Innovations in medical tourism

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Abstract. Medical tourism in the modern world is becoming a new, actively developing market segment. This market segment is expanding due to the active introduction of highly professional medical services. Instruments such as innovation certificates (vouchers) for small and medium-sized high-tech companies to pay for medical R&D services. This is an investment by the government to support innovation in medicine and population wellness. The results of the global ranking for 2022 made it possible to highlight the key advantages and disadvantages of the innovation system of the Russian Federation. It is noted that the main purpose of innovation implementation in medical tourism is to improve its efficiency, the question of measuring the impact of innovation on the quality of medical services provided to tourists inevitably arises. In this regard, we have reviewed some of the innovations that can be used in medicine such as: artificial intelligence, DNA sequencing for deciphering the genetic code, CRISPR-Cas9 system for genetic "scissors", virtual and augmented reality technology for treating neurological and psychosomatic disorders, VR technology, patient-specific devices (PSD) for customized implants, Cast21 for prosthetic limbs, bioprinting, smart insulin port, Kardia-electrocardiograph. They can be used in the development of proposals for medical tours. With the application of innovations in medicine and the introduction of an international certification system in the medical sector, the attractiveness of medical tourism will increase significantly and attract new clients.

1 Introduction

To improve the competitiveness of medical tourism enterprise, various aspects of innovation are usually considered.

The quality of medical services is an important component that affects customer satisfaction and loyalty. To assess customer satisfaction and loyalty, marketing tools are used, which include methods (economic, statistical) and ways of obtaining information. This

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includes surveys, focus groups, customer feedback (on social networks, forums or the organization’s website).

All the information obtained is combined to accurately assess customer satisfaction. As methods for assessing customer satisfaction, for example, the Likert scale is widely used, in which respondents are asked to evaluate the services or performance of the organization’s staff according to some developed criteria or scales (three-, five-, seven-level).

It should be noted that medical tours are of two types - health-improving and therapeutic. Health-improving tours are to a clinic for the treatment of nervous disorders to breathe mountain air. Or to especially rare muds to fight cellulite. Therapeutic - to save yourself from an ailment that doctors in the country or in your home region are not able to cure. The popularity of medical tourism in a country or region is determined by two main factors: tourist appeal and the level of effectiveness of the medical services offered in the organization [1-5].

2 Main Part

One of the important factors that affect the competitiveness of a medical tourism organization is consumer expectations. Expectations are formed on the basis of the need to treat a disease. Often these are chronic diseases. If expectations do not correspond to reality, consumers lose interest in this service of the company. The company loses customers and reduces its competitiveness.

It is necessary to allocate the following directions of increase of competitiveness of the company in the sphere of medical tourism:

1. development of loyalty programs for the company's clients
2. development of diagnostics, treatment and recovery programs based on innovations in medicine.

Innovation in medicine is one of the few things that can change the way customers relate to a company. Globally, there is an increase in the number of people suffering from chronic diseases that our healthcare is not yet able to cope with. The only way to deal with these diseases is to improve current healthcare practices, to focus more on monitoring, which in turn will help us to be more prepared for anything we may encounter.

"Global Innovation Index 2019, the diffusion of innovation in healthcare tends to be slower than in other sectors of the economy. Sometimes it takes decades to move from the laboratory research stage to the implementation of solutions available to the patient. This is due to the structural complexity of the healthcare innovation ecosystem and the conflicting incentives of interested partners [6].

The national innovation system of our country is characterized by a high role of the state in the development of innovations. Instruments of state support for innovation in the Russian Federation are conventionally divided into two groups: grants and subsidies to specific companies (direct support) and the creation of conditions, institutions, incentive mechanisms, support of various funds that improve the environment for the development of innovations in the field of medicine and health improvement, i.e. form favorable innovation ecosystems. When creating innovative companies, direct support is less effective, but it is more preferable for maintaining high growth rates of medium and large companies.

It should be noted that the range of innovation support instruments has been gradually expanding in recent years. For example, support for private high-tech enterprises has been implemented since 2016, tax incentives for R&D in the field of medicine were expanded in 2017, and from 2018 the tax on movable property was cancelled.

Instruments such as innovation certificates (vouchers) for small and medium-sized high-tech companies to pay for medical R&D services, which, in fact, represent an investment from the state to carry out innovative activities in companies, are also being introduced into
the practice of supporting innovative activities in the field of medicine and public health improvement [7].

