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OPTIMIZATION OF MEDICAL EQUIPMENT UTILIZATION IN HEALTHCARE FACILITIES: ANALYSIS, FORMALIZATION AND MODELING

Анотація. *У статті розглянуто проблематику побудови оптимізаційної моделі використання медичного обладнання в закладах охорони здоров'я в умовах цифровізації управлінських процесів. Питання побудови оптимізаційних моделей щодо використання медичного обладнання в умовах стрімких трансформаційних, турбулентних змін і нестабільності стають більш актуальними не тільки в Україні, а й у міжнародному масштабі. Виникає об'єктивна потреба в розробленні засад і практики застосування оптимізаційних моделей використання медичного обладнання, які б мали відповідну універсальність й були придатними до використання суб'єктами охорони здоров'я різних форм власності. Метою дослідження є розробка та формалізація в рамках системи аналізу оптимізаційної моделі використання медичного обладнання для максимізації кількості корисних процедур. Методологія дослідження ґрунтується на системному підході, методах економіко-статистичного аналізу, порівняльному аналізі, моделюванні, елементах методів прийняття рішень та формалізації показників. Застосування цих методів дало змогу визначити основні причини потреби розробки оптимізаційної моделі використання медичного обладнання, провести структуризацію її побудови та формалізувати її відповідно до обраних змінних і обмежень. У результаті дослідження сформовано інформаційно-аналітичну основу (побудовано покрокову схему) й обґрунтовано підхід до формування моделі оптимізації (запропоновано формалізацію), орієнтованої на підвищення доступності медичних послуг, зниження непродуктивних витрат та забезпечення сталого функціонування закладів охорони здоров'я. Практичне значення отриманих результатів полягає у можливості застосування запропонованого підходу для удосконалення системи управлінського обліку та контролю в*

медичних установах, прийняття управлінських рішень щодо модернізації обладнання, планування інвестицій та підвищення ефективності використання такого роду активів. Зроблено висновок про те, що формалізація ключових показників і моделювання процесів використання обладнання створюють підґрунтя для розроблення інтегрованої системи підтримки рішень у сфері управління ресурсами медичних закладів.

Ключові слова: *аналіз, управлінський облік, оптимізаційна модель, медичне обладнання, формалізація, управління, оптимізація, ефективність, показники.*

JEL Classification: D24, I18, C63

Absztrakt. *A tanulmány az egészségügyi intézményekben alkalmazott orvostechnikai berendezések használatának optimalizációs modellje kialakításával foglalkozik a vezetési folyamatok digitalizációjának feltételei között. Az orvostechnikai eszközök használatára vonatkozó optimalizációs modellek kidolgozása a gyors ütemű transzformációs, turbulens változások és instabilitás környezetében nemcsak Ukrajnában, hanem nemzetközi szinten is egyre aktuálisabbá válik. Objektív igény mutatkozik olyan optimalizációs modellek elméleti és gyakorlati megalapozására, amelyek megfelelő univerzalitással rendelkeznek, és különböző tulajdonformájú egészségügyi szolgáltatók számára is alkalmazhatók. A kutatás célja egy, a hasznos egészségügyi beavatkozások számának maximalizálására irányuló orvostechnikai berendezés-használati optimalizációs modell kidolgozása és formalizálása az elemzési rendszer keretében. A módszertani alapot a rendszerszemlélet, az ökonómiai-statisztikai elemzés módszerei, az összehasonlító elemzés, a modellezés, a döntéshozatali módszerek elemei, valamint a mutatók formalizálása képezi. E módszerek alkalmazása lehetővé tette az optimalizációs modell kidolgozásának szükségességét megalapozó fő okok azonosítását, a modell felépítésének strukturálását, valamint annak formalizálását a kiválasztott változók és korlátok figyelembevételével. A kutatás eredményeként kialakításra került az információs-analitikai alap (lépésről lépésre felépített séma), és megalapozásra került egy, az egészségügyi szolgáltatások hozzáférhetőségének növelésére, a nem produktív költségek csökkentésére és az egészségügyi intézmények fenntartható működésének biztosítására irányuló optimalizációs modellkoncepció (formalizált megközelítés).*

