CASE STUDY

Development of Internet technologies for health care in the Russian Federation

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ABSTRACT

All around the world, the health sector is currently transitioning from e-health to digital health, which offers improved quality of medical care, including support for medical decision-making. Both e-health and digital health are structured around using the Internet as a way of communicating, exchanging data and obtaining essential medical information.

The health sector in the Russian Federation has entered into a new stage of development and is consistent with the technological and economic levels seen globally. A key factor in this was a technological breakthrough, both in the use of high technologies as well as the applied functions of health monitoring devices. The national health-care system is actively utilizing this potential and integrating it into practice. Despite the scale of the Russian Federation's territory and the disparity in the financial and economic state of the regions, high technologies are already available equally throughout the country (1). Internet users in the Russian Federation aged 16 years or older make up 72.8% of the population or about 87 million people. This has a significant impact on the integration of Internet technologies in all areas of public life, including health care.

The most promising areas for the further development of Internet technologies in health care in the Russian Federation are: online navigation of the health-care system for ordinary citizens, disease prevention and engaging in a healthy lifestyle, clinical telemedicine, intelligent support systems, medical information systems, mHealth and the Internet of medical things, medical care quality assessment and monitoring, distance education, support for scientific clinical solutions and the distance selling of medicines and medical equipment. These technologies could potentially become crucial in changing the architecture of health promotion and medical care in the next few years.

This article provides a detailed analysis of how these areas are developing and specifies the actions that need to be taken to introduce them into practical health care.

Keywords: HEALTH INFORMATION TECHNOLOGIES, E-HEALTH, DIGITAL MEDICINE, TELEMEDICINE

INTRODUCTION

In the WHO Regional Office for Europe, the implementation of the Health 2020 policy has created an understanding of the key role played by a nationwide approach to health care and involves the whole-of-society approach in an effort to make substantial improvements to the public's health and well-being, reduce health inequalities and strengthen public health. The main factor behind this success is the development of "universal, socially just, sustainable, and high-quality human-centred health systems" (2). The outcome statement of the high-level regional meeting, Health Systems for Prosperity and Solidarity: Leaving No One Behind (Tallinn, Estonia, 13–14 June 2018), notes that it is essential to "support policy action and the strengthening of applied research to ensure that our health systems are modern with up-to-date health information systems, fit-for-purpose, and able to harness new technologies in a manner that seeks to minimize current inequities in access to and quality of services"(3).

The current trend in the global health-care industry is the transition from e-health to digital health. E-health ensured electronic document workflow between the patient, doctor and medical organization, the introduction of telemedicine technologies into the practice of health-care provision and the creation and maintenance of medical databases with information about every time a patient seeks medical care, including information from mobile medical devices and other

information that can be collected remotely. The transition to digital health means complementing e-health capabilities with analytical and mathematical methods to process medical data and smart modules; this offers improved quality of medical care, including support for medical decision-making.

Digital health is closely intertwined with the development of Internet technologies. The emergence of the Internet was the most striking phenomenon of the 20th century in terms of the development of information technologies and has significantly changed people's lives. According to the analytical agency We Are Social and the major social media marketing platform Hootsuite, more than 4 000 million people worldwide use the Internet today *(4)*. Internet users in the Russian Federation aged 16 years or older make up 72.8% of the population or about 87 million people. The emergence of mobile phones followed by smartphones as well as the availability of mobile Internet in the Russian Federation led to an increase in the number of Internet users predominately due to mobile traffic. According to experts, as of early 2018, "more than half of adult residents of the Russian Federation (51.5%)" accessed the Internet from portable mobile devices *(5)*.

All these phenomena are manifested in health care as well. Information technologies in the operations of medical organizations encompass almost all aspects of their activities, including the management of resources, the medical process and the provision of medical care *(6–7)*. The broadest sphere for the use of information systems is the medical information system (MIS) of health-care institutions, which combines the medical decision-making support system, electronic medical records of patients, digital medical research data, patient monitoring data obtained directly from medical devices, means of communication between employees as well as financial and administrative information *(8)*.

