

*Medicina i tehnologija/
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ORGANIZATION OF POLAR EXPEDITION
MEMBERS HEALTH PROTECTION
USING TELEMEDICINE MONITORING
TECHNOLOGY

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ORGANIZACIJA ZDRAVSTVENE ZAŠTITE
ČLANOVA POLARNE EKSPEDICIJE
PRIMENOM TEHNOLOGIJE
TELEMEDICINSKOG MONITORINGA

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Key words

Telemedicine, Polar Regions, polar expeditions, Arctic and Antarctic, information system, psycho-emotional stress.

Ključne reči

Telemedicina, Polarni regioni, polarne ekspedicije, Arktik i Antarktiki, informacioni sistem, psiho-emocionalni stres

Abstract

The article sanctifies the study of telemedicine Polar Regions to develop and pilot testing of medical information system of the Arctic and Antarctic Research Institute (AARI) in order to ensure continuous monitoring of the health of Russian citizens working in polar expeditions in the Arctic and Antarctic. It describes the structure of the developed virtual network, collected on technology-based integration of heterogeneous media, and uniting information space outpatient terminals of polar stations. Based on the analysis of the experience of creation and operation of automated lines of AARI data center with separate polar stations we worked out the requirements for a telemedicine system for monitoring indicators of health at polar stations. We present experimental results on the remote access of the specialists of mobile medical unit AARI to medical data workstation outpatient Bellingshausen. A technique for organizing remote medical monitoring parameters of health status is described. The research results can be used to design and develop extreme telemedicine systems.

Polar expeditions - a specific kind of human activity associated with the constant risk of human habitation in the extreme geographical areas in the Arctic and Antarctic. Professional human activity in these areas involves high psycho-emotional stress, stress functional load on the body and specific climatic adaptation. The influence of these factors on the participants of the expeditions requires special attention and constant monitoring of their health status. So far, the problem of quality control by the medical service of the polar expedition has not been solved. This is due to a number of objective reasons, among which should be allocated lack of regular full-scale medical examination, the qualitative and quantitative composition of the medical specialists, as well as limited using a highly sensitive diagnostic techniques in outpatient polar stations.

Since 1998, Arctic and Antarctic Research Institute (AARI) has been working on the investigation of the possibility of solving the mentioned problems by introducing information and communication technologies into the med-

ical practice of the polar stations. To date, there has been reached some result, expressed in the confirmation of the effectiveness of the use of telemedicine technology in the Russian Antarctic Expedition [1]. There have been performed the first experiments on the organization of remote medical consultations on a regular basis [2]. The gained experience has allowed revealing a significant disadvantage of the traditional paradigm of telemedicine - the doctor asks the advice from the expert. In terms of polar expeditions a doctor (a subscriber of the telemedicine system) works at a considerable distance, when not enough diagnostic and therapeutic resources, and evacuations of patients, or difficult, or impossible. Application of the traditional paradigm of telemedicine in such circumstances can complicate even more the situation, because the doctor cannot professionally manage the telemedicine equipment. Many years of operating experience created in the Russian Antarctic Expedition telemedicine system "Ambulance-Consultant RAE / AARI" [3] have shown that doctors of polar clinics, while carrying

out non-core functions of collection management, primary processing and data transmission, regularly make mistakes that lead to the disruption of remote consultations and, consequently, to inefficient use of the entire organization of the health protection of the polar expeditions. In this case, the increase in details of operating instructions and the number of extra classes on instilling the theoretical and practical skills in working with hardware and software medical information system does not give any noticeable improvement of the situation.

One of the solutions to the problem (at least in the polar zones) can be changing the paradigm of Telemedicine and changing technical approach to it solving associated with the radical overhaul of the role and position of the components of telemedicine systems - as a basic tool of telemedicine technology. One of the remedies of the situation is to make the expert service as active. Thus, entrust to it to manage the supervision of the patient independently under the supervision of a doctor. In this case, telemedicine system is transformed from an advisory tool into monitoring service of observation of the parameters of human health. Partially, the effectiveness of this approach at current stage is confirmed by the intense development of the tools of so-called "personal telemedicine". Therefore, the doctor regularly monitors the changes of indicators for the cardiovascular system of a certain range of patients. The proposed approach is supposed to review some properties of a new type of telemedicine system and its structure. First of all, you should consider a technical solution that can allow carrying out active monitoring of the expert service in terms of ability to remotely manage by the collection, primary processing and broadcasting of data for further analysis and decision making. Because of the limited size of this article, only consideration has been given to this question. The current level of communication networks development can implement the technology of remote access to information and data on certain terminals. The essence of the mentioned technology is well-researched and developed. However, in the case of specific organizational circumstances, determined by departmental needs, as well as the causes of an objective nature, coupled with the characteristics of the instruments in specific geographic areas (such as the polar zones, mountain areas), the structure of the telemedicine network is undergoing significant changes, requiring withdrawal from standard solutions and / or search of the possibility of synthesis of the known solutions in heterogeneous and hybrid systems. E.g. of such a solution is telemedicine network developed by the Arctic and Antarctic Research Institute. Let us consider the structure (Fig. 1).

