

Modernization of accounting of material and technical management of rural health care through information technology

Modernización de la contabilidad de la gestión material y técnica de la atención de salud rural a través de la tecnología de la información

Aleksei I. SOZONOV [1](#); Natalia S. BRYNZA [2](#); Andrey Yu. KUDRYAKOV [3](#); Iuliia S. RESHETNIKOVA [4](#); Lena A. SUNGATULLINA [5](#)

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Content

- [1. Introduction](#)
 - [2. Literature review](#)
 - [3. Materials and methods](#)
 - [4. Results and discussions](#)
 - [5. Conclusions](#)
- [Bibliographic references](#)

ABSTRACT:

The lack of reliable information on the status of fixed assets of medical institutions located in rural areas complicates the development of management systems for the material and technical resources of rural health care. Given that modern information technologies are widely used in health care, a topical solution of this problem is the automatic collection, processing, storage and analysis of data on material and technical equipment of rural health care. The aim of the research is to develop an automated information system that provides the collection of indicators of the material and technical equipment of rural health care for monitoring purposes. To achieve this goal, methods to collect, process and analyze information on the equipment of feldsher-midwife stations and outpatient clinics were used. Automated system "Monitoring of material and

RESUMEN:

La falta de información confiable sobre el estado de los activos fijos de las instituciones médicas ubicadas en áreas rurales complica el desarrollo de sistemas de gestión de los recursos materiales y técnicos de la atención de salud rural. Dado que las modernas tecnologías de la información son ampliamente utilizadas en el cuidado de la salud, una solución tónica de este problema es la recolección, procesamiento, almacenamiento y análisis automáticos de datos sobre el material y el equipo técnico de la atención médica rural. El objetivo de la investigación es desarrollar un sistema de información automatizado que proporcione la recopilación de indicadores del material y el equipo técnico de la atención de salud rural para fines de monitoreo. Para lograr este objetivo, se utilizaron métodos para recopilar, procesar y analizar información

technical management of rural health care" was developed as a result of the study.

Keywords Rural health care, a feldsher-midwife station, outpatient clinic, material and technical management, equipment standard.

sobre el equipo de las estaciones de feldsher-midwife y las clínicas ambulatorias. El sistema automatizado "Monitoreo de materiales y gestión técnica de la atención médica rural" se desarrolló como resultado del estudio.

Palabras clave: Atención de salud rural, una estación de feldsher-midwife, clínica ambulatoria, gestión material y técnica, equipamiento estándar.

1. Introduction

One of the urgent problems of modern health care is optimal resource management, which consists in maximizing the effective use of the available material resources of health care and the rational development of material and technical management (Starodubov *et al.*, 2002a, pp. 19-24; Starodubov *et al.*, 2002b, 10-13).

Given that medical care continues to be a "pain point" of the social infrastructure for the rural population of Russia, one of the important problems in the methodology of health development is the consideration of the need for medical care for the rural population (Gasnikov, 2002, pp. 4-5); at the same time, they should also be given sufficient attention in the course of comprehensive informational support of regional health care (Gasnikov, 2004, pp. 4-11; Kudrjakov *et al.*, 2011, p. 107).

An important condition for the provision of quality medical care to the rural population is the availability of material and technical management (MTM) of feldsher-midwife stations (FMS) and outpatient clinics (OC), which meets the requirements of regulatory acts.

The development of management systems for the material and technical resources of rural health care is complicated by the lack of reliable, timely information on the status and dynamics of fixed assets of medical institutions located in rural areas.

In order to obtain this information, it is necessary to take into account more than 170 parameters in every rural health care institution, including factors such as: population health as the dominant factor, socio-economic and climatic-geographical differences of regions, territorial features of the established systems of medical assistance organization (Martynchik, 2007, p. 53). Evaluation and analysis of all the above parameters without the use of information technology is represented as a time-consuming and resource-expensive problem. Given that modern information technologies, the development of which provides for the optimization of management, activities' intensification, the possibilities for effective control, forecasting, development planning and financing, are widely used in all sectors of the national economy, including health care (Gulieva *et al.*, p. 6-18 2011; Sannikov *et al.*, 2008, pp. 96-97), an actual solution to this problem is the automatic collection, processing, storage and analysis of MTM FMS and OC data.

2. Literature review

Problems of accounting information formation in the conditions of information systems technologies' application were considered in (Berest, 1969, pp. 1039-1047; Manevich, 1967, pp. 53-56; Ng *et al.*, 2017, p. 34) studies and others. However, questions related to the system automation in the sphere of resource support in health care institutions remain underinvestigated.