Kulcsszavak: *elemzés, vezetői számvitel, optimalizációs modell, orvosi berendezések, formalizálás, irányítás, optimalizálás, hatékonyság, mutatók.*

Abstract*. The article examines the development of an optimization model for the utilization of medical equipment in healthcare institutions under conditions of digital transformation of management processes. The issues of developing optimization models for the use of medical equipment under conditions of rapid transformation and turbulent changes, as well as instability, are becoming increasingly relevant not only in Ukraine, but also internationally. There is an objective need to develop the principles and practical approaches for applying optimization models of medical equipment utilization that would ensure sufficient universality and be suitable for healthcare entities of various forms of ownership. The purpose of the study is to develop and formalize, within the framework of the analysis system, an optimization model for the use of medical equipment aimed at maximizing the number of useful procedures. The research methodology is based on a systemic approach, methods of economic and statistical analysis, comparative analysis, modeling, elements of decision-making methods, and formalization of indicators. The application of these methods made it possible to determine the main reasons necessitating the development of an optimization model for medical equipment utilization, to structure its construction and formalize it in accordance with the selected variables and constraints. As a result of the study, an information and analytical foundation was developed (a proposal was substantiated on the feasibility of forming statistical data on the availability of medical equipment in accordance with world practice; a step-by-step scheme was constructed) and an approach to forming an optimization model was substantiated (formalization was proposed), aimed at increasing the accessibility of medical services, reducing unproductive costs and*

ensuring the sustainable functioning of healthcare institutions. The practical significance of the obtained results lies in the possibility of applying the proposed approach to improve the management accounting and control system in medical institutions, to support managerial decision-making regarding equipment modernization, planning investments and increasing the efficiency of using such assets. It was concluded that the formalization of key indicators and modeling of equipment use processes create the basis for developing an integrated decision support system in the field of resource management of healthcare institutions.

***Keywords**: analysis, management accounting, optimization model, medical equipment, formalization, management, optimization, efficiency, indicators.*

Problem setting. In the activities of healthcare institutions, equipment plays an exceptional role, ensuring the high-quality performance of diagnostic and treatment procedures.

Therefore, the provision of equipment to healthcare institutions is one of the key components of their operational activities. Given the constant shortage of funds, which is characteristic of medical institutions that operate at the expense of budget funds in the form of non-profit institutions, this process should be given special attention. It should, in particular, be expressed in the implementation of clear, accurate and substantiated calculations of the need and possibilities for providing medical equipment.

To form a high-quality and effective resource base, in particular equipment, rational planning of its acquisition and use is of great importance. This requires the construction of an optimization strategic model for providing medical institutions with the necessary equipment. At the same time, there is a need to take into account many different indicators to ensure the effective use of medical equipment, so such a model should be multi-criteria and provide justification for making decisions regarding the procurement, placement, use of medical equipment in a particular institution, as well as its replacement and renewal.

The unconditional result that can be provided by conducting careful calculations related to identifying optimal quantitative indicators for medical equipment is obtaining economic benefits. In conditions of instability and increasing costs, research aimed at optimizing resource use becomes particularly relevant and important.

The problem lies in the complexity of building multi-criteria optimization models, as well as the difficulties of identifying the necessary indicators and elements used in the analysis and formalization process.

Analysis of recent research and publications. In the scientific literature, this direction of scientific research is represented by numerous publications by Ukrainian scientists, mainly in the field of financial support and analysis of the existing achieved indicators of the level of provision, the effectiveness of the use of medical equipment and other important issues. Among them, the following researchers should be mentioned: Lazoryshenets V. V., Slabkyi G. O., Kartavtsev R. L., Semeniv I. P. and others [1], Kartavtsev R. L. [2], Lomakin A. M., [3], Grishchuk S. M., Kilnitska O. S., Yaremova M. I. [5] and a number of other scientists and practitioners. At the same

time, researchers unanimously conclude that the level of medical equipment provision is insufficient.

