Telemedicine technologies as one of the promising intellectual areas of medicine in the pandemic conditions

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Abstract. The article discusses the functional, fundamental and role-based component of the organization of telemetry instruments in medical support of remote settlements in pandemic conditions. The importance of adherence to technical and technological features in the design of an intelligent environment which provides the telemedicine sector of the provided services is substantiated. The model of anonymized telemetry of medical research is indicated. An adaptive model for deploying of an information portal for a medical office is proposed. Much attention is paid to compliance with responsive design. A method for solving this problem is demonstrated.

1. Rationale

Medical services for individuals, which include not only just consultation, but also holding conferences and consultations in a remote mode, occupy a niche role in the modern ideology from the public point of view. There are no proper analogies on the market. And the efficiency of the implementation of these services is directly related to the stack of applied technologies and special tools that have been validated, but not directly related to the medical industry [1].

In the current digitalization programs, determined by state institutions of various states that, in particular, are highly differentiated according to the territorial principle. These countries include Brazil, the Russian Federation, China.
The problems of sustainable economic development of these countries in the past impose extrapolation as a result, expressing the insufficient level of the coverage map of medicine: the shortage of inpatient medical institutions in its hard-to-reach corners [2].

The only way to implement the established role of providing this type of service from the state or a private provider is through the use of telemedicine support mechanisms.

2. Determination of the role-based policy of telematics in medicine and the model of an intelligent service system

The role-based policy of telematics in medical support, in order to maintain the integrity of the permanence and continuity of information exchange, is reduced to the following principles:

- Compliance with the possibilities of accessing global networks through existing mediators;
- Determination of mediators of information interaction - satellite telemetry (that has a high level of availability on a global scale with the general high cost of implementation and maintenance), mobile telemetry systems, system of connection to wire backbones of the global telecommunications system; Implementation of the selected method of information exchange with encapsulation and conversion mechanisms at the final stage.
- Determination of the requirements for the end devices of the provided service.
- Determination of a typical (basic) scheme of information and specialized support, based on the typological features of medicine. Determination of equipment, measuring instruments, the volume of generated traffic and means of its’ adaptation to a form convenient for the user of the service.
- Determination of the rules (principles) of information security in the communication path. Observance of reliability and confidentiality in the process of interworking.

As an indivisible structural unit of the topic under consideration, let's define the most realistic model, which is designated as a “mobile telemedicine treatment and diagnostic room” [3].

From the name it follows that this office will be engaged in diagnostics, collecting all the data received and sending them over the Internet to anywhere in the world for the appointment of treatment and constant remote monitoring of the patient. The telemetry entity is defined by the above items.

A resident of a remote settlement or provincial city can receive treatment from physicians of federal centres, scientists of medical universities and even physicians of foreign countries for any profile of the disease.

To do this, we need to have this office in a physical and one, specially trained medical professional, competent in data collection.

The requirement for one employee is dictated by the following reasons:

- Explained shortage of medical personnel in developing countries.
- Minimizing the risks of deployment in a complex epidemiological situation;
- The commutative role of an employee is the implementation of an intermediary role between competent specialists and the patient. It is important that there shall not be any duality in the behavioral component of the counterparty, which is inherent at the psychological level to several employees working simultaneously with the same set of data, analyzes, tasks. This does not apply to the shift mode of operation, but it implies that the superadditive (already from the point of view of performance) principle does not work with a limited number of tasks in a deterministic (with a rigid definition of the functional of tasks) medical office [4].

A general analysis of the requirements for functional support determines the following office structure. It must be equipped with:

- 24-hour blood pressure and ECG monitors
• A video camera on a tripod that will record the collection of complaints, life history, medical history, StatusPresent, as well as record a complete examination of the patient with the physician's comments during the examination.

Necessary categorical requirements: plug-in flash memory of large volume and high reliability class, preferably with online synchronization of recording with the mobile office's RAID-array provided for and dedicated specifically for these requirements. It can be achieved by purchasing cameras with a wireless network interface.

• An electronic stethoscope will record the sound of the heart and sound of breathing in the lungs.

• Computer electrocardiograph, which will allow to save the ECG record in electronic form [5].

• A dermatoscope with a video and photo recording function will allow to assess suspicious areas of the skin and scalp.

• Hand-held digital fundus-camera that will allow to assess the condition of the patient's eyes and record the examination on video.

• Endoscopes for the nose, ear and pharynx can also record a video picture of the health state from the inside.

The proposed algorithm implies a step-by-step comprehensive survey, according to the "as is" model, following the listed steps. Then, a swab from the pharynx, nose, and anal fold is taken from the patient for examination under a microscope. Examination of analyzes under a microscope with the participation of the patient gives a tremendous increase in the patient's confidence in the physician. This effect can be characterized by the “open kitchen” model in medicine [6].

Thus, the Patient is actively involved in the diagnostic process and can see with his own eyes the cause of his illness. For more complex examination methods, the patient will be offered to undergo an ultrasound scan, an examination of the intestines using fiberoptic gastroduodenoscopy, colonoscopy or a more expensive technique such as capsule endoscopy.

X-rays, CT and MRT have been recording results on removable drives for a long time, so there won't be big problems with this. The main thing is the presence of a controlled environment (system) of information transmission (GSM / WDCMA / Wi-Fi / Ethernet / LPWAN).

