

Regional Market of Medical Equipment: Perspectives of Development

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Abstract: The level and quality of life of population are determined by the state of its health and that of health care system which largely depends on material and technical base of health care institutions and their provision with medical equipment. In countries with developed market economies, medical industry is one of the leading sectors in terms of revenue from the export of its products. At the same time, the share of domestic enterprises in the Russian market of medical equipment and medical products is reduced. For this, in high-tech segments the import share is 100% of total consumption of products. Despite the development of the latest achievements of medical science by the leading medical institutions of the Russian Federation, quality and effectiveness of medical care currently is not satisfactory. This is due to insufficient public funding for health care with high (up to 80%) level of depreciation of current medical equipment and need in supplying medical institutions with new medical equipment, low susceptibility of management to social and managerial innovations in the social sphere in general and health care in particular. The study investigates the problems and development prospects of regional market of medical equipment. Interpretation of the content of regional market of medical equipment is given, its dual nature is revealed the segmentation of medical equipment market is presented in view of features of producer and consumer behavior within the territorial localized formations.

Key words: Regional market, medical equipment, market of medical equipment, the concept of the formation and development of the market of medical equipment, Russia

INTRODUCTION

In recent years, within the framework of the Federal Target Program (FTP) "Development of Pharmaceutical and Medical Industry of the Russian Federation for the period up to 2020 and further prospects" the intensive technological re-equipment of health care institutions in the regions is carried out. However, the actions taken have not stopped the decline in consumption of finished pharmaceuticals and medical products produced in Russia which annually amounts to 1-2%. In this regard it seems necessary to implement two interrelated strategies, namely import substitution and innovative development which involves process retooling and modernization of production capacities of domestic pharmaceutical and medical industries creation of industrial research base of production increase in production of domestic pharmaceutical and medical products as well as medical devices and equipment, substituting the imported analogues. The need to output of the Russian Federation to the level of developed countries in terms of social

welfare supposes the necessity in development and implementation of qualitatively new and adaptation of foreign innovative technologies to the system of regional management of the market of medical technology that determined the choice of research topic, its importance in theoretical and practical aspects.

The theoretical basis for functioning of regional markets, the methods of their diagnostics are considered in the researches of Abalkin, E.T. Gaidar, S.Yu. Glazyev, A.I. Dobrynin, V.V. Klimanov, O.V. Kuznetsova, D.S. Lvov, V.N. Leksin, V.A. Mau, P.A. Minakir, Ye.M. Primakov, A.G. Porshnev, G.B. Polyak, A.I. Tatarin, F.I. Shamkhalov, A.N. Shvetsov, B.M. Shtulberg, G.A. Untura, E.G. Yasin and others. The significant contribution to the development of problems of regional development was made by the works of Russian economists: P.M. Alampiev, A.D. Arzamastsev, N.G. Bagautdinova, L.V. Kantorovich, N.N. Kolosovskiy, V.V. Leontyev, A.S. Novoselov, A.E. Probst, S.G. Strumilin and R.F. Shaykhelislamov.

The industry markets were traditionally the subject of research of alternative economic schools and trends. Representatives of the Harvard School are at the origin of this science and the main attention in market research is paid to conditions determining the market structure within the paradigm of “structure-conduct-performance”. This approach is reflected in the works of J. Beyn, A. Marshall, E. Meyson, J. Robinson, G. Hotteling, R. King, Chamberlin and others. The representatives of Chicago school more emphasise on the study of the problem of economic choice which allows considering the individual participants of sectoral markets from the position of optimization decision making (Vdovina, 2011, 2012; Vdovina and Runova, 2014; Vdovina, 2011). A. Alehian, S. Vaytzecker, R. Gilberg, A. Diksit, R. Keyvz, R. Kouz, M. Kesson, M. Spens, J. Stigler, O. Wilyamson and others. The problem of development of industrial markets is fully developed within the concepts of state regulation (J. Gelbreyt, J.M. Keynes, L. Yohansen, P. Samuelson, O. Wilyamson, F. Hayek, K. Eklund, L. Erhard etc.) (Demyanova, 2011).

