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The current state and problematic issues of medical care in the waters of the Northern Sea Route

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Introduction. The solution of state issues for the development of the Arctic zone of the Russian Federation involves the active use of the Northern Sea Route as the main strategic highway. In order to preserve the life and health of ship crews in conditions of climatic and geographical and industrial risks, a smoothly functioning national system of medical care, harmonized with international requirements, is of great importance.
The study aims to assess the state of the medical care system for ship crews on the Northern Sea Route, identify regulatory and organizational problems, and substantiate proposals for their elimination.
Materials and methods. The researchers conducted an expert and analytical study, as well as analyzed and compared data during search and rescue operations in the waters of the Northern Sea Route (2010–2020), statistical data on medical examinations of ship crews conducted in 2020 in the organizations of the FMBA of Russia. The authors also have studied the main stages and forms of medical care in the waters of the Northern Sea Route. Scientists have conducted the analysis of scientific publications for the period from 2000 to 2021, contained in scientific electronic libraries, current international and Russian regulatory legal acts, information from official websites of executive authorities and organizations.
Results. The system of medical care involves the implementation of measures for several interrelated elements: the provision of medical care on a ship, consultation by a medical professional using communication means, search and rescue operations, medical evacuation, medical care in the conditions of a coastal medical organization. International and Russian regulatory legal acts regulate the implementation of measures to provide medical care on board the vessel, the work of a wide range of participants from among federal executive authorities, executive authorities of subjects, institutions and organizations, officials and employees. In the course of the study, we found that there are concretized schemes of medical care, name lists and coordinates of participants. Specialists update all this in the Basin Plans for each territory of the Northern Sea Route. Despite the established rules of interaction of participants and conditions of medical care, the gaps identified by the researchers in administrative and legal regulation significantly affect the quality of medical care to members of the crews of ships, violate the constitutional rights of citizens to health protection.
Conclusions. *Experts have substantiated the proposals for improving the system of medical care in the waters of the Northern Sea Route when applying an integrated approach to the development of the coastal infrastructure of medical organizations, staffing ships with medical workers and providing medicines.*
Ethics. Scientists conducted the study in compliance with Ethical standards. This study did not require the conclusion of the Ethics committee.
Keywords: *medical care; search and rescue operations; Arctic zone of the Russian Federation; Northern Sea Route; water transport workers; administrative and legal regulation*
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Voronkova S.V. — the concept and design of the study data collection and processing, the text writing;
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Introduction. Transformations in the Russian state, aimed at its development and improving the well-being of people, affect all sectors of the economy and spheres of life. One of the main tasks of the healthcare system in recent years is the need to preserve human potential for the stability of the economy of the Russian Federation and the preservation of national security. Therefore, it is natural that the health authorities strive to build an optimal system of medical care at all levels and for all categories of citizens, including ship crew members on board the vessel.

Another major task for Russia is the preservation of sovereignty and the strengthening of borders, as well as the search for new resources and mining. Such a strategic direction for today is the development of the Arctic zone of the Russian Federation (AZRF). Specialists work in various branches of scientific knowledge and adopt legislative acts on the development of the AZRF.

The development of the northern territories depends on the problem of preserving labor resources, therefore scientific developments indicate the relevance of tasks in the field of health protection of seafarers in the waters of the Northern Sea Route. This is primarily due to the high risk of accidents, special climatic and geographical conditions and difficult working conditions of water transport workers.

In this regard, it is urgent to improve the medical support system to preserve the health of workers employed both in the coastal infrastructure and on ships of the Russian fleet and performing tasks of maritime activities: cargo transportation, fishing, research, pilotage and icebreaking, as well as search and rescue and towing operations.

The study aims to analyze regulatory legal acts, scientific literature and statistical data to determine the current state of the medical care system for ship crews in the waters of the Northern Sea Route, identify regulatory and organizational problems in this area, as well as substantiate proposals for their elimination.

Materials and methods. In preparing this article, the researchers analyzed publications for the period from 2000 to 2021 contained in the scientific electronic libraries "CyberLeninka", "E-Library", current international and Russian regulatory legal acts posted in the reference legal systems "Consultant Plus" and "Guarantor", information from the official websites of executive authorities and organizations, as well as mass media. The methodological basis of the research determined by its object and subject and includes philosophical, general and special scientific methods: dialectical, historical, comparative-legal, formal-logical, statistical, as well as methods of analysis and synthesis.

