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ANALYSIS OF PATENT ACTIVITY IN RE KAVETSKY INSTITUTE OF EXPERIMENTAL PATHOLOGY, ONCOLOGY AND RADIOBIOLOGY OF THE NAS OF UKRAINE

Introduction. *The effectiveness of innovation activities of R&D oncology institutions is determined by the level of legal protection of intellectual property and affects the degree of implementation of research results in health care practice.*

Problem Statement. *Combatting cancer is one of the most important medical and social problems of our time and progress in solving it can be achieved through the use of fundamental knowledge as a significant source of innovation.*

Purpose. *To assess the status of patent and inventory activities of the RE Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology of the National Academy of Sciences of Ukraine (IEPOR) in terms of the formation of strategic management decisions concerning its optimization.*

Materials and Methods. *The main quantitative indicators of patent and invention of the IEPOR for 2009—2017, in particular, the number of applications and the number of patents issued; the index of patents of various types (for inventions, utility models, industrial designs) obtained; and rating of patent activities by the IEPOR departments have been evaluated. On the basis of the quantitative analysis and analysis of the international patent classification (IPC) of IPR objects, the orientation of the IPR objects by themes and subjects has been studied.*

Results. *The peaks of patent activities were reported for 2010 (13 objects of IPR), 2013 (17 objects of IPR), and 2016 (12 objects of IPR). Data analysis for 2009—2017 on the received patent documents of various types has shown the priority of declarative patents for utility model.*

The patenting rating for 2009—2017 by the IEPOR research departments shows a different level of patent activities of researchers. A characteristic feature of the development of patent and invention of researchers is the thematic orientation of the objects of IPs in full accordance with the main directions of the research work of the institute.

Conclusions. *The indicators of patent activities show a high level of the scholarly research activities and innovative potential of the institute and are an informative basis for the formation of strategic management decisions regarding the optimization of patent and invention activities.*

Keywords: patent activity, objects of intellectual property rights, invention activity, innovative potential, information support, and experimental oncology.

Combatting oncological diseases is one of the most pressing medical, biological, and socio-economic problems of health care in Ukraine. Progress in the field of practical oncology, as well as in medicine, can provide a new paradigm for the use of fundamental knowledge as the most important resource of innovation policy. Innovative processes in experimental oncology shall be deemed a priority in the development of oncological medical science and practical health care, while the

legal protection of intellectual property, in particular, the results of R&D works, shall be considered a key factor in this process. The effectiveness of innovation activity depends, to a large extent, on implementing results of oncological R&D institutions in the health care practice. At the same time, many problems of researchers are associated with a certain imperfection of the legislative framework in the field of intellectual property [4, 6] and the system of intellectual property rights management, the lack of innovative management and technology transfer of R&D results, underdeveloped market of intellectual property rights objects (IPRO), insufficient funding of R&D institutions from the national budget, and with the lack of experience in and systematic approach to studying the mentioned problems in research institutions [10].

One of the factors that gives significant competitive advantages to inventors is patenting and introduction of their inventions into practical oncology, with the number of applications submitted and patents registered being an important indicator of effectiveness of inventive activities. The global demand for patent assertion of inventions is increasing year by year and attracting more financial and human resources to protect intellectual property rights, in line with ascending dynamics of international technology transfer [22].

Patent statistics, along with such a common indicator of R&D activity as publication activity, is a tool that enables to assess the technological results of R&D activity. Recent studies have indicated that statistical analysis of patent activity is a common method for assessing the effectiveness of R&D activities in domestic and foreign R&D institutions [1, 14], as well as a means of assessing innovation. Methodological issues of the use of statistical analysis of patent and licensing activities have been widely reported in foreign [15—17] and domestic research [4, 7, 9].

Thus, the British *Research Assessment Exercise* program evaluates the effectiveness of national universities in terms of IPRO every four years and, based on the current ranking, provides them with appropriate funding [19]. The Australian Government has been implementing the Research Quality Framework program to assess the effectiveness of organizations, research laboratories, and individual researchers based on meta-analysis of University Repositories and *Thomson Scientific* indicators [15, 18, 20, and 21].

Due to its advantages, the analysis of patent and invention has been successfully used to determine the effectiveness of R&D activity:

- ease of use, since most patent data is public and available for analysis;
- expert evaluation of the patent applications (for novelty and technical level), which increases the competitiveness of the proposed innovations, and therefore, patent indicators can be used as a basis for future commercial proposals;
- the possibility of comparison with international patent statistics through standardizing the patent law;
- the number of patents is an effective indicator of the performance of applied research and development [3].