The domestic economists were engaged in study of problems of medical services market functioning in Russia, quality of medical aid to population: A.S. Akopyan, B.I. Boyarintsev, E.Sh. Gontmakher, S.V. Kiselev, N.H. Sabitov, R.Sh. Sungatov, T.M. Sheyman, S.V. Shishkin, L.I. Yakobson. To issues of studying the structure of domestic market of medical technology, mechanism of its formation are devoted the works of O.V. Kadik, I.V. Kudina, A.P. Petrov.

However, it should be recognized that, despite the increased attention from the part of domestic and foreign researchers to the laws and principles of functioning of industrial markets in general and peculiarities of their implementation in the market of medical equipment, on the state of which largely depends the level and quality of health services, a number of problems requires further study. This has determined the goals the objectives and the structure of the work.

The purpose of the study is scientific substantiation of theoretical and methodological approaches to the mechanism of functioning of the regional market of medical technology at the present stage of development of the Russian economy as well as to develop on the basis of the findings the practical recommendations ensuring the effectiveness of its government regulation.

The object of the study is the regional market of medical technology. The subject of the study is a set of organizational and economic relations arising in the process of development of the regional market of medical equipment in the modern Russian economy.

The present study was performed with the use of such general scientific methods of cognition as: monographic, economical-statistical, analytical, methods of comparative and structural analysis, method of classification, economic-mathematical modeling. Each of these methods was applied adequately to its functional possibilities, thus allowing the ensuring of reliability and validity of generalizations, conclusions and statements of the thesis.

The scientific novelty of the results of the study is in developing the set of theoretical and methodological statements and practical suggestions for improving the system of regulatory impact on the state of the regional market in order to ensure socially-centered development of mezoformations which are specified in the following statements.

MATERIALS AND METHODS

Interpretation of the content of the regional market of medical technology as a set of contractual relationships with participation of economic entities implementing the powers of ownership over the health products for personal and productive consumption within a competitive geographically localized space.

The dual nature of the regional market of medical equipment has been revealed which is focused, on the one hand, to the production of the mixed public goods, indirectly meeting the needs of the population in high-quality and affordable health care, based on equipping the therapeutic and preventive institutions (social effect), on the other hand, obtaining economic benefits by manufacturers of these products (economic effect).

The methodological approach to determination of degree of influence the supply of medical equipment to therapeutic and preventive institutions in the region on the dynamics of indicators of health and social efficiency.

Theoretical basis and modern trends of development of the regional market of medical equipment

The content of the concept of “regional market of medical technology”, the researcher’s view: The market of medical equipment in the research is defined as a set of contractual relationships in which producers (suppliers) and consumers exchange by property rights within the framework of territorial-localized system to meet the needs of the population in high-quality and accessible health care by equipping the therapeutic and preventive institutions with high-quality medical equipment having the competitive prices, on the one hand and obtaining

economic benefits by state and manufacturers of these products, on the other hand. The boundaries of the regional market of medical technology are reflected in the index of demand elasticity as to price closeness of competitive conditions (interconnectedness of demand, the same level of transaction costs of entry into the market, low transport costs within the regional market boundaries and their sharp increase in the case of the border crossing, etc.).

To regional market of medical equipment are peculiar mainly the features of the market of manufactured goods which allows identifying in its structure a part of the regional market of medical equipment of wholesale trading with focusing to the wholesale-based companies, regional market of medical equipment of retail sales, focused on the sale of consumer goods (devices to measure blood pressure and others) the regional market of medical technology that focuses on government procurement (medical equipment for therapeutic and preventive institutions). The consumers in this market are commercial and non-profit organizations in the field of provision of health services, for which the medical equipment is a means of production (provision) of health services wholesale distributors who resell such goods (the intermediaries are absent in the distribution chain if the object of contracts is unique complex medical equipment which is implemented by manufacturers themselves or their representatives) state and municipal institutions, when medical equipment is purchased for state and municipal needs using competitive bidding for therapeutic and preventive institutions, educational institutions and others according to various federal and municipal programs households purchasing medical equipment for their own use. Such purchases are made through tenders.