Results. Despite the constant development of methods, methods and technical means of ensuring the safety of navigation, more than 200 large vessels suffer disasters every year. In particular, according to the European Maritime Safety Agency, there are 762 cases of marine disasters in the waters of the EU countries in 2007, 754 in 2008, 626 in 2009, and 644 in 2010 [1]. According to the statistics of evacuation and hospitalization of patients abroad, injuries on fishing vessels account for 37.5%, and the real picture of the state of health of seafarers in Russia remains unclear [2].

In the Russian Federation, according to official data, experts note a steady increase in accidents on the Northern Sea Route (NSR) over the past 10 years (2010 — 255, 2020 — 439), which leads to the need for complex search and rescue operations (2010 — 33, 2020 — 221) ***(Table)***, evacuation of a significant number of patients (2010 — 51, 2020 — 160), implementation of medical consultations for workers at sea (2010 — 34, 2020 — 73)[1] ***(Figure)***.

Despite the need to strengthen medical support for water transport workers, according to the Norwegian Maritime Agency, as of December 2021, the list of Russian ship doctors consists of only 7 specialists[2] with documented qualifications in Norway and other countries, which requires attention to the system of training specialized medical personnel in Russia.

Such a situation for the preservation of human life at sea cannot remain without the attention of scientists and practitioners, therefore, today experts are studying the experience of medical support for fleet activities in the harsh conditions of the Arctic, actively studying the issues of sanitary and preventive maintenance of voyages in the waters of the Northern Sea Route in historical retrospect [3], exploring the specific features of marine labor [4], and the influence of climatic and geographical factors on the health of seafarers [5].

Specialists are forming theoretical and educational models of innovations, including for the accelerated implementation of marine telemedicine, which will ensure effective assistance to patients (injured) during the voyage, even in the absence of a medical worker on board the ship [6].

Medical care activities in the Arctic researchers consider in two strategic directions. The first is the organization of medical care for the indigenous population of the AZRF, the second direction is relevant for people employed in the economy, including for workers of sea and river transport. We note that the indicated vectors of medical care there are common problems associated with its inaccessibility due to geographical and climatic conditions, as well as with other factors: low level of development of the structure of healthcare institutions, lack of medical personnel, non-compliance of national legislation with the requirements of international standards.

The study of the issue of medical care on the route of the NSR allows us to identify several interrelated elements: firstly, the provision of medical care on board the vessel (if there is a medical worker on board); secondly, the provision of medical advice by radio and other types of communication; thirdly, search and rescue operations and medical evacuation; fourth, the provision of medical care in a medical organization.

Among the main tasks facing the organization of medical care for seafarers during the voyage, it is necessary to highlight the following: first aid and primary health care for patients and victims (if there is a medical worker on the ship or a rescue vehicle); medical consultations using available means of communication; evacuation, if necessary, hospitalization of patients and victims in medical organization.

Provision of medical assistance to employees on board the ship. Modern researchers pay a lot of attention to providing medical care to workers on board the ship. Russian legislation does not provide for the presence of a full-time medical worker if the number of crew on the ship is less than 100 people. This condition does not contribute to the preservation of the life and health of water transport workers. This problem is especially relevant in the conditions of the NSR and considerable distances to the nearest medical organization on the shore. The Chairman of the State Duma Committee on Health Protection (2016–2021), D.A. Morozov stressed in his report that "competent and timely first aid (and, if possible, medical assistance) on board an airplane, on rail or water transport can save a human life. And there is a way out in the existence of "First aid kits for a diploma", in which there are the necessary means to help a professional doctor" [7]. Currently, international legal acts have introduced a mandatory condition for the presence on

[1] The main marine rescue and coordination Center. Official website. Statistics on search and rescue at sea. https://smrcc.ru/statistika_po_poisku_i_spasaniyu_na_more.html (Accessed: 12/20/2021).
[2] Norwegian Maritime Agency official website. https://www.sdir.no/en/shipping/seafarers/approved-seafarers-doctors/?country=russland&city (Accessed: 12/20/2021).