Despite the commonly known disadvantages (investments and high labor inputs required for preparing the patent application), patent statistics have optimistic prospects in terms of economic and commercial potential of innovations. Patent analysis is also useful in determining the prospects for technology development and competitiveness in certain areas of activities in various countries. The formation of national strategies oriented towards advanced technologies is impossible without taking into account the results of patent analysis, which can also be used to form a model for the development of the market for new technologies [16, 22].

The development and implementation of new IPRO in the field of experimental oncology promotes ensuring an advanced level of solving clinical diagnosis problems, improves the means and approaches to the prevention of cancer, the treatment of patients with malignant neoplasms, and the improvement of the quality of life of patients. Therefore, the implementation of IPRO of the

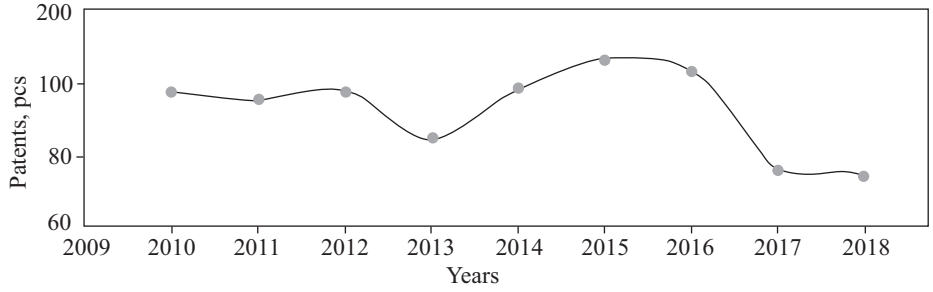

Fig. 1. Total number of IPROs held by IEPOR of the NAS of Ukraine in 2010—2018

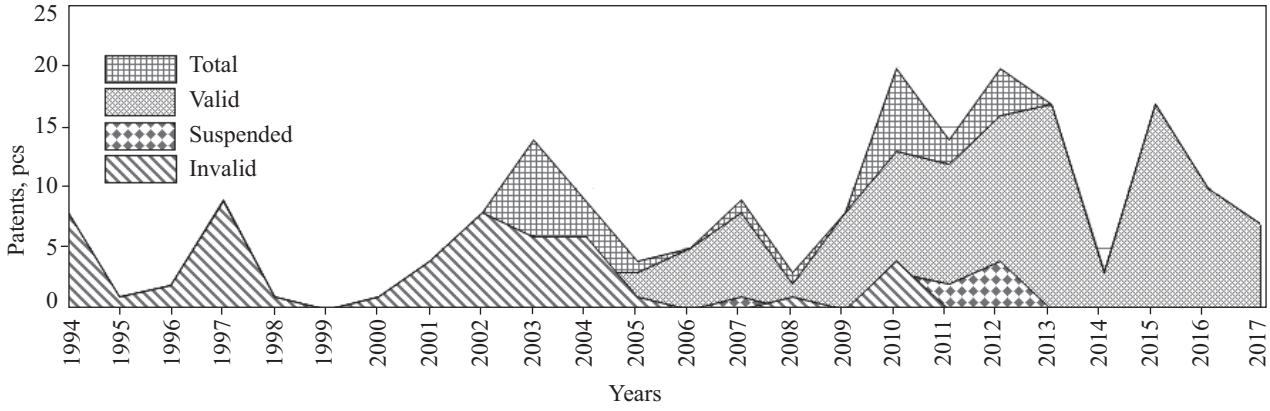

Fig. 2. Number of patents obtained and their status (1994—2017)

RE Kavetsky Institute of Experimental Pathology, Oncology, and Radiobiology of the NAS of Ukraine (IEPOR) in the field of experimental pathology, molecular biology, biotechnology, clinical oncology, the development of methods of early and differential diagnosis, and the treatment of patients with malignant tumors based on achievements of modern science is extremely relevant.

The aim of this research is to assess the status of the IEPOR patent-and-inventive activities in order to make strategic management decisions on their optimization.

