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Mechanism of competitiveness management in the public healthcare: a practical aspect

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Abstract: Healthcare is a key element of the state's national security. The effectiveness of the healthcare industry functioning is a relevant object of research today, especially after the outbreak of the COVID-19 pandemic, during which this sector globally demonstrated its potential and problems. It necessitates a comprehensive assessment of the competitiveness of the healthcare industry and institutions as an important component of their effective management. The objects of the research are public healthcare and institutions as service organizations. The purpose is to develop a scientific-methodical approach to managing the competitiveness in the country's healthcare industry. That is, the research is aimed at developing a market-oriented competitiveness management mechanism for public healthcare institutions. The construction of the mechanism is based on the analysis of statistical data on Ukrainian healthcare institutions according to indicators based on the "7P" marketing concept. Clustering methods, an integral indicator of competitiveness, and multidimensional methods of taxonomic analysis were also used for assessing the level of competitiveness of healthcare institutions and the comparative effectiveness of alternative measures to increase it.

Keywords public healthcare, healthcare institution, medical service, competitiveness.

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Introduction

Health care is a branch of state activity, the purpose of which is the organization and provision of affordable medical care for the population. Protection of public health is one of the main areas on which the attention of social protection/care is concentrated in various countries (Androniceanu et all, 2022).

The dynamics of functioning and development of health care in the world today demonstrate positive changes for society. Measures are actively being taken to improve the quality of medical services (Prado-Prado et all, 2020). In particular, in Ukraine digital transformation of the healthcare system and its electronic platform took place (https://ehealth.gov.ua/). The platform consisting of a central database and an electronic medical information system (https://helsi.me/) is a convenient and reliable system created for patients, doctors, and medical institutions. A number of patients' requests to health care institutions, the volume of services provided to them, consumer satisfaction with the received medical services and number of concluded medical declarations form the competitiveness of a health care institution.

To a large extent, the efficiency of the healthcare sector and the quality of services it provides are a foundation of a healthy society. The COVID-19 pandemic has become a challenge for the healthcare industry worldwide (Shekh et all, 2022). For example, in Ukraine, coronavirus influenced the development of the Health Care Strategy 2030 (https://moz.gov.ua/strategija). Challenges faced by the health care system revealed its weakest points in it. Implementation of the Health Care Strategy 2030 will allow citizens to receive high-quality free medical services, but it is necessary to assess the risks of its implementation (Shpak et all, 2018). The main task of Strategy 2030 is to make the healthcare system in Ukraine human- and market-oriented. However, despite positive trends, cases of public dissatisfaction with the quality of healthcare services are still common in Ukraine. Many healthcare workers do not consider themselves dependent on consumers, as they should be in a market economy; the principle of patient orientation is not yet fully applied. While patient experience is traditionally seen as a fundamental indicator for healthcare quality evaluation (Padayachee and Mutambara, 2021). On the other hand, the state does not provide sufficient financial resources for healthcare institutions. Statistical data indicated that 3-4% of GDP is spent on health care in Ukraine (http://ukrstat.gov.ua/), which is half as much as in developed countries. This creates prerequisites for researching the effectiveness of functioning of both public and private healthcare institutions, since the indicators of their competitiveness (which, in particular, can be evaluated in terms of marketing mix elements) for patients may differ. Accordingly, in order to increase the resource utilization efficiency of the health care in conditions of market relations formation and reformation of the healthcare sector of Ukraine, the development of a market-oriented paradigm of the healthcare sector and institutions' functioning, aimed at finding optimal options for ensuring their competitive advantages, is extremely relevant.

The competitiveness of health care institutions should also be considered from the perspective of efficiency/effectiveness. This requires new management models (Shpak et all, 2016) and certain criterion indicators characterizing economic

efficiency/effectiveness. They could facilitate an objective assessment of all alternatives to solving a specified task (Sorochak, Mykhalyuno, 2019).
Today's conditions determine the critical need for the development of the health care sector, and its competitiveness management is gaining more and more practical and theoretical relevance. The purpose of the study is to develop a mechanism for market-oriented competitiveness management of the country's health care institutions (with an emphasis on public ones) and its practical approbation. The article is structured as follows. First, the authors present the theoretical basis of their study. Second, the researchers offer the methodology used in this study. The next part of our article provides the results. Finally, we submit the conclusions and limitations of the study.

1. Literature review

The greatest value of every person is his/her life and health. Often, they directly depend on the quality of the provision of medical services by the country's healthcare industry in general and institutions in particular.
The healthcare industry is an aggregation and integration of sectors within the economic system that provides services/goods to treat patients with preventive, curative, rehabilitative, and palliative care. A healthcare institution is an institution that provides medical and concomitant services to the population, as well as carries out activities to ensure the sanitary and epidemic well-being of the population. That is why the attention of society, medical workers, and authorities is increasingly focused on this sphere, and the issue of competitiveness management in healthcare at the current stage is becoming an urgent subject of research.
For a thorough analysis of scientific sources, two main key directions of research were singled out: 1) competitiveness as an economic category, and its estimation in the healthcare industry; 2) competitiveness management and market orientation of healthcare institutions. Scientific works in each of the specified directions are analyzed below.

Competitiveness as an economic category, its estimation in the healthcare industry
Analysis of specialized literature showed that the main scientific developments on the subject are: substantiation of the concept of "competitiveness", systematization of factors affecting it and construction of a system of indicators of enterprise competitiveness, development of various methods of its assessment (Yankovy, 2013; Shpak et al. all, 2019, Mykhalyunyo, 2020), application of a strategic management concept to the formation of competitive advantages, their competitive strategies, regulation and management of competitiveness of economic systems (Piddubna, 2007; Ocheretko, 2004), mechanism of its provision (Kachmarik et all, 2012) etc.
The issue of competitiveness management, which is understood as a set of measures aimed at systematically improving the characteristics of various objects compared to their competitors at the micro- and macro-level, is disclosed in numerous scientific works. Thus, (Porter, 1990) describes the formation of industries' competitiveness based on the intensification of market competition. He uses the concept of an economic cluster, indicating that the competitiveness of firms depends on their

economic environment, that is, on basic conditions and competition within the cluster.

Competitiveness is a special area, and for its analysis it is important to assess innovative development (Litvinov, 2017). Stefan et all, 2016 formed a model of sustainable competitiveness of healthcare institutions. Pashkus et all, 2017 developed a competitive positioning model for evaluating healthcare facilities, allowing them to assess the competitiveness of a medical organization, its market positioning, and create its strategy. The authors focused their attention on the competitiveness of public healthcare institutions, which is related to their market position according to the rating.

