

ANALYSIS OF MEDICAL EQUIPMENT USAGE EFFICIENCY, AS A KEY ELEMENT OF MATERIAL AND TECHNICAL RESOURCE MANAGEMENT OF HEALTHCARE INSTITUTIONS

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Abstract. The article defines the problem of efficiency of use of medical equipment as a key element of the management of material and technical resources of healthcare institutions. The basic directions are considered to increase the efficiency of use of medical equipment.

Keywords: healthcare facility, resources, material and technical resources, medical equipment, fixed assets, methods of calculation of depreciation.

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Introduction

Maintaining and improving the health of the nation today is the main goal of the modern healthcare system. The practical realization of this goal is feasible by providing a highly qualified curative and preventive medical care, which is currently impossible without the use of modern medical equipment.

Today the effective functioning of the health system is determined by the main backbone factors, including the development of infrastructure and resources for healthcare, such as financial, material and technical and technological equipment of medical institutions on the basis of innovative approaches and principles of standardization.

The relevance of this problem is confirmed by the lack of the development of issues related to the resource management in healthcare. These issues in various aspects were studied by such domestic and foreign scientists as A. I. Vyalkov, N. F. Gerasymenko, O. V. Yemelyanov, F. N. Kadyrov, N. Kravchenko, V. N. Korablyov, V. Z. Kucherenko, A. L. Lindenbraten, D. Rais, O. V. Rutkovsky, V. I. Starodubov, F. Figeyras, V. O. Flek, O. P. Shchepin, R. Akehurst, M. Audibert, A. Becerril-Alquicira, L.K. Brown, E. D. Kinney, S. Ross, M. Sohnuv, K. Werling, etc.

The management and reproduction of fixed assets of healthcare institutions were considered by many researchers, including: A. B. Zhdanko, D. Cox, V. Korzhnevskaya, Yu.V. Kurenkov, P. M. Pivniv, P.P. Tokarev, S. Feller, and others. The works of D. M. Polterovich, A. V. Selivanov, N. Z. Akberdin, A. C. Conson touch the problems of repairing fixed assets, which are the equal sources of their reproduction, types of repairs, features and consistency of their conducting, the cost and time of the regulatory period. The necessity to establish a system of reproduction control was defined, which requires varying the lifespan based upon certain operating conditions of the equipment.

Factors of influence on rendering medical services

The rational use of medical equipment and functional capacity contributes to the improvement of all technical and economic indicators, in particular to reduction of the labor input of the units of work performed or services rendered and the increase of the effectiveness of the institution as a whole.

Determining the efficiency level of medical equipment use by its range and cost represents one of the ways to assess the operation of this equipment in the healthcare sector. However, this evaluation method is not effective in relation to the efficient use of equipment in medical and diagnostic work.

The vast majority of devices, gadgets in hospitals are in constant operation, and the quality of medical care depends on the efficiency of their use. In future terms provided by the medical reform, the development of medicine will contribute to the formation process of technical re-equipment of medical institutions with medical equipment, where the most important criterion should be the growth of available medical services. The influencing factors at "creating medical services" can be divided into primary and secondary factors, which in the ultimate combination recreate the synthesized results (Figure 1).

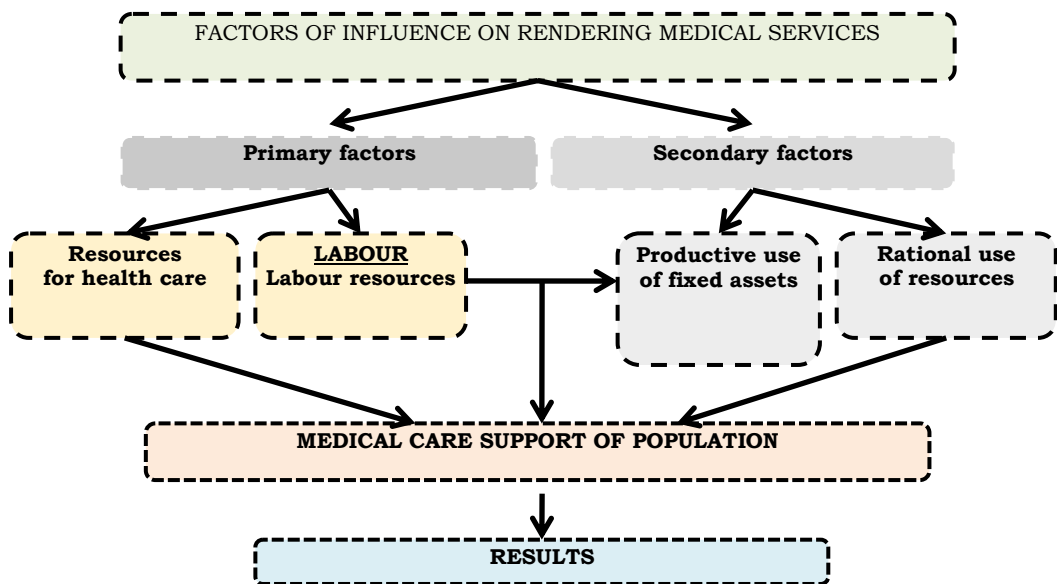


Fig. 1. Factors of influence on rendering medical services.

