

Medical Evacuation and Liquidation of the Medical-Sanitary Aftereffects in Crisis

Natalia Baranova, PhD Candidate; Boris Boby, PhD; Sergei Goncharov, PhD;  Natalia Nechaeva, PhD Candidate

Center of the Medical Evacuation of the All-Russian Center of Disaster Medicine “Protection” of the Ministry of Health Care of Russian Federation, Moscow, Russia

Correspondence:

Sergei Goncharov
123182, Moscow, Shukinskaya Str., 5, Russia
E-mail: goncharov_ser@rambler.ru

Conflicts of interest: None declared.

Keywords: crisis situation; medical evacuation; medical-sanitary aftereffects; organization; transportation

Abbreviations:

CS: crisis situation
ME: medical evacuation
MT: medical transportation
RF: Russian Federation

Received: May 25, 2021

Revised: August 27, 2021

Accepted: September 8, 2021

doi:[10.1017/S1049023X22000206](https://doi.org/10.1017/S1049023X22000206)

© The Author(s), 2022. Published by Cambridge University Press on behalf of the World Association for Disaster and Emergency Medicine.

Editor’s Comment

The following article was cleared for publication following peer review and upon the Editor-in-Chief’s decision. The manuscript is an addition to the global health literature. The manuscript reads uneven in the current English version, but the topic and concepts presented are of global interest and add to the disaster planning, response, and recovery knowledge base.

Abstract

Crisis situations (CS) are, unfortunately, happening in present days in each world side. And in this case, medical evacuation (ME) becomes necessary to save human lives. The presented study is regarding the description and analysis of the phases, peculiarities, and perspectives of ME organization and development. The study characterized the inter-sectoral method of the planning, and realization of crisis outcomes liquidation is provided. Four main ways of the realization of approaches that could guarantee the development of the ME system were found. Also has been identified the number of main problems which the ME system faces. Among them are lack of personnel/equipment in the medical crews; high time of transportation; the noise pollution and vibration in time of evacuation by air; the infection and exposure risk of the evacuation aircrews in the places of mass destruction weapons usage; the organizational and legislative problems of the foreign citizens’ evacuation; and ME of the persons from the oil and gas production places.

Baranova N, Boby B, Goncharov S, Nechaeva N. Medical evacuation and liquidation of the medical-sanitary aftereffects in crisis. *Prehosp Disaster Med.* 2022;37(2):255–258.

Introduction

The Experience of Medical Support in Critical Situations (CS)

The international and native organizations’ experience of emergency medical care rendering in time of liquidation of the medical-sanitary outcomes of the natural disasters, accidents, catastrophes, terrorist attacks, and armed conflicts (the crisis situation [CS]) indicates the great importance of medical evacuation (ME) in the common medical support system for populations particularly suffering from the CS.

Nowadays, CS becomes a result that a large number of people had been suffered, so increases the fraction of the first aid given in hospitals (60%–70% and more). In Russia, significant attention is paid for providing the development of the medical care system for increasing its availability, quality, and people’s life duration.^{1–4}

It is fixed law, ME in critical situations is provided by the Russian Service of the Disaster Medicine (further – Service), including disaster medical services of Russian Ministry of the Health Care (Moscow, Russia) and Russian Ministry of Defense (Moscow, Russia).^{1,5,6}

The specialists of *Disaster Medicine Center “Zashchita”* (“Protection”) evacuate more than 1.5 thousand patients every year at the federal level. Still, the main volume of ME has been performed at the local level of the constituent entities of the Russian Federation (RF). On average, the disaster medicine service of the constituent entities annually evacuates seven-thousand to nine-thousand patients suffering in the anthropogenic and natural CS. And the medical staff of the aviation ambulance department evacuates 80–100 thousand patients, and the children part is greater than one-third.^{7–9}



Baranova © 2022 Prehospital and Disaster Medicine

Figure 1. Stages of Medical Evacuation.