Healthcare performance ratings reflect the existence of local and global quality competition (Domenico Lisi et all, 2021). It is quality that is the priority and the most important among different factors, and quality problems in healthcare institutions are the object of constant attention nowadays (Nagorna et all, 2002). The scientists analysed the competitive effects of the introduction of the reform of the nationwide choice of hospitals by the patient. It was proven, that a healthcare facility that offers lower quality care is at risk of losing patients after the reform, as patients may seek care from a more distant hospital where the general practitioner provides better care and has positive patient feedback. Thus, granting a patient the choice of physician is likely to make the demand for hospital care more elastic with respect to quality and thus strengthen the competitive position of the healthcare facility (Kurt et all, 2021). Lupo, 2016 applied a new fuzzy evaluation system to assess the quality of services in the public healthcare sector. In particular, the method proposed by the author is based on the ServQual cancellation paradigm and includes a method of analytical hierarchical process for obtaining reliable estimates of the expected quality of medical services. Patients were more satisfied with the quality of medical services provided by private healthcare institutions, which today compete at a high level with public healthcare institutions, but their services are more expensive (Androniceanu andTvaronavičienė, 2019).

As competitiveness is a complex concept, it is necessary to determine all possible factors/sources that stimulate/destimulate it. The only reasonable method of its assessment is an integral one (Činčikaitė et all, 2021).

Competitiveness management and market orientation of healthcare institutions

Ștefan et all 2016 developed a model of competitiveness of healthcare facilities. They also provided empirical data on the contribution of management processes to strengthening the influence of all other factors/dimensions on sustainable competitiveness in the country's healthcare sector, thus emphasizing the concept of sustainable management. Mishra et al; Thuemmler and Bai substantiated that competitive management of healthcare institutions should be based on a new approach, in particular, using the principles of individual profile, administrative planning (Kuzmin et all, 2020) and teamwork, which directly depends on the quality of health care services (Kossaify, Hleihel, 2017). This is especially relevant in a dynamic and aggressive competitive environment (Litvinov, 2015).

An important practical aspect of managing healthcare facilities is the motivation of employees. Kotenko et all, (2021) proposed a set of evaluation indicators combined

into a single integrated system – key performance indicators (KPI), as a basis for calculating premium wage fund. The specified system of material motivation should encourage medical personnel to work effectively, and increase activity and initiative. Majerova et all (2021) found changes in the sources of intrinsic motivation of healthcare workers caused by the COVID-19 pandemic. The rating of internal motivation sources before the COVID-19 pandemic was as follows: 1) a sense of choice; 2) a sense of significance; 3) a sense of progress and 4) a sense of competence, while during the COVID-19 pandemic: 1) a sense of choice; 2) a sense of progress; 3) a sense of significance, and 4) a sense of competence. The researchers stated that the pandemic significantly affected existing principles and models of internal marketing communication, which should now be critically reviewed.

Malynovska et all (2022) developed a methodology for motivating employees, based on the theory of games, which allows for the formation of many possible parameters of the optimal structure of fixed and commission rewards of employees to maximize their effectiveness, depending on the inclination or reluctance of these employees.

Carey and Friel, 2015 examine the development and implementation of reforms in public policy that will contribute to healthcare development. Attention was focused on the public health care sector, and the gaps that create obstacles in the implementation of medical reforms at an administrative level of a state are considered.

It is also important to monitor the general coverage of health services within the framework of the Sustainable Development Goals (Hogan et all, 2018), and financing of transformational healthcare systems to achieve the Sustainable Development Goals of health care (Stenberg et all, 2017), financing of universal health insurance (Aman et al., 2019). To improve healthcare management, the Global Health Cluster developed a working document on the use of essential packages of health services in protracted emergencies (Global Health Cluster, 2018), which is extremely relevant in healthcare management during the COVID-19 pandemic (Kobis, Karyy, 2021).

In the management of healthcare institutions today, marketing is critically important and effective. Thus, Gajanova et all, 2021 demonstrated that marketing communications are crucial for healthcare institutions, being a dominant tool of a marketing mix in terms of formation and management of brand value. Godsey et all (2020) investigated if the brand theory can help to change the brand image in nursing, which directly shapes the quality of medical services in healthcare facilities.

In order to increase the resource utilization efficiency of health care and to reform the medical industry, the application of a market-oriented paradigm that prioritizes identifying the needs/desires of consumers and creating products/services that satisfy them is extremely relevant. We consider elements of the paradigm as factors for the formation of competitive advantages and competitiveness of healthcare institutions. According to (McNaughton, 2002) market orientation is positively related to firms' performance. However, for service industries, where intangible assets are more important, this relationship is yet to be explored. The authors propose a model describing the interconnection between market orientation and increased firm value. As it was shown by (Avinandan, 2010; Yaghoubi et all, 2015), nowadays market orientation is essential for healthcare institutions to survive.

Raju P. et al (2000) confirmed the strong relationship between market orientation and performance in the hospital industry using Structural Equation Modelling.
In some scientific works usage of the different marketing mix components for the healthcare industry (in this case 7P (product, price, place, promotion, people, process, physical evidence) – for service organization) is investigated. CatanaandToma (2021) describe the applicability of components of the extended marketing mix (7P) in the field of healthcare services based on a quantitative desk research method. Ravangard R., Khodadad A., Bastani P. tried to identify factors in the marketing mix which influence the selection of hospitals by patients in Iran. Ahmad, Alaeddin et all (2013) while assessing the impact of marketing mix strategy on patient satisfaction in private sector hospitals in Saudi Arabia, stated that five out of seven variables (health service, promotion, physical evidence, process and personal strategies) are significant, but two variables (pricing and distribution strategies) are insignificant.
All this determines the need for further research and development of theoretical aspects of managing the competitiveness of healthcare institutions, in particular, based on their clear and decisive market orientation. As a result, the ***hypothesis*** of this study is as follows: the mechanism for managing the competitiveness of public healthcare institutions should be market-oriented and based on an integrated assessment of the impact of the components of the 7P marketing complex on it.

2. Methodology and data construction

Based on the economic context, the competitiveness of an enterprise is a complex attributive concept, various aspects of which are reflected by a set of factor symptoms, that is, it is a latent feature (an abstract concept that is determined by various indicators that are reduced to a certain dimension of competitiveness assessment. Each researcher can take different indicators for evaluating the same phenomenon and evaluate them differently).
Latent features can be assessed only by using multidimensional mathematical and statistical methods, based on the construction, analysis and use of models with latent indicators (Lazarsfeld, 1973; Mikhalyuno, 2020; Plyuta et all, 1989; Halafyan, 2007; Yankovy, 2002). Usual indicators of the metric scale, that is, symptoms, prove that the competitiveness of firms is a latent indicator.
In the scientific literature, three multidimensional statistical methods are considered, which are aimed at evaluating latent indicators: the taxonomy method, the method of principal components, and the non-metric method of multidimensional scaling (Halafyan, 2007). Having considered these methods, we concluded that the taxonomy algorithm can maximally take into account all the features of a structure and interrelationships of indicators of the latent concept of "competitiveness" for healthcare institutions.
As mentioned above, healthcare institutions have specific features. In particular, most organizations and institutions (especially the public) cannot focus solely on making a profit, as they are obliged to provide services to all groups and categories of the population, regardless of their level of well-being. One more specific feature is its service character. These features make operational management in the field of

medical care quite difficult from the point of view of ensuring activities' effectiveness. Indeed, the closer interactions with a consumer, the higher the degree of individualization of service, the higher labor intensity of a process of its creation, and the more difficult it is to ensure the high economic efficiency of the health care institution.