This is confirmed in particular by a study conducted by Kartavtsev R. L. Based on a survey of heads of municipal healthcare institutions, the researcher found that "the majority of them are not satisfied with the level of provision of medical equipment: diagnostic – 14.0%, treatment – 32.0%, rehabilitation – 18.0%, and the existing level of provision of health care institutions with medical equipment allowed only 14.0% to conclude contracts with the National Health Insurance Fund for the provision of all types of medical care" [2, p. 13] (Fig. 1).

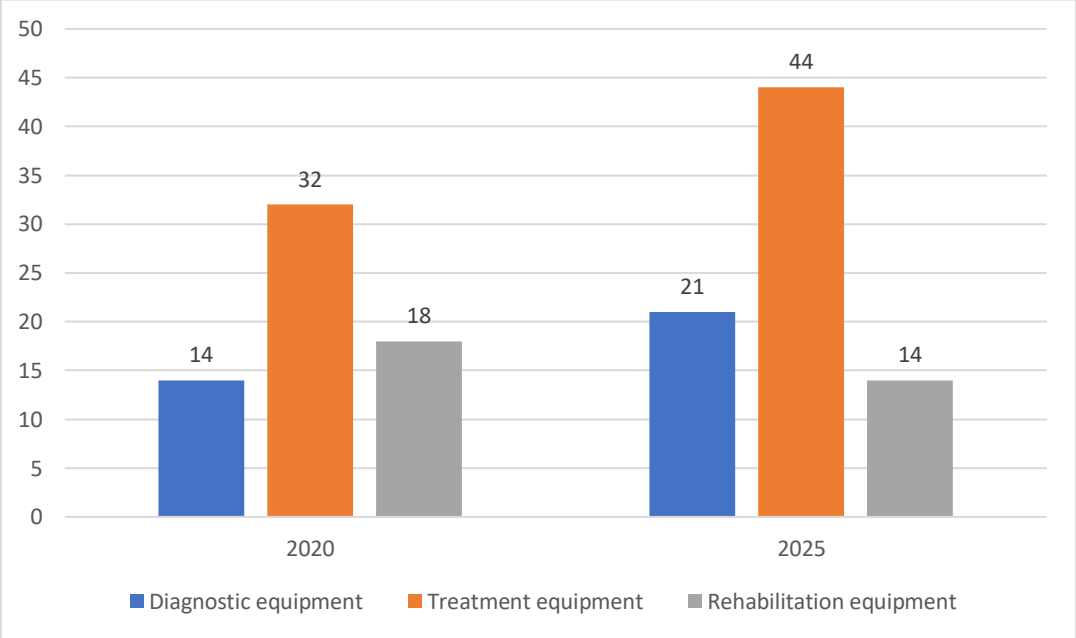

Figure 1. Satisfaction index of heads of municipal healthcare institutions with the level of medical equipment availability, %*

** Source: compiled by the authors based on [2, p.13]*

data for 2025 – according to the results of a study conducted by the authors based on a questionnaire survey of heads of municipal non-profit enterprises - medical institutions of the Ternopil region

Thus, the level of satisfaction of heads of municipal non-profit enterprises - healthcare institutions with the state of provision of medical equipment is quite low. The main reason for this is usually the insufficient level of financial support for the activities of such institutions. Lomakin A. M., recognizing the presence of problems in the development of the provision of medical services related to financing, summarizes that ensuring their proper quality causes "the need to integrate the latest technologies into medical practice, which requires a comprehensive and thoughtful approach to management [3, p.69]. Thus, the implementation of this task requires both high-quality equipment and adequately qualified human capital.

Under martial law, a range of additional challenges emerges. Radchenko O.O. draws attention to these issues by identifying key problems in the material and

technical support of healthcare institutions, particularly emphasizing the shortage of qualified specialists for the installation and maintenance of medical equipment [4, pp. 788–789]. Similarly, Zub V.O. and Kotuza A.S. report a high degree of equipment obsolescence, especially MRI and nuclear medicine equipment, with service lives extending up to 60 years, which results in frequent failures and prolonged downtime [5, p. 59]. Many modern publications are devoted to the economic efficiency of medical technologies, the problems of conducting economic and other types of analysis of resource use in health care institutions [6; 7; 8], as well as the issues of conducting an analysis of activities in the health care sector in general [9; 10; 11]. So, it should be noted that most studies are devoted to solving the problems of financial provision of medical equipment, organizing its supply and efficiency.