In conditions of limited resources the limiting factor is the economic effectiveness of medical institutions, because the increasing cost of medical equipment worsens the financial capability to purchase it. As a result more and more urgent becomes the task of evaluating the economic aspects related to medical equipment, the urgent problems of the "necessity" to purchase this or that equipment.

The above aspects, particular the assessment of the economic efficiency of the equipment can be considered at several levels, namely the equipment purchase efficiency; the

equipment use efficiency; the equipment maintenance efficiency; the effectiveness of equipment recycling.

The quality of medical care, its availability and security are directly related to the capital-labor ratio of the medical staff. The increase in depreciation level of medical facility each year produces the reduction of its impact.

According to the Regulations (standard) of accounting 7 the Main assets are defined as tangible assets that the company/institution holds for the purpose of using them in manufacturing process/activities or the supply of goods, rendering services, renting to others or for the implementation of administrative and socio-cultural functions, the expected term of life operation of which is more than one year (or operating cycle, if it's longer than a year) (Regulation (Standard) of Accounting 7 "Fixed Assets", of 27.04.2000).

Table 1.

Groups of fixed assets

Groups of fixed assets	Minimum allowable lifespan period
group 1 - land	not fixed
group 2 - capital expenditures on land improvement not related to construction	15 years
group 3 – buildings, structures and transferrable extensions	20, 15 & 10 years correspondingly
group 4 – devices and equipment of them: - computers and other devices for data processing, related to them - devices for reading and printing the information, related to them - software (except software recognized as royalties and/or software recognized as intangible assets), other information systems, switches, routers, modules, modems, UPS and means of connection to telecommunication networks, telephones (including cellular), microphones and radios which cost more than UAH 2500.	5 years 2 years
group 5 – transport means	5 years
group 6 – instruments, tools, utensils (furniture)	4 years
group 7 - animals	6 years
group 8 – perennial plants	10 years
group 9 – other fixed assets	12 years
group 10 – library holdings	not fixed
group 11 – low-value non-currant assets	not fixed
group 12 – temporary (not title) structures	5 years
group 13 – natural resources	not fixed
group 14 – inventory packaging	6 years
group 15 – rental items	5 years
group 16 – long-term biological assets	7 years

At the present stage it is an increasingly urgent task to improve the medical-technical policy, as the development of the national healthcare system is largely determined by the degree of technical equipment of medical institutions. An important role in the performance of healthcare institutions belongs to medical equipment, other medical devices and tools for special purposes, which largely determine the quality of medical care. The whole group identifies the most active part of fixed assets in contrast to passive ones, which includes

buildings, structures (tab.1). Depending on the group to which a particular object of fixed assets refers, the minimum allowable depreciation periods are set (from 2 to 20 years) (Regulation (Standard) of Accounting 7 "Fixed Assets", of 27.04.2000).

One of the main factors to increase the efficiency of fixed assets usage is their timely updating and technical improvement. The considerable reserves of efficient increase of fixed assets usage are contained in the longer work duration of medical equipment, and therefore it is necessary to create a system of "support". As a result of prolonged use of the basic tools they are subject to wear and tear. For the objective assessment of the assets state we must take into account their physical and moral deterioration. In determining the operation life there should be taken into account:

- the expected use of the part of fixed assets on the basis of its capacity and productivity;
- the alleged physical and moral wear and tear;
- legal or other restrictions on the timing of the use of the object and other factors.

The rational use of resources in conditions of limited funding is the most important priority of health reform.

To ensure the continuous operation of medical institutions, the need for constant reproduction of physically worn out and technically outdated means of labor (fixed assets) acquires a new meaning (Fig.2).