To substantiate the proposed hypothesis and achieve the set goal, the research methodology used in this article includes the following stages:

Stage 1. Formation of a factor indicators system for assessing the competitiveness of healthcare institutions based on the 7P marketing mix.

Stage 2. Creation of an economic-mathematical model for finding an integral competitiveness index, according to a predefined system of indicators.

Stage 3. Analysis of factor indicators of the health care institutions' competitiveness in order to identify possible reserves for its improvement.

The result of the implementation of the described stages will be the development of a mechanism for market-oriented management of healthcare institutions' competitiveness. Each of the proposed stages is described in detail below.

Stage 1. It is advisable to base the competitiveness assessment of healthcare institutions on the needs of patients, that is, to apply a market-oriented approach and the 7P marketing mix concept (Sorochak et all, 2019). Its components are indicators of assessing the competitiveness of healthcare institutions (factor indicators were chosen based on the availability of information) (Table 1).

Table 1. Indicators for evaluating the competitiveness of healthcare institutions based on the concept of the "7P" marketing mix

"7P" components	**Indicators for evaluating the competitiveness of healthcare institutions**
Product	1. Quality of medical care, the average number of bed-days. 2. Level of specialization (treatment of certain diseases), coefficient
Price	1. Average cost of diagnostics, €/person. 2. Average cost of medicines, €/person. 3. Average cost of medical procedures, €/person
Promotion	1. Annual advertising expenses, €. 2. Image of the institution, points.
Place	1. Convenience of access to the facility, points. 2. Level of application of IT technologies, points.
People	1. Qualification level of doctors (average length of service), years. 2. The level of staffing of positions according to the staff list, %. 3. Material motivation (average salary of a doctor), €.
Process	1. Level of standardization of medical procedures, %. 2. The level of automation of laboratory research, %.
Physical evidence	1. Quality of repair of the premises, points. 2. Quality of arrangement of places for waiting for patients, points. 3. The level of coverage by the free Wi-fi zone, %.

The taxonomic index is determined based on the algorithm shown in Figure 1.

Figure 1. Algorithm for determining the taxonomic indicator of the healthcare institution competitiveness

Formation of a matrix of observations *Mx* with dimension *n*×*m* from the values of indicators that characterize various aspects of the competitiveness of health care institutions

$$Mx = \begin{pmatrix} x_{11} & \dots & x_{1j} & \dots & x_{1n} \\ \dots & \dots & \dots & \dots & \dots \\ x_{i1} & \dots & x_{ij} & \dots & x_{in} \\ \dots & \dots & \dots & \dots & \dots \\ x_{m1} & \dots & x_{mj} & \dots & x_{mn} \end{pmatrix}$$

where $i = \overline{1, m}$, m – the number of compared objects in this case;
$j = \overline{1, n}$, n – the number of indicators identifying the level of competitiveness of health care institutions.

↓

Standardization of elements' values of the observation matrix

$$Mz = \begin{pmatrix} z_{11} & \dots & z_{1j} & \dots & z_{1n} \\ \dots & \dots & \dots & \dots & \dots \\ z_{i1} & \dots & z_{ij} & \dots & z_{in} \\ \dots & \dots & \dots & \dots & \dots \\ z_{m1} & \dots & z_{mj} & \dots & z_{mn} \end{pmatrix}$$

$z_{ij} = \frac{x_{ij} - \overline{x}_j}{\sigma_j}$, where $\overline{x}_j$ – arithmetic mean value of the *j*-th feature; σ_j – mean squared deviation of the *j*-th feature.

↓

Distribution of indicators into stimulators and destimulators and formation of the standard vector (Z_0)

$$Z_0 = z_{01}, z_{02}, \dots, z_{0j}, \dots, z_{0n}$$

$z_{0j} = \max\limits_i z_{ij}$, if the *j*-th indicator is a stimulator,

$z_{0j} = \min\limits_i z_{ij}$, if the *j*-th indicator is a destimulator.

↓

Determination of the distances between the values of indicators in individual observations and the reference ones

$$R_{i0} = \sqrt{\sum_{j=1}^{n} (z_{ij} - z_{0j})^2}$$

where R_{i0} – distance between the values of indicators in the *i*-th observation or period and the reference values.

↓

Determination of the taxonomic indicator of the competitiveness of health care institutions in their strategic group

$I_i = 1 - d_i$, where $i = \overline{1, m}$

where $d_i = \frac{R_{i0}}{R_0}$ – a parameter that is an indicator of the level of competitiveness of healthcare institutions; R_0 – normalizing values for the distances between individual observations and the reference vector, which is calculated as $R_0 = \overline{R}_0 + 2 \times \sigma_0$, and accordingly $\overline{R}_0$ and σ_0 are calculated by formulas:

$$\overline{R}_0 = \frac{\sum_{i=1}^{m} R_{i0}}{m}, \qquad \sigma_0 = \sqrt{\frac{\sum_{i=1}^{m} (R_{i0} - \overline{R}_0)^2}{m}}.$$

The proposed algorithm for determining the taxonomic indicator of the healthcare institution's competitiveness is an important element of its market-oriented management mechanism formation.

It is important that the economic mechanism for competitiveness management be based on the calculation of an indicator that characterizes a ratio of cost measures and an achieved effect. In general, the effect of implementing measures to increase the institution's competitiveness should be the improvement of its competitive market position, that is, to increase the competitiveness index. Therefore, the criterion indicator should be based on the results of a taxonomic assessment of the level of competitiveness and characterize the degree of convergence of the analyzed healthcare institution to the leading institution of the strategic group, which has the highest competitiveness in the market, expressed in percentage points.

The lag of the competitiveness indicator of a specific healthcare institution from a leader in percentages before the implementation of a measure is calculated according to the formula:

$$\rho_b = 100 - \frac{I_i^b}{I_l^b} \times 100, \quad (1)$$

where I_i^b, I_l^b – the value of the indicator of the health care institution competitiveness before implementation of the measure in relation to the object under study and the leader, respectively.

