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International Scientific Cooperation as a Tool for e-Health Promotion

Grigory Viktorovich Prytkov[1]*, Vladimir Pavlovich Rubtsov[2] and Natalya Yurievna Tsvetus[2]

[1]Non-for Profit Organization ANEK, Moscow, Russia; belisary@yandex.ru
[2]NRC Kurchatov Institute, Moscow, Russia; lid_krydo@mail333.com, ntsvetus@yandex.ru

Abstract

Objectives: Nowadays trends in high-tech implementation is connected with introduction of value-oriented preventive medicine. This approach is seen as a tool to modernize the lifestyle with affordable funding. **Method:** The concept of full cycle integrated project "Development of Distant Medical Care" is discussed to be implemented in Russia within upcoming 10 years. **Findings:** For Russian Federation the idea of a so called full cycle integrated project was proposed. The project aims at value-based medical care organized with the help of biosensors implementation, and consists of 3 stages: the usage of foreign sensors and devices (till 2016); the formation of the Russian branch of the telemedicine sector (2016-2020); the incorporation of e-Health into the existing medical industry in the Russian Federation (after 2020). The main idea of e-Health development is neither a device, nor patients themselves, but rather the medical service as a whole. Main challenges associated with this issue are concerned. It is shown that international collaboration and acceptance of successful practices is proved to be absolutely necessary to fulfill the goal of the value-based healthcare. Telemedicine is seen as a part of arising e-Infrastructure – the organization and formation of innovative infrastructure based on digitalization. **Improvements:** Horizon 2020 program is shown to be a probable tool to accomplish the discussed purpose. Adoption of the existing successful approaches could contribute a lot for socio-economic development.

Keywords: e-Health, High-Tech Medicine, Telemedicine, Horizon 2020, Full Cycle Integrated Project (FCIP)

1. Introduction

New technologies found their way in medicine development in various aspects. One of the trends to be mentioned is connected with value-oriented preventive medicine.[1-3] This approach is treated as a response to several challenges differing from country to country. For Russian Federation it is seen as a tool to modernize the lifestyle with affordable funding, and also to deal with remote areas problems, the most important of them being the Arctic region. For the developed countries it is the way to sustain high life quality standards.

This issue is multi-disciplinary due to its nature and is based on the synthesis of a number of sciences, such as: nanotechnology, medicine, telemedicine, data handling, etc. The e-Health (or telemedicine) refers in this case to new small smart devices capable to monitor vital signals from human body that send/receive data wirelessly.

Most experts predict the rapid growth of corresponding markets (devices, applications to operate with data, etc.), but this forecast is rather uncertain.[2,4] In upcoming future the telemedicine biosensors are supposed to become smaller in size, and greater in numbers, all connected together. Thus, a smart grid could be established. First, it would be a "nervous system" at the level of the human body (within next 10 years, according to forecasts). To construct such a grid nanotechnology is supposed to be the tool, especially in manufacturing small-sized devices operating autonomously. In 2013 the National Nanotechnology Initiative held a special round-table dispute about probable application of nanobots for medical purposes; some first standards, methods and

**Author for correspondence*

approaches were discussed. Next roundtable was planned for 2016[5]. Next, it will turn to a multi-level grid with a human-based smart grid as a constructing element.

In Russia the Ministry of Health runs now the concept of full cycle integrated project "Distant Medical Care Development". The main idea of the project is to turn to value-based healthcare based on personal medicine development (medical biosensors), arrangement of the mobile network to transmit the data and formation of the data centre analysis.

2. Concept headings

The paper is organized as follows. First, we discuss the concept of full cycle integrated project proposed in Russia. Second, we consider the international scientific cooperation as a necessary tool to obtain the goals associated with telemedicine development. In conclusion we stress that despite growing political tensions international scientific cooperation remains the effective tool for promoting new high-tech ideas into practice, especially in medicine.

3. Results

To promote the idea of telemedicine the full cycle integrated project "Development of Distant Medical Care" was introduced. The proposed project is considered by the Russian government as "pushing", i.e., it can be regarded as a driver of several economic sectors. First, the implementation of medical biosensors was discussed within the special consortium "Distant medicine" organized within the technological platform "Medicine of the Future"[6]. The latter represents a public-private partnership, the way to mobilize the possibilities of the stakeholders (government, business, academic community) and a tool for creating a scientific, technological and innovation policy.

Now the technological platform "Medicine of the Future" is regarded as a scientific coordinator of the project. Analytical support was organized by research conducted in NRC "Kurchatov Institute" and other institutions interested in the development of this project. Financial support is expected to come from targeted programs of Ministry of Health and state-owned banks.