Table

Elimination of accidents in the waters of the Northern Sea Route

Name of events	Number by year, units											Total, units
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Total accidents	255	305	195	181	183	191	295	316	379	453	439	3192
Search and rescue operations	33	103	110	34	96	86	122	98	117	185	221	1205
Total people saved	413	421	489	174	289	336	131	93	147	707	166	3366
— including foreigners	9	131	31	13	38	60	1	11	46	19	0	359
Participation in assistance to courts	81	126	128	112	166	44	74	53	38	36	24	882

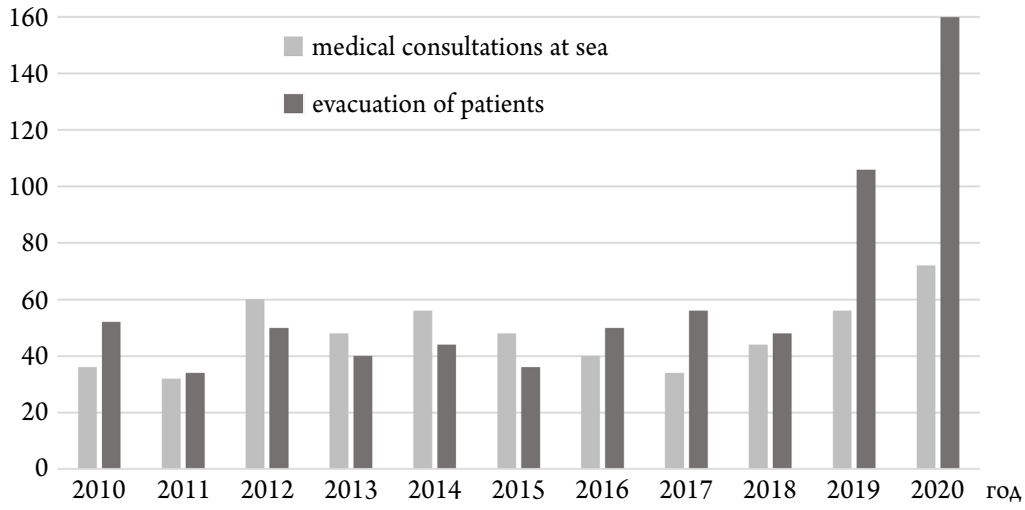

Figure. Providing medical assistance to the ship's crew on the Northern Sea Route in 2010–2020.

the ship of crew members[3] who have been trained in first aid in accordance with the requirements of the International Convention on the Training and Certification of Seafarers and Watchkeeping of 1978 (as amended in 2010) and have a certificate of the established sample.

In addition, Russian legislation regulates the use of medicines only by medical professionals, as it relates to medical intervention. Thus, the new requirements for the configuration of first aid kits for first aid workers assume the presence of only medical devices[4] in them. These circumstances limit the implementation of the constitutional rights of seafarers to quality medical care due to the imperfection of the legal regulation of the organization of medical care, especially manifested in the conditions of the NSR.

In case of illness or injury on a ship requiring medical intervention, the ship's captain, in the absence of a medical worker, is responsible for organizing measures to preserve the life and health of sick or injured crew members. In addition, the duty of the ship's captain to provide emergency medical care to any person on board the ship is enshrined in Russian legislation[5]. In such cases, obtaining medical consultations using available means of communication is possible in several ways: through the on-duty services of medical organizations (including Disaster Medicine Centers), through marine rescue coordination centers, directly from a consulting specialist doctor.

Provision of advisory assistance. Doctors provide medical care in accordance with the Basin Plans [8–13], which have coordinates and contact details for reports, alerts, communication and information exchange between the participants of interaction. It is important that consultation by a medical professional is an important stage of medical care, taking into account the long waiting time. The time of preparation of forces and means for emergency evacuation may differ by several orders of magnitude, for example, from two hours (for Arkhangelsk) to seventy-five hours (the time of passage Arkhangelsk — Cape Desire, Barents Sea). The

[3] International Labour Organization Convention No. 186 "On Maritime Labour" (Geneva, February 23, 2006) (with amendments and additions). http://www.consultant.ru/document/cons_doc_LAW_121500 / (Date of appeal: 12/20/2021).