The definition of the accounting information system in a generalized form is given in (Éksler, 1985, pp. 218-222; Mil'chenko *et al.*, 1980, pp. 327-331; Zernov *et al.*, 1975, pp. 429-432). Information support is a dynamic system of obtaining, evaluating, storing and processing data created for the purpose of developing managerial decisions.

Based on the above definition (Grigor'ev *et al.*, 2015, pp. 244-250) we can allocate the main aspects of reforming the accounting information structure of a medical institution:

Hardware-in-the-loop (environment and means of economic information's automated processing);

Organizational (management system, hierarchy of levels, objectives, integration of management functions, program-target approach);

Accounting and methodological.

Accounting and information system – is a set of implemented solutions for the volume, location and forms of organization of information circulating in the system of economic information's automated processing. In the study (Éksler, 1985, pp. 218-222) breaks down the entire accounting process into several stages while maintaining the financial accounting under the conditions of the automated information processing system and considers that a comprehensive study of automation of accounting, control and analysis requires the creation of a conceptual model.

The main prerequisites for organizations to introduce information technologies are due not only to the desire to increase the productivity of everyday work, but the need to increase the efficiency of the medical institution management as a whole through the adoption of rational management decisions. In addition, keeping records, in particular, the movement of material values in medical institutions requires the organization of a cumbersome workflow with the compilation of a significant amount of primary documents and the maintenance of accounting registers. Daily manual processing of primary accounting documents with the entry of data into the accounting registers is quite laborious. Successful implementation of the task assigned to the counters should be provided by modern computer facilities.

The importance of solving the problem of constructing an effective accounting system in the field of resource provision in the conditions of rapid informational support of society predetermines the need for using such information products that have a wide range of functionality, that is, they contain the necessary data for planning, accounting, monitoring, analysis, and evaluation of medical institutions.

Therefore, it is possible to improve the efficiency of accounting work of an accountant, analyst or manager in a medical institution through the use of modern information technologies and the document circulation automation. It is possible to quickly solve the tasks and satisfy the interests of all stakeholders in the accounting with the help of information technology. In conditions of rapid development of information systems and technologies, software products that are used in medical institutions often do not meet the requirements set by the company's management team (for example, centralized resource management, etc.) through their functional obsolescence. As the issues of long-term development of the company determine the direction of improving the management system, we therefore proposed the use of an integrated automated management system based on modern software products in medical institutions.

The costs of the logistics process should be subject to a constant and strict accounting, as along with other costs have an impact on the formation of the organization's final financial result. The lack of information on the costs of the logistic support process contributes to their ineffective management. In turn, incomplete research and study of these costs contributes to their uncontrollability. Depending on the form of organization of the activity type and the existence of various barriers in the activity of the medical institution, such expenses can be significant and essentially affect managerial decisions regarding future activities. That is why ignoring the issues of their reflection in the account is not advisable.

However, this issue did not find an unequivocal solution in the modern accounting system, and the reflection of costs arising at the stage of the material and technical management's organization and in the future is not regulated by law. So, you can get the necessary information about the costs of the logistics process with the help of a well-organized system of financial and management accounting. Based on this information, the management of the medical institution will have the opportunity to optimize the amount of these expenses.

It is stated in paper (Sygulla *et al.*, 2014, pp. 107-115) that the cost of purchasing and supplying resources is roughly equivalent to one third of the total costs due to inefficient management of material resources in general. This is explained by the inconsistency in the planning of material and technical management's processes, the acquisition of excess stocks or, conversely, the shortage of necessary resources. That is why it becomes necessary to clearly organize the process of material and technical management in the medical institution and determine the list of cost elements that will characterize each of these processes.

So, the main problems that medical institutions face when reflecting the accounting of supply costs are:

accounting for the costs of the material and technical management's process is not regulated by any normative document at the state level and, accordingly, it is not maintained, mostly. Probably, the laboriousness of collecting information on the costs of the logistics process should be compensated by the economic effect of using this information to reduce it, in which the modern accounting and information systems help significantly.

3. Materials and methods

Modernization of the accounting of rural health care's material and technical management through information technology is an actual topic. Therefore, various materials and methods were used to study it, which contributed to the full disclosure of the topic. The method of analysis made it possible to divide the problems of equipment modernization accounting into many elements, which facilitated a more detailed structuring of the problem under study. Also, with the help of the analysis, the regulatory framework in the field of MTM FMS and OC was monitored, the equipment standard in the form of a formalized paper form was adapted. The synthesis method contributed to the development of the data collection concept, input and analysis and the creation of an automated monitoring system for the material and technical management of rural health care (FMS and OC).