The patent information research is based on the results of a search in specialized database *Inventions (Utility Models) in Ukraine* of the Ukrainian Institute of Industrial Property (*Ukrpatent*) for the period of 2013—2017. The keywords in IPRO names are "cancer treatment", "cancer diagnosis", "cancer prediction", and "cancer prevention", as well as the names of the leading oncological institutions. The materials of the IEPOR patent and inventive activities (2013—2017) have been analyzed on the basis of annual reports for the NAS of Ukraine. The main quantitative indicators of patent activity (the number of applications for patents of all types and the number of issued protective documents by the patent offices; the number of obtained protective documents of various types (for inventions, utility models, and industrial designs); patenting rating by research departments of IEPOR) have been assessed. Based on the results of the abovementioned quantitative analysis and the analysis of IPRO IPC, the thematic orientation of IPRO has been studied.

According to the Ukrainian Institute of Intellectual Property [13], the total number of patents issued in Ukraine in the field of oncology for the period of 2012—2016 has been analyzed. As a result of search, 328 patents (52 patents for inventions (16%) and 276 for utility models (84%)) have been found. Among the thematic areas on

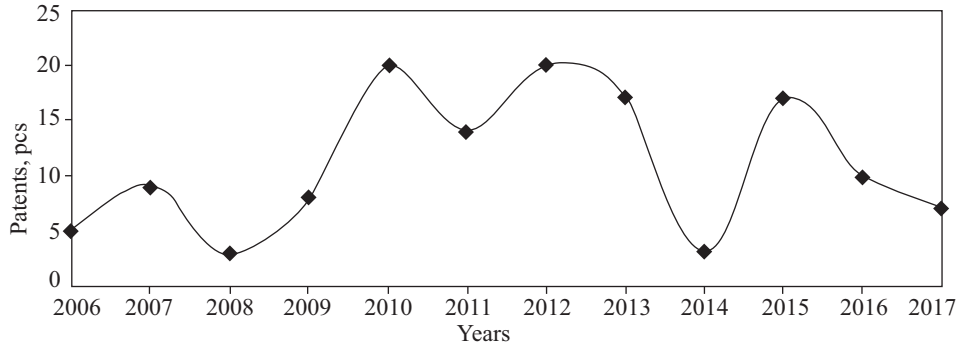

Fig. 3. Overall patent activity of IEPOR of the NAS of Ukraine in 2006—2017

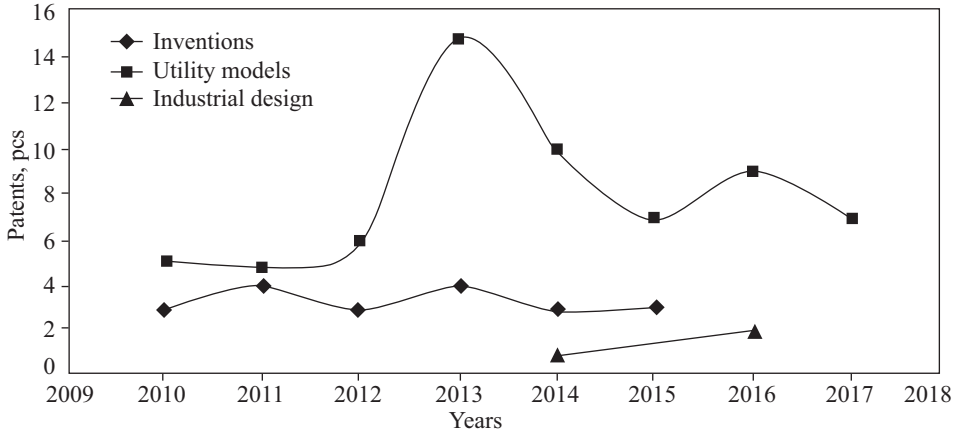

Fig. 4. Types of IPROs obtained by IEPOR of the NAS of Ukraine in 2010—2017

which researchers have been focusing their efforts are as follows: methods for treatment of patients with oncological diseases: 211 patents (64%); diagnostic methods: 94 (28.6%); methods for prediction of the course of the disease: 16 (5%); methods and means of prevention: 7 (2.4%). It should be noted that among the patents for improving the treatment of cancer patients almost all inventions (47 patents) belong to foreign applicants who represent 12 countries; the majority of them is registered in the USA (52%) [11]. The given data testify to a high relevance of studying the problem of malignant neoplasms, and the various departmental subordination means that both fundamental science and clinical institutions have made their contribution to developing medical innovations in the field of oncology [23].