As the Internet develops in health care, telemedicine technologies have gained a fresh impetus and entered a new stage of development. Telemedicine is a remote way of implementing diagnostic, treatment, preventive, organizational and managerial processes in health care through computer and telecommunication technologies *(9)*. The ever-growing use of smartphones, tablet computers and mobile broadband Internet around the world including in the Russian Federation has resulted in previously inaccessible telemedicine technologies becoming part of an ordinary person's life. Doctors and medical organizations have begun creating personal and corporate websites, where patients can easily obtain information about the scope of specialists' activities and contact details to get in touch with

representatives of the health-care system. Thanks to the Internet, doctors have become visible to ordinary citizens.

For its part, digitized medical data have become easily accessible to patients and doctors: the results of a computer or magnetic resonance tomography (CT or MRT) can be transmitted using digital media, including by email, without distorting the data or diminishing its quality.

Thanks to such communication channels, doctors and patients have begun interacting more and can easily transfer digitized medical data, which medical experts can then use to take more objective clinical decisions *(10)*. Social media is also facilitating patients' interaction with doctors and starting to play a greater role in obtaining medical information that had been previously inaccessible to many non-professionals *(11)*.

In the Russian Federation, just like in many other countries, a new focus in health care has been gaining momentum; this emerged at the point where Internet technologies, mobile devices, new ways of communication and the need to expand the availability of medical services all overlapped – mHealth (or mobile health) – along with an important component of this phenomenon: the Internet of medical things *(12–13)*. In the next few years, these technologies could become crucial in changing the architecture of health protection and medical care, and the Internet will play an important role in this as well.

Having supported the adoption of global and regional resolutions to strengthen the information component of health-care systems, the Russian Federation is making it a priority to develop Internet technology in medicine. The purpose of this publication is to provide a detailed analysis of the most promising areas for the development of Internet technologies in the Russian health-care sector *(14)*:

- online navigation of the health-care system for ordinary citizens

- disease prevention and engaging in a healthy lifestyle

- clinical telemedicine

- distance education

- support for scientific clinical solutions.

The article also presents the actions that need to be taken to introduce these technologies into practical health care. In our

opinion, these are the specific areas that require the primary attention and efforts of the professional community from the practical health-care industry, IT industry, medical equipment manufacturers, insurance companies, the pharmaceutical industry, patient communities and government regulators.

ONLINE NAVIGATION OF THE HEALTH-CARE SYSTEM FOR ORDINARY CITIZENS

By integrating medical institutions, first within a region and then into a single national information system, the Russian Federation has created the prerequisites for the transition to electronic document workflow throughout the country by 2020 (15). This has provided the public with online navigation capabilities for choosing an institution for medical care, obtaining advice on healthy lifestyles and disease prevention as well as communication with medical organizations and other organizations working in the health-care sector (insurance companies, pharmacies, etc.), which include:

- searching for medical organizations should the need arise for emergency (including specialized) and urgent medical care;

- searching for the best medical organization to receive primary, specialized, or high-tech medical care, including making an appointment with an online primary care doctor using e-government services;

- selecting and registering with a medical organization as part of a programme for medical insurance or the provision of paid medical services;

- searching for resources that present telemedicine services by specialization, level or type of medical care;

- searching for the most suitable way to obtain various documents and examinations;

- selecting health centres and fitness centres.

In order to successfully develop this area of focus, uniform requirements have been created for medical resources (above all for the websites of medical organizations under various forms of ownership); these enable the available resources to be categorized and the most valid resources to be elevated in search engines. Specifically, a national rating is used to assess how informative the interactive services of medical organizations' websites are.

DISEASE PREVENTION AND ENGAGING IN A HEALTHY LIFESTYLE

According to WHO experts, medical care and hereditary factors jointly contribute to 30% of a person's health, while their lifestyle accounts for 50% (16). As the Internet develops, people use specialized websites, media aggregators and social media to search for information about health. Over the course of a month, 84% of Internet users use more than one device to go online – for example, work and home computers or a computer and mobile device. More than half of them use mobile devices along with computers and a fifth of them only access the Internet using the former. People who use both a computer and a mobile device will go online an average of 19 times per week and spend more than seven hours there (17).

Thus, the Internet plays an important role in forming a healthy lifestyle (HLS) by providing information and motivating people to maintain a HLS while also offering interactive tools for assessing disease risk factors. One example of this is the effective work conducted by the So Healthy official resource of the "Healthy Russia" programme of the Russian Ministry of Health (http://www.takzdorovo.ru/). The website's materials are being tested by leading Russian health-care specialists and HLS experts. The information that has been published has been confirmed by studies and contains reliable information. The website enables users to download and widely disseminate videos, take part in online conferences, pose questions to an expert, log into social media and take part in online research.

