	6	0,05
Развитие идеологии трехуровневой системы здравоохранения и др. – O12 Development of a three-tier health care system ideology, etc. – O12	5	4	20	0,15
Всего/Total	–	–	131	1,0

Фактор Factor	Значимость Significance	Оценка Evaluation	Взвешенная оценка Weighted estimation of the factor	Уд. вес фактора Specific weight of the factor
Риски – Т /Threats – T				
Бездорожье – T2 / Off-road – T2	3	3	9	0,10
Водные препятствия – островные территории и др – T3 Water obstacles – island territories, etc. – T3	2	1	3	0,04
Перегруженность ближайших больниц – T4 Capacity overload of nearby hospitals – T4	4	5	20	0,22
Ошибки при проведении эвакуационной медицинской сортировки – T5 Mistakes during aviation medical triage – T5	5	3	15	0,16
Неблагоприятные погодные условия и время суток – T6 Adverse weather conditions and time of day – T6	4	5	20	0,22
Сложности при определении: точного числа пострадавших и их местонахождения – завалы и др.; лечебно-эвакуационной характеристики пострадавших – профиль патологии, тяжесть состояния – T7 Difficulties in determining the exact number of victims and their location – blockages, etc.; difficulty in medical and evacuation characteristics of victims-pathology profile, severity of the condition – T7	5	3	15	0,16
Отсутствие/недостаточное развитие нормативной базы для создания мобильных медицинских формирований в субъекте – T9 Lack / insufficient development of regulatory framework for creation of mobile units in region – T9	3	3	9	0,10
Всего/Total	–	–	91	1,0

mation space in many regions are compensated by the unification of emergency and disaster medicine stations, by the development of regulations for interdepartmental interaction and by other activities. While the absence of route points in the suburban area in most subjects is compensated by the mobile medical units' prompt departure to the emergency site for deployment of evacuation receivers.

3. Strategy of "defense" — the use of strong "internal" sides to minimize the "external" risks (S + T) and to improve medical evacuation in emergencies in a suburban area — can be based on the following. In off-road conditions, in presence of water or other natural obstacles (mountains, etc.), the only option is to use air, water, in some cases — railway, transport. Under these conditions, the project for development of helicopter ambulance aviation provides an additional opportunity to use helicopters for medical evacuation in most regions. Risk factors associated with violation of evacuation triage, with unfavorable weather conditions, with disruption of medical evacuation routing and with "overloading" of the nearest medical facilities, can be compensated by working out the regulations for involving mobile medical units, by deploying evacuation receivers in the emergency zone and by using ambulance helicopters for medical evacuation to remote medical facilities of the 2nd and 3rd level, etc.

4. Strategy of "containment" — minimizing the influence of "internal" weaknesses and of "external" risks of medical evacuation — in this case can be aimed at intensifying the process of merging the emergency and disaster medicine stations, at a joint work to create a unified information space, at the formation of a regulatory framework for the functioning of mobile medical units, at the development of interdepartmental interaction and at the training of personnel through exercises, distance and full-time education.

Elimination of medical and sanitary consequences of an emergency in a remote area has its own essential features. According to the results of case studies, in such conditions an average distance is: to the 1st level medical organisation — 120 km; 2nd level — 270; to the 3rd level medical organisation — 400 km and more (see Table 1). Thus, before arriving at the scene of an emergency, medical forces and means attracted from the nearest medical facilities must first cover the indicated distances. As a result, both the time needed for the arrival of medical specialists at the emergency site and the time for medical evacuation of victims to medical organisations increase significantly.

It should be added that in this case, medical forces and means — most often, paramedic teams — will arrive at the

emergency site in the required quantity not at once, but gradually. The competence of medical specialists who would be the first to arrive at the scene of an emergency will determine: further distribution of information about the number of victims, about the necessary forces and means; about medical and evacuation triage; about organization of medical evacuation routing.

While waiting for the arrival of the first and subsequent teams of medical specialists to the place of emergency, factors such as unfavorable weather conditions, night time, terrain, water obstacles, lack of telephone communications, etc., are of great importance. In such situations, implementation of interregional agreements will play an important role. It would allow to attract medical forces and means, including airmobile medical complexes on Mi-8 and Mi-38 helicopters, from neighboring subjects for the provision of emergency medical care and for the deployment of evacuation receivers near the emergency site. It will also provide a possibility of routing medical evacuation taking into account the location of medical organisations of the nearest subject.