Highlighting previously unresolved parts of the general problem. Instead, the issues of building optimization models for the use of medical equipment in conditions of rapid transformation, turbulent changes and instability are becoming more relevant not only in Ukraine, but also on an international scale. There is an objective need to develop the principles and practice of applying optimization models for the use of medical equipment, which would have the appropriate universality and be suitable for use by healthcare entities of various forms of ownership.

Formulation of the objectives of the article (task statement). The purpose of the study is to develop and formalize within the framework of the analysis system an optimization model for the use of medical equipment to maximize the number of useful procedures.

Presentation of the main material of the study. The use of medical equipment is certainly an important element of effective management of the activities of healthcare institutions. The quality of medical services largely depends on the condition, quality and intensity of use of medical devices and instruments. In world practice, MRI and CT are used to perform medical procedures and diagnose in modern conditions. Relevant statistics are even being formed regarding their availability (Table 1).

Table 1.

Availability of MRI and CT in some countries of the world (units per 1 million population), 2021*

Country	MRI / per 1 million population	CT / per 1 million population
Japan	55,2	111,5
USA	38,0	44,0
Germany	30,5	33,9
Italy	25,4	37,0
France	16,0	18,5
Poland	15,0	17,3
Ukraine (unofficial estimate)**	5-6	8-9