The modeling method allowed to develop an automated system called "Monitoring of material and technical management of rural health care (FMS and OC)". Its development was carried out with the help of an objective-oriented programming environment Delphi 7.0 in Object Pascal. The authors used Firebird 2.1 to manage the database. The management system was implemented as a web interface.

4. Results and discussions

The basis for creating a formalized paper accounting form was the standard for equipping FMS and OC (Order of the Ministry of Health and Social Development of the Russian Federation of May 15, 2012 No. 543n "On Approval of the Provision on the organization of primary health care for the adult population"), adjusted for the projects on the comprehensive equipping of health facilities with medical equipment implemented in the region in 2007-2014.

We determined the following scheme for organization of work on the collection, processing and analysis of information on the equipment of FMS and OC. The first stage is the dispatch of a formalized registration form to each FMS and OC of a medical facility located in the countryside. The second stage is the quarterly monitoring of the collection of completed paper forms in the regional data processing center (DPC). At the third stage, the information sent is digitized, automatic recognition of the data is performed using the automated system created with the simultaneous input of information into the database, on the basis of which further analysis of the of the MTM FMS and OC conformity to normative indicators is carried out.

The use of modern information technologies in everyday life turns computing technology from an auxiliary tool to the determining factor of accounting organization. This is due to the fact that the ways of data processing as well as the speed of reporting information are changing, which, in turn, changes the efficiency of the accountant, analyst and manager at the enterprise. Such a significant increase in efficiency due to the means of informational support and

automation of document circulation allows to quickly accumulate relevant databases on the results of economic activity and use them for the formation, editing and printing of output documents, quarterly, semi-annual and annual reports, as well as provide information services on performance to relevant organizations.

The computer program is the basis of the computer form of accounting; it does not exist without it. In this case, accounting registers in different programs have similarities, but they are not the same, which distinguishes one computer program from another. Therefore, automated data processing on accounting for the material and technical management process in practice is provided in various ways:

development of the administrative information system of a medical institution (including the information system of accounting) by a special company;

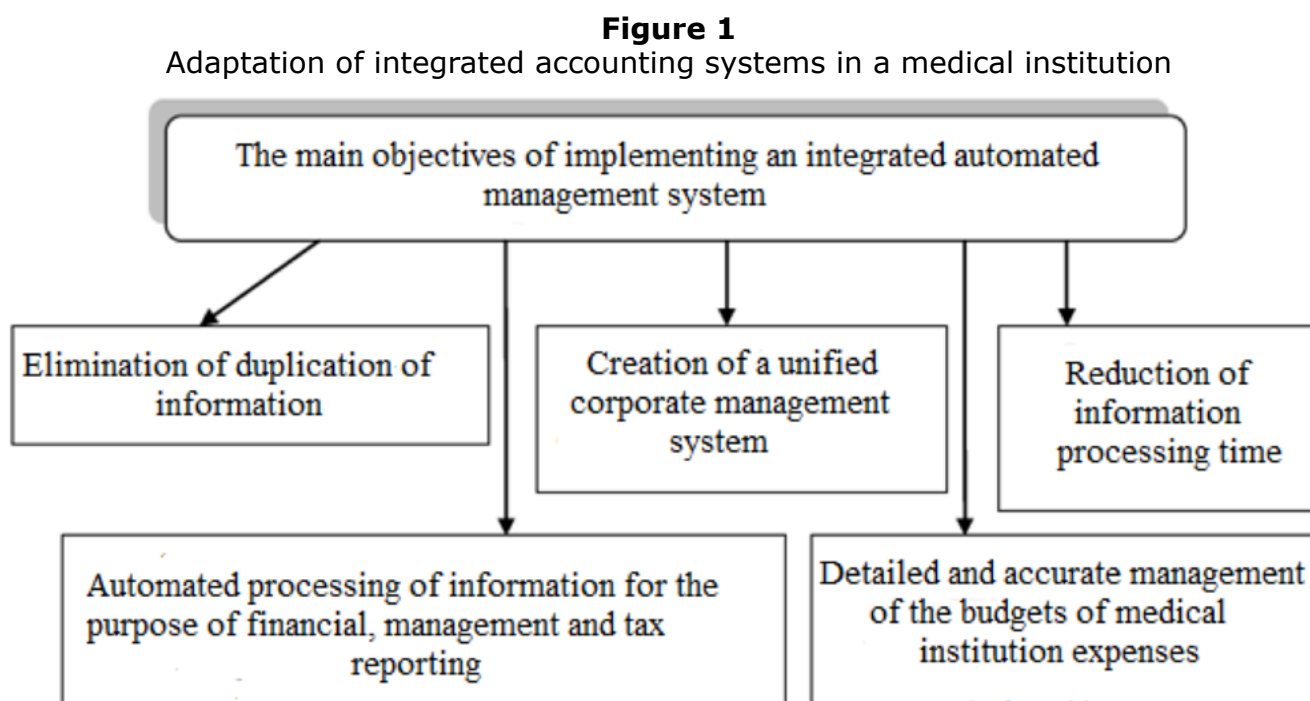
purchase of a universal software package (or its separate module) in the software market;