According to the heads of territorial disaster medicine centers and to the members of their teams who took part in solving the cases, as well as to the experts of the Headquarters of the Disaster Medicine Service, who analyzed the decisions, the organization of medical evacuation in an emergency at a great distance from a city is much more difficult in the regions of the Far North. This explains the mistakes often made while organizing medical evacuation, which resulted in a large number of losses among the victims, and requires constant readiness of medical units, taking into account the specific characteristics of the territory of each subject.

To develop strategies to improve the efficiency and quality of medical evacuation in an emergency in a remote area, a weighted score of was assigned to the factors (Table 4).

The assessment of the proportion of factors influencing the organization of medical evacuation in the event of an emergency in a remote area, carried out by specialists-experts of the Headquarters of the Disaster Medicine Service, shows a significant excess of weak "internal" sides and of existing threats. At the same time, in this case, a correct development of strategies for improving medical evacuation would allow managers and their teams to competently dispose of the available human, material and technical resources, using all the "external" opportunities to maximize risk prevention.

Based on the analysis of case solutions, the following "averaged" variants of medical evacuation improvement strategies can be identified.

Значимость факторов и их оценка (баллы) при возникновении ЧС в отдаленном районе
Significance of factors and their assessment (points) in emergency in a remote area

Фактор Factor	Значимость Significance	Оценка Evaluation	Взвешенная оценка Weighted estimation of the factor	Уд. вес фактора- Specific weight of the factor
Сильные стороны – S /Strengths – S				
Наличие системы трассовых пунктов – S4 Availability of a system of highway points – S4	5	3	15	0,23
Наличие санитарных вертолетов – S7 Availability of ambulance helicopters – S7	5	4	20	0,31
Наличие мобильных медицинских формирований – ММО, БЭР, ПМГ – S8 Availability of flexible medical units – MMF, MMO, REM, PMG* – S8	5	3	15	0,23
Хорошая материально-техническая база – S11 Good material and technical base – S11	5	3	15	0,23
Всего/Total	–	–	65	1,0
Слабые стороны – W /Weaknesses – W				
Недостаток медицинского персонала – W1/Lack of medical staff – W1	5	4	20	0,22
Фельдшерские бригады – W2/Paramedic teams – W2	4	5	20	0,22
Недоступность телемедицинских технологий – W3 Unavailability of telemedicine technologies – W3	4	3	12	0,12
Низкая мотивация медицинского и немедицинского (водители) персонала к работе – W5 Low work motivation of medical and non-medical (drivers) personnel – W5	4	2	8	0,09
Недостаточное количество санитарного автотранспорта – W6 Insufficient number of sanitary vehicles – W6	5	3	15	0,15
Несвоевременность информационного обмена – W9 Absence of timeliness of information exchange – W9	5	2	10	0,11
Отсутствие ЕДДС догоспитального и госпитального периодов – W10 Absence of EDDS of pre-hospital and hospital periods – W10	4	2	8	0,09
Всего/Total	–	–	93	1,0
Возможности – O /Opportunities – O				
Обеспечение транспортных, в том числе немедицинских, средств системой Глонасс – O2 Provision of transport facilities, including non-medical, with the Glonass system – O2	3	4	12	0,09
Наличие новых медицинских технологий (оборудования), позволяющих снизить численность медицинского персонала – O3 Availability of new medical technologies (equipment), allowing to reduce the number of medical personnel – O3	4	2	8	0,06
Проведение регулярных учений и тренингов, в том числе межведомственных учений, медицинского персонала и др. – O4 Conducting regular exercises, training of medical personnel etc including on interdepartmental level – O4	4	2	8	0,06
Разработка регламентов межведомственного взаимодействия на региональном и межрегиональном уровнях – O5 Development of regulations for interagency cooperation at the regional and interregional levels – O5	4	4	16	0,14
Развитие системы дистанционного обучения – доступность образования – O6 Development of the distance learning system-accessibility of education – O6	4	3	12	0,09
Развитие системы менеджмента качества и безопасности медицинской деятельности при выездных формах работ – O7 Development of the quality and safety management system for medical activities in field-work environment – O7	5	2	10	0,08
Объединение ТЦМК и СМП и создание РЦ СМП и МК, позволяющее объединить организационные, кадровые и материально-технические ресурсы для проведения более эффективных ЛЭМ – O9 Merger of Territorial Centres for Disaster Medicine with Emergency Medicine Centers and creation of Regional Centers for Emergency and Disaster Medicine allows to combine organizational, human, material and technical resources for more efficient medical evacuation measures – O9	5	4	20	0,16
Развитие проекта по использованию санитарных вертолетов в регионе – O10 Development of the project for the use of medical helicopters in the region – O10	5	4	20	0,16
Возможности использования железнодорожного и водного транспорта для проведения медицинской эвакуации – O11 Possibility of using rail and water transport for medical evacuation – O11	3	3	9	0,07
Развитие идеологии трехуровневой системы здравоохранения – O13 Development of a three-tier health care system ideology – O13	4	3	12	0,09
Всего/Total	–	–	127	1,0