Another promising concept that is being implemented in the Russian Federation is the creation of specialized resources for the preventive monitoring of the health of working-age citizens; these push them to focus on taking care of their health, which ultimately reduces the risk of developing chronic diseases. Smart devices are used to process the data that are collected and create an individual health programme for each person as well as predict trends in the health of an entire specific population group; this helps to organize the redistribution of the health-care system's resources.

The following measures need to be taken to develop this concept in the Russian Federation:

- the development of a monitoring methodology, including the structure of health data, data exchange and storage formats, data collection procedures as well as data processing and decision-making algorithms;

- the establishment of a registry of mobile devices that allows for the effective monitoring of one's health;

- the development of insurance programmes in the compulsory and voluntary medical insurance system that allow for conducting monitoring;

- the development of software for mobile and remote devices to organize the collection of monitoring data and for the monitoring centre to store and process big data;

- the formation of a medical monitoring group and trial operation;

- the development of recommendations on the selection of organizational and legal principles for the preventive monitoring of public health;

- the analysis of information risks and the drafting of proposals to minimize them (protection of personal data, identification and authentication of medical workers and patients, etc.).

CLINICAL TELEMEDICINE

Telemedicine involves the use of telecommunications and electronic information (computer) technologies to provide medical care where needed (in cases where geographical distance is a critical factor). Clinical telemedicine includes the following areas of focus:

- remote doctor–patient and doctor–doctor consultations, both in synchronous mode via video and audio communication and the exchange of text information and medical data, and in asynchronous mode via information exchanges through various communication channels;

- remote health monitoring with mobile diagnostic devices using specialized medical and robotic consoles;

- the provision of personalized medical data storage and the maintenance of a personalized electronic medical record;

- the ability to purchase drugs in e-pharmacies, including the use of e-prescriptions.

As the Russian Minister of Health, Veronika Skvortsova, noted, both doctor–doctor and doctor–patient formats are being developed in the Russian Federation. When the national programme on vascular disorders was launched, it set the goal of providing round-the-clock electronic communication between regional and primary vascular offices so that images from CT scanners could be transmitted promptly for interpretation and diagnoses established. The doctor–doctor format is already being used in all regions and in all areas of medicine. Since 2016, all 20 Russian national medical research centres have had the ability to receive and transmit the necessary medical information, including in visual form, around the clock. Top specialists help their colleagues from the regions to analyse complex cases and work on errors during conference calls, organize video training seminars and broadcast the most interesting, and often unique, operations. The transition to round-the-clock communication for all 85 regions will be completed this year (18).

The technologies that form the basis of telemedicine are rapidly evolving and this requires systematization and scientific assessment in terms of their clinical/economic efficiency and safety of use. This requires regular reviews of international scientific literature and examples of the introduction of telemedicine, the organization and support of scientific and clinical research in various health-care industries, the creation of specialized scientific periodicals that publish the results of basic and clinical research, and the publication of the results in specialized and industry-specific medical and biological journals. To this end, the Russian Federation has initiated the creation of a network of institutes that are subordinate to the Ministries of Health of the Commonwealth of Independent States in order to exchange experience in this and other fields.

In our opinion, clinical telemedicine within the three-tier system of medical care organization could be developed more effectively if the emphasis were placed on the development of primary care and the provision of diagnostic express systems to doctors, general practitioners, and paediatricians with the ability to record, archive and transmit data in digital form. In addition, the workplaces of highly specialized doctors working at major multidisciplinary clinics should be equipped with telemedicine channels for communication with their colleagues in other regional and federal centres.

The creation of portable (mobile) diagnostic systems using telemedicine technologies for the collection, transmission and processing of data could be a great help in ensuring the availability of medical care. In our opinion, equipping ambulance crews with telemedicine diagnostic equipment, MISs and communication channels with instant access to resource centres via a telemedicine channel to aid decision-making would significantly improve the quality of emergency services.

Similarly, equipment should be provided for midwifery stations, where fixed telemedicine stations could be established.

Legislative regulation of the use of telemedicine technologies is constantly progressing in order to successfully develop this area of focus in the Russian Federation. In 2017, the Federal Law On the Fundamentals of the Health Protection of Citizens in the Russian Federation (No. 323-FZ, 21 November 2011) *(19)* was amended to modify the regulatory framework for e-health in the Russian Federation: regulations allowing for electronic document workflow were introduced, a definition was provided for the ability to provide medical care using telemedicine technologies and the layout of the Unified State Healthcare Information System was supplemented.