An important support measure is to create demand for domestic medical innovation products by giving priority in public procurement of products (based on the introduction of relevant legislative amendments).

One of the main documents defining the goals and objectives of the development of the national innovation system of the Russian Federation is the Strategy for Innovative Development until 2030. The analysis of the fulfilment of the targets set by the strategy is presented in Table 1.

Table 1. Analysis of the fulfilment of the targets set by the Strategy for Innovative Development until 2030.

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<tbody>
<tr>
<td>Inventive activity coefficient, %</td>
<td>2,01</td>
<td>1,85</td>
<td>2,00</td>
<td>2,00</td>
<td>1,65</td>
<td>2,00</td>
<td>1,83</td>
<td>1,55</td>
<td>1,7</td>
<td>1,59</td>
<td>1,6</td>
<td>2,8</td>
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<tr>
<td>Share of organizations implementing technological innovations, %</td>
<td>7,9</td>
<td>8,9</td>
<td>9,1</td>
<td>8,9</td>
<td>8,8</td>
<td>8,3</td>
<td>7,3</td>
<td>20,8</td>
<td>19,8</td>
<td>21,6</td>
<td>23,0</td>
<td>25</td>
</tr>
<tr>
<td>Share of innovative goods, works and services in the total volume of exports of goods, works and services of industrial organizations, %</td>
<td>4,5</td>
<td>8,8</td>
<td>12,1</td>
<td>13,7</td>
<td>11,5</td>
<td>8,9</td>
<td>8,4</td>
<td>7,1</td>
<td>6,6</td>
<td>5,2</td>
<td>6,2</td>
<td>15</td>
</tr>
<tr>
<td>Share of expenditures on technological innovations in the total volume of expenditures of industrial production organizations, %</td>
<td>—</td>
<td>1,5</td>
<td>1,8</td>
<td>2,2</td>
<td>2,1</td>
<td>1,8</td>
<td>1,7</td>
<td>1,5</td>
<td>1,6</td>
<td>1,9</td>
<td>2,5</td>
<td></td>
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<tr>
<td>Share of innovative goods, works and services in the total volume of shipped goods, works and services of industrial production organizations, %</td>
<td>4,9</td>
<td>6,1</td>
<td>7,8</td>
<td>8,9</td>
<td>8,2</td>
<td>7,9</td>
<td>8,4</td>
<td>6,7</td>
<td>6,0</td>
<td>6,1</td>
<td>6,4</td>
<td>25</td>
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<tr>
<td>Share of innovative goods, works and services new for the sales market of organizations in the total volume of shipped goods, works and services of industrial production organizations, %</td>
<td>0,8</td>
<td>0,6</td>
<td>1,1</td>
<td>1,1</td>
<td>0,9</td>
<td>1,0</td>
<td>1,3</td>
<td>0,9</td>
<td>0,6</td>
<td>0,9</td>
<td>0,6</td>
<td>8</td>
</tr>
<tr>
<td>Domestic expenditure on research and development, % of GDP</td>
<td>1,13</td>
<td>1,02</td>
<td>1,03</td>
<td>1,03</td>
<td>1,07</td>
<td>1,10</td>
<td>1,10</td>
<td>1,11</td>
<td>1,04</td>
<td>1,1</td>
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The data of Table 1 show that all the efforts of the state related to the implementation of the strategy of innovative development of the Russian Federation did not provide the expected success. At the end of 2022, most of the target indicators are far from the norms established by the Strategy. The result of implementation indicates the possible presence of systemic miscalculations in the formation of mechanisms of state support, stimulation and
development of innovation activity. Low indicators of the Strategy implementation indicate the need to revise approaches to its implementation, to conduct a detailed analysis of the methods and tools used for their quality and efficiency.

The Global Innovation Index 2022 places Russia in the group of countries with GDP per capita above average, and it ranks 6th out of 34 countries in this group. At the same time among 39 European countries Russia took only the 32nd position.

The results of the rating for 2022 allow us to highlight the key advantages of the innovation system of the Russian Federation:

1. Science and human capital (30th position in the ranking): higher education enrolment rate (17), engineering and science graduates (15), student-teacher ratio in secondary education (15).

2. Level of development of the business sector (42nd position): payments for the use of intellectual property (17), employees engaged in the production of knowledge-intensive services (18), employment of women with scientific degrees (10).