Ambulatory of the Polar stations and the maritime fleet of the Arctic and Antarctic Research Institute are related to the medical expert service via the departmental service - the Central Medical Advisory Office (CMAO), which coordinates the flow of information in telemedicine sessions. Established structure allows unification of the methodology for data exchange, elimi-

nating the many errors in the work of doctors concerning a connection to a telemedicine network in remote medical consultations. On the other hand, physician's mistake should be avoided when choosing an expert service.

However, the traditional concept of telemedicine, involves organizing a remote query on the advice of a doctor to an expert which does not rule out the set of operator errors of both objects during the telemedicine session, even in the presence of a structure with "telemedicine coordinator" whose role in the scheme (Fig. 1) performs CMAO AARI. This was confirmed by the experience in operating a virtual e-health network developed in AARI and based on satellite communication system Inmarsat.

Signing in involves an initiating role and expertise of the operator - the doctor of polar surgery. Prospective communication system, implemented by the Russian Antarctic stations, in the short term will enable changing the scheme of work due to a greater degree of automation of many specific tasks currently performed by the operator. An important difference of the new communications system - is the provision of fixed broadband data exchange (64 kbit / s and above), which will provide a permanent connection of a doctor workstation to CMAO and, most importantly, the ability to data query on the initiative of CMAO.

As shown earlier, it is possible to avoid errors of a physician, who is making the request for consultation and expert (medical consultant), as operator of the telemedicine network, if we apply technology to remote access in the network. In this case, "telemedicine coordinator" assumes the functions of remote monitoring of the state of terminal web subscribers, and the functions of data presentation by a selected specialist of the Network of Expert Service.

The approach described here for the organization of telemedicine monitoring is currently undergoing pilot testing in the telemedicine system "Ambulance-Consultant AARI / RAE". For the organization of experiments to test the ability to remote access a private network is organized with an authorized input, connecting a workstation of a polar physician of Antarctic station Bellingshausen clinic and a client - a duty operator of CMAO via the server communication of Information Technology Division AARI. The Connection allows you to see and get access to certain

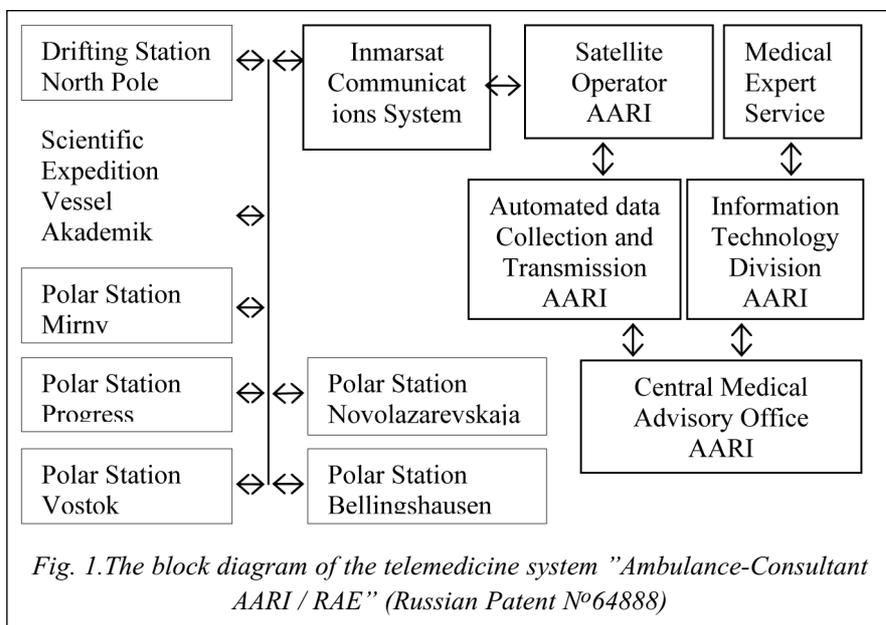


Fig. 1. The block diagram of the telemedicine system "Ambulance-Consultant AARI / RAE" (Russian Patent N^o64888)