These amendments specify procedure and allow for the provision of medical care using telemedicine technologies through consultations and multidisciplinary team meetings as well as the remote medical monitoring of a patient's health. Consultations using telemedicine technologies are the right of both the doctor and the patient and patients should not be restricted to receiving medical care in person. From 1 January 2019, the amendments also allow for e-prescriptions to be issued for drugs, and medicines containing narcotic drugs or psychotropic substances. The e-prescriptions will be sent directly to pharmacies. Electronic medical records may be processed electronically. In particular, a person can consent to or reject medical intervention as well as obtain medical reports, certificates, and extracts from medical records all in electronic form.

Improvements have been made to the procedure for information support in the health-care industry and the Unified State Healthcare Information System continues to develop. It will contain comprehensive data on personal health-care records and federal registers, information on medical organizations and medical documentation and data on the organization of high-tech medical care and the provision of preferential medicines to citizens, among other things. The unified system will ensure e-health services are available to citizens via the Unified Public Services Portal.

Thus, we could say that e-health has already been introduced legislatively in the Russian Federation and continues to develop. A number of regulatory documents that specify the procedure and rules for applying the provisions of the Federal Law have been issued. At this stage, digital health is being actively developed and e-health will fully transition to digital health in the foreseeable future.

DISTANCE EDUCATION

Distance learning involves remote interaction between a teacher and students with all the components that are inherent in the educational process (goals, content, methods, organizational forms and teaching aids) and is conducted using specific Internet technologies or other interactive means. It is one of the youngest forms of education in the medical environment. The term "distance education" has increasingly become part of the everyday life of the teaching staff at Russian educational institutions and medical workers. It is needed to constantly replenish and update the knowledge gained during university studies and also due to organizational difficulties in obtaining continuing education *(20)*.

The government devotes special attention to ensuring that the Russian health-care industry has highly qualified specialists with up-to-date skills. In 2012, the government adopted Federal Law No. 273 On Education in the Russian Federation in which Article 16 makes "the implementation of educational programmes using e-learning and distance learning technologies" legally valid. This Federal Law was later supplemented by Order No. 2 of the Russian Ministry of Education and Science, 9 January 2014, On the Approval of the Procedure for Organizations Engaged in Educational Activities and E-Learning Activities to Use Distance Education Technologies in Educational Programmes *(21)*. The order devotes considerable attention to the technical side of the issue and creates the conditions for the electronic information environment to function: reference and educational resources, reference and telecommunication technologies and the appropriate technological equipment. In addition, when educational programmes are created, the educational organization is given the ability to independently determine the scope of the teaching load and the correlation of the scope of classes without interrupting the workflow *(22)*.

Distance medical education in the Russian Federation is being developed with the following areas of focus:

- the creation of electronic educational courses, distance learning and advanced training programmes on medicine and pharmaceuticals as well as distance examination systems, including the use of models and mannequins;

- the creation of systems for group-based professional collaboration among medical and pharmaceutical personnel and students at medical and pharmaceutical secondary special and higher educational institutions;

- the provision of access to the State electronic medical library;

- ensuring real-time viewing of surgical procedures, both at medical institutions in the Russian Federation and at leading medical centres around the world;

- remote lectures by leading medical specialists from the Russian Federation and around the world;

- the creation of a library of expert medical systems that automates the process of supporting medical decision-making based on formalized knowledge databases and case law.

We believe that the successful development of this area of focus will require developing mechanisms to manage resources online in order to elevate the ratings of the most useful resources on distance education in search programmes. In our view, an important aspect of distance learning using online technologies is the education of patients and healthy citizens based on the concept of P4 Medicine (predictive, preventive, personalized, and participatory, i.e. medicine that requires that patients are actively involved in taking care of their health) *(23)*. The author of this strategy, Leroy Hood, argues, "the strategy of P4 Medicine is a thing of the near future, approximately 10–15 years, and its successful implementation not only requires scientific and technical achievements, but also a change in public opinion as regards to taking care of one's health".