The IPRO assertion documents are the patent for invention, the patent for utility model, the patent for industrial design, and the certificate for goods/services mark [8]. The analysis of IEPOR patent activity that results in the creation of IPRO, in particular, inventions, utility models, industrial designs, innovation proposals, marks for goods and services, has shown that in 2010—2018, the IEPOR intangible assets include an average of 93 IPROs annually (Fig. 1). At the same time, the patent activity of researchers reached its peak in 2015 and 2016, when 107 and 104 IPROs, respectively, were accounted in the institute's portfolio. As of 2018, 74 IPROs are kept valid.

The number of applications submitted to *Ukrpatent* and the number of IPR assertion documents issued to IEPOR in 1994—2017 has been shown to be identical, which means a success in formal and qualification examinations and positive decision on the issuance of IPR assertion documents.

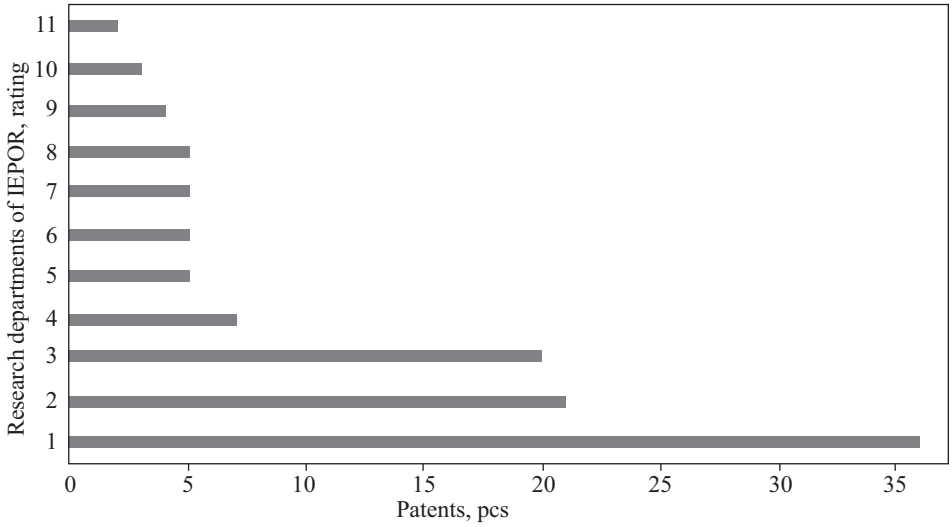

Fig. 5. Patent activity of research departments of IEPOR of the NAS of Ukraine in 2010—2017

Fig. 2 illustrates the dynamics of quantitative indicators of IPR assertion documents received by IEPOR for the period of 1994—2017. According to the mentioned data, peaks in the patent activity determined by the number of applications submitted and the number of corresponding documents received were reported in 2010, 2013, and in 2016. In 2010, the Institute received 13 IPRO, including 4 patents for invention, 8 patents for utility model, and 1 patent for industrial design; in 2013, IEPOR obtained 17 IPRO, and in 2016, it got 12 assertion documents, including 3 patents for invention, 6 patents for utility models, 2 patents for industrial designs, and 1 certificate for trade/service mark.

In 2010 and 2013, the validity of 4 IPRO were invalidated and terminated as a result of the expiration of patents. The most notable decline in the patent activity was observed in the 1998—2000.

In 2013—2017, there was reported an increase in the patent activity of the IEPOR researchers, as the number of patent applications related to the results of R&Ds funded from the general fund grew by an average of 11.6% annually.

At the end of 2017, the Institute's intangible assets comprised 76 IPRO, including 20 patents of Ukraine for invention, 41 patents for utility models, 3 patents for industrial designs, 1 certificate for trade/service mark, and 6 work-for-hire (WFH) copyright registration certificates.

The dynamics of IEPOR patents in 2006—2017 based on annual reports on the creation and use of intellectual property right objects (Fig. 3) show that since 2008, there has been observed an ascending trend in patenting the IEPOR R&D results (except for a slight decrease in 2011 and 2014), especially, in 2012 (an increase by 15%) and in 2015 (an increase by 11%). Peaks in the patenting correspond to the years of completion of R&D projects in most research departments and, consequently, to obtainment of results that have a high innovation capacity and need to be put into oncology practice (technology transfer) or to be further developed in special research [12].

The analysis of data on IPR assertion documents of various types (patents for inventions, utility models, and industrial designs) received in 2010—2017 (Fig. 4) has demonstrated a prevalence of the declarative patents for utility models, which, for example, in 2014, exceeded almost four times the patents for invention, primarily, because of the differences in the procedure for obtaining patents (formal examination versus substantive examination, respectively). Also, during this

period, the Institute received 6 copyright certificates and 1 certificate for trade/service mark (2016).