** Source: compiled by the authors based on [12, 13,14].*

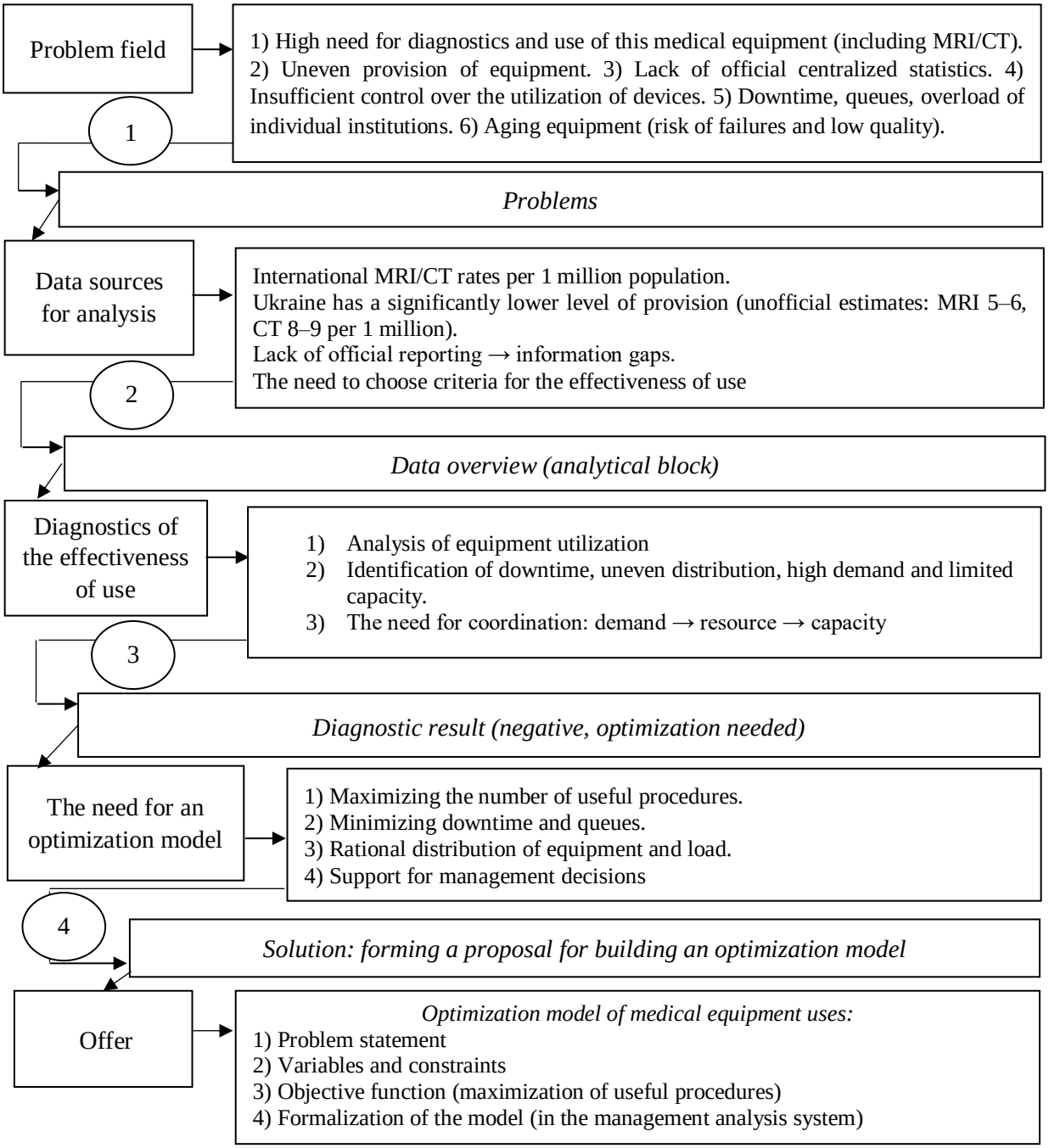

Figure 2. Step-by-step scheme of substantiation and formation of an optimization model for the use of medical equipment*

* *Source*: author's generalization

From the table 1 we can see that the availability of the analyzed types of medical equipment in developed countries varies significantly. However, it should be recognized that in most countries of the European Union and OECD, stable and detailed statistics on the number of units of medical diagnostic equipment (MRI, CT) per 1 million population are formed annually. Such data are published in the open

access and are used for planning financing, determining the need for new equipment, analyzing the availability and efficiency of using technical resources of healthcare. In contrast, in Ukraine, similar statistics at the level of the Ministry of Health of Ukraine, the State Statistics Service or the National Health Service of Ukraine are not officially formed. Information on the availability of equipment is available only in the form of separate data sets of individual KNPs or hospitals, as well as fragmentary registers, which does not allow for a full analysis of the provision of the industry with such assets. The estimated data for Ukraine presented in the table were formed in accordance with available information data.

To build optimization models, as well as based on the need to analyze the relevant indicators, it is justified to develop and legalize the formation of such statistics. Centralized accounting of the quantity and efficiency of medical equipment plays a critical role in healthcare management. It enables the improvement of strategic planning in healthcare financing, the optimization of resource allocation (including equipment), the analysis of equipment workload to determine actual needs, and the development of optimization and forecasting models for the use and renewal of medical equipment. Such an approach contributes to more effective decision-making and ensures that healthcare institutions can allocate resources efficiently. Therefore, the establishment of an appropriate registry and the publication of regular statistical reports, as practiced in developed countries, represent valuable experience that could be adopted in Ukraine. This would facilitate the application of modern approaches to healthcare resource management, and enable the optimization, modeling, and analysis of equipment use efficiency.

To solve the problem of forming an optimization model of the use of medical equipment, it would be logical to implement a certain scheme of step-by-step solutions (Fig.2).

In general, in international practice, the issue of modeling the provision of medical equipment lies in the plane of logistics and has both standardized and special solutions [15]. But they cannot fully correspond to Ukrainian practice. Therefore, research aimed at developing a unified approach, maximally suitable for use by Ukrainian healthcare institutions, is relevant.