3.1 Existing Technical Solutions. Universal Biosensor Concept

The main idea of FCIP is to turn to the value-based healthcare. This involves personal medicine due to use of medical biosensors; usage of the mobile network to transmit the data; formation of the data analysis center; development of the appropriate institutional solutions (laws, standards, rules, etc).

The Russian market of mobile biosensors is actually a niche market, and it depends greatly on the governmental support. It is not oriented for export perspectives and mostly aims at solving the existing problems in the considered country[7]. Thus the position of experts' community is crucial for choosing the priorities of scientific development and practical implementation of the results. The latter is typical for many other countries, thus the approaches set off in Russia could be adopted in other areas.

So far there are several trends in medical biosensors development. The first and very important issue is the attempt to create a universal device that can monitor a number of physiological parameters. Up to now it is reported that about 200 devices can be used to create a universal medical biosensor that could be implemented in Russia. Those devices are divided into 7 large groups: cardiac, cochlear, blood sugar control, gastrointestinal, nerve stimulators, sports and others. They mostly originate from the US companies, such as Medtronic, St. Jude Medical, and others[7].

This approach (to construct the universal device) is very close to the telemedicine development based on smartphone use. However, smartphones and existing applications lack the universality and accessibility. Intended universal sensor is primarily a medical device aiming at monitoring and – perhaps – curing some diseases. It should be rather cheap, and could be produced in large numbers. It should be simple to operate and install (preferably with minimally invasive procedures, e.g., by special syringe). It should monitor as many parameters, as possible. Specialists gave the following minimum list of parameters: body temperature; blood pressure; blood analysis; glucose level; oxygen, proteins and enzymes; and ECG.

It should be safe, and undergo testing for biocompatibility, cytotoxicity, sensitization, irritation, system toxicity, subacute and subchronic toxicity, genotoxicity, implantation, hemocompatibility, chronic toxicity, and carcinogenicity[2,8,9]. The best option is to create a biosensor made of biodegradable polymers. Additional characteristics of biosensor include technical properties: Size, weight, radiation. As a result of the available papers analysis, the device should be rather small (approximately 10 mm), not heavy (less than 10 g). System must not exceed the recommended electromagnetic radiation or tissue heating levels, thus electromagnetic radiation should be less than 10 mW/cm. It also should not produce tissue heating more than 1°C increase in tissue temperature.

An intriguing issue is dealing with data: Transmitting, analyzing, storing. There has been noted a new trend connected with gathering "additional" (previously referred as "useless") data in conjunction with the necessary parameters. These surplus data (mostly body positioning, body temperature, speed of the movement, etc.) can adjust the diagnosis.

The most challenging problem up to now is charging the device[2,10]. In fact, a technological solution has already been developed, but the lifetime of the sensor is extremely short. Some interesting ideas are now being studied: Charging from temperature difference in body tissues, or using low-frequency radio waves to conduct energy through the body.

Second trend to be mentioned is connected with fabrication of the device. The idea is to implement 3-D printing as a way to produce such biosensor. The living cells (often belonging to the patient) are used as a substrate. Previously those devices were motionless or dependent on blood flow, but now they are equipped with a strip of skeletal muscle cells that can be triggered by an electric pulse thus serving as a pusher. The size of such bio-bot is now about 1 cm with prospects to decrease. Experts estimate these devices to be in use in about 3-5 years. In Russia there are several projects conducted in Skolkovo at 3D Bioprinting Solutions[11] dealing with 3-D printing[7].

3.2 Details of the FCIP Idea

Currently the technological platform "Medicine of the Future" includes 32 FCIPs uniting 142 companies, including representatives of business (37 entities), federal and research universities (16 institutions)[6].

The basic tool for FCIP implementation is a road map, which is a dynamic atlas of intermediate objectives and sub-control stations and interconnections agreed in tasks, time and resources needed to achieve the main goal. In this project (remote medicine) it contains three levels: Scientific, technological and medical; promotional and infrastructure; industry, including the formation of standard clinical practice with the use of domestic medical devices.

The proposed project consists of 3 stages. At the beginning the usage of foreign sensors and devices is involved. They would go through pre-critical selection and adaptation to the Russian requirements (e.g., radio frequency). At the same time the following processes are run: localization of the production of medical devices and sensors in the Russian enterprises, launching a series of R&D in order to develop Russian counterparts/analogues, and, moreover, development of fundamentally new sensors and devices; conducting R&D on biocompatible materials, given the considerable backlog of Russian material science.