The analysis showed that the regional market of medical equipment are peculiar characteristics of a seller market and a buyer market. On the supply side the target market is dominated by foreign manufacturers. The greatest proportion of customers are therapeutic and preventive institutions (80%). The share of purchases of medical equipment among the population is smallest due to the low level of technical complexity and low cost of production (instruments for measuring blood pressure, syringes, etc). The low level of awareness of buyers and sellers about the state of the market situation leads to unjustified loss of state funds and commercial organizations. Analysis of the competitive environment has shown that regional markets of medical technology have signs of imperfect competition and are oligopolistic.

The dual nature of the regional market of medical equipment: Medical technology is a mixed public benefit which determines the dual nature of the incentives of economic activity of the subjects of the investigated market. On the one hand, they tend to maximize profits, on the other hand, they are designed to meet the vital needs of the population which in turn determines the state of the human capital the level and quality of life of society. Analysis of the subject composition of market relations made it possible to distinguish four groups of economic agents with different amounts of resource potential, varying degrees of impact on the socio-economic processes and having different needs. The first group is represented by the public authorities of different levels (the State Duma Committee on Health, the Ministry of Health and Social Development of RF, the Ministry of Health of Tatarstan, the Health Administration of the Executive Committee of the Municipality of Kazan and others). They have significant resource potential and express the interests of society (local community) in production of the proper amount of public goods which finds expression in preparing the strategic plans for development of the investigated market segment. The second group is represented by non-profit organizations that have significant scientific and human potential but do not have significant influence on the management decisions with respect to investments in the production of public goods (medical equipment). This group is represented by the Russian Academy of Medical Sciences, medical higher institutions, experts of the World Health Organization, specialized research institutes, public associations and others. The third group consists of stakeholders with low volume of resource potential and low degree of influence on the decisions made with respect to the production of public goods with the certain tolerance for quality management and quality of medical care in general (health part of the population, a group of the population not participating in voluntary medical insurance). The fourth group is represented by stakeholders who have employment potential are interested in maximizing income (profits, wages, quasi-rent) but not able to exert significant influence on the management decisions regarding the directions of development of the regional market of medical equipment (medical professionals, commercial organizations that provide medical services).

Methodological approach to determining the degree of impact of medical equipment supply for detectability of diseases of the population of the Republic of Tatarstan: Modern diagnostic equipment ensures timely detection of diseases is the essential factor in improving the quality of

human capital and positive dynamics of social indicators. The study contains a list of socially significant diseases of the population, the mortality rate from which is the highest in the Republic of Tatarstan diseases of circulatory system, cancer diseases. Within the study performed the analyzes of dynamics of tuberculosis diseases indicators was carried out as infectious disease, carrying the potential threat to epidemic. Determination of diseases characteristic of the region allowed the identification of a number of specialized clinics which carry the main load of qualified diagnostics detection and treatment of these diseases and get a significant portion of funds coming from the budget. These include: the Republican Clinical Hospital (RCH) children's Republican Clinical Hospital (DRKB) Republican Oncological Center (ROC) Interregional Clinical Diagnostic Center (ICDC) Republican TB Dispensary (RKPD).

In the study, the efficiency of investment is not identified with general economic category of efficiency with the corresponding indicators in the sphere of material production. Unlike other industries the results of activities in the health sector should be considered from the standpoint of social, medical and economic efficiency. Medical efficiency of the purchased equipment is the degree of achievement of health outcomes, expressed in increased rates of detectability and further, in reducing morbidity of population which reflects the degree of achievement of the objectives of diagnostics and treatment of diseases taking into account the criteria of quality and effectiveness. Social efficiency is expressed in the achievement of social outcomes, i.e., increase in life expectancy of population, in reducing mortality, in satisfaction of public with the quality of their lives.