The strategy of "breakthrough" (S + O) in improving the quality of medical evacuation in this case will be facilitated by the maximum implementation of the available opportunities for the development of the strengths. Thus, development of regulations for interdepartmental and interregional

interaction; unification of emergency and disaster medicine stations; participation in the development of medical aviation in the regions; development of the ideology of a three-level healthcare system — all this would allow to cumulate forces and means, including the personnel component,

ambulance vehicles and helicopter medical aviation of various medical organisations of the region, "in the same hands". If necessary, the possibility of involving the aviation of other ministries and departments — of the Ministry of Defense, of the Ministry of Emergencies of Russia, etc. — can be applied. In those regions where this is not applicable, it is advisable to consider the use of railway and water transport.

Regular joint exercises will allow maintaining various mobile medical units in constant readiness, increasing the competence of medical personnel in conducting medical evacuation trials, and strengthening interdepartmental cooperation.

The strategy of "development" (W + O) — increasing the efficiency of medical evacuation in the elimination of the health consequences of emergencies in remote areas — can be aimed at using: new types of medical equipment with the ability of online transmission of data on the state of victims, support systems for organizational and clinical decisions, which would allow conducting telemedicine consultations in the prehospital period, compensating for the shortage of medical personnel, etc.

The trend towards the formation of regional centers of emergency and disaster medicine will allow to link various medical organisations in one information space, while the installation of the Glonass system on medical vehicles will allow to monitor their movement and to use them if necessary in order to move into the emergency zone at once.

The development of a quality management system for off-site work would help managers, using a process approach, to develop a number of standard operating procedures, taking into account specific characteristics of their subject, identifying and preventing possible risks in a timely manner.

Continuous training, through full-time or distance learning, of management staff and of medical specialists of mobile medical units — first of all, for actions on the spot of an emergency — would allow to effectively use the medical personnel under conditions of specialists shortage, etc.

The "defense" strategy — use of "internal" strengths to minimize "external" threats (S + T) to improve medical evacuation in an emergency in a remote area — should be based on the following principles of "approaching" medical care to the emergency zone:

- obligatory involvement of helicopter ambulance aviation with the use of medium-class helicopters of increased range — such as Mi-8, Mi-38 - of the Ministry of Defense and of the Ministry of Emergencies of Russia will allow to overcome off-road conditions, to reduce the time of delivery of medical teams as well as the time for medical evacuation of victims immediately to specialized medical treatment facilities, avoiding multi-stage;

- usage of medical mobile units, including airmobile medical complexes, with a possibility of early initiation of emergency medical care, deployment of an evacuation receiver in the emergency zone, will help to reduce the impact of adverse weather and of other factors, to create conditions for

provision of emergency medical assistance to victims, for medical evacuation triage, etc.;

- development of a system of route points will reduce the time of arrival of teams of medical specialists for organizing and providing emergency medical care, for conducting triage, for attracting necessary forces and means (by accelerating information exchange).