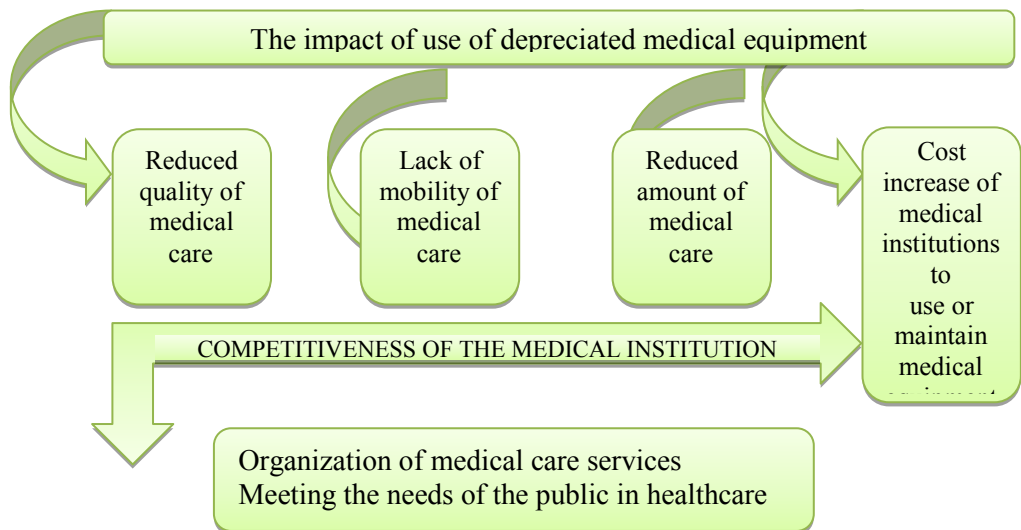


Fig.2. The impact of the depreciation of medical equipment on the quality of medical care

Based on the aforesaid, it can be claimed that the use of the outdated equipment directly affects the quality of medical care and the expenditures of healthcare institutions. The use of obsolete and technically worn-out equipment leads to the increased energy and material consumption of products that affect the increase in the cost of medical services. In addition, the depreciation of the equipment constitutes an imbalance of the functioning of healthcare institutions, which makes it impossible for the timely and fully satisfied needs of the public in medical care.

The compensation for wear and tear of the functioning medical equipment and the accumulation of a certain amount of funds required for the purchase of new equipment are carried out by charging depreciation. The amount of accumulated depreciation during the operation of an object of fixed assets represents the value of its wear and tear, which shall timely and effectively influence the state of medical equipment.

The effective functioning of modern healthcare institutions in a market environment requires a prudent depreciation policy, which will provide a timely update of the fixed assets and at the same time give the opportunity to keep prices for medical services not higher than their average market level.

Consequently, the absence of a holistic approach to accounting of depreciation of fixed assets in the conditions of market economy creates a practical need for a comprehensive study of methodological issues in its implementation, and leads to high relevance and significance of the research on this issue.

In practical management the medical institutions can apply one of several methods of depreciation calculation: straight-line, production, reduction of the residual value, the accelerated reduction of residual value and cumulative depreciation methods (Yevtushenko, 2004). To determine a more economical and expedient method for calculating the depreciation by medical institutions we have to analyze the main characteristics of each of them.

The method of straight-line depreciation provides uniform charges throughout the useful life of fixed assets, the amortized cost is uniformly charged to operating costs of the medical institution; the method is easy to apply for the institution which annually provides medical services in stable quantities and the basic assets of which almost never lose their value and relevance over the years. If the volume of medical services varies significantly, while using this method in the periods when the services are provided in small quantities, their value in the market can be much higher than the market average and lose attractiveness to potential consumers (Thompson, Strickland, 2008). This is due to the need of distribution of annual depreciation among fewer units of services provided, as a result each given service will account for a greater amount of depreciation, and services, respectively, will become more expensive.

The production depreciation method is based on the assumption that the fixed asset depreciates only during its operation, the time of its idleness does not affect the process of depreciation, and the production rate of depreciation determines what part of the cost of the asset, which amortizes, falls per unit of provided medical services, based on estimated total volume of provided medical services for all its useful life. In the calculation of depreciation using the production method, special attention is drawn to the full use of the productive capabilities of the equipment in providing services; the method is used if it is possible to determine the actual volume of services over a certain period.

Methods of calculating depreciation belonging to accelerated ones enable faster compensation of depreciation of fixed assets. Their essence is that at the beginning of fixed assets operation the sums accrued in this case significantly exceed the depreciation amounts accrued at the end of the lifetime of the objects. The attractiveness of these methods is that most types of fixed assets are more efficient when they are new and have high production capabilities. Over time, the repair costs increase, and at the end of the lifetime of the object they are much more than in the beginning. One method, which is based on the assumption that the object of the basic means operates best in the first years of its use is a cumulative method, for its calculation the coefficient of cumulating is used, it is a method of writing off the costs on the sum of the number of years.

Judging from above the accelerated methods of calculating amortization can be recommended for use in healthcare institutions as they timely and fully reimburse acquisition, repair and modernization costs of fixed assets.