3. Development of the knowledge and technology economy - an indicator reflecting the efficiency of innovation results - (50th position): number of patent applications (17) and utility model applications (5).

Among the positive factors of the national innovation system, the level of competition and trade (11th place) and the size of the country's domestic market (6) are also noteworthy.

Negative impact on the overall efficiency of the innovation system according to the results of the rating is caused by:

1. State institutions (74th position): rule of law (114), quality of regulatory impact (105).

2. Economic infrastructure (60th position): compliance of environmental management with the ISO 14001 quality standard (106), environmental stability (101), GDP per unit of energy expenditure (115).

Other shortcomings of the national innovation system that determine Russia's low positions in the above rating include: compliance of management systems with the requirements of ISO 9001 quality standards (105), availability of microfinancing (77), a group of indicators of innovation results in ICT and medicine, creation of business models (91), development of mass media (78) and others.

Over the period of 2012-2022, the Russian Federation has managed to significantly increase the level of NFP capacity. The Russian Federation managed to significantly increase the level of NIS potential compared to other countries of the world, improving its position in the Global Innovation Index from 64th to 47th place. However, in recent years, there has been a trend towards a slowdown in the growth rate of key innovation indicators, including in the medical sector. Comparative analysis shows that Russia still lags behind both developed and many rapidly developing countries in most indicators characterizing the efficiency of resource use and the degree of impact of the results of innovation and scientific and technological activities in the medical sphere.

At present, such innovative technologies as big data, artificial intelligence, telemedicine promise new methods of prevention, diagnosis and treatment of diseases. The main purpose of innovation in medical tourism is to increase its efficiency, and the question of measuring the impact of innovation on the quality of medical services inevitably arises.

Artificial Intelligence (AI) market, particularly the application of the technology in medicine will reach $28, 24bn in 2024.

Various Artificial Intelligence oriented technologies such as computer vision, analysis processing, detection of congenital diseases, treatment of neurological and psychosomatic disorders, application of implantable devices and prostheses, bioprinting, implementation of insulin port will be actively introduced in medicine.
Let's consider some innovations that can be used in medicine. These can then be used in shaping medical tour offerings [10-14].

In medicine, DNA sequencing is a laboratory method used to decipher the genetic code. Scientists determine the sequence of chemical compounds that form the DNA chain - nucleotides A, G, C and T. Behind them lies information about the life of the organism and the nature of genetic diseases.

The Portable Nanopore Sequenator is an innovation that fits in the palm of your hand. Its small size hides powerful sequencing capabilities. A DNA molecule passes through the device's nanoscale protein pores and is read in real time.

Software synchronized with the nanopore sequencer processes the data:
- assesses the quality of the information;
- looks for and corrects errors;
- analyses and assembles the genome.

Developers are constantly updating the system, creating new engineered proteins to analyze. According to the results of some studies, the accuracy of the latest systems can exceed 90%.

Despite its fundamental nature, the genome can change. The CRISPR-Cas9 system is used as genetic "scissors". The innovation was prompted by bacteria. They need the CRISPR system to protect themselves from foreign genetic material. Cas9 nuclease is capable of cleaving the DNA strand that a hostile virus introduces into the cell.

Scientists have improved the system and made it more specific. CRISPR-Cas gives rise to many scientific experiments, such as changing gene activity or adding sites. Genome editing makes it possible to create new cell lines or genetically modified animals. Laboratory models are needed in medicine to understand the mechanisms of human disease.

Another innovation is virtual and augmented reality technology for the treatment of neurological and psychosomatic disorders.

Virtual Reality (VR) and Augmented Reality (AR) make it possible to simulate various situations in medicine. Using head-mounted devices and three-dimensional projections, doctors and patients are immersed in a virtual world. There, a suitable solution for diagnosis and therapy can be found.
The points of contact between innovation and medicine are meeting more and more frequently:
- Treatment of chronic and phantom pain;
- improving the attention and memory of patients with neurological diseases;
- help with psychiatric disorders: anxiety, depression, phobias, eating disorders.

VR technology is a visual textbook and a convenient simulator for medical students. Three-dimensional anatomical models make you feel like a real researcher: you can rotate the virtual organ and change its scale. The innovation helps future surgeons to hone their skills. Before working with real patients, they can meet with virtual patients to improve communication skills and practice emergency care techniques.

The next innovation is implantable devices and prosthetics.
Medical implants are devices or tissues that are placed inside or on the surface of the body. Implants have long been used in medicine for a variety of purposes, from controlling bodily functions to replacing a missing body part.