Methods

Data Collection

Main information sources became normative and methodical documents which regulate the order of the organization and the implementation of ME, including the Russian Service of Disaster Medicine, scientific works of the world disaster medicine specialists, service documents with ME issues, as well as authors' personal experience in organization and providing of ME in time of the CS.

Results

Organization of Modern Medical Evacuation (ME)

Medical evacuation is a multi-stage process and it consists of several connected stages, one of such is medical transportation (MT) by ground, water, or airmobile transport to the medical institution.^{10–13} The patient's diagnostics and treatment results in unspecialized institutions have significantly lower marks compared to the trauma centers, and the death rate becomes higher than 30%.^{14–17} Thus, ME cannot be considered as a decisive factor for the patient's health. Usually, it is a forced action, and MT is the most unprotected of its stages.^{18,19}

Can be picked out three stages of ME: preparatory, transportation, and after-transportation stabilization (Figure 1).^{10,17} Each stage has its organizational peculiarities which depend on the place and circumstances, but there are some common principles that are used on each stage.

The preparatory stage includes:

- Reception, registration, and injured sorting;
- Special treatment of the sufferer, decontamination, degassing, and disinfection of their clothing and equipment; and
- First aid and preparation for further transportation.

Medical transportation can be provided by different kinds of transport depending on the accident type, location, or weather conditions. The MT stage is the most unprotected because of various suddenness types may arise. As usual, it happens because of the equipment fault. Also, many different complications occur in body position changing. So, all precautions should be intensified in the patient's transfer.

The stabilization stage is provided in the closer medical institutions to the disaster. It's important these institutions must have conditions and equipment to provide special treatment. Such medical institutions are:

- Hospitals of the disaster medicine service;
- Diversified, specialized hospitals, clinics, and centers of the Ministry of Health and Social Development of RF, and medical forces of the Ministry of Defense of RF;
- Medical institutions of the Ministry of Railways of Russia, the Ministry of Internal Affairs of Russia, the border troops of Russia, and the Federal Security Bureau of Russia; and
- Staff and the medical service of the Civil Defense.²⁰

Current Problems in Health Crew Creation

The total or partial deficiency of paramedics in health crews is one of the global problems for providing ME. The interstate research of the dependence of the health crews' effectiveness in their staffing and competency level shows that a part of the medical crews would like to be equipped by an extra doctor or a doctor assistant. At the same time, the necessary condition for a successful ME improvement is additional training of the MT crew's specialists to constantly increase their qualifications.^{21,22}

The decreasing of MT crews is another important and often unresolved problem. Important problems are bad roads, the fuel limit, and non-working vehicles. But it must be remembered that the correct chosen transport remains necessary to avoid the complications in time and after transportation.^{22–24} For example, the height rising in aircraft flight leads to the atmosphere pressure reducing that may cause hypoxia and the gas expansion in the patient's body cavities,^{25,26} which can cause dangerous physiological reactions for the patient.²⁷

One more is the undesirable usage of aircraft for ME purposes in places of biological, chemical, or nuclear weapons usage because of the possible infection or poisoning of the crew. It is impossible to guarantee the security of air transport and to control crew's health and life safety.^{28–30}

The problem of foreign citizens' evacuation in rescue operations in RF regions is caused by the communication barrier. It also demands organization and quick interstate interaction with the patient's relatives, lawyers, and the insurance agents to solve the question of medical service payments, especially on occasion its cost is not covered by the compulsory health insurance fund sources.³¹ The other side is ME of citizens from aboard. It is consisting of the international legislative regulation of the issue of workflow, the improvement of the medical insurance system, and the solving of the technical questions of the ME.³²

Finally, ME from the oil and gas extraction places has critical problems caused by the high injury risk for the workers and by the significant distances between extraction places and medical institutions. The implementation of new technologies of telemedicine is a necessary condition for providing high-level health care in this field.^{33,34}

World Experience

According to the international rating results, RF refers to the middle-risk category countries that are providing quality ME and further medical care (Table 1).^{35,36}

The reasons of the ME necessity are:

- Limited capabilities of medical units in the cure for injured people at the location of the disaster or near to it;
- Necessity of the emergency cure;
- Impossibility of enough medical forces' concentration at the CS location;
- Necessity of specialized medical care rendering; and
- Presence of the real risk repeating and the secondary injuries danger for people in the CS center.^{29,30,36}

Low	Middle	High	Extreme High
Australia	Brunei	Cameroon	Iraq
Denmark	Cyprus	China	Nigeria
France	Northern Korea	Gabon	Syria
Italy	Malaysia	Indonesia	
The Netherlands	Oman	Kazakhstan	
Singapore	Philippines		
Spain	Qatar		
Switzerland	Russia		
	Taiwan		
	Trinidad and Tobago		
	UAE		

Baranova © 2022 Prehospital and Disaster Medicine

Table 1. Level of Medical Evacuation Risk in Countries that have Evacuation Services
Abbreviation: UAE, United Arab Emirates.

The primary factors to better ME's actual problems, according to Russia's conditions, are:

- Optimized conditions creation for the availability, timeliness, and higher quality of the medical care achievement for the sufferers in the CS;
- Realization steps of long-term program health care infrastructure optimization; and
- Medical care system organization and development (with emergency and first aid) using new information technologies and telemedicine.

So, analysis of medical-sanitary CS consequences liquidations results shows that ME is the required and independent, diverse, and complex component event in treatment and evacuation activities. It is conducted by the special medical forces for life-saving and preserving the health of the injured.^{4,7}

Discussion

Approaches that Can Supply the Development of Russia's ME System

Four main ways or approaches that can provide the evacuation system development have been created based on the analysis of carrying out the ME activities system in RF and on the international experience.

Management Optimization of the ME System—The legislative regulation order and management organization methodical support in all stages of the ME system should be regulated, taking into account it has an interdepartmental nature. The organizational structure and the ME management organs' functions must be defined considering their supply with telemedicine means. All ME management organs, medical units, and organizations must be supported with the management activity technologies within their authority, including the ME routing realization. And finally, the interaction areas and their content in the evacuation activity context should be specified.^{33,34,37}

Organizational Structure, Material, and Technical Base Improvement for the Medical Units and Organizations Providing ME—Within the framework of this complex, the

following arrangements should be done. The organizational structure and the functioning order of the medical units and organizations must be improved, taking into account the peculiarities of ME tasks solving. The medical units and organizations must be equipped with the modern sanitary vehicles, including the aircrafts. The medical-technical means of ME, the state monitoring of the evacuation, and the medical data automatic transfer should be developed and improved.³³

Supplying Medical Units and Organizations Management Organs with High-Qualified Staff—The functioning professional training system for the management organs, medical units, and organization specialists must be provided. The educational material base of the ME issues for specialists' preparing should be improved. The modern forms and methods implementation should take a place in the ME specialists' educational process. The ME modern textbooks, study guides, and other teaching materials must be created. Carrying out the ME special exercises, pieces of training, and competitions, including joint interdepartmental ones, should also take a place in the educational process.²²

Scientific Background of the ME Organization and Functioning System—It is defined that in the new conditions, the ME problem needs a new complex of scientific elaboration. It consists of the following steps:

- Development and refinement of the scientific issue, including the interdepartmental programs, definition (clarification) of the researches priority covering the ME system, and their systematic implementation;
- Improvement of evacuation vehicles and their medical equipment;
- Development of telemedical technologies and their implementation into the ME system;
- Scientific accompaniment of management organs specialists' training, medical units, and organizations providing ME; and
- Carrying out the ME scientific-practical activities, including the interdepartmental ones.

Limitations

The limitation in the presented research has been in taking into account the government health care system data in the main. The private medical organizations' opportunities in Russia have not been included in the current research. Moreover, it will be the next way to analyze and to study the international experience cooperation action in CS.

Conclusions

The victims of emergency ME process are extremely important. But there are a lot of unresolved problems that accompany this process. The study results of the experience of the ME organization in the different CS allow to state that ME is an integral part of the medical care providing system for saving the life and preserving the health of the CS suffering population.

