Formation of requirements to telemedicine system services taking into account specifics of the Arctic Zone of RF

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Abstract. The work is aimed at establishment of telemedicine service system at the territory of the Arctic Zone of the Russian Federation taking into account specific peculiarities of this region. Making possible to render remote medical assistance is one of the priorities within strategic planning of the Government of the Russian Federation. Implementation of telemedical technologies is the most urgent for remote and hard-to-get regions including the regions of the Arctic Zone. This article considers telemedical system as the set of services within the development of which at first the requirements are formed taking into account specific peculiarities of the regions of the Arctic Zone. Set of top-level services is offered with the indication of the advanced informational and communication technologies implemented. Also the diseases are analyzed which are the most characteristic for inhabitants of the regions of the Arctic Zone aimed at offering the most urgent telemedical services for implementation.

1. Introduction

Active development of informational and communication technologies predetermined the development of business, sphere of human activity as well as health care sphere. The result of informational technology (IT) integration into medicine may be called appearance of telemedicine. Telemedicine is the directions of medicine where modern IT is used for medical information exchange and remote medical assistance rendering. In Europe, one of the first countries to focus on the development and implementation of telemedicine technologies was Norway, more than a third of whose territory lies beyond the polar circle. In Norway remote medical assistance rendering became possible 25 years ago – in the University Hospital of Northern Norway the Department for Telemedical Technologies was established in 1993, in several years it was transformed into independent enterprise – Norway Telemedicine Center.

Speaking about Russia, here one of the most important milestones in telemedicine development is “Arkhangelsk-Tromse” project within which since 1993 Norwegian doctors of the same University Hospital of Northern Norway remotely received medical data from Arkhangelsk Regional Hospital (histological sections, ultrasound images, X-ray images) and consulted Russian medical workers. Thus, it can be said that the development of telemedicine in the Arctic regions of Norway and Russia took place in parallel [1].

Nevertheless integrated implementation of telemedical technologies into the Russian Health Care System practice has been complicated for a variety of reasons until quite recently [2].
One of the basic and fundamental troubles was legal framework of application of this technology. The situation is that until quite recently (up to 01.01.2018) there was no any legislation that would allow legally implementing telemedicine into processes of organizations.

Besides legal aspect one of the important components is a business aspect. It consists of several factors. On the one hand, the volume of investments into informational technologies is always quite high, when we speak about implementation of integrated solutions, such as telemedical center processes. On the other hand, pay back of such investments in case of telemedical services is quite disputable issue because there are no reference models of financing of this sphere.

Besides, not taking into account legal and investment aspects that increase complicacy of implementation of telemedical services, also there is no elaborated architecture of services and IT-infrastructure of health care organization that would allow accomplishing integrated implementation of this process. Herewith implementation of such process, just like other changes of informational and technological support, will face with troubles of re-orientation of health care personnel from tradition processes to implementation of medical assistance rendering by means of telemedical technologies.

The tasks described above, which need to be solved within the framework of the introduction of the telemedicine concept, are considered a general list. In terms of implementation of telemedical service system in such hard-to-get regions as the Arctic Zone, additional factors may be emphasized, referring to such regions. They include: extreme climatic conditions of living; isolated location of the region and its territorial expansion [3]. On the one hand these factors cause the trouble of implementation of timely medical assistance (including emergency situations), on the other hand they set the context for implementation of telemedical services which, in their turn, may be considerably different for the Arctic Zone compared to the other regions with more developed infrastructure and without extreme climatic conditions. These differences include both technological (for example data transfer possibilities) and process (requirements to the level of specialists as well as time of medical assistance rendering process) differences.

This article describes formation of requirements to the telemedical service system, which should be the basis for integrated architecture establishment. Architecture should be developed in accordance with the Health 4.0 concept and the fundamental requirement is taking into account the peculiarities of the regions of the Arctic Zone of the Russian Federation.

2. Literature review
Development of medical technology system and informational processes related to medical services is one of the top-priority tasks at the governmental level on the one hand. Telemedicine technologies are highlighted in a special way as part of this development strategy. This can be confirmed by excerpts from the Decree on the approval of the state program of the Russian Federation “Healthcare Development”. The document states that “number of constituent entities of the RF adopting the processes of medical assistance rendering with the use of telemedical technologies in accordance with the requirements of the Ministry of Healthcare of the RF is on of the target indicators and by 2020 it should be increased till 65 constituent entities”.

On the other hand, the State program “Social and economic development of the Arctic zone of the Russian Federation” was published in parallel, which highlighted as one of the main tasks “modernization of social infrastructure facilities, ensuring accessibility and improving the quality of medical care to the population, eliminating the harmful influence of environmental factors habitats and the formation and implementation of healthy lifestyle programs” [4].