The "containment" strategy consists in minimization of threats and the leveling of "internal" weaknesses (W + T). Taking into account the fact that a large number of predictable unfavorable factors impact the organization and conduct of medical evacuation, a lot would depend on an active position of the leader and on a professional motivation of his team. As practice shows (according to the analysis of case solutions), an emergency with a large number of victims in remote areas provokes a misunderstanding from a higher management, which does not support the expediency of maintaining readiness and the need for expensive equipment of mobile medical units, the development of a system of route points, the active use of medical helicopter aviation and the adoption of other measures. This is accompanied by a deficit in the regional regulatory framework, especially in the context of the reorganization of the health care system. In such cases, the head of the Disaster Medicine Service of the region should take a proactive role in the development of a regulatory framework, demonstrating a leadership example to his team, developing relations, concluding contracts and signing agreements on interregional and interdepartmental interaction that would underlie prevention, identification and minimization of risks during medical evacuation in case of emergencies with a large number of victims in remote areas, building up internal personnel, material and technical potential, which ultimately forms the basis for development of a quality management system for field work in emergencies [1-3].

Conclusion

The presented SWOT-analysis of medical evacuation in the framework of elimination of medical and sanitary consequences of emergencies was carried out on the basis of solutions of the situational tasks "100 victims" by teams from 85 subjects of the Russian Federation. The data obtained as a result of the analysis of case solutions were summarized by specialists-experts of the Disaster Medicine Service Headquarters. As a result, approximate strategies were developed to improve quality and efficiency of medical evacuation for three variants of the emergency location. At the same time, on the basis of the outlined SWOT analysis methodology, each interested leader can put into practice team exercises with situational problems, taking into account specifics, personnel, material, technical, climatic-geographical, social and other features of a respective region. The results obtained will allow the leaders to make decisions, to form a team of like-minded people, to motivate their leadership, to work proactively, to prevent risks, thereby reducing severity of irrecoverable and sanitary losses in various emergencies.

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RESULTS OF OPTIMIZATION OF SANITARY AVIATION EVACUATION IN THE CONDITIONS OF A METROPOLIS

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Abstract. The aim of the study is to analyze the main results of optimization of the work of aviation medical brigades in a metropolis and the dynamics of typical reasons for refusal to use an ambulance helicopter.

Materials and research methods. The article presents the characteristics of the BK-117C-2 (EC-145) helicopter used to deliver patients to a specialized medical organization.

A retrospective analysis of all aviation medical brigades flights of the Scientific and Practical Center for Emergency Medical Aid of the Moscow Department of Health in 2017–2019, as well as a comparative analysis of aviation medical brigades performance indicators for 2005–2007 and 2017–2019, was carried out. The main compared indicators: time from the call to the departure of an ambulance helicopter to a patient; time of aviation medical brigade arrival to the place of call; total time before the patient is admitted to a specialized hospital; typical reasons for a refusal to use a helicopter when there is a call for it.

Research results and their analysis. The analysis of the research results led to the following conclusions:

- use of helicopters to provide emergency medical care and to carry out air ambulance evacuation of patients in a metropolis makes it possible to successfully solve a number of complex problems. With the start of optimization and the introduction of algorithms for the operation of ambulance helicopters, flight time to a patient decreased by 2019, compared to 2007, by 1.9 times – from (33.2 ± 1.07) to $(17.8 \pm 0, 72)$ min;
- when evaluating the results of optimizing the aviation medical brigades work in Moscow, it should be borne in mind that there are objective limitations when using an ambulance helicopter. If you do not take into account reasons such as a patient's refusal or a lack of indications for helicopter evacuation, impossibility of using an ambulance helicopter in the metropolis was on average: in 2017–2019 – 6.51% (210 cases per 3227 applications); in 2005–2007 – 10.23%. For about 10 years, impossibility of evacuating a patient to a specialized hospital has decreased for objective reasons by 3.72%, which emphasizes the effectiveness of the developed algorithms for air ambulance evacuation of urgent patients in a metropolis.