The field of patient-specific devices (PSD) is exploring methods of making customized implants. These products take into account the anatomical features of the patient and provide an acceptable aesthetic result. PSD development is closely linked to additive manufacturing. The implant model is first created on a computer using CT and MRI images of the patient and then printed on a 3D printer.

Even more ideas for innovation come from wireless technology. Implants transmit information about the processes inside the body to a computer. Orthopaedic prostheses are incorporating pressure sensors to learn more about joint movement. Implantable sensors are being developed to assess cardiovascular parameters. In neurosurgery, prototypes are emerging that transmit brain activity data over Wi-Fi.

In the field of medical innovations in prosthetics, the US start-up Cast21 can be singled out. It has designed an orthosis that fits perfectly to any hand. The Cast21 orthosis takes the shape of the corresponding hand once it is filled with a patented gel that hardens over time. Doctors choose the size of the "sleeve" depending on whether the patient is a child or an adult. This sleeve is then placed on the arm and filled with a proprietary compound that turns into a malleable gel after a period of time. The doctor can then adjust (mold) the gel so that it surrounds the limb perfectly, giving it the support it needs. Patients can even choose the color of the gel, selecting combinations and gradients, providing an opportunity to get rid of the traditional stigma associated with a cast. The gel hardens through an exothermic reaction, warming the arm as the orthosis begins to take shape.

Another innovation in medicine is bioprinting. Bioprinting is the creation of organs and tissues to replace damaged or lost ones. The innovation is based on 3D printing methods. Special bionics and biopaper are used for printing. They are created from viable cells, biomaterial and biological molecules.

To create a tissue or organ model, CT and MRI images of the patient are loaded into the program. Cells are then isolated, biomaterial is selected and bionics are created. The printed structure matures in a bioreactor. Bioprinting is used in several areas of medicine: in transplantation, drug discovery and research.

The innovation has helped create tissue structures for many body systems. Scientists are experimenting with nerve cells, printing blood vessels, and growing bone and cartilage fragments for plastics for injuries and fractures.

A very important innovation needed by millions of people with diabetes is the smart insulin port.

Mitul Lad and Cambridge Consultants have developed the concept of a smart insulin port attached to the skin that can deliver the right dose of medicine at the right time. All control of the device and analysis of data from the sensor on the skin is handled by an app, which allows control of insulin administration, taking into account blood sugar levels, timing of
medication and health status. Kite is designed for type 1 diabetics and, thanks to the insertion of a soft cannula, replaces the familiar process of daily multiple injections. The device automatically dispenses an accurate dose of insulin and will cost significantly less than the current sugar monitoring and insulin injection systems on the market.

An important innovation in the field of cardiology is Kardia.

Kardia is a miniaturized six-channel electrocardiograph that works in conjunction with an app to give the user the ability to monitor the heart. Simple in design, with two textured finger touch pads, the device takes readings and the app processes and visualizes the data. It only takes 30 seconds to take measurements, after which the user receives medical-grade ECG data.

The device provides information about the electrical activity of the heart, helping to identify arrhythmias and diagnose heart conditions including bradycardia and tachycardia.

Just as the thermometer became a household medical product, followed by the blood sugar glucometer, Kardia aims to become the next household medical device that helps people monitor their heart health [10].

The healthcare sector has a special specificity in terms of the nature of services provided. Therefore, when analyzing the efficiency of a medical organization, it is important to take into account not only the commercial effect, but also the social responsibility of these organizations. Not only profit is important, but also the availability of services provided to the population. Their quality level should meet modern standards, and financial conditions should be acceptable to patients.

Automated collection of data on patients combined with the convenience of telemedicine provides a more complete assessment of their health status. Fewer trips to the doctor, easier surgeries and faster diagnosis improve the quality of treatment. Thus, digital technologies create great opportunities to facilitate access and provide quality patient care, and reduce overall health care costs.

Currently, such innovative technologies as big data, artificial intelligence, telemedicine promise new methods of prevention, diagnosis and treatment of diseases. The main purpose of innovations in medical tourism is to improve its efficiency, and the question of measuring the impact of innovations on the quality of medical services inevitably arises.

The artificial intelligence (AI) market (Fig. 1), in particular, the application of the technology in medicine will reach $28, 24 million in 2024 [9].