The transfer of data determines an intelligent approach to their processing. The part of the data already at the stage of transfer is brought into telemedicine correspondence, and the captured test results that have a metric nature (in accordance with the scales of norms and deviations) are almost immediately processed and transmitted, as well as to the recipient (panel of physicians) and to the sender.

After the patient has passed all types of examinations, the electronic medical record is aggregated into the archive with all anonymized results of the examinations, and the tag to the archive (in the form of a link generated by strong hash algorithms, that excludes the receipt of data to other persons) is sent directly to the physician who will evaluate the data and write a review of the story.

Since it implies leveling and anonymization of personal data from the part of the client, then, there will be no regulatory issues from Russian legislation. This principle is based on the regulatory framework for ensuring of confidentiality in the medical field of the Russian Federation [7].

3. Structural and fundamental component of the developed telemedicine system
For data exchange, it is planned to create a distributed information cloud system with a convenient interface for the work of medical researchers and medical supervisors (see figure 1).
Figure 1. Decentralized cloud system of the information system for telemedicine support of the mobile office.

The process of implementation of these services is imposed on the principles of vending, defining the nature of the integration of the principles of “game theory” into the intellectual environment.

Thus, the reference algorithm is reduced to a call or access through the site interface, then registration takes place. The address and operating time of the mobile office (presented in the form of a specialized vehicle on a wheel or tracked base) are specified. Already at the place, the registrar will offer to put on shoe covers and undress in the wardrobe, sign a contract and agreement for medical intervention, pay for medical services (cash, card). Before the start of the examinations, the physician gives a very brief tour and explains what they will do now, shows all the equipment and tells what it is and what it is used for. Warns where it might be uncomfortable. It is necessary for the moral preparation of the patient. The specialist says that he will not hurt patient and the patient can finish the examination at any time.

The physician warns that everything will be recorded on a video camera, and if the patient thinks that something from what is happening in this room does not need to be entered into history, then it will be deleted in his presence. No one will have access to this information without the knowledge of the patient. The access to information will be granted only with the personal permission of the patient.

The developed interface of the telemedicine portal (see figure. 2) in the Russian version (there is native support for an intuitive design for non-native speakers)
The physician informs that after the formation of the electronic history, even he will not have the right to open this history without the patient's permission.

From the point of view of service in a pandemic, point-to-point interaction is as adequate as possible, because, it shall be emphasized that multiple contacts are avoided. Combination of the physical mobility of the service provider and information technology can agree on the option of visiting the patient's home, and the remote mode of receiving test results and counseling minimizes the burden on the entire healthcare system [8].

4. Adaptive component of telemedicine support

An important parameter of the correctness of usability from the point of view of information technologies by the user himself is the parameter of the adaptability of the information system design for various devices. Due to the fact that the aspectology of application in developed countries is considered, an extremely pronounced component of the differentiation between users' income and their capabilities is also implied. In addition, not everyone has personal computers or laptops.

Therefore, it is necessary to find a way to bring the interface of the software component into a general form. We believe that in order to do this it is necessary to implement the platform itself, not as a web application, but as a web page. Because web applications only work on specific devices, based on the latest revisions of operating systems. Web pages, however, are built on an architecture that
supports HTTP/HTTPS (HyperTextTransferProtocol) which, using the most common elements. It has been reproduced equally on all types of devices through various web browsers since 1991. That is, on all digital devices and computers that users could theoretically have.

Including on mobile devices that support WirelessApplicationProtocol (WAP) as the only way to access the Internet. Elderly people or disadvantaged groups of the population have such devices. In addition, such devices are more reliable than smartphones or tablets in cold or humid conditions [9], so they are still widely used today.

For these purposes, it is suggested to use the CSSGrid (see figure 3), a method in cascading style sheets that allows web developers to create complex responsive web design layouts more easily and consistently across browsers. There are other web page layout techniques that have been used in the past, including tables, CSSBoxmodel, and CSSFlexbox.

CSSGrid is a template model optimized for two-dimensional templates (matrix-terinal, as in the case of the developed telemedicine interface) [10]. This technology is used as a model for website templates, forms, galleries, and anything else that requires precise and careful positioning. Despite its newness (it was standardized in 2017), it has already gained widespread acceptance in the responsive design mixing methodology. The matrix (panel) user interface that has been discussed earlier is ideally suited to adaptation through this technology. It does not require any software modules. It is enough to simply redefine the type of device from which the content is viewed (via media queries (functions in CSS)), and present it in a convenient form. If the patient has a sensory device, large cells (the basis of this matrix adduction) will allow working through all sections, even in case of problems with finger motor skills.

If the device is button type then CSSGrid will align the content in the form of one vertical bar. The approximate structure of adaptation of the interface of the telemedicine treatment and diagnostic office for a mobile device is shown in figure 4 (on the right).
5. Findings
Thus, the structural and fundamental model of the mobile service delivery system has been determined. The equipment, the principle of operation, processing, interaction are indicated. The digital contour of the pilot office, functionally identical to the medical institution, is determined, the importance of use of the model in difficult epidemiological conditions is indicated. The telemetric principles of work are determined. The technological and technical aspects of the organization of the office are determined. Attention is paid to the design aspects of the medical portal, the observance of data confidentiality, in the information exchange path.

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