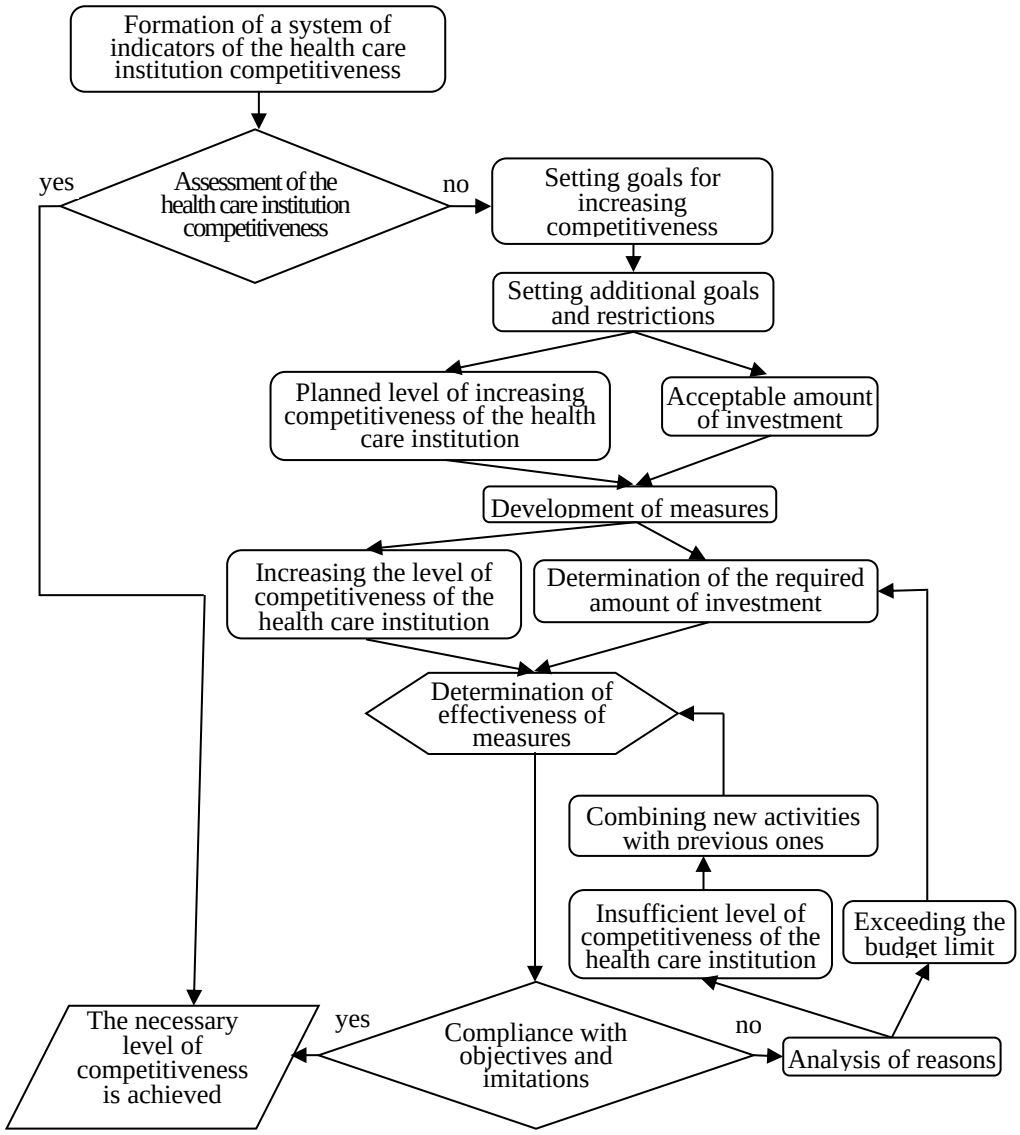
It is advisable to divide healthcare institutions into strategic groups using cluster analysis. After all, the task of cluster analysis is to (based on the data contained in the set *X*) divide the set of objects *G* into *m* (*m* is an integer) clusters Q_1, Q_2, …, Q_m so that each object G_j belongs to one and only one subset. At the same time, objects belonging to the same cluster must be similar, and objects belonging to different clusters must be dissimilar.

We assume that the set *G* includes *n* health care institutions, and any of them is characterized by *k* parameters: average number of bed days (F_1), coefficient of specialization of the medical institution (F_2); annual advertising expenses (F_3); the level of application of IT technologies (F_4), etc. Then X_1 (vector of measurements) is a set of specified characteristics for the first healthcare institution, X_2 – for the second, X_3 – for the third, ..., X_n – for *n*-th (and $X_n = x_{n1}, x_{n2}, \ldots, x_{nk}$). The task is to divide healthcare institutions into clusters (homogeneous groups) according to their competitiveness level.

The result of the cluster analysis is the division of healthcare facilities into strategic groups that meet a certain criterion of optimality.

Implementation algorithm of a mechanism of market-oriented management of the healthcare institutions' competitiveness developed based on the above methodology is presented in Figure 2.

Figure 2. Algorithm for implementation of the mechanism of market-oriented competitiveness management of healthcare institutions



The proposed mechanism of market-oriented competitiveness management allows one to: evaluate the effectiveness of each measure; choose effective ways to increase competitiveness; determine a set of measures to improve competitiveness to a given level; determine a set of measures to raise competitiveness to a given level within the established budget.

3. Results and discussions

Based on the proposed system of indicators for assessing competitiveness in the public healthcare sector, which correspond to elements of the "7P" marketing mix, Table 2 shows an observation matrix created on the basis of a database collected from 18 Ukrainian healthcare institutions of various profiles (mostly public and operating in the western region of Ukraine, for which it was possible to obtain complete information on the evaluated indicators). The matrix includes 17 parameters that characterize their competitiveness level according to the proposed system of indicators (see Table 1). Of the selected parameters, 14 are stimulators (an increase in a numerical value of the indicator corresponds to an improvement in the resulting characteristic), and 3 are destimulators (their increase corresponds to deterioration of the resulting characteristic). For the convenience of calculations, destimulators are placed at the end of the observation matrix.

Results of the taxonomic coefficient calculations with the help of an algorithm program compiled using the MathCAD software package for each of the researched healthcare institutions are presented in Figure 3.