[4] Order of the Ministry of Health of the Russian Federation No. 1331n dated 12/15/2020 "On approval of the requirements for completing first aid kits with medical products for first aid workers". http://www.consultant.ru/document/cons_doc_LAW_378982/ (Accessed: 12/20/2021).

[5] Code of Merchant Shipping of the Russian Federation No. 81-FZ dated 30.04.1999 (as amended on 11.06.2021). http://www.consultant.ru/document/cons_doc_LAW_22916 (Accessed: 12/20/2021).

possibilities of attracting marine search and rescue forces depend significantly on seasonal factors. For example, in the Tiksi region, such a period may be limited to summer-autumn navigation, in the Murmansk region — by polar night.

The duty captain-coordinator of the Marine Rescue Coordination Sub-center (MRCSC) organizes the provision of necessary medical assistance to victims on ships at sea. For these purposes, specialists use the technical means of the Global Maritime Distress and Safety System (GMDSS), direct radio communication of the ship's captain with doctors of coastal medical organizations. If it necessary, operators send medical forces and equipment to the disaster site.

The MRCSC provides medical consultations by radio or, if possible, by telephone directly with the consulting specialist doctor, which is preferable. There is a communication of the vessel on board of which the patient is with a consulting doctor through the coastal radio station of Rosmorport and in the ultrashort wave range through the MRCSC.

Upon receipt of primary information from the ship's captain or shipowner about the need for medical evacuation of a crew member from the ship, the MRCSC organizes a medical consultation with the shore medical staff and coordinates the evacuation of a sick (injured) crew member to shore.

If there is a full-time medical worker on an air or sea vessel who participate in rescue and(or) evacuation, the injured will receive medical assistance directly on board. Taking into account the assessment of all risks, the head of rescue operations makes the final decision to evacuate people. In general, medical evacuation allows you to solve several tasks: saving the life of a patient (victim) in Arctic Sea conditions; providing emergency medical care in an emergency or urgent form at a distance from medical organizations and poor transport accessibility; reduction of the time from the moment of the onset of a threatening condition (injury) to the beginning of primary health care in the required volume in a medical organization.

Conducting search and rescue operations and evacuation of victims. Conducting search and rescue operations and evacuation of victims on the NSR today is a joint work of ministries and departments performing their functions in the assigned territories within the framework of approved powers.

For example, the rules of interaction between executive authorities and organizations during search and rescue operations are in the Russian legislation[6]. There is a circle of all participants in search and rescue operations and conditions for medical care on the basis of the agreed Basin plans, taking into account the territorial principle.

As you know, rescuers have a "golden hour" during which the victim needs to be helped and taken to a medical facility. However, in the conditions of the Russian Arctic (climatic and geographical conditions, large-scale and inaccessible areas, sparsely populated, off-road, difficulty in providing medical care), evacuation to a medical organization is not always possible. To minimize human losses in accidents (diseases), it is extremely important to urgently deliver to the place of medical care not only resuscitation equipment, medicines and medical devices, but also means of communication for consultation with a specialist using unmanned aerial vehicles[7].

Currently, the Main Marine Rescue Coordination Center (MMRCC) of "Marine Rescue Service" carries out the direct management of operations in accordance with the assigned powers through Marine Rescue Cordination Centers (MRCC) and their sub-centres (SC). The direct executors of search and rescue operations at sea can be organizations of various forms of ownership, depending on the availability of the necessary forces and means, their location, and the conditions of the situation.

Interaction between the captain-coordinator and the Main Marine Rescue and Coordination Center exists by using using the automated information system (AIS) "Search–Sea". There are the Western and Eastern sectors, and the first involves sub sub-center Arkhangelsk and MMRCC Murmansk, the second includes sub-centre Dixon, MMRCC Tiksi, MMRCC Pevek, sub-centre Petropavlovsk-Kamchatsky on the route of the NSR.

Within their territories, during searching and rescuing people at sea, the MMRCC and the sub-centres solve the tasks of organizing the implementation of the International Convention on Search and Rescue at Sea of 1979, organizing and coordinating the work of executive authorities, other Russian institutions, as well as rescue services of foreign states (the Kingdom of Norway, the USA, Canada, Japan, the Republic of Korea).