The main goal of building a mathematical model is to optimally (with a limited budget) determine how many units of equipment to purchase for each type and each department in order to maximize the total "utility" (equivalent of useful diagnostic procedures / expected improvement in the patient's condition) and minimize unmet demand. For modeling and building its formalization, it is advisable to use some variables and their designations. In particular:

–$w \in W$ – types of equipment (in the example, we will consider 3 types of equipment, namely $Eq_1, \dots, Eq_3$, which is most often used to provide medical services for diagnosing diseases, namely ultrasound machines);

–z∈Z – department (the example will consider 4 departments: Dept1, ... , Dept4 – surgical, therapeutic, urological and cardiological);

–T – planning interval in months (for example, T=12);

–ywz – the available units of equipment of type *w* in department *z* will be marked;

–pwz – the number of units purchased or the planned number of units of equipment to be purchased (target ≥0);

–capw – the throughput of one unit of type w (procedures / month);

–qwz – the number of procedures (throughput) that will actually be provided in the forecast range (procedures / 12);

–dwz – the demand for medical procedures, which is identified on the basis of the achieved actual indicator: (procedures) for the period T;

–cwc – the cost of a unit of equipment, which is established based on prices in the active market (UAH);

$-eff_w$– the effectiveness of treatment (the share of procedures that lead to a valuable diagnostic/treatment result);

–B – budget (set based on the capabilities of the medical institution and usually it can be less than required) (UAH);

–wearwz – existing wear indicator (the calculation of this indicator is proposed to be carried out as the ratio of the total accumulated depreciation to the initial cost of the asset) (0..1);

–other parameters: linear "penalty" for unfulfilled demand φ, permissible wear parameter wear limit – coefficient of equipment wear increase per procedure k.

As a basis for building an optimization model, it is appropriate to take a mathematical model characterized by linearity and integrity – linear / mixed integer – MILP.

So:

Let eff_w – w be the efficiency coefficient of equipment of type w (the proportion of procedures that give a useful result), q_{wz} – be the number of provided procedures, and d_{wz} – be the total demand for procedures. In general, unprovided demand for procedures negatively affects diagnostics and the accuracy of establishing a medical diagnosis, which, of course, affects both treatment and its results. Therefore, in view of this, it is advisable to introduce a penalty weight φ into the model for unfulfilled demand. As a result, the objective function takes on the following formalized form:

$$\sum_{w,z}(eff_w * q_{wz} - \varphi(d_{wz} - q_{wz})) \qquad (1)$$

Having performed purely mathematical operations, in particular, opening the brackets, we obtain:

$$\sum_{w,z}(eff_w + \varphi) * q_{wz} - \varphi d_{wz}) \qquad (2)$$

Given that the sum $\sum_{w,z} \varphi d_{wz}$ contains only known parameters (demand) and does not depend on the decision variables, it, therefore, does not affect the search for the optimum.

Given this fact, this objective function can be written in a simplified form:

$$max \sum_{w,z}((eff_w + \varphi)\, q_{wz}), \qquad (3)$$

where $p_{wz} \in Z \geq 0$, $q_{wz} \geq 0$.

Taking into account the content and components, the proposed objective function of the model maximizes the number of useful procedures (i.e. those that provide diagnostic or therapeutic effectiveness) and, at the same time, takes into account the penalty for unsatisfied demand. The corrective component is introduced in the form of a coefficient φ, which emphasizes the presence of unsatisfied medical services for which there was actually a demand, respectively, reduces the value of the results by the indicator of unsatisfied procedures. Automatically, the conclusion suggests itself about the need to rationalize the use of medical equipment, i.e. to improve its distribution between departments, or to make a decision to purchase additional equipment. Thus, the model is focused on maximizing the efficient use of equipment, taking into account its impact on the effectiveness of medical procedures and the penalty for unfulfilled demand.

The implementation and experiment (in brief) in our example is based on data from one of the hospitals in Ternopil . The hypothesis is to represent them as randomly simulated data to show how the approach works. The details of the simulation consist in using the declared variable data (w∈W in the corresponding section, z∈Z , which, as is known, was selected in the amount of 4 departments, T=12 months, i.e. 1 year, as well as taking into account additional (random) indicators, in particular: generation: y_{wz} – random 0-2 units; d_{wz} – random demand in the range of 500-4000 procedures per planning interval; cap_w – [120, 80, 200] procedures/month; *cost* – [1200k, 800k, 2500k] UAH; *effw* – [0.6,0.4,0.8]; *wear* random value [0.1..0.6]. The budget is set to B=10000000 UAH.