Figure 3. Diagram of distribution of taxonomic coefficients of health care institutions' competitiveness

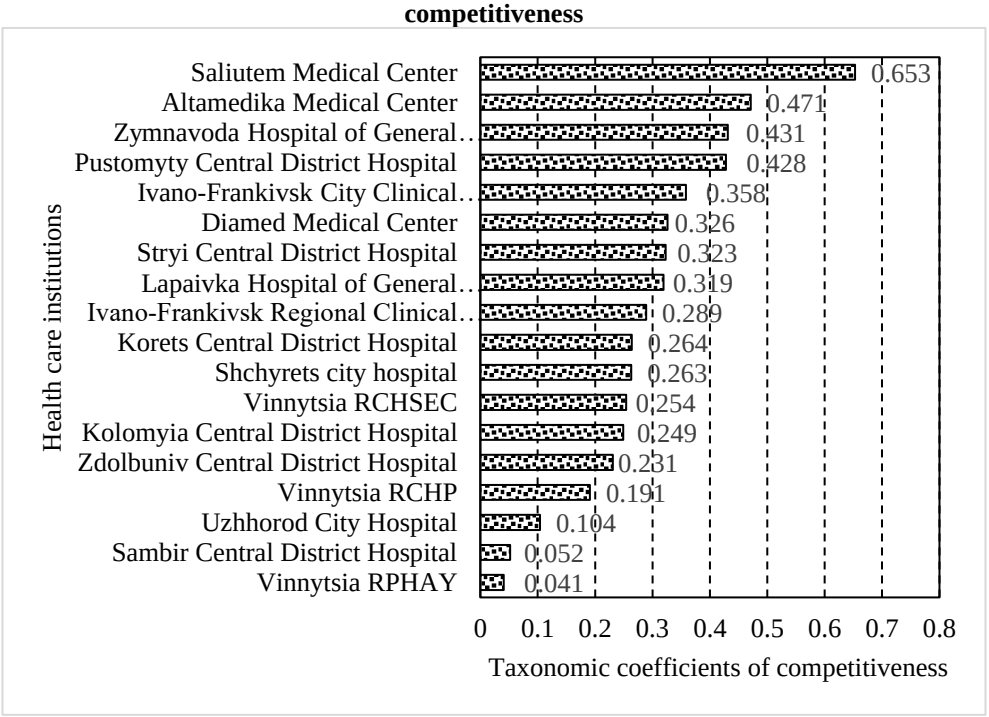


Table 2. Observation matrix formed from the competitiveness indicators of 18 researched health care institutions

№	Health care institutions	Indicators-stimulators														Indicators-destimulators		
		Quality of medical care, average number of bed-days	Level of specialization (treatment of certain diseases), coefficient	Annual advertising expenses, €	Image of the institution, points	Convenience of access to the facility, points	Level of application of IT technologies, points	Qualification level of doctors (average work experience), years	Level of staffing of positions according to the staff list, %	Material motivation (average salary of a doctor) €	Level of standardization of medical procedures, %	Level of automation of laboratory research, %	Quality of renovation of the premises, points	Quality of arrangement of waiting places for patients, points	Level of coverage by the free Wi-fi zone, %	Average cost of diagnostics, €/person	Average cost of medicines, €/person	Average cost of medical procedures, €/person
1.	Vinnytsia RCHSEC (Regional Clinical Highly Specialized Endocrinology Center)	4	1	0	4	5	3	20	100	133	90	100	4	4	0	26.7	133.3	5
2.	Vinnytsia RCHP (Regional Clinical Hospital named after Pirogov)	4	1	0	4	5	3	24	100	153	70	30	3	3	0	21.7	106.7	4
3.	Vinnytsia RPHAY (Regional Psychoneurological Hospital named after Academician Yushchenko)	4	1	0	4	5	2	28	100	5200	60	30	2	2	0	40	200	26.7
4.	Zdolbuniv Central District Hospital	4	0.8	0	4	5	3	21	94	173	70	60	4	4	3	6.3	8	56
5.	Zymnavoda Hospital of General Practice – Family Medicine	5	0.6	0	5	5	3	27	100	311	70	70	5	5	60	2.6	8.2	11.8
6.	Ivano-Frankivsk City Clinical Hospital №1	5	0.8	0	5	5	4	20	100	166	85	85	5	5	30	16.5	22.2	140.7
7.	Ivano-Frankivsk Regional Clinical Hospital	5	1	0	4	4	4	17	100	182	90	90	5	4	30	20.7	34	163.3
8.	Kolomyia Central District Hospital	5	0.6	0	4	5	3	22	100	166	60	50	5	4	10	0.53	8.8	36.3
9.	Korets Central District Hospital	4	0.8	0	4	4	3	25	100	177	70	60	3	4	3	4.4	7.7	37.2
10.	Laparivka Hospital of General Practice - Family Medicine	5	0.6	0	4	5	3	21	95	292	60	70	5	5	80	1.7	6.5	4.9
11.	Altamedika Medical Center	5	1	1 666	4	4	5	20	100	350	100	100	5	5	100	53.3	133.3	33.3
12.	Diamed Medical Center	5	1	0	4.5	2	5	15	100	297	100	100	5	5	80	33.3	16.7	16.7
13.	Salutem Medical Center	5	1	3 333	5	5	5	25	100	333	100	100	5	5	100	46.7	116.7	26.7
14.	Pustomyty Central District Hospital	5	0.8	0	5	5	4	28	100	232	85	85	5	5	60	15.8	20.5	158
15.	Sambir Central District Hospital	4	0.8	0	4	5	2	18	94	170	50	40	2	2	30	4.5	7	49.1
16.	Stryi Central District Hospital	5	0.8	0	4	5	2	21	100	177	70	85	5	5	60	10.7	6.3	70
17.	Uzhhorod City Hospital	3.5	0.8	0	3	4	3	15	100	150	70	100	3.5	3	0	16.7	10	0
18.	Shchyrets City Hospital	5	0.6	0	4	5	3	18	98	163	70	60	4	4	40	5.87	7.7	36

(The data were collected by the authors in the respective health care institutions with the permission of their management)
(1 € = 30 UAH according to the NBU exchange rate as of March 22, 2020)

As can be seen in Fig. 3, the taxonomic coefficients of the competitiveness of the investigated healthcare institutions differ significantly in their values.

First of all, this is related to their form of ownership, specialization and size, as well as partly to their location (regional centres, district towns, etc.). Therefore, in our opinion, it would be incorrect to compare them all in one competitive (strategic) group, since they are not direct competitors. According to M.Porter, 1990, strategic groups are rival organizations characterized by close market positions and similar opportunities.

In order to divide all examined healthcare institutions into strategic groups, given that they are characterized by a significant number of indicators, it is advisable, as justified above, to apply the clustering technique. There are quite a lot of cluster analysis algorithms, but all of them can be divided into hierarchical (tree-like) and non-hierarchical. Three clustering methods are used in this research: tree-like clustering according to Ward's method, the Kohonen network, and the K-means method (Halafyan, 2007).