The patenting rating for 2010—2017 by IEPOR research departments (Fig. 5) has shown the different level of patent activity (number of received IPROs) of R&D staff from different structural units. Significant differences in the number of received IPR assertion documents can be used as an informative basis for making objective managerial decisions.

The overwhelming majority of IEPOR patents has the same IPC classification [5], which means that the obtained IPROs belong to the same class, division, group, subgroup, and subject matter (experimental and clinical oncology). Based on the quantitative analysis and analysis of IPRO IPC, it has been established that the characteristic feature of the patent and inventive activities of IEPOR researchers correspond to the main lines of the Institute's activities, in particular:

- identifying markers of malignant transformation for the purpose of early and differential diagnosis and prognosis of the course of the disease;
- identifying biological properties of tumor cells and their microenvironment factors;
- developing biotechnological and sorption drugs for pharmacological correction of metabolic processes of tumor disease;
- developing approaches to targeted therapy based on the use of nanoparticles and nanocomposites;
- developing effective means for preventing malignant neoplasms on the basis of the study of the molecular genetic mechanisms of tumor disease;
- pathogenetic influence of carcinogenic environmental factors, etc.

The patent activity of IEPOR researchers aims at protecting the results of intellectual work on the development of new methods of diagnosis, prevention of malignant neoplasms and treatment of patients with oncological pathology.

Another way of evaluating the patent activity of the Institute in terms of the creation and use of inventions and utility models is to hold the annual competition of inventive works and IPRO assertion among the academic institutions. According to the results of the competition, annually, the top ten inventors get the *Inventor of the Year of the National Academy of Sciences of Ukraine* title. The activities are evaluated using 17 differentiated indicators, with points scored for each. Based on the score, R&D institutions in every Department of the National Academy of Sciences of Ukraine and in the National Academy of Sciences of Ukraine as a whole are rated. Another significant achievement is the *Honored Inventor of Ukraine* title awarded to the 12 best inventors of the National Academy of Sciences of Ukraine.

Every year, IEPOR researchers take part in the *Inventor of the Year of the National Academy of Sciences of Ukraine* contest. In 2014, according to the Resolution of the Presidium of the NAS of Ukraine No. 119 dated May 21, 2014, on the Results of the Contest of the Institutes of the NAS of Ukraine for the Best Indicators of the Inventive Work, and the Creation, Assertion, and Use of Intellectual Property Rights Objects and for the *Inventor of the Year of the National Academy of Sciences of Ukraine* Title in 2013, IEPOR was the first prize winner among the institutes of the Department for Biochemistry, Physiology, and Molecular Biology of the NAS of Ukraine. In 2015, IEPOR won the second prize among the institutes of the Department for Biochemistry, Physiology, and Molecular Biology of the NAS of Ukraine and the third prize, in 2016.

Hence, in this research there have been given the data on patent activity of RE Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology of the NAS of Ukraine (the total number of patents received in 1994—2017); the dynamics of patenting (for the patents received in 2006—2017); breakdown of IPROs by different types (2010—2017); and breakdown of the patent activity by IEPOR research units). This information testifies to effective and fruitful R&D activities of the Institute, high innovative poten-

tial of developments and can be used as basis for making objective managerial decisions.

It has been established that the characteristic feature of IEPOR patent and inventive efforts is the thematic orientation of IPROs that correspond to the main lines of the Institute's activity. In other words, they aim at protecting the results of intellectual works on the development of new methods of diagnosis, approaches to the prevention of malignant neoplasms, and methods for treatment of patients with oncological pathology.

A high level of R&D, patent and inventive activities of the Institute and its researchers has been confirmed by winning prizes of the *Inventor of the Year of the National Academy of Sciences of Ukraine* nationwide contests both by individual researchers and by IEPOR of NAS of Ukraine as member of the Department for Biochemistry, Physiology, and Molecular Biology of the NAS of Ukraine.

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АНАЛІЗ ПАТЕНТНОЇ АКТИВНОСТІ В ІНСТИТУТІ ЕКСПЕРИМЕНТАЛЬНОЇ ПАТОЛОГІЇ, ОНКОЛОГІЇ І РАДІОБІОЛОГІЇ ІМ. Р.Є. КАВЕЦЬКОГО НАН УКРАЇНИ

Вступ. Ефективність інноваційної діяльності онкологічних наукових установ визначається рівнем правового захисту інтелектуальної власності та впливає на ступінь впровадження результатів наукових досліджень в практику охорони здоров'я.