At the second stage the Russian branch of the instrument and the telemedicine should be formed. It would be followed with the third stage – the incorporation of e-Health into the existing medical industry.

The main concept in this process is that neither devices (nor patients themselves) are the end target of the process, but rather the medical service. Thus, the medical biosensor is only a tool in creating and promoting the value-based healthcare in Russia.

3.3 Evaluation of the Project. Expected Outcomes and Obstacles

Ultimately, the project aims at a significant reduction in health expenditure (up to 6% of government guarantee program makes about 20-30 bln Euros in 6 years). Target groups of the projects are patients with chronic non-communicable diseases such as hypertension, coronary heart disease, bleeding disorders, violation of heart rhythm and conduction, diabetes, respiratory diseases. For these categories of patients the following outcomes are expected: A significant increase in the effectiveness of therapeutic and diagnostic activities; increasing life expectancy of the population (up to 12% reduction in mortality and disability in the population, primarily working age (30%) reduction in time-consuming patients to receive medical care (50%), development and transfer to production of at least 20 new brands of domestic innovative and non-invasive implantable devices; development of innovative microelectronic and electronic component base through increased requirements; integration of the existing scientific and technological groundwork for the development of micro-electronic and electronic component base for new applications sectors; significant improvement in the hardware and software capabilities of the device, in particular for ultra-fast processing of large volumes of data stream; accumulation and the commercialization of the previous work in the field of biocompatible materials, including the use of nanotechnology; creating conditions for the implementation of the previous achievements in the medical industry; providing extra medical services to more than 5 million patients; the use of energy technologies, data transfer in developing neuro-controlling devices.

Public opinion also applies to this issue. To promote e-Health in Russia it is also important to define the readiness of the population to accept the innovations. Based on sociological survey data not published in the open sources but available for our team we undertook the analysis of people's inclinations. The main challenging problem is the lack of trust to medical personnel, and doubts on the quality of healthcare. In Russia 57% of population are not satisfied with the existing medical service, 40% would prefer to go abroad for medical treatment; 21% of people point at poor equipment as the reason for weak medical service, 23% of respondents see the incompetence of the staff as the main source of bad health care, and only 6% suppose Russia develops high-tech economic sectors.

Furthermore, medical staff expectations are not met. In the end of 2014 All-Russian Public Opinion Research Centre conducted a number of surveys among physicians[12]. It revealed that specialists' positioning plays the crucial role in their work. The aim of medicine is to help people, to serve the society, cure its diseases. However, nowadays it is substituted by "service": The idea "pay-and-get" is considered (at least in the Russian medical society) as flawed.

Thus, there is a contradiction: on the one hand, there is dire need to establish and promote personalized treatment, but on the other, it is represented as a personalized service that supposedly would cost higher. Right now the Russian society seems to be not ready for telemedicine implementation.

Therefore we conclude that nowadays the position of experts' community is crucial: They can influence the future of medical care. To our mind, the value-oriented healthcare could be successfully applied in Russia with consideration of the risks and problems mentioned above.

Now the pilot implementation of research on the introduction of medical biosensors in a number of the Russian regions is under way. The main objective is to identify regional features related to the development of telemedicine, and formulating suggestions for the authorities. Particularly, this approach has been successfully implemented in the Nenets Autonomous District for Arctic exploration purposes.

If successfully functioning, the FCIP idea is expected to be adopted throughout the Russian Federation.

4. Discussion

Nowadays political situation is characterized by growing tensions and science seems to be strongly affected by the political disturbance. However many challenges we face can be only overcome by joint efforts. The authorities seem to be fully aware of this, and many scientific cooperation projects Russia is involved in are still in force.

With regard to the FCIP concept the international collaboration and/or interactions with foreign specialists are extremely important at the starting stage of the project. First, the formation of e-Health market in the developing countries can be based only on the results already obtained in the leading countries (such as the EU and the USA). Russia, as well as India or Brazil, is adopting the existing technical solutions. Second, experts' community in Europe is more advanced and experienced as compared to the Russian one, and evaluation of new devices will necessarily be biased to their opinion.

4.1 e-Infrastructure Concept in Medical Care

An important trait of high-tech medicine to be mentioned is that institutional aspects are much more influential than technological. Thus, the organization and formation of innovative infrastructure starts to play a crucial role in telemedicine development.