Key words: ambulance brigades, aviation medical brigades, BK-117C-2 (EC-145) helicopters, emergency medical assistance, helicopter use algorithms, medical organization, metropolis, optimization, sanitary aviation evacuation, Scientific and Practical Center for Emergency Medical Aid of the Moscow Department of Health

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РЕЗУЛЬТАТЫ ОПТИМИЗАЦИИ ПРОВЕДЕНИЯ САНИТАРНО-АВИАЦИОННОЙ ЭВАКУАЦИИ В УСЛОВИЯХ МЕГАПОЛИСА

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Резюме. Цель исследования – проанализировать основные результаты оптимизации работы авиамедицинских бригад (АМБр) в мегаполисе и динамику типичных причин отказа в вылете санитарного вертолета.

Материалы и методы исследования. Представлена характеристика вертолета БК-117С-2 (EC-145), используемого для доставки пациентов в профильные лечебные медицинские организации (ЛМО).

Выполнен ретроспективный анализ всех вылетов АМБр Научно-практического центра экстренной медицинской помощи Департамента здравоохранения г. Москвы (ЦЭМП) в 2017–2019 гг., а также сравнительный анализ показателей работы АМБр за 2005–2007 и 2017–2019 гг. Основные сравниваемые показатели: время от поступления вызова до вылета санитарного вертолета к пациенту; время прибытия АМБр на место вызова; общее время до поступления пациента в профильный стационар; типичные причины отказа в вылете вертолета при наличии вызова.

Результаты исследования и их анализ. Анализ результатов исследования позволил сделать следующие выводы:

- использование вертолетов для оказания экстренной медицинской помощи и проведения санитарно-авиационной эвакуации пациентов в мегаполисе позволяет успешно решать ряд сложных задач. С началом оптимизации и введением алгоритмов работы санитарных вертолетов время полета до пациента уменьшилось к 2019 г., по сравнению с 2007 г., в 1,9 раза – с $(33,2 \pm 1,07)$ до $(17,8 \pm 0,72)$ мин;
- при оценке результатов оптимизации работы АМБр в Москве следует иметь в виду, что в столице существуют и объективные ограничения при использовании санитарного вертолета. Если не учитывать такие причины, как отказ пациента или отсутствие показаний к вертолетной эвакуации, то невозможность использования санитарного вертолета в мегаполисе

составляла в среднем: в 2017–2019 гг. – 6,51% (210 случаев на 3227 заявок); в 2005–2007 гг. – 10,23%. В течение примерно 10 лет невозможность эвакуации пациента в профильный стационар снизилась по объективным причинам на 3,72%, что подчеркивает эффективность разработанных алгоритмов санитарно-авиационной эвакуации ургентных пациентов в мегаполисе.

Ключевые слова: авиамедицинские бригады, алгоритмы использования вертолета, бригады скорой медицинской помощи, вертолеты BK-117C-2 (EC-145), лечебные медицинские организации, мегаполис, Научно-практический центр экстренной медицинской помощи Департамента здравоохранения г. Москвы, оптимизация, санитарно-авиационная эвакуация, экстренная медицинская помощь

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In large cities of the Russian Federation, the share of diseases of cardiovascular system in the structure of requests for emergency medical care is 47–52%; of central and peripheral nervous system – 14–17%; of acute surgical pathology of abdominal organs – 9–12%; of respiratory diseases – 8–10%. In 2018, more than 3.9 million people were provided with emergency and urgent medical care in Moscow. [1–4].

According to the World Health Organization – WHO (2015), in the structure of prehospital mortality the first place is occupied by coronary heart disease. The causes of coronary death were: acute myocardial infarction (35.8%); acute coronary (36.6%) and cardiovascular (27.6%) insufficiency. Among people aged 45–75 years, in 52% of cases the death was sudden and occurred within first 1–2 hours after the onset of symptoms, while in 25.6% of cases prehospital resuscitation measures were successful [5].

The reason for optimizing the previously existing approaches to air ambulance evacuation with the use of helicopters was the assessment of prehospital measures for the main urgent diseases requiring special treatment: acute coronary syndrome; acute cerebrovascular accident – stroke; traumatic brain injury; bleeding [6–8]. In patients with the above diseases, an increased likelihood of developing an early lethal outcome was perceived. In a number of cases, there were long intervals between the call to ambulance and the delivery of the patient to a specialized hospital. At the same time, it should be emphasized that the time from the onset of the disease until the arrival of an urgent patient to a specialist doctor is an extremely important factor.