To accomplish the task, non-parametric statistical criterion of Mann-Whitney (U) was selected, supposing the setting of two statistical hypotheses, namely, zero (main) H_0 hypothesis or the hypothesis of absence of difference between the samples and the competing (alternative) hypothesis H_1 or hypotheses about significance of differences. Testing of statistical hypotheses is to compare the value of criterion U_{MPT} (obtained by calculation) with the critical value U_{kp} .

To calculate U criterion, the ranking method was used which consisted of the following: To the smaller value is assigned the lower rank, i.e. to the smallest value is added rank 1 and to the highest, the rank corresponding to the number of values being ranked. If several values are equal, then to them is added the rank which is the average of the ranks which they would have got if they were not equal. The total of ranges must coincide with the calculated one (Eq. 1):

$$\sum(R_i) = \frac{N \times (N+1)}{2} \quad (1)$$

Where:

R_i = The total sum of the ranks

N = Total number of values being ranked

To calculate Mann-Whitney criterion it was adopted the following algorithm:

- Determine 2 samples of values
- Merge the values in one sample and rank it, attributing the lower value to the lower rank. The number of ranks must be equal to the number of values of both samples
- Calculate the sum of the ranks of each sample and check whether the total sum of ranks coincides with the calculated one
- Determine the larger of two rank sums
- Calculate the value U_{MPT} using Eq. 2:

$$U_{\text{MPT}} = (n_1 \times n_2) + \frac{n_x \times (n_x + 1)}{2} - T_x \quad (2)$$

Where:

U_{MPT} = Criterion of Mann-Whitney obtained as the result of calculation

n_1 = The number of values in the first sample

n_2 = The number of values in the second sample

n_x = The number of values in the sample with larger sum of ranks

T_x = The most of the rank sums

Determine the critical values U_{MPT} according to the table of critical values of criterion U Mann-Whitney for the level of statistical significance $p = 0.05$. If $U_{\text{MPT}} > U_{\text{kp} 0.05}$, H_0 is accepted. If $U_{\text{MPT}} = U_{\text{kp} 0.05}$, H_0 is rejected. The study showed that investments in the purchase of medical equipment for the needs of Therapeutic and Preventive Institutions (TPI) during the period 2006-2010 are significantly lower than the costs in 2011-2015. In this regard, the hypothesis are formulated in the following way:

- H_0 : Investments in the purchase of medical facilities to equip TPI of RT do not significantly affect the change in health indicators of population, i.e., differences in two samples are random
- H_1 : Investments in the purchase of medical equipment to equip TPI of RT have significant impact on the change in health outcomes of population

RESULTS AND DISCUSSION

We investigated health outcomes of population: detectability of cancer and circulatory system diseases, active tuberculosis incidence of population of RT. Investigation of influence of money invested in medical equipment on cancer detection rate was carried out according to the proposed algorithm above. The analysis of two samples the value detection indicator of cancer for 2006-2010 and 2011-2015 showed that the average value of the index on the second sample is by 0.96% higher than the average figure of the first one. The objective was to

Table 1: Values of rank sums as to samples of values of cancer detectability among the population of RT

Years	Values of index	Rank
2006	12.3	2
2007	13.0	5
2008	13.9	8
2009	12.5	3
2010	12.2	1
2011	12.8	4
2012	13.1	6
2013	13.4	7
2014	15.2	10
2015	14.2	9

Table 2: Values of rank sums as to samples of values of active tuberculosis incidence of population of RT

Years	Values of index	Rank
2006	71.7	9
2007	72.1	10
2008	65.4	8
2009	60.9	5
2010	61.3	7
2011	61.1	6
2012	58.7	3
2013	59.0	4
2014	58.4	2
2015	53.5	1

determine the effect of the supply of medical equipment to specialized clinics on the growth of the indicator studied. Following the algorithm, the values of the studied indicator for 2006-2015 were combined into a single sample and ranked (Table 1).