The development of the ME system in the CS circumstances liquidation demands the complex solution of interdepartmental and interdisciplinary problematic issues, the realization of precise adjustments, and the further scientific and methodological support.

Medical and other specialists should take part in the organizational structure improvement steps and the functioning order of the ME system in the CS development. Such position allows stating

ME consists not only of transportation aspects, but displays complex problems in the medical system providing for the suffering in

the CS population, and it is actually not only on the territory of Russia, but also beyond its borders.

References

1. On the Approval of the Regulation of the All-Russian Service of Disaster Medicine. Decree of the Government of the Russian Federation from August 26, 2013; No. 734.
2. On the Approval of the List of the Federal State Institutions, Providing the Medical Evacuation. Order of the Ministry of Health of Russia from June 5, 2012; No. 500.
3. All-Russian Center of Disaster Medicine. *The Clinical Recommendation on Providing the Medical Care to the Suffered in the Emergency Situations*. Moscow, Russia: FSBI ACDM "Protection;" 2015.
4. Starodubtseva VI, Shepina OP. *Public Health and Healthcare. National Guide*. Moscow, Russia: GEO-TAR-Media; 2013.
5. Fisun AY, Vlasov AU, Sushilnikov SI. System improvement of medical-evacuation activities in the troops using the mobile specialized units. *Skoraya Meditsinskaya Pomoshch*. 2013;7:4–8.
6. Fisun AY, Kalachev OV, Shegolev AV. Medical-technical means of providing of the single cycle of the evacuation activities in military-medical organizations of the Ministry of Defense. *Voyenno-Meditsinskiy Zhurnal*. 2015;6:4–7.
7. Kulnev SV, Bobrov UM, Soldatov EL. *Organization of the Medical Evacuation in the Military Forces of the Russian Federation on the Modern Stage*. Moscow, Russia: FSBI "State RI of Military Medicine" Ministry of Defense of Russia; 2017.
8. Shegolev AV. *Problematic Issues of Medical Evacuation of the Injured and Sick in the Critical State*. Moscow, Russia: FSBI "State RI of Military Medicine" Ministry of Defense of Russia; 2017.
9. Baranova NN. Medical evacuation of the suffered: state, problems (2nd report). *Disaster Medicine*. 2019;1:42–46.
10. Goncharov SF, Bystrov MV, Bobij BV. *The Basics of the Organization of the Providing the Medical Care to the Suffered in the Emergency Situations: Study Guide for Doctors*. Moscow, Russia: FSBI ACDM "Protection;" 2017.
11. Goncharov SF. The problems of development of the system of urgent and consultative medical care and medical evacuation in the Russian Federation. *Disaster Medicine*. 2012;2:6–11.
12. Makhnovskiy AI, Ergashev ON, Blinda IV, et al. The main directions for improvement in regional system of medical care arrangement for military men with polytrauma in the Western Military District. *The Experience in Use of Workforce and Means of the Medical Service of RF (Defense Ministry of USSR) in Liquidation of Medico-Sanitary Consequences of Emergency Situations 2016: The Materials of All-Army Scientific and Practical Conference*. Saint Petersburg, Russia: VMedA named after Kirov; 2016:27–33.
13. Kasimov RR, Makhnovskiy AI, Loginov VI, et al. *Objective Estimation of Injury Severity in Military Level, Garrison and Basic Military Hospitals: The Guidelines*. Nizhny Novgorod, Russia: Stimul ST; 2017.
14. Hurd WW, Jernigan JG, (eds). *Aeromedical Evacuation. Management of Acute and Stabilized Patients*. New York USA: Springer-Verlag; 2003.
15. Samokhvalov IM, Boyarintsev VV, Gavrilin SV, et al. Traumatic disease: the state of the problem, variants of the course (1st report). *Vestnik Anesteziologii i Reanimatologii*. 2009;6(3):2–8.