The aim of the study is to analyze the main results of optimization of the work of aviation medical brigades in megacities and the dynamics of main reasons for the refusal for ambulance helicopter usage.

Materials and research methods. In Moscow, BK-117C-2 (EC-145) helicopters are used to deliver patients to specialized medical organizations – Figure 1.

In everyday use of helicopter, its transformable cabin is equipped with a stretcher. If necessary, the helicopter can be retrofitted with a second stretcher or with an incubator for transporting newborns. The equipped medical wall contains: depending on the helicopter board – either 2 Dräger Oxylog 3000 Plus artificial lung ventilation devices (IVL), or Dräger Oxylog 1000 and LTV 1200 Pulmonic ventilators; Corpuls 3 combined device with a built-in GSM satellite mo-

dem, including a monitor, defibrillator, pacemaker; at least two B. Braun Perfusor Space syringe pumps. Each board is equipped with a dielectric floor, which makes it possible to perform electro-pulse therapy in flight. All equipment used to operate these helicopters is certified for use on aircraft.

A retrospective analysis of all aviation medical brigades flights of the Scientific and Practical Center for Emergency Medical Aid of the Moscow Department of Health in 2017–2019, as well as a comparative analysis of aviation medical brigades performance indicators for 2005–2007 and for 2017–2019 was carried out. The main compared indicators: time from the call to the departure of an ambulance helicopter to a patient; time of aviation medical brigade arrival at the place of call; total time before the patient is admitted to a specialized hospital; main reasons for the refusal to use a helicopter in case of a call for it.

Research results and their analysis. Currently, in Moscow, in all cases, except for cases of interhospital medical evacuation, an ambulance team is sent to the patient's location. Its specialists decide: whether an ambulance helicopter is needed for hospitalization of the patient or not; whether the helicopter will be able to land at the scene of the event, or it is possible to transfer the patient to an intercepting platform, which reduces overall hospitalization time.

To optimize aviation medical brigades operation, the following algorithms were developed for using the helicop-



Рис. 1. Вертолет санитарной авиации, используемый при госпитализации пациентов
Fig. 1. Ambulance helicopter used for hospitalization of patients

ter to provide medical care to the population of Moscow: "Arrival of the helicopter before the arrival of an ambulance brigade"; "Arrival of the helicopter after the arrival of an ambulance brigade"; "Medical evacuation from medical institutions"; "Work of aviation medical brigades in an emergency situation"; "Transfer of the patient from an aviation medical brigade to an ambulance team if it is impossible to use a helicopter."

In each specific case, we tried to determine the most optimal indications, to minimise the time and to adapt approaches to hospitalization of patients in specialized medical facilities using a medical helicopter for the conditions of Moscow.

Time of arrival of an aviation medical team to a patient

In Moscow, an average annual number of aviation medical brigades departures was: in 2017–2019. — (752.3 ± 2.33) cases; in 2005–2007 — (194.0 ± 5.17) cases, which highlights the rapid pace of development of air ambulance in the capital.

An important criterion for the provision of urgent medical care is the time of arrival of a doctor to a patient. Results of the optimisation of aviation medical brigades operation in 2017–2019 are presented in Tables 1, 2.

Thus, an overwhelming majority (78.6%) of flights within Moscow were prepared for departure within 15 minutes from the moment of a call. An average time spent on preparing

an ambulance helicopter for departure was: in 2017–2019. (10.97 ± 1.34) min; in 2005–2007 — (26.48 ± 1.91) min.

The time of flight and evacuation of a patient from the place of his localization to a respective medical organisation was no more than 10 minutes, an average time was (6.83 ± 0.67) minutes both in 2007 and 2019.

Thus, in 2017–2019, the total time from the call to the arrival to the patient in 91.8% of cases was up to 40 minutes, while in 2005–2007 the share of departures within this time frame was 88.3%.

In general, creation of algorithms and their optimization resulted in the fact that by 2019 an average time of arrival to a patient from the moment of a call was reduced from (33.2 ± 1.07) min to (17.8 ± 0.72) min (Figure 2).