Some indicators of efficient use of industrial facilities (equipment) are reflected also in evaluating the effectiveness of the use of medical equipment in treatment- and- prevention healthcare institutions. These include indicators characterizing the efficiency of equipment in time: the calendar coefficient of equipment use and the coefficient of variability of the equipment. The actual (real) equipment fund-time consists of actual work time, as well as preparatory - useful and auxiliary time, and the mode of operation is determined by the actual equipment work in the medical office of healthcare institutions. The level of equipment use per hour is characterized by a system of coefficients of equipment extensive loading, calculated as the ratio of the actual working time of medical equipment to the general fund of time (calendar, operating, planned).

There are various methods of calculating this ratio. The most common method used is for the installed equipment, which takes into account both fully and not fully worked out shifts. It's enough for a device or tool to work for a few minutes as this work is counted as fully-established shifts. The method makes it possible to calculate the coefficient of variability for all the equipment installed in a medical office, laboratory, department. One can assume that during the work shift each of the machines and devices installed in the office will be used at least for a short period of time.

The value of the coefficient of variability can not exceed the number of shifts to the established mode of operation of an office, department, laboratory. The more the length of time to analyze, the more accurate the coefficient of variability is. Along with the hospital capacity, availability of the trained personnel, the amount of population served, the coefficient of variability is influenced by the number of available hospital rooms of the same type, i.e. equipment concentration. The centralization of a medical - diagnostic service contributes to a more efficient use of medical equipment.

The coefficients of the calendar use of equipment and shift, characterizing the use of the equipment in time, can't give us an answer about the extent of its use for direct care of patients. The equipment can work in 1.5 and even 2 shifts, but it can be not fully loaded.

To assess the extent of use of the medical device, apparatus or group of apparatus, devices, it's necessary to know their bandwidth, or have the possibility for indirect calculation of bandwidth. This possibility arises in cases where the labor of personnel using medical equipment is normalized.

The degree of equipment utilization (in percentage) can be calculated as the ratio of actual workload to the rates of bandwidth. In the same way, you can indirectly assess the degree of use of equipment of laboratories and physical therapy offices, given the load of the medical personnel working with this equipment.

An indicator that reflects the level of equipment use for a capacity factor is the coefficient of the intensive use of equipment, which is calculated as the ratio of an actual performance of a piece of equipment to a planned one.

The next group of efficient performance of fixed assets that can be singled out is efficiency and capacity of fixed assets (capital productivity / capital ratio) (Kobylyanska, 2007). The impact of fixed assets depends on the schedule of the institution (the average number of days of bed occupancy within a year and the number of days of clinics operating).

Along with increasing of the time operation of fixed assets to intensify their impact it is particularly important to increase the intensity of their use. This is an increase in turnover of

beds in hospitals by reducing the average length of hospitalization, and the improved work organization.

The return of fixed assets characterizes the share of hardware services supplied by a medical institution for a certain period per 1 UAH of average annual value of fixed assets.

A sharp increase in the fixed assets output can be associated with the overload calendar days throughout the year, or the clinic excessive load, and the increase in the efficiency of fixed assets output should not receive a positive assessment.

Another aspect of the analysis of fixed assets use is the characteristic of their updating. Fixed assets may get overage not only physically but also morally. The degree of updating of fixed assets largely reflects the intensity of the institution involvement in the scientific-technical progress.

The annual renewal of the active part of fixed assets by 12-15% can be accepted as the standard (Devashchuk, 2002).

The indicators specified in this section together characterize the use of fixed assets in medical institutions.

The more efficient use of fixed assets contributes to solving a wide range of economic issues related to the effective rendering of health services: the increase of the medical services volume, the increase of the productivity of the medical personnel, the reduction of costs of services provided, saving capital investments.

The most important indicator of the efficiency in the use of assets by medical institutions is the growth in services provided by them. One of the most important factors of increase of efficiency of fixed assets is primarily updating and the technical improvement and the introduction of achievements of scientific-technical progress that allows us to increase the level of mechanization and automation in rendering healthcare services as a result of the increased productivity of the medical staff.

Conclusions and suggestions

Hence, the set of possible reserves to increase the efficiency of use of medical equipment can be provided at the following levels:

- The technical improvement of means of labor, which provides:
 - technical upgrading on the basis of complex automation;
 - the replacement of obsolete machinery, equipment upgrading;
 - the elimination of bottlenecks and imbalances in the production capacity of medical institutions;
 - the mechanization of auxiliary and servicing industries;
 - the development of invention and innovation.
- The increase of work duration of machinery and equipment due to:
 - the elimination of inoperative equipment (to rent, to lease, to realize, etc.);
 - the reduction of terms of equipment repairing;
 - the downtime decrease: the whole shift closing and inside the shift.
- Improving the organization and management of production, namely:
 - accelerating the achievement of the designed capacity of the commissioned fixed assets;
 - the introduction of scientific organization of labor in healthcare services;
 - the improvement of the provision of material and technical resources;
 - the improvement of the management based on modern computer technologies;

- the development of material incentive of employees, thereby increasing the production efficiency.

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