The calculated further value of Mann-Whitney criterion allowed us to reject the hypothesis H_0 and confirm the assumption that equipping the Oncology Center with modern medical technology contribute to the growth of values of cancer detectability. Investigation of influence of investment of funds in medical technology on reducing the active tuberculosis incidence was also carried out according to previously designated algorithm. The analysis of two samples-index values of active tuberculosis incidence per 100 thousand of average annual resident population of the RT for 2006-2010 and 2011-2015 has revealed its reducing in average by 8.14 per 100 thousand of average resident population of RT during the period from 2011 to 2015. The objective was to determine the influence of equipping RKPD with medical technology on reducing the studied indicator (Table 2).

The obtained value of Mann-Whitney criterion allowed us to reject the hypothesis H_0 and confirm the assumption that the amount of funds given for equipping RKPD with medical facilities contributes to reducing the active tuberculosis incidence of population of RT.

In the course of the study, the effect of investments in equipping the TPI of RT with medical equipment on the growth rate of detectability of circulatory system diseases

Table 3: Values of rank sums from samples of values of detectability indicator of diseases of circulatory system among the population of RT

Years	Values of index	Rank
2006	22.3	1
2007	25.6	2
2008	26.2	3
2009	27.7	4
2010	37.0	8
2011	46.3	10
2012	38.4	9
2013	32.9	7
2014	31.8	6
2015	30.8	5

two samples were considered the values of detectability indicator of diseases of circulatory system per 1,000 of average annual resident population of RT for 2006-2010 and 2011-2015. Comparative analysis of the samples revealed the increase in the level of detectability of circulatory system diseases in average by 8.28 cases per 1000 average annual permanent population of RT during the period from 2008-2012. The objective was to determine the influence of equipping ICDC and specialized departments of other clinics (RCH, CRCH) with modern medical equipment on the growth of the studied indicator (Table 3).

The value obtained has confirmed the assumption that equipping the specialized health care institutions with modern medical equipment contributes to increase of the level of detectability of blood circulation diseases among the population of RT.

CONCLUSION

During the study performed, the following results were obtained. The content of regional market of medical technology was determined, the peculiarities of its functioning in the conditions of modern Russian economy and the procedure for determining the boundaries of the market. The dual nature of the regional market of medical technology and the influence on the content of competitive strategies of manufacturers were disclosed. The methodological approach to determining the degree of influence of medical equipment supply to therapeutic and preventive institutions of the region on the dynamics of health and social efficiency indicators. On the calculations carried out the following results were obtained: The medical effect of introduction of medical equipment in 2011-2015 is reflected in increase of the average value of the index of cancer detectability by 0.96%, in reducing the mean value of active tuberculosis incidence by 8.14 cases per 100 thousand of average annual resident population of RT, in the growth of the average value of detectability index of circulatory system diseases by 8.28 cases per 1000 of average annual

resident population of RT compared with the same indexes during the period of weak financing of medical institutions (2006-2010).

Social impact of acquisition of medical equipment to medical institutions of the republic in 2011-2015 is in increase of life expectancy of the working population. The studies performed have confirmed the particular social significance of the market of medical technology. The results obtained in that study confirmed that the market is in its infancy. On the one hand, there is the large number of programs that provide republican medical institutions with modern medical equipment. On the other hand, there is the low share of expenditures in health care budget to ensure the minimum level of equipment, for example, of city, district and rural hospitals.

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There are 3 articles in journals "National interests: priorities and safety" (Moscow, 2010), "Regional

economy: theory and practice" (Moscow, 2011), "Scientific Review" (Moscow, 2014) which are included in the register of journals recommended by HAC of Russia for publication of materials on candidate and doctoral dissertations. Monograph "Development of regional market of medical equipment" (Kazan, 2012) was published.

Practical recommendations are used in the activity of the Ministry of Health of Tatarstan in development of proposals for preparing the regional sectoral programs for development of social sphere as well as in the educational process of LEU "Academy of small business" which is confirmed by the certificate of introduction.

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