"Ideal" — from the point of view of feasibility and validity — can be considered the hospitalization of urgent patients in hospitals from remote areas of the metropolis.

If we compare the delivery of patients to medical organisations by an ambulance helicopter with their hospitalization by ambulance vehicles, the difference was almost 20 minutes. During the evacuation by aviation medical brigades, the total time from the moment of a call till the patient's delivery to

Таблица 1/Table No 1

Среднее время готовности АМБр к вылету в 2017–2019 гг.

Average time span from call to aviation medical brigade readiness for departure 2017–2019

Время от вызова до вылета, мин Time span from call to departure, min	Кол-во вылетов, абс./% Number of departures, abs. / %			Среднее значение, % Average, %
	2017 n=795	2018 n=752	2019 n=710	
До 5 /Up to 5	88/11,2	54/7,2	34/4,8	7,73
5–10	295/37,1	274/36,4	199/28,0	33,83
10–15	255/32,1	275/36,6	301/42,4	37,03
15–20	116/14,6	102/13,6	131/18,5	15,57
20–25	24/3,0	24/3,2	22/3,1	3,1
Свыше 25/Over 25	17/2,1	21/2,8	23/3,2	2,7

Таблица 2/Table No 2

Среднее время от поступления вызова до прибытия АМБр на место события в 2017–2019 гг.

Average time span from call to arrival of aviation medical brigade at the site 2017–2019

Время от вызова до прибытия на место события, мин /Time span from call to arrival at the place, min	Кол-во вылетов, абс./% Number of departures, abs. / %			Среднее значение, % Average, %
	2017 n=783	2018 n=742	2019 n=703	
До 15 /Up to 15	79/10,1	79/10,7	26/3,7	8,17
15–20	164/20,9	143/19,3	40/5,7	15,33
20–25	185/23,6	159/21,4	76/10,8	18,60
25–30	175/22,4	177/23,9	169/24,0	23,43
30–35	103/13,2	95/12,8	184/26,2	17,40
35–40	43/5,5	46/6,2	105/14,9	8,87
40–45	16/2,1	18/2,4	41/5,8	3,43
45–60	10/1,3	12/1,6	37/5,3	2,73
Свыше 1ч/Over 1h	8/1,0	13/1,8	25/3,6	2,13

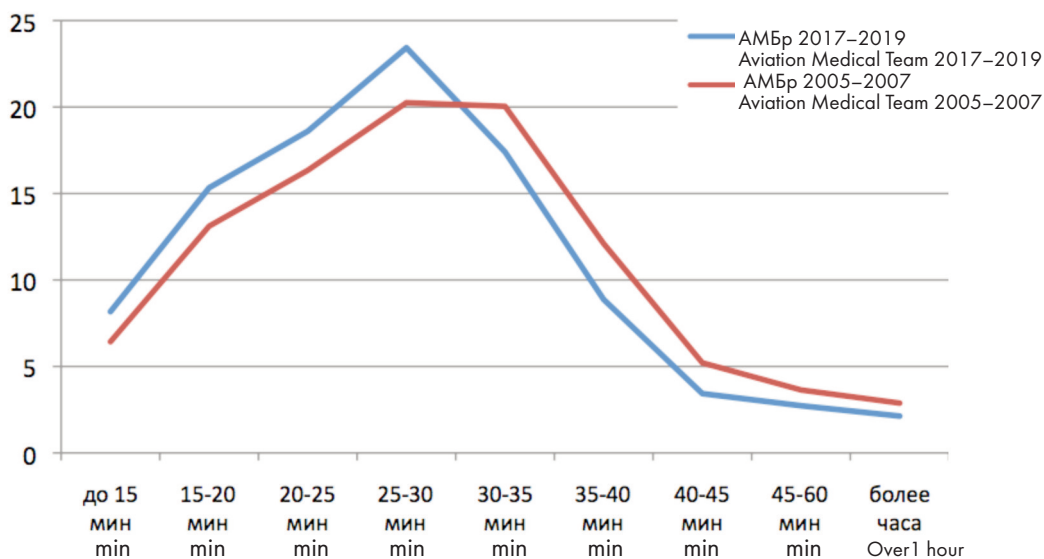


Рис. 2. Временные интервалы от момента поступления вызова до прилета АМБр к пациенту в 2017–2019 гг., %
Fig. 2. Time intervals from call to arrival of aviation medical brigade in 2017–2019, %