objects of the file structure of a remote computer on which basis a workstation of a doctor is assembled. Reading and writing the required data in the telemonitoring session is limited by the bandwidth of a satellite communication canal and is now able to reach traffic of 64 kbp/s, which meets the needs of the telemedicine session with the transmission of data files of clinical measurements in off-line mode. The system of Inmarsat remains, so far, the only means of communication for mobile objects, such as a station "North Pole", "Akademik Fyodorov" and the mobile units and groups in the polar regions. In addition, Inmarsat is a system of emergency communications to ensure the safety of ships at sea and it is not optimized to support a wide range of applications such as telemedicine.

In AARI were developed the structure of the telemedicine system for remote monitoring using satellite broadband to solve the problem of obtaining medical records without a polar surgery doctor. A fragment of the modified structure of the telemedicine system "Ambulance-Consultant AARI / RAE" is presented in Fig. 2. An exclusion from the block structure of obsolete hardware of automated data collection service and the transmission of AARI allows you to bring channels of information exchange in a telemedicine network

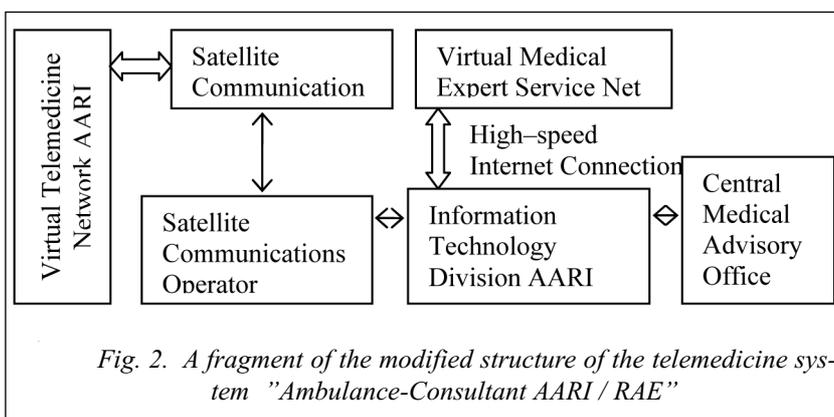


Fig. 2. A fragment of the modified structure of the telemedicine system "Ambulance-Consultant AARI / RAE"

in full accordance with current standards of computer networks as well as introduce intensively the advanced intra-interaction technology of its components.

Thus, studies in the field of remote medical expertise in the polar areas allowed developing technology for telemedicine monitoring with remote access. The technology is based on the application of methods for remote access to data in a heterogeneous computer network and allows you to virtually eliminate most of the errors of doctors - subscribers of the telemedicine network of AARI who used to perform non-core functions of operators of the telemedicine system.

Apstrakt

Rad je posvećen razvoju telemedicine u polarnom regionu i probnom testiranja medicinskog informacionog sistema Instituta za istraživanje na Arktiku i Antarktiku u cilju obezbeđenja kontinuirane kontrole zdravlja ruskih građana koji rade u polarnim ekspedicijama na Arktiku i Antarktiku. Rad opisuje strukturu razvoja virtuelne komunikacije prikupljene na bazi tehnološke integracije raznovrsnih medija i zajedničkog informacionog centra sa vanbolničkih terminala u polarnim stanicama. Analizama zasnovanim u toku stvaranja i rada sa automatizovanim linijama (AARI) računarskog centra i pojedinačnih polarnih stanica shvatili smo potrebu za telemedicinskim sistemom u polarnim stanicama u kontroli zdravstvenih indikatora. Prikazujemo eksperimentalne rezultate sa udaljenih lokacija dobijene od specijalista mobilne medicinske jedinice (AARI) u kompjuterskoj jedinici vanbolničkih medicinskih podataka u Bellingshausenu. Opisana tehnika je korišćena u organizovanju parametara daljinskog medicinskog monitoringa zdravstvenog stanja. Istrazivački rezultati mogu se koristiti u izradi i razvoju najsavremenijih telemedicinskih sistema.

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