One of the probable solutions to promote telemedicine is connected with formation of e-Infrastructure. This approach is a part (the first step) of e-Science development. In the European Union the concept of introduction of telemedicine services using e-Infrastructure has been proposed and is now under way. E-infrastructure in this case refers to the digital infrastructure that promotes the data exchange. The idea is to provide researchers with simple and controlled access to devices, databases, experimental installations. Practically, it is the establishment of a dedicated data network and implementing remote access practice. In the future, this refers to creating the so-called e-Science and building a single unified scientific system in the European Union. This system is viewed as non-scientific, but rather one with strict codification and systematization. The first steps in this direction were taken within the framework of the EU's 7th Framework Program, and now within Horizon 2020 program the EU aims at the development of new world-class research infrastructures. Support will be provided for the implementation and operation of the research infrastructures listed in the ESFRI Roadmap[13]. The idea is to go "beyond science", and use scientific infrastructure and associated institutional aspects as a tool for commercialization and society development.

Nowadays a number of projects are under way. Biotronik can be considered as one of positive practices in the e-Infrastructure development operating for more than 10 years. People wearing the device possess also a transmitting tool sending information to the data center situated in Germany (for European based patients) for further handling. Thus, there is a trans-border data performance that ultimately requires international cooperation.

4.2 Horizon 2020 Program

To function as an international scientific team a number of regulations should be established. Rather than creating new ones (for such specific purpose as medical care) the present solutions could be adopted. The EU has been running Framework Programs for more than 20 years, and the acquired experience could be claimed for medical field. Ongoing Horizon 2020 program has both financial and institutional instruments to provide the support for e-Health in various countries.

Horizon 2020 is an action program of the European Union for Research and Innovation for 2014-2020, its particular attention is focused on the commercialization of the research projects results. Despite the territorial conditionality, the program provides mechanisms for collaboration (scientific and technological cooperation) with countries outside the EU. National contact points assist in establishing links between different countries and scientific fields.

To promote e-Health the Program provides more than 10 competitions directly related to research and development in the field of e-health for the period of 2016-2017. Most proposed activities focus on the digital health literacy of the patients and of the Healthcare Workforce.

In addition, under the ICT Policy Support Program within the Competitiveness and Innovation Framework Program (CIP) a project to develop Electronic Simple European Networked Services (e-SENS) was launched in 2013. E-Health serves as a part of e-SENS in terms of making it easier to use healthcare services abroad in cases of emergency. The objective of e-SENS in the e-Health domain is to facilitate cross-border access to health services within the EU[14].

4.3 International Scientific Cooperation of Russian Federation: Main Trends

As to the Russian Federation, however, several peculiarities should be mentioned.

First, Russia is fully open for international scientific collaboration, but only as an equal partner. This includes participation of Russian scientists in teamwork, involvement of the Russian side into the decision making process (e.g., development of standards), respect of local rules (e.g., privacy protection in regard to trans-border data handling). The same is applied to India, China, Brazil, etc.

Second, these developing countries are ready to invest into e-Health implementation. In Russia, for instance, there is a number of scientific programs striving to promote international collaboration. Several to be mentioned are: 5-100 Project with goal to maximize the competitive position of a group of the leading Russian universities in the global research and education market; calls within Federal Target Program coordinated with Horizon 2020 (event 2.2.)[15], joint calls of RFBR, RSF, and others. Total budget allocated for these calls exceeds 1 billion Euros for upcoming years.

Third, countries try to diversify their scientific links. Therefore, new trends are arising, such as cooperation within BRICS, or Russian attempt to build scientific collaboration with partners of the Custom Union or the Euro-Asian Union[16-17].

Fourth, as participation of many actors involves an ever-growing number of bureaucratic procedures, countries try to avoid this. Thus, bilateral collaboration is preferred.

The cooperation between Russia and the EU in scientific field is carried out through the activity of national contact points on various subjects. By now, the main task of the national contact point is to provide information and consulting support to Russian scientists and research teams who are interested in joint research activities with European partners on all issues of participation in the projects of the "Horizon 2020" program as part of international consortiums. NCP experience can contribute a lot for establishing new links and organizing new projects.

5. Conclusion

We stress that currently institutional aspects of e-Health development are the most important. Since high-tech in medicine is still being implemented, joint efforts of different countries are needed. They can both contribute to better performance of the telemedicine as well as cost redemptions. The existing tool such as Horizon 2020 program with its international scientific collaboration options can be used for organizing/establishing new links. The impact of experts' community (that is in no way institutional) could give rise to hindering political tensions and improve medical care all over the world.

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