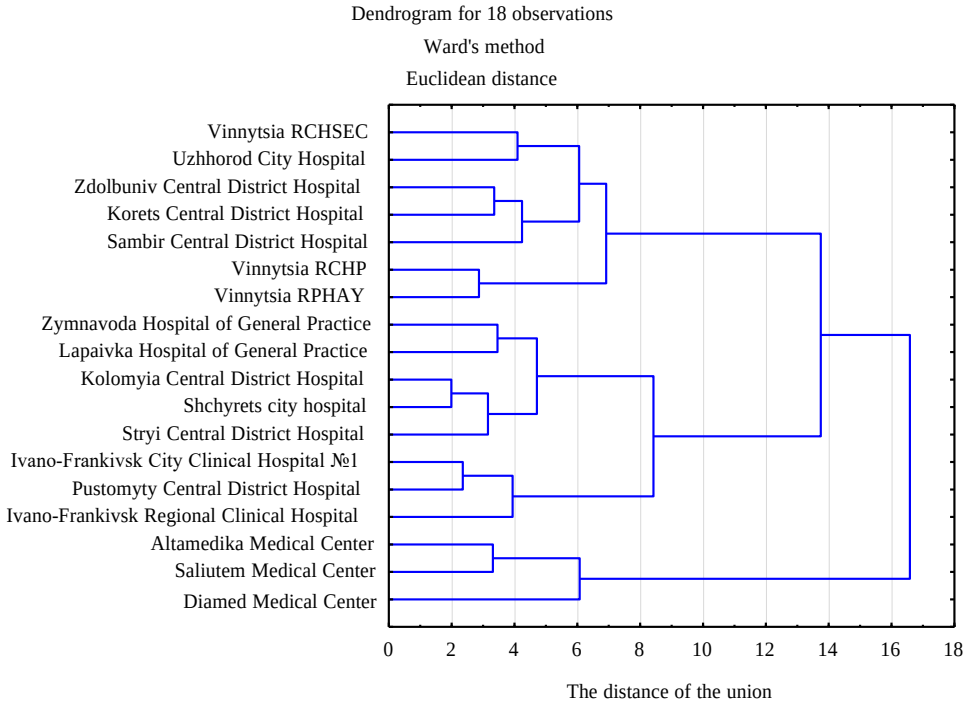
Using hierarchical clustering (Figure 4), three clusters (strategic groups) were identified, which include the following healthcare institutions:

- cluster 1 – Zymnavoda Hospital of General Practice, Ivano-Frankivsk City Clinical Hospital №1, Ivano-Frankivsk Regional Clinical Hospital, Kolomyia Central District Hospital, Lapaivka Hospital of General Practice, Pustomyty Central District Hospital, Stryi Central District Hospital, Shchyrets City Hospital;
- cluster 2 – Altamedika, Diamed and Saliutem Medical Centers;
- cluster 3 – Vinnytsia Regional Clinical Endocrinology Center, Vinnytsia Regional Clinical Hospital, Vinnytsia Regional Psychoneurological Hospital, Zdolbuniv Central District Hospital, Korets Central District Hospital, Sambir Central District Hospital, Uzhhorod City Hospital.

By applying the Kohonen neural network for clustering of the healthcare institutions, three clusters were also obtained:

- cluster 1 – Vinnytsia Regional Clinical Highly Specialized Endocrinology Center, Zymnavoda Hospital of General Practice, Lapaivka Hospital of General Practice, Stryi Central District Hospital;
- cluster 2 – Ivano-Frankivsk City Clinical Hospital №1, Ivano-Frankivsk Regional Clinical Hospital, Altamedika Medical Center, Diamed Medical Center, Saliutem Medical Center;
- cluster 3 – Vinnytsia Regional Clinical Hospital, Vinnytsia Regional Psychoneurological Hospital, Zdolbuniv Central District Hospital, Kolomyia Central District Hospital, Korets Central District Hospital, Sambir Central District Hospital, Uzhhorod and Shchyrets City Hospitals.

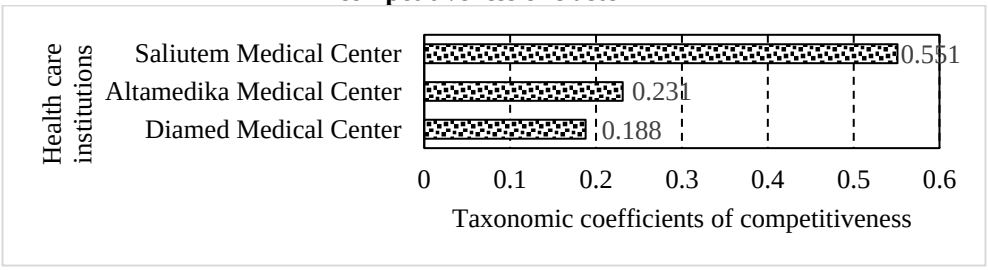
Figure 4. Horizontal dendrogram of the clustering of the researched healthcare institutions according to Ward's method



Clusters obtained by different methods are slightly different from each other, but the basics of the groups in both cases remained practically the same.

In the case of clustering by the K-means method, compositions of all three groups were acquired similar to hierarchical clustering. Therefore, further assessment of the taxonomic coefficients of the healthcare institutions' competitiveness was carried out precisely according to these compositions of clusters, that is, strategic groups. The first strategic group includes private healthcare institutions, among which Saliutem Medical Center has the highest level of competitiveness (Figure 5).

Figure 5. Diagram of taxonomic coefficients distribution of health care institutions' competitiveness of cluster 1



The second strategic group includes most healthcare facilities, dominated by central district hospitals and city clinical hospitals (Figure 6).

The proposed algorithm for determining the taxonomic indicator of the healthcare institutions' competitiveness is an important element of the formation of its market-oriented management mechanism.

The third strategic group of healthcare institutions (Figure 7) is also quite big in terms of volume, and it includes several central district hospitals, as well as three regional medical institutions from Vinnytsia. Healthcare institutions of this group can be divided into two subgroups with almost the same levels of competitiveness.