In particular, the participants in interdepartmental cooperation include such structures as: the Ministry of Emergency Situations of Russia, the Ministry of Internal Affairs of Russia, the Federal Security Service, the Federal Air Transport Agency, the Federal Agency for Fisheries; management bodies and units of the Joint Strategic Command "Northern Fleet" and the Pacific Fleet, the All-Russian Disaster Medicine Service, the offices of regional governments and others.

Transport, passenger, fishing, hydrographic vessels located directly in the disaster area, regardless of their State flag and departmental affiliation perform duties to provide assistance at sea.

Each search and rescue area takes into account up-to-date information about the composition of forces, means and resources of participants in interaction and the level of readiness when compiling and approving a system (scheme) of reports, alerts, communication and information exchange. In the internal instructions there is a list of initial actions and connections within each of the services of the participants in the interactions.

Provision of medical care in the conditions of a coastal medical organization. Specialists provide medical care in the conditions of a coastal medical organization within the framework of state guarantees of free medical care in accordance with the approved programs of the subjects of the Russian Federation. Taking into account the peculiarities of practical healthcare in Russia, it is necessary to pay attention to the issues of improving the quality and accessibility of medical care, as well as the prospects for creating a new generation of Arctic medicine in general [14].

Today, the provision of specialized, including high-tech, medical care to persons operating on the NSR is possible only in large cities (Murmansk, Arkhangelsk, Petropavlovsk-

[6] Decree of the Government of the Russian Federation No. 1928 dated 11/25/2020 "On Approval of the Rules for the Interaction of Federal Executive Authorities, Executive Authorities of Constituent Entities of the Russian Federation and Organizations during Search and Rescue Operations at Sea". http://www.consultant.ru/document/cons_doc_LAW_369454/. (Accessed: 12/20/2021).

[7] Official website of the Ministry of Health of the Republic of Sakha (Yakutia). 05.04.2019. https://minzdrav.sakha.gov.ru/news/front/view/id/3010824. (Accessed: 12/20/2021).

Kamchatsky, Vladivostok). For the rest of the NSR, there are only low-power medical organizations, most of which are located at a considerable distance from the coastline (200 kilometers or more).

The structure of the Federal Medical and Biological Agency defines institutions that carry out medical evacuation and provide medical care in the Russian Arctic. In the field of medical care for seafarers on board a ship in the waters of the NSR, there are two medical organizations of the FMBA of Russia: the Northern Medical Clinical Center named after N.A. Semashko (Arkhangelsk) and the Murmansk Multidisciplinary Center named after N.I. Pirogov (Murmansk)), which include departments of ship medicine, ship doctors and paramedics [21]. Other organizations of the FMBA of Russia include interregional administrations, departmental Centers of Hygiene and Epidemiology and medical and sanitary units located in St. Petersburg, Murmansk Region, Arkhangelsk Region, Petropavlovsk-Kamchatsky, Vladivostok, Chukotka Autonomous Okrug.

Regional institutions play a significant role in providing medical care to water transport workers. Territorial and regional Disaster Medicine Centers, district, regional and central district hospitals and ambulance stations provide medical care in accordance with the Basin Plans.

In order to provide the highest quality medical care, specialists carry out hospitalization of rescued victims (patients) in medical institutions located in the immediate vicinity of the area of search and rescue operations, airfields, ports, berths or other possible landing sites of aircraft and mooring vessels. However, the situation differs significantly in different parts of the Russian Arctic.

In the Western sector of the NRS in the Murmansk and Arkhangelsk region there are: communication, radio consultation with medical organizations on the shore.

In the Eastern sector of the NSR water area (starting from the Kara Gate), the ports are far from each other, the material and technical equipment and staffing of medical organizations is currently at an insufficient level.

The Basin search and rescue plans contain detailed address schemes, according to which, with interdepartmental cooperation, the creation of conditions for organizing the reception of victims on the shore, their accommodation, the allocation of transport, the provision of warm clothes and food, the provision of medical care is assigned to the structural divisions of the administrations of the constituent entities of the Russian Federation responsible for each section of work.

In addition to the types and methods of medical care considered, it is necessary to note several other important areas in the system of medical support for the health of seafarers in the waters of the NSR. First of all, it is the conduct of qualified medical selection of water transport workers.