automation of the accounting process by the specialists of the automated data processing unit of the enterprise;

use of table processors by accounting personnel to provide an automated solution of individual tasks of a specific accounting site.

However, regardless of the chosen form of accounting, their common features are characteristic for any of them.

Integrated automated management system is a corporate information and analysis system of a modular type that is designed to record, monitor business processes, compile reports and conduct business analysis (Fig. 1).



Based on the above mentioned, it can be concluded that the use of an integrated automated control system makes it possible to:

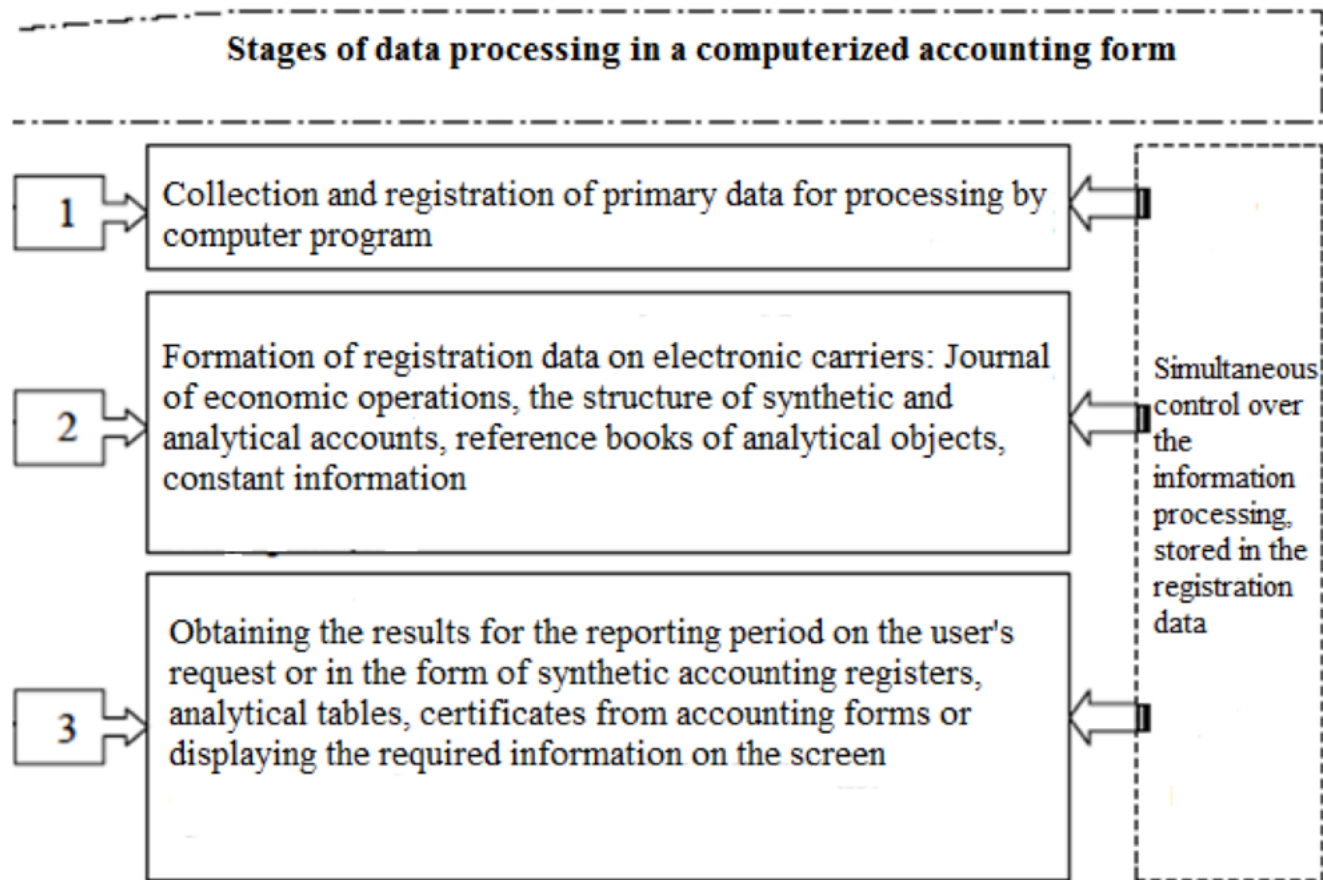
ensure a complete life cycle of work with documents – from creation, editing and joint processing using routes of coordination and implementation control, archival storage organization with appropriate time control in accordance with the requirements of the country’s legislation, internal enterprise’s orders;