An example of such training in the Russian Federation is the Health and Active Social Longevity School that is conducted at certain medical institutions, for example the Lopatkin Research Institute of Urology and Interventional Radiology – a branch of the National Medical Radiological Research Center of the Russian Ministry of Health – uses distant forms of thematic training. Such schools have demonstrated their clinical effectiveness and marketing profitability, as evidenced by their target audience's growing interest in their health, heightened awareness of health matters among patients, increased vigilance and, consequently, their timely recourse to medical care with a focus on prevention and early diagnosis of diseases *(24)*.

In order to continuously improve the professionalism of doctors, a unified educational portal was created for distance medical and pharmaceutical training and the selection of full-time educational and training programmes of the Russian Ministry of Health (http://edu.rosminzdrav.ru/). Today, it features more than a thousand interactive educational

modules on various specializations. Users already include 236 000 Russian doctors or 43% of the total number of doctors in the Russian Federation *(25)*.

SUPPORT FOR SCIENTIFIC CLINICAL SOLUTIONS

Developing support for medical research involves conducting multicentre studies in a distributed manner, monitoring their implementation, publishing results and exchanging information between researchers in the process of researching and analysing the results.

In the Russian Federation, support for medical research is being developed with the following areas of focus:

- the provision of technology to search for, integrate and process medical information about a patient from various information sources using modern intelligent systems (Semantic Web);

- the integration into a common network of distributed semantic repositories created by various organizations (health authorities, medical organizations, research centres, professional communities, universities, etc.) based on common open standards (Linked Open Data);

- the implementation of joint projects to organize an interstate electronic medical data space;

- the systematization, cataloguing and classification of all types of medical knowledge, and the provision of access to this data;

- support for electronic scientific journals and other online resources that support the publication of scientific results;

- the monitoring and management of the publication activities of researchers and increasing citation indices;

- the monitoring of results from scientific research in medicine;

- the management of applications for research work, conducting expert examinations of applications and informational collaboration with organizations and funds that provide financial support for research;

- informational collaboration with organizations that support scientific research in medicine (the Medicine of the Future technology platform, Medical Science portal, etc.);

- the creation of expert systems that automate the process of supporting medical decision-making based on formalized knowledge databases and case law;

- the creation of professional portals for researchers to interact on matters concerning medical science and the provision of access to depersonalized storage warehouses of electronic medical records.

DEVELOPMENT OF ONLINE TECHNOLOGY INFRASTRUCTURE IN HEALTH CARE

The issues related to developing online technologies cited in this article cannot be solved without developing the appropriate infrastructure. We include project financing, staffing as well as software, hardware and technical support in this area of focus. Organizational support also plays an important role.

The Russian Deputy Minister of Health, who was appointed on issues concerning the digitalization of health care, and the Department of Digital Development and Information Technologies play a leading role organizationally in the development of digital health. The Central Research Institute for the Organization and Informatization of Health Care under the Russian Ministry of Health has established a research department for the development of online technologies in health care, and the Institute of Digital Medicine has been established at Sechenov University.

In order to solve issues related to the unification of information exchanges in digital health care, information security, personal data protection, and the semantic compatibility of medical data, including interaction with foreign information systems in the Russian Federation, the Health Informatization Technical Committee (TC-468) *(26)*, which is a representative of the international technical committee ISO TC215 in the Russian Federation and which has already approved five new and 79 international ISO standards, was established on the core of the Central Research Institute for the Organization and Informatization of Health Care under the Russian Ministry of Health.

Financial support for health-care informatization consists of funds from the federal budget and the budgets of the regions of the Russian Federation. A resolution of the Russian Government has earmarked RUB 2 000 million for the implementation of the e-health priority project *(27)*.

CONCLUSIONS

Online technologies have taken on a strong presence in health care in the Russian Federation and encompass all aspects: from maintaining a HLS to the remote monitoring of the body's physiological functions.

Each of the areas of focus we looked at for the development of online technologies requires a serious scientific and methodological study and substantiation of their impact on the health-care sector. This will make it possible to most effectively develop and introduce the projects that are most useful and essential from the standpoint of practical health care. Developing them requires uniting the efforts of experts from various health-care sectors, the IT industry, manufacturers of medical equipment, insurance companies, the pharmaceutical industry, patient communities and State regulators, and, of course, their legislative regulation, in particular the use of telemedicine technologies, distance education, and the distance selling of medicines.

These technologies could be crucial in changing the architecture of health promotion and medical care in the next few years.

Disclaimer: The authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions or policies of the World Health Organization.

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