16. Inozemtsev EO, Grigoryev EG, Apartsin KA. The actual issues of surgery of associated injuries (according to publications in Polytrauma journal). *Politrauma*. 2017;1:6–11.
17. Shatalin AV, Agadzhanian VV, Kravtsov SA, et al. Estimation of transportability in patients with polytrauma during interhospital transfer. *Skoraya Meditsinskaya Pomoshch*. 2011;2:20–25.
18. Tulupov AN, Besaev GM, Sinchenko GI, et al. Polytrauma in road traffic accidents: solved and unsolved problems in conditions of Saint Petersburg. *Kremlyovskaya Meditsina*. 2015;2:30–35.
19. Kuvshinov KE, Sushilnikov SI, Yakovlev SV, et al. Arrangement of sanitary aviation evacuation in Military Forces. *Voyenno-Meditsinskiy Zhurnal*. 2017;338(4):4–11.
20. Sahnno VI, Zaharov GI, Karlin NE, Pilik NM. *Organization of Population Medical Care in Emergency Situations*. Saint Petersburg, Russia: Foliant; 2003.
21. Goncharov SF, Sahnno II. The questions of the disaster medicine in the system of the higher and additional professional education of the medical staff. *Disaster Medicine*. 2017;2:67–68.
22. Rasmussen K, Røislien J, Sollid SJM. Does medical staffing influence perceived safety? An international survey on medical crew models in helicopter emergency medical services. *Air Med J*. 2018;37(1):29–36.
23. Stowell A, Bobbia X, Cheret J, et al. Out-of-hospital times using helicopters versus ground services for emergency patients. *Air Med J*. 2019;38(2):100–105.
24. Homma H, Niiyama Y, Sonoda H, et al. The impact of air transport for acute coronary syndrome patients. *Air Med J*. 2019;38(2):73–77.
25. Kashani KB, Farmer JC. The support of severe respiratory failure beyond the hospital and during transportation. *Curr Opin Crit Care*. 2006;12(1):43–49.
26. Parsons CJ, Bobechko WP. Aeromedical transport: its hidden problems. *Can Med Assoc J*. 1982;126(3):237–243.
27. Poulton TJ, Worthington DW, Pasic TR. Physiologic chest sounds and helicopter engine noise. *Aviat Space Environ Med*. 1994;65(4):338–340.
28. Joshi MC, Sharma RM. Aero-medical considerations in casualty air evacuation (CASAEVAC). *Med J Armed Forces India*. 2010;66(1):63–65.
29. Yanagawa Y, Anan H, Oshiro K, et al. An evaluation of a mass casualty life support course for chemical, biological, radiological, nuclear, and explosive incidents. *SAS J Med*. 2016;2(5):110–114.
30. Yanagawa Y, Ishikawa K, Takeuchi I, et al. Should helicopters transport patients who become sick after a chemical, biological, radiological, nuclear, and explosive attack? *Air Med J*. 2018;37(2):124–125.
31. Logunov KV. Evacuation of patients and injured from the board of non-emergency marine vessels ashore in the search and rescue areas of responsibility of the Russian Federation. *Skoraya Meditsinskaya Pomoshch*. 2015;3:49–54.
32. Kachanova NA. Medical evacuation of citizens of the Russian Federation from abroad: basic problems and ways of their solution. *Disaster Medicine*. 2019;2(106):45–51.
33. Evjemo TE, Reegård K, Fernandes A. Telemedicine in oil and gas: current status and potential improvements. *Procedia Manufacturing*. 2015;3:1289–1296.
34. Norman JN, Ballantine BN, Brebner JA, et al. Medical evacuations from offshore structures. *Br J Ind Med*. 1988;45(9):619–623.
35. Toner S, Andrée Wiltens DH, Berg J, et al. Medical evacuations in the oil and gas industry: a retrospective review with implications for future evacuation and preventative strategies. *J Travel Med*. 2017;24(3):1–7.
36. Wynberg E, Toner S, Wendt JK, et al. Business travelers' risk perception of infectious diseases: where are the knowledge gaps, and how serious are they? *J Travel Med*. 2013;20(1):11–16.
37. Boultinghouse OW, Fitts TG. Telemedicine technologies enhance offshore health-care, reduce illness-related departures. *Drilling Contractor*. 2009;11.