The input parameters of the model are 3 types of equipment: electrocardiographs (equation 1), X-ray machines (equation 2) and ultrasound diagnostic machines (equation 3). This medical equipment is located in such departments as therapeutic (department 1), urological (department 2), cardiological (department 3) and surgical (department 4). At the input of the optimization model, we have data on the quantitative composition of the equipment in the analyzed departments (Table 2).

Table 2.

The number of available medical equipment in 4 departments of the hospital*

Type of equipment	Dept1	Dept2	Dept3	Dept4
Eq1	2	0	2	1
Eq2	0	2	2	2
Eq3	1	0	1	2

** Source: based on data from Hospital*

Individual indicators of the available medical equipment, which confirm both normative and actual data on its use, are summarized in Table 3. In this table, actual use is represented as a relative indicator: efficiency shows the ratio between the actual and normative number of medical services.

However, there are other options for calculating the efficiency of equipment use, which medical institutions can use in the represented model.

Table 3.

Throughput and efficiency of medical equipment use*

Type of equipment	Throughput (procedures/month)	Efficiency	Unit cost, thousand UAH
Eq1	120	0.6	1 200
Eq2	80	0.4	800
Eq3	200	0.8	2 500

* *Source: based on data from Hospital*

For the selected medical equipment in the depreciation level was calculated. It will be considered the initial (baseline) indicator (Table 4.).

Table 4.

The initial depreciation level of medical equipment, identified taking into account the amount of accrued depreciation and the original cost*

Type of equipment	Dept1	Dept2	Dept3	Dept4
Eq1	0.33	0.12	0.50	0.22
Eq2	0.43	0.15	0.34	0.44
Eq3	0.41	0.11	0.56	0.32

* *Source: based on data from Hospital*

Taking into account requests for examinations using medical equipment, which are recorded in the logs of examinations conducted, and schedules for appointments with an ultrasound doctor, it is possible to identify the demand for this type of medical procedures (Table 5).

Table 5.

Demand for diagnostic services using medical equipment

Type of equipment	Dept1	Dept2	Dept3	Dept4
Eq1	3 500	2 200	3 100	2 700
Eq2	1 800	2 900	3 400	2 300
Eq3	2 600	3 100	3 500	3 000
Total by branch	7 900	6 220	10 000	8000
Total	32 120			

* *According to the data of examination logs and examination records*

Taking into account all these initial indicators, the optimization model will take into account the most important parameters, which will contribute to its maximum approximation to real requests and conditions. In this case, the main parameters of the model are the planning period (planning horizon), the possible allocated budget for the purchase of equipment, the wear and tear of medical equipment, the reducing coefficient for unsatisfied demand due to the lack of free time zones, the maximum equipment (Table 6).

Table 6.

Main parameters of the optimization model*

Parameter	Designation	Value
Planning horizon	T	12 months
Total budget	B	10 000 000 UAH
Depreciation limit	w_{lim}	0.85
Depreciation growth rate	k	1×10^{-5}
Penalty for unfulfilled demand	φ	0.5
Maximum purchase units	p_{max}	20

* *Source*: *Generated by authors based on the main model parameters*

According to the formalized representation of the model, the results of optimizing the use of medical equipment were obtained, which are summarized in Table 7.

Table 7.

Resulting table of optimizing the amount of equipment to fully meet the needs for medical services*

Type of equipment	Dept1	Dept2	Dept3	Dept4	Total
Eq1	1	0	0	1	2
Eq2	0	1	0	0	1
Eq3	0	0	1	0	1
Total	1	1	1	1	4

* *Source*: *Calculated by authors based on input data*

Therefore, according to the results of building an optimization model for the use of medical equipment in the studied hospital, in order to fully ensure the provision of services that are in demand from the population, it is necessary to purchase 4 units of medical equipment (1 of each type). That is, it is most expedient to purchase 4 units of equipment of different types for different departments, which provides the best "efficiency/cost" ratio. In addition, this will make it possible to provide the appropriate number of services (procedures) (Table 8).