Проблематика. Подолання онкологічних захворювань — одна із найважливіших медико-соціальних проблем сучасності, прогрес у вирішенні якої може бути досягнутий шляхом використання фундаментальних знань як вагомих ресурсів інновацій.

Мета. Оцінка стану патентно-винахідницької діяльності Інституту експериментальної патології, онкології і радіобіології ім. Р.Є. Кавецького НАН України (ІЕПОР) для формування стратегічних управлінських рішень щодо її оптимізації.

Матеріали й методи. Оцінено основні кількісні показники патентно-винахідницької діяльності ІЕПОР за 2009—2017 рр., зокрема, надходження заявок та кількість виданих патентів; отриманих патентів різних видів; рейтинг патентування за підрозділами ІЕПОР. На основі кількісного аналізу та аналізу міжнародної патентної класифікації об'єктів права інтелектуальної власності (МПК ОПІВ) досліджено тематичну спрямованість ОПІВ.

Результати. Найбільша патентна активність відмічена у 2010 (13 ОПІВ), 2013 (17 ОПІВ) та 2016 (12 ОПІВ) рр. Аналіз даних за 2009—2017 рр. щодо отриманих охоронних документів різних видів виявив пріоритетність деклараційних патентів на корисну модель.

Рейтинг патентування за 2009—2017 рр. за науковими підрозділами ІЕПОР свідчить про різний рівень патентної активності науковців. Характерним у розвитку патентно-винахідницької діяльності науковців є узгодженість тематики ОПІВ з основними напрямами дослідної роботи установи.

Висновки. Показники патентної активності свідчать про високий рівень результативності наукової діяльності установи та інноваційний потенціал розробок і є інформаційним підґрунтям для формування стратегічних управлінських рішень щодо оптимізації патентно-винахідницької діяльності.

Ключові слова: патентна активність, об'єкти права інтелектуальної власності, винахідницька діяльність, інноваційний потенціал, інформаційний супровід, експериментальна онкологія.

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АНАЛИЗ РЕЗУЛЬТАТОВ ПАТЕНТНОЙ АКТИВНОСТИ В ИНСТИТУТЕ ЭКСПЕРИМЕНТАЛЬНОЙ ПАТОЛОГИИ, ОНКОЛОГИИ И РАДИОБИОЛОГИИ им. Р.Е. КАВЕЦКОГО НАН УКРАИНЫ

Введение. Эффективность инновационной деятельности онкологических научных учреждений определяется уровнем правовой защиты интеллектуальной собственности и влияет на степень внедрения результатов научных исследований в практику здравоохранения.

Проблематика. Преодоление онкологических заболеваний — одна из важнейших медико-социальных проблем современности, прогресс в решении которой может быть достигнут путем использования фундаментальных знаний как весомых ресурсов инноваций.

Цель. Оценка состояния патентно-изобретательской деятельности Института экспериментальной патологии, онкологии и радиобиологии им. Р.Е. Кавецкого НАН Украины (ИЭПОР) для формирования управленческих решений по ее оптимизации.

Материалы и методы. Оценены основные количественные показатели патентно-изобретательской деятельности ИЭПОР за 2009—2017 гг., в частности — подача заявок и количество выданных патентов; полученных патентов различных видов; рейтинг патентования по подразделениям ИЭПОР. На основе количественного анализа и анализа международной патентной классификации объектов права интеллектуальной собственности (МПК ОПИС) исследована тематическая направленность ОПИС.

Результаты. Наивысшая патентная активность отмечена в 2010 (13 ОПИС), 2013 (17 ОПИС) и 2016 (12 ОПИС) гг. Анализ данных за 2009—2017 гг. по полученным охранным документам различных видов выявил приоритетность декларационных патентов на полезную модель.

Рейтинг патентования за 2009—2017 гг. по научным подразделениям ИЭПОР свидетельствует о разном уровне патентной активности ученых. Характерным в развитии патентно-изобретательской деятельности ученых является согласованность тематики ОПИС и основных направлений исследовательской работы учреждения.

Выводы. Показатели патентной активности свидетельствуют о высоком уровне результативности научной деятельности учреждения, инновационном потенциале разработок и являются информационной основой для формирования управленческих решений по оптимизации патентно-изобретательской деятельности.

Ключевые слова: патентная активность, объекты права интеллектуальной собственности, изобретательская деятельность, инновационный потенциал, информационное сопровождение, экспериментальная онкология.