In this regard, the primary importance belongs to preliminary medical examinations and surveys. In 2020, sixty-five thousand people passed medical examinations of persons working on ships in medical organizations of the FMBA of Russia. Only the Northern Medical Clinical Center named after N.A. Semashko of the FMBA of Russia conducted a medical examination of 4250 persons working on ships during the specified period. Specialists have issued 2560 international medical certificates of suitability for work on ships.

In addition, in 2020, the ship's doctors of this medical center performed seven Arctic voyages lasting more than 1,000 days. Specialists have trained 85 skippers from among the fleet commanders under the program of the International Maritime Organization "Medical care for the sick and wounded" [15].

Recently, the Government of the Arkhangelsk Region has widely discussed the project of creating a Federal Center for Arctic Medicine in Arkhangelsk, initiated by the Ministry of the Russian Federation for the Development of the Far East and the Arctic and the Federal Biomedical Agency. The main goal of the center will be to increase life expectancy and improve the health of the population in the Far North, which will favorably affect the development of the entire healthcare system in the Arctic zone of the Russian Federation, including for the purpose of providing medical care in the waters of the NSR[8].

Discussion. The analysis of the current state and capabilities of the system of medical care in the waters of the NSR showed that specialists provide medical care in several stages: assistance on the ship, consulting, search and rescue operations, medical evacuation, medical assistance in the coastal organization.

The problem of assessing the health status of workers exposed to harmful production factors remains paramount.

Great importance for the effective functioning of the medical support system is the conduct of mandatory preliminary and periodic medical examinations of seafarers and training of ship crews according to training programs for specialists in first aid cycles.

The results obtained indicate the unresolved nature of many organizational and regulatory issues.

There are still numerous problematic issues, including regulatory and legal regulation in the organization of medical care on ships in Arctic conditions [16–23], which indicates the need for their improvement.

The capabilities of the forces and means of ministries and departments to provide medical care in the Russian Arctic, as well as their interdepartmental interaction necessary to direct to achieving the goals and solving priority tasks provided for in strategic planning documents. However, despite the significant number of bodies and organizations involved in various stages of medical care in the Russian Arctic, detailed plans for interdepartmental cooperation in search and rescue operations, other issues, in particular, the creation of a unified system of medical care in the NSR, are subject to regulation by the current Russian legislation.

Thus, in order to prevent extreme situations, prevent injuries and morbidity in the waters of the NSR, it is necessary to create specialized organizations that conduct medical examinations of water transport workers.

It is necessary to introduce into the Legislation the concept of "Extended medical care" provided by persons without medical education and who have undergone special training. In the absence of a specialist with a medical education, it will be possible to legitimately use medicines on board the vessel, which can contribute to harmonization with international legislation.

In order to provide medical care in the coastal territory of the Russian Arctic, it is necessary to develop the infrastructure of medical institutions.

[8] A Center of Arctic medicine for health protection will be created in Arkhangelsk. RIA Novosti: Arkhangelsk region. 12.11.2021 https://ria.ru/20211112/meditsina-1758739837.html. (Accessed: 12/20/2021).

Limitations. When assessing the state of the medical care system for ship crews in the waters of the Northern Sea Route, experts have considered the norms of modern international and national legislation in the field of public health and safety of navigation, scientific publications on the topic under consideration from 2000 to 2021. The researchers have analyzed data on search and rescue operations in the waters of the Northern Sea Route for the period 2010–2020.

Conclusion. *The variety and complexity of working conditions, both on sea vessels and on vessels of mixed navigation (river–sea), determine the consistency of medical care for crew members, including therapeutic and preventive, sanitary and hygienic and rehabilitation measures, taking into account the specifics of various types of work on sea transport. To create a unified system of medical care for water transport workers in the waters of the Northern Sea Route, it is necessary:*

1. to continue scientific research in the field of organization of medical care and evacuation of victims (patients) in the waters of the NSR, improving the equipment of ships with medical devices and the system of training ship's doctors (paramedics);

2. to issue official, including ratified, international regulatory legal acts and information documents on medical care of crew members of the sea, river and fishing fleets, employees of offshore mining platforms in Russian;

3. to create a permanent interdepartmental working group on the regulatory legal regulation of social and labor relations in maritime navigation, including medical support (with the representation of interested ministries and departments, shipowners' organizations, seafarers' unions and specialized experts).

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