a hospital — when comparing cases with approximately same distance to the hospital — averaged (48.8 ± 9.1) minutes. This is almost 2 times faster, if we do not take into account evacuation from remote areas of the metropolis, when the total hospitalization time using a helicopter and an ambulance car was 90.7 and (69.7 ± 2.44) minutes, respectively. This supports the performance of created algorithms for aviation medical brigades operation.

The main reasons for non-fulfillment of applications for sanitary aviation evacuation

During hospitalization of patients by aviation medical teams in the hospitals of the capital, there were cases when the helicopter, for one reason or another, could not fly to the place of the patient's localization. Reasons for non-fulfillment of requests for the departure of aviation medical brigades in 2017–2019 are presented in Table 3.

The reasons specified in paragraphs 7 and 8 of Table 3 were relevant in 2017, but completely eliminated by 2019. Clause 7 ("No equipped site"), as a rule, meant either a snow-covered area, or inability for ambulance vehicles to approach it for any other reason that prevents landing of a medical helicopter. The issue was resolved through constant checking and snow removal. Clause 8 ("Refueling / crew exchange") — the issue was solved by agreements with the administration of the Moscow Aviation Center — the flight personnel began to take over duty not all at the same time, but at different times. For example, the first helicopter is on duty from 8: 00 to 18:00, the second — from 10:00 to 20:00, the third helicopter — from 12:00 to 22:00.

The above reasons for non-fulfillment of requests for aviation medical teams departure should be taken into account in any megalopolis when creating an emergency medical service in general and air ambulance in particular.

Conclusion

1. The use of helicopters for the provision of emergency medical care and for the medical and aviation evacuation of patients in a metropolis allows to successfully solve a number of complex problems. With the start of optimization and with the introduction of algorithms for operation of ambulance helicopters, the flight time to the patient decreased in 2019, compared to 2007, by 1.9 times — from (33.2 ± 1.07) to ($17.8 \pm 0, 72$) min.

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Таблица 3/ Table No 3

Основные причины невыполнения заявок на вылет АМБр в 2017–2019 гг.

Main reasons for the non-fulfillment by aviation medical team of applications for departure 2017–2019

Причины невыполнения заявок Reasons of non-fulfillment of applications	Кол-во заявок, абс./% Number of applications, abs./%			Итого, % Total, %
	2017 n=916	2018 n=873	2019 n=1438	
1. Отмена/запрет по метео-условиям / Cancellation/prohibition due to weather conditions	7	5	10/75	97/3
2. Запрет Федеральной службы охраны / Prohibition of the Federal Guard Service	18	6	54	78/2,4
3. По техническим причинам / For technical reasons	4	4	10	18/0,6
4. Посадка невозможна / Landing is not possible	5	5	7	17/0,5
5. Отсутствие показаний или наличие противопоказаний / Absence of indications or presence of contraindications	5	7	22	34/1,1
6. Отказ пациента/отмена вызова / Patient refusal/call cancellation	82	94	40/16	232/7,2
7. Нет оборудованной площадки / No equipped site	8	-	-	8/0,25
8. Дозаправка/обмен экипажа / Refueling/crew exchange	259/186	-	-	445/13,78

2. When evaluating the results of optimizing the aviation medical brigades work in Moscow, it should be borne in mind that there are objective limitations for an ambulance helicopter usage in the capital. If not taking into account reasons such as the patient's refusal or the lack of indications for helicopter evacuation, the impossibility of using an ambulance helicopter in the megalopolis was on average: in 2017–2019 — 6.51% (210 cases per 3227 applications); in 2005–2007 — 10.23%.

3. Thus, within about 10 years, the impossibility of evacuating a patient to a specialized hospital has decreased for objective reasons by 3.72%, which emphasizes the effectiveness of the developed algorithms for medical aviation evacuation of urgent patients in a metropolis.

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