Figure 6. Diagram of taxonomic coefficients distribution of healthcare institutions' competitiveness of cluster 2

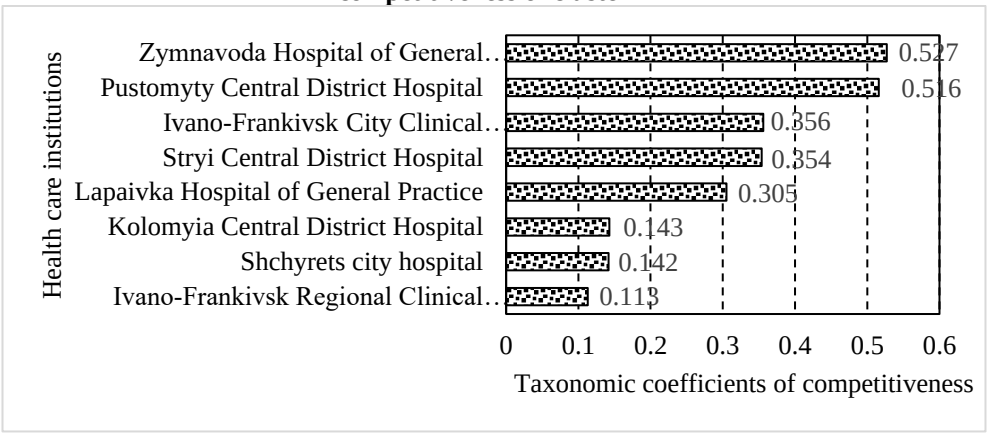
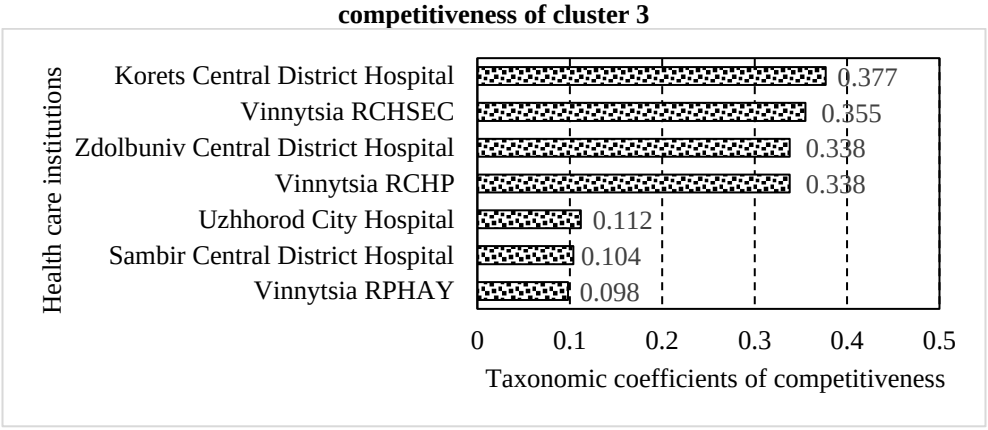


Figure 7. Diagram of taxonomic coefficients distribution of healthcare institutions' competitiveness of cluster 3



Application of the proposed mechanism of market-oriented management of the healthcare institutions' competitiveness will be considered further on the example of the first cluster/strategic group (see Fig. 5), since this strategic group contains a small

number of healthcare institutions and has a clearly defined leader, which in turn will facilitate understanding and reduce the amount of numerical data.

According to the results of the evaluation, Saliutem MC is its leader with the value of the taxonomic coefficient I_l^b = 0.551. Accordingly, the value of the same coefficient for Diamed MC is I_3^b = 0.188, and this institution ranks 3rd in this strategic group. Thus, the lag of Diamed MC from the leader prior to the implementation of measures to improve competitiveness according to formula (2) is:

$$\rho_b = 100 - \frac{0.188}{0.551} \times 100 = 65.9\% \quad (2)$$

In order to choose the most appropriate measures to increase the taxonomic coefficient of the Diamed MC, it is necessary to consider its distance (according to specific indicators, on the basis of which it is calculated) from the reference indicators of this cluster. Maximum distance values correspond to such indicators as annual advertising expenses – 2.449; the convenience of access to the facility – 2.405; qualification level of doctors – 2.449; material motivation (average salary of a doctor) – 2.394; Wi-Fi coverage – 2.121.

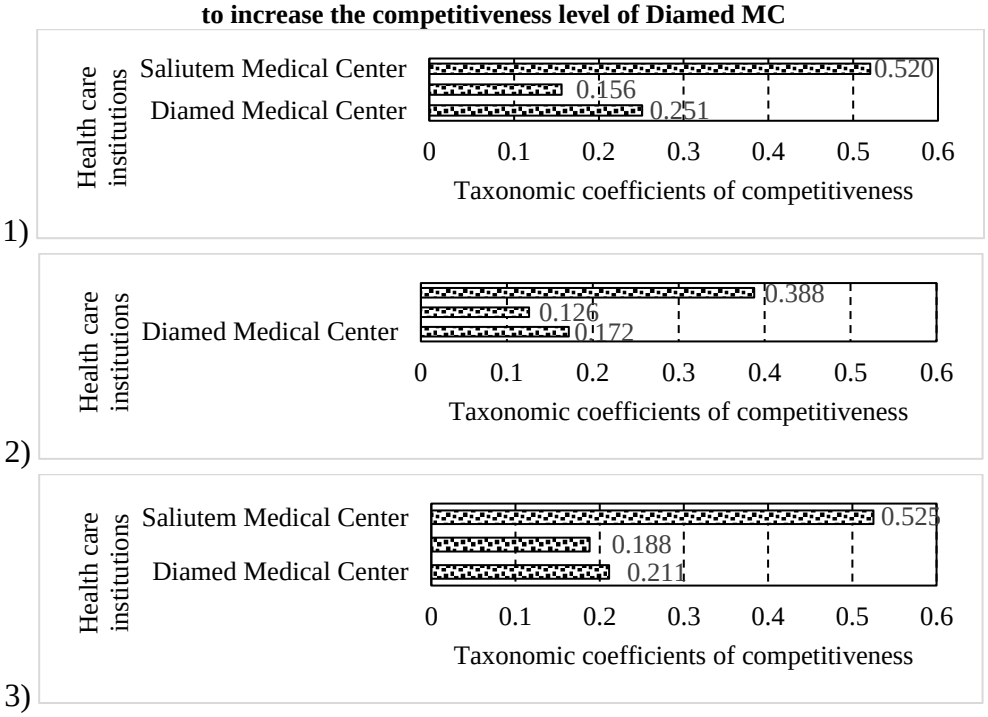
The lag in the indicator of annual advertising expenses of Diamed MC can be eliminated by allocating €3330 for an advertising campaign. However, it is worth noting that the advertising campaign, in addition to increasing the number of customers, will obviously have a positive effect on the image of the institution, which is quite difficult to evaluate. As for the convenience of access to the facility, it is quite difficult to improve this characteristic, therefore, this measure is not even considered.

As for the qualification and motivation of doctors, these two indicators are quite closely interrelated: a higher salary will attract employees that are more qualified. In order to reach the level of Altamedika, which is a reference value in this strategic competitive group, the salaries of Diamed should be increased by 18%. Taking into account the size of the annual salary fund for the medical staff of Diamed MC, the cost of this measure is €17980.

The last proposed Diamed measure is to expand its free Wi-fi zone to 100%. For this, the company needs to purchase 2 Asus BRT-AC828 routers at a cost of 506.3 EUR/piece, as well as incur additional costs for their installation and the electricity they consume. General costs will amount to €1600.