Various AI-oriented technologies such as computer vision, analysis processing, detection of congenital diseases, treatment of neurological and psychosomatic disorders, application of implantable devices and prostheses, bioprinting, implementation of insulin port will be actively introduced into medicine.

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The intensification of health innovation in response to the COVID-19 pandemic has helped to boost innovation in the medical and rehabilitation sector [15, 16].

The development of a medical cluster is becoming popular, which will bring innovation to medical tourism.
An innovative direction is the creation of a medical cluster for the development of medical tourism.

The synergetic effect of the medical cluster will have a positive impact on the activities of a commercial medical organization. An example of a medical cluster is the complex of medical clinics, educational and interdisciplinary research centers being built in Moscow on the territory of the Skolkovo Innovation Centre (the first object of the cluster has already been built, the construction will be completed by 2029).

The World Health Association predicts that the annual turnover of the medical tourism is 600 billion dollars. Medical outbound tourism of Russians occupies only 1% of the country's outbound tourist flow. (Fig. 2.)

Medical tours are sold by no more than 10 tour operators. Nevertheless, medical tourism is considered to be a new and actively developing area.

According to the unified international ranking of countries on medical tourism (Medical Tourism Index), the ranking is headed by Canada, Singapore and Japan. The top ten also includes Spain, UAE, Israel, Costa Rica and others. In this rating, Russia ranks 34th out of 41 countries in terms of the volume of medical tourism services provided.

At the same time, according to UNWTO, Russia ranks fifth in the world in terms of attractiveness of medical and health tourism. However, in terms of realization of this potential it is only 59th.

From the data provided by the Expert Analytical Centre of the Russian Federation, it follows that the majority of inbound medical tourists in Russia are patients of the UIS countries (80%), as well as the near abroad (China). The Central Federal District was the leader in terms of the number of foreign patients (44%), followed by the Urals Federal District (15%) and the Volga Federal District (10%).

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**Fig. 2.** Outbound tourism market size, in%.
Source: built according to the data of the Federal State Statistics Service URL: https://rosstat.gov.ru (date of the application: 28.12.2023) [17].

On average, about 44% of foreign patients come to Russia annually to receive dental care. The next most popular are such areas as gynecology and urology (25%); plastic surgery (10%); ophthalmology (10%); cardiology (5%).

The main directions of medical tourism in Russia can be considered to be:
- dentistry;
- ophthalmology;
- stem cell treatment;
- oncology;
- cosmetic and elective surgery traumatology/orthopedics cosmetology;
- treatment of rare diseases;
- cardiac surgery;
- transplantology.

Medical tourism has already practically lost its seasonality, and the range of prices will satisfy the demands of any consumer: from 3-4 thousand for three "stars" to 9-12 for five "stars". With the application of innovations in the field of medicine, the attractiveness of organizations that offer innovative products will grow significantly and attract new customers.

Of course, quality control in the sphere of medical tourism is ensured by the Ministry of Health of the Russian Federation on the basis of regular sociological monitoring of the quality and distribution of medical tourism services in the country.

For medical tourists, one of the main indicators of the quality of medical care is whether a clinic has a Joint Commission International (JCI) certificate. This is a quality standard in the field of medical services, which is issued to clinics that have been audited for compliance with modern clinical requirements. For comparison, this certificate has in Saudi Arabia - 96 organizations, in China - 57, in Brazil - 63, in India - 36, in Japan - 31, in Turkey - 31, in South Korea - 11, in Russia so far only five clinics, of which only one is state-owned. Clinics that are expecting a foreign tourist must pass this certification [18].

However, the difficulties that have arisen in foreign policy make it impossible to continue this practice of standardization. Therefore, the JCI international quality standard should be replaced by the quality standards of countries friendly to Russia. The basic parameters for evaluating an institution should be:
- quality of rendered medical services and its stability;
- their safety for patients and staff of the institution.

It should be noted that the development of medical tourism is becoming an urgent task and an important tool for improving the health of the nation as a whole.

3 Conclusions

The modern approach to building customer service in medical tourism implies multi-channel interaction between the consumer and the innovative product. The results of the application of innovative products and services to improve the competitiveness of the organization of medical tourism sphere are:
- elimination of barriers of interaction of clients with service in the sphere of medical tourism;
- introduction of medical innovations taking into account the business processes of the company;
- introduction of an international system of standardization of the quality of medical services in countries friendly to Russia;
- increase in overall customer satisfaction in the sphere of medical services.

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