Solving problems at the junction of the two described priority areas of development of the Russian Federation may become a relevant research area, namely the design of a telemedicine services system in the regions of the Arctic. This task also corresponds to one more strategic initiative of the Strategy of scientific and technological development of the Russian Federation as of December 1, 2016 [5]. Building a system of telemedicine services, their introduction into the infrastructure of the Arctic space meets the requirement of “connectivity of the territory of the Russian Federation through the creation of intelligent transport and telecommunication systems”.

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Tendency to the decrease of population in the RF Arctic Zone is a serious problem and is the result of a problem with the availability of high-quality medical care (and, as a result, a high level of morbidity). However, as the researches show, the indicated problem is more related to the natives of the Arctic Zone. Also there is a problem of high-quality medical assistance for those who come to the regions on a rotation basis. For example, the researches show that over 95% of workplaces of oil field rotational employees may be considered hazardous on all the parameters (it is mainly related to influence on the cardio-vascular system) [6].

The researches have also shown that more and more often telemedical technologies are used for remote consultations, however, as previously noted, there are several constraints for development of this technology and its implementation in the Arctic Zone. They mainly include the absence of telemedical service financing mechanism in the compulsory medical insurance system and absence of stimulation mechanism for health care organization personnel at different level for daily use of telemedicine [7].

Big number of researches considers technologies as well as their implementation methods and models [8–11]. Analysis of different resources has shown that there is a clear integrated solution for telemedical service system (particularly, we speak about foreign practice). Telemedical service system development in the short term will be connected with the development of informational technologies [12].

3. Techniques
As a method for building an integrated telemedicine system, a service-oriented approach and the concept of enterprise architecture were used, which is a single whole of the principles and methods of enterprise development as a single system. The concept of enterprise architecture includes analysis of processes, organizational structure, application landscape, implementing IT-services, as well as technological infrastructure supporting the set of applications [13].

This approach is based on elaboration of requirements to telemedical services taking into account the specifics of health care organizations, as well as the context planning project implementation. The context characteristics include the peculiarities of the Arctic region, such as extreme climatic conditions, local nature of industrial and economic exploration of territories, remoteness from the main industrial centers, high resource intensity and others [8].

4. Results
The classification of services within the framework of the Smart Hospital concept proposed by AWTG Ltd was chosen as the basis for determining the structure of top-level services. Top level service structure determination is based on classification of services within Smart Hospital concept, offered by AWTG Ltd [14]. Top level service system with the indication of the corresponding technologies is shown in figure 1. However in this case what is important is the set of services necessary to be implemented; technologies are not crucial here.
Figure 1. Structure of top level services of Telemedical System within the Smart Hospital concept.

Taking into account the most common diseases occurring in the Arctic region the list of top-priority services making the “core” of telemedical service has been prepared (here the main focus has been made on such diseases as respiratory diseases, cardio-vascular diseases, diseases of joints, kidney diseases, skin, eye and infectious diseases). In accordance with this list the following technologies are recommended to be implemented in the telemedical center of the RF Arctic Zone:

- **Telepulmonology and telespirometry.** Possibility of sending and remote interpretation of spirometric tests by qualified medical personnel. Remote consultations of pulmonary specialist.
- **Telecardiology.** Modern equipment for tele-ECG, sensors for health monitoring of patients with cardio-vascular diseases, web-monitoring of vitally important data.
- **Telerheumatology and teletraumatology.** Video and image delivery systems allow doctors not only to receive the information from remote patients but to manage it as well. It allows traumatology specialists to almost be present in the remote place and participate in pre-hospital treatment.
- **Teledermatology and teleophthalmology.** Equipment that allows performing remote diagnostics for dermatologic and ophthalmologic diagnosing.
- **Telemedicine for the diagnosis and treatment of infectious diseases.** Diagnosis and treatment of infectious diseases has also been successfully implemented for a long time using telemedicine technologies, for this purpose both video conferences and special equipment in the form of tele-boxes are used, where the patient can pass the necessary tests in real time, wait for their results and get advice from a specialist.
5. Conclusion
The paper analysed the specifics of the Arctic zone of the Russian Federation, as well as reviewed current achievements and research related to the introduction of telemedicine technologies in remote regions. It also contains the analyzed strategic importance of telemedical technology implementation in the regions with harsh climatic conditions and analyzed methods of establishment of service-oriented architecture to solve the problem of creation a complex system of telemedicine services. Analysis of the existing concepts related to the development of system of medical assistance rendering by means of informational and communication technologies allowed determining the structure of top level telemedical services based on Smart Hospital concept. The further analysis of specifics of the Arctic region allowed performing top level service adaptation and offering the list of the main medical services, implementation of which will allow establishing the specialized telemedical system suitable for implementation in the RF Arctic Zone.

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