Next, it is necessary to assess the impact of each considered measure on Diamed's competitiveness, by successively making appropriate adjustments to the original observation matrix and recalculating its taxonomic coefficient. The new observation matrix and results of calculations are presented in Figure 8.

Figure 8. Diagrams of the distribution of the taxonomic competitiveness coefficients of healthcare institutions of cluster 1, subject to the implementation of three measures to increase the competitiveness level of Diamed MC



Next, it is necessary to determine the lag of the Diamed competitiveness indicator from the leader in percentages after implementation of each of the measures considered above using a formula similar to formula (1):

$$\rho_p = 100 - \frac{I_i^p}{I_l^p} \times 100 \quad (3)$$

where I_i^p, I_l^p – values of the competitiveness indicator after implementation of a measure in relation to the object under study and the leader, respectively.
Calculated indicators for each proposed measure:

1. Conducting an advertising campaign:

$$\rho_{p1} = 100 - \frac{0.251}{0.520} \times 100 = 51.7\% \quad (4)$$

2. Increasing doctors' salaries: $\rho_{p2} = 100 - \frac{0.172}{0.388} \times 100 = 55.7\%$ (5)
3. Expanding free Wi-fi coverage: $\rho_{p3} = 100 - \frac{0.211}{0.526} \times 100 = 59.9\%$ (6)

The change in the position of Diamed in relation to the leader of cluster 1 after the implementation of each measure in percentage points is calculated:

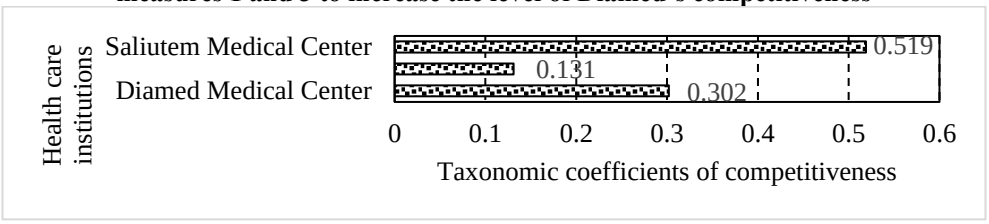
$$\Delta\rho_1 = 65.9 - 51.7 = 14.2\%; \quad \Delta\rho_2 = 65.9 - 55.7 = 10.2\%; \quad \Delta\rho_3 = 65.9 - 59.9 = 6.0\% \quad (7)$$

Next it is necessary to calculate the value of the criterion indicator for each of the three measures according to formula (1):

$$CI_1^{\rho} = \frac{3333}{14.2} = 234.74 (€/\%); \quad CI_2^{\rho} = \frac{17980}{10.2} = 1762.75 \ (€/\%); \quad CI_3^{\rho} = \frac{1603}{6.0} = 267.22 \ (€/\%) \quad (8)$$

As it can be seen, implementation of the first measure will have the highest effect, the second measure is the least effective; the third measure is almost equivalent to the first one in terms of costs, however, the resulting lag of Diamed's competitiveness indicator from the leader is the largest. The first and the third measures can be implemented at the same time (see Figure 9).

Figure 9. Diagram of the distribution of taxonomic competitiveness coefficients of healthcare institutions of cluster 1, subject to simultaneous implementation of measures 1 and 3 to increase the level of Diamed's competitiveness



In addition, the value of the criterion indicator for simultaneous implementation of these two measures will be:

$$\rho_{p1+3} = 100 - \frac{0.302}{0.519} \times 100 = 41.8\%; \quad \Delta\rho_{1+3} = 65.9 - 41.8 = 24.1\%; \quad CI_{1+3}^{\rho} = \frac{4936.7}{24.1} = 204.84 \ (€/\%) \ (9)$$

This combination of two measures, providing Diamed's sufficient financial means, is more effective than any of the single measures discussed above. Therefore, the developed mechanism allows for effective management of the competitiveness of healthcare institutions in their strategic group. The advantage of the proposed methodology is that it not only allows comparing the results of the research conducted at a certain moment but can also be used to assess the dynamics of changes in the competitiveness indicator for each healthcare institution in its strategic competitive group.

4. Conclusions

The study revealed problems of managing the competitiveness of the public healthcare sector. The mechanism for increasing the competitiveness of healthcare institutions, taking into account specific features of the sphere of their operation, was developed.

It is substantiated that in order to make effective decisions on increasing the competitiveness of healthcare institutions, it is necessary to evaluate this level and the factors affecting it. In this regard, the authors have developed a system of indicators for assessing the competitiveness of healthcare institutions. Taking into account service specifics of the medical industry, it consists of seven groups of indicators, in accordance with the 7P marketing concept: quality of medical services, their cost, methods of promotion and distribution, level of qualification and motivation of personnel, level of organization of a service process and a medical care environment. The proposed system of indicators makes it possible to assess comprehensively the competitiveness of health care institutions, identify factors that negatively affect them, and make appropriate effective management decisions.

A methodology for assessing the competitiveness of healthcare institutions has been developed based on the application of multidimensional methods, namely taxonomic analysis, the practical application of which will help managers of medical institutions to effectively manage this latent economic indicator. The taxonomic analysis makes it possible to assess the level of competitiveness of healthcare institutions in dynamics and to determine the main indicators that have the greatest impact on its change.

For economic justification of the effectiveness of measures to increase the level of competitiveness of a healthcare institution in its strategic group, the authors proposed a mechanism of market-oriented management, based on an assessment of the relative effectiveness of alternative measures regardless of the dimensions of their input and output parameters in the form of a relative criterion indicator.

Developed scientific and methodological approaches and practical recommendations were tested on the example of the Diamed Medical Center. Recommendations for increasing its competitiveness in its strategic group in relation to the leader of this group – Saliutem Medical Center – were given.

The research made it possible to confirm the formulated hypothesis, that is, in order to increase the level of competitiveness of healthcare institutions, it is necessary to develop market-oriented measures based on elements of the "7P" marketing mix.

Limitations of the proposed mechanism are that the system of specific indicators is defined for health care institutions. However, the developed system of indicators in the process of its users to assess the level of competitiveness of other service organizations as well as of healthcare institutions with different specializations can be supplemented, refined, and developed.

The mechanism proposed in the article and tested at healthcare facilities can be used to form programs for the development of the country’s healthcare system, plan investment measures in healthcare, and implement the country's medical reform. The proposed mechanism of competitiveness management will have practical value for managers of both public and private healthcare institutions; specialized departments both at the local and state level; the Ministry of Health of the country.

Further research can be aimed at developing/adapting the methodology of competitiveness management for production enterprises of various industries and forms of ownership, or local self-government bodies, as service organizations.

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