Table 8.

Number of medical services (procedures) provided using the optimized medical equipment fleet*

Type of equipment	Dept1	Dept2	Dept3	Dept4	Total
Eq1	3 100	2 100	3 000	2 700	10 900
Eq2	1 800	2 800	3 200	2 300	10 100
Eq3	2 400	3 000	3 400	3 000	11 800
Total	7 300	7 900	9 600	8 000	32 800

* *Source*: *Calculated by authors taking into account optimization proposals*

The obtained indicators in the optimization model allow us to calculate the predicted number of diagnoses that can be established using the new medical equipment (Table 9).

Table 9.

The predicted number of diagnoses*

Type of equipment	Coefficient of use of equipment for clarification of diagnoses	Number of diagnoses
Eq1	0.60	6 540
Eq2	0.55	5 555
Eq3	0.60	7 080
Total	-	19 175

* *Source*: *Calculated by authors taking into account optimization proposals*

In the Procurement Plan, if we take into account the prices on the medical equipment market, the total purchase amount will be 6,687,435 UAH. (Table 10).

Table 10.

Financial indicators of medical equipment purchases*

Type of equipment	Number of purchases	Unit cost, UAH (1)	Amount of expenses, UAH
Eq1	2	135 000	270 000
Eq2	1	3 731 935	3 731 935
Eq3	1	2 685 500	2 685 500
Total	-	-	6 687 435

** - price quotes from open sources; (1) – cost: (Eq1) 12-channel electrocardiograph Mindray BeneHeart R12; (Eq2) Browiner MobileCooper – X-ray machine; (Eq3) GE VOLUSON E10 – ultrasound machine.*

In general, the generalized results obtained when forming the optimization model based on the selected parametric input data are as follows:

– Total demand for medical services using medical equipment – 34,200 (examinations);

– Examinations provided – 32,800 (≈ 96%);

– Number of diagnoses established through the use of medical equipment – 19,175;

– Equipment purchases costs (forecast budget) – 6,687,435 UAH.

In summary, it should be noted that the proposed model showed the fact of possible rational and effective use of the available budget, ensuring almost full satisfaction of demand at minimal costs. According to the results of analytical calculations, the most effective in the context of the number of medical services provided are ultrasound devices, which provide the largest contribution to the total number of diagnoses. The optimal distribution of investments, which is identified in the model as financial indicators, ensures an increase in the diagnostic capacity of the institution by ≈15–20% without exceeding financial constraints.

Conclusions and prospects for further research. The growing role of medical equipment in the treatment and diagnosis of diseases and the rapid development of innovativeness of such assets require a critical assessment of their capabilities and efficiency of use. In conditions of instability and shortage of funds, the use of the proposed optimization model to improve the quality of medical care and overcome the

gaps between demand and real technical capabilities of its provision is a priority task. In addition, the model is focused on taking into account the limitations of financial resources and acts as a comprehensive approach based on system analysis, standardized data collection and the implementation of optimization models of resource provision. The proposed general logic of formalizing the model in the management analysis system includes the main basic elements: taking into account the function and purpose; key variables and limitations.

Thus, the results of the study not only highlight the problematic aspects of managing the technical resources of medical institutions, but also form the basis for the introduction of mathematical modeling tools into management practice. The proposed approach has the potential to be used by health care management bodies, KNP and regional departments in order to increase the efficiency of the use of expensive equipment and increase the availability of quality medical services for the population.

In the future, there is a need to study the problems of forming and substantiating basic tools and libraries for preparing a software environment for implementing the proposed model. In addition, it is advisable to develop the issue of individual selection of initial indicators for building a model in order to take into account the specifics of each specific medical institution. It is no less important to carry out a practical implementation (experiment) using the proposed approach to identify the level of its adaptability and compliance with modern management languages and requests.

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