provide general access and work not only to direct program users, but also to users who are not directly involved: everyone can work with a single documents’ archive, although using different access paths.

The introduction of an integrated automated management system will improve the

exchange of information between structural divisions and form a single space for decision-making at the tactical, operational and strategic levels of government. Thus, the management system will become more flexible – it will give an opportunity to coordinate changes that are introduced in the process of carrying out economic activities. This is especially relevant in the process of material and technical management, since several links and levels of management take part in making a final decision about its progress and imagery (fig. 2).

Figure 2
Stages of using accounting information



It is important that the use of the information system makes it possible to take into account the organizational structure of medical enterprises' management, the composition of units and their interaction among themselves, the scope of activities, the level of centralization and the degree of managers' authority at different levels of management, taking into account the information needs of each of them for making effective managerial decisions.

To carry out the technological process of data processing in a computerized form of accounting, three stages should be distinguished, each of which must correspond to the accounting methodology adopted in the organization.

When using a computer form, the entry of economic transactions into an array of data and the creation of registers can be carried out by making business transactions or by filling out electronic primary documents.

A software product developed by the authors, which has a number of modules that simplify accounting procedures in the process of FMS and OC material and technical management, is interesting for use in practical every day work.

To start the work, the user needs to enter the names of FMS and OC, taking into account their belonging to the territory, and also to enter the names of the reported quarters as information is received (Kovačević *et al.*, 2014, pp. 152, 159-160).

To recognize the digitized accounting form, the corresponding module, based on the algorithm developed by us, is used.

When starting the specified process, the data of the MTM from all 2 sheets of the form are automatically entered into the database. It is possible to check their correctness and to make the necessary corrections by enabling the "Perform step by step" function or by returning to the

primary program window. The received data array can be exported to the MS Excel using the corresponding item in the main menu of the primary window of the automated system.

The analytical component of the program is presented in the table with the required values of FMS and OC equipment parameters for the selected medical institution and the reporting period, the norm ranges and the conclusion about the excessive, inadequate or normal value of all parameters.

With the information accumulation for several reporting periods for each FMS and OC, it becomes expedient to use the monitoring module of MTM, which is presented in the form of a graphic time series for the selected equipment parameters. This analytical information can be used as a tool for making managerial decisions by health care managers in forming programs for the development of material and technical management for rural health care.

Automatic processing of information about the MTM FMS and OC in the framework of the automated system "Monitoring of material and technical management of rural health care" (FMS and outpatient clinics) will significantly reduce the received data processing and analysis time to make a correct and timely management decision in the direction of modernizing rural health care.

The process approach makes it possible to consider the material and technical management as a continuous band of interrelated management functions (organization, planning, regulation, motivation and incentives, accounting, control) adapted to the needs of enterprises in providing business processes with material and technical resources (Starodubov *et al.*, 2002a, p. 23).

The objectives of the material and technical management plan are to determine the optimal need of the medical institution for material resources to carry out activities; timely, uninterrupted and complete provision with all necessary material resources.

The work on planning the medical facility's need for material resources is part of the planned activity and is carried out with the aim of providing all types of material and technical resources and reducing costs (Gasnikov, 2002, p. 5).

The balance method is designed to reflect the ratios, proportions of two groups of interrelated and balanced indicators, the results of which should be identical. This method consists in comparing two sets of indicators that aspire to a certain equilibrium (Gasnikov, 2004, pp. 4-11).

The sphere of applying the balance method is planning, forecasting, statistics, economic analysis. With the help of the balance method, there is a mutual comparison of the available material, labor, financial resources with the needs in them.

The balance method allows to mathematically and structurally present the financial and economic mechanism and its operation within the framework of any organization from a small enterprise to the state as a whole (Kudrjakov, 2011, pp. 106-109).

The use of the balance method seems appropriate at all levels of material and technical management planning (MTM) - strategic, tactical and operational. At the strategic level, a long-term forecast is being developed. At the tactical level (timeframe - from several months to a year), there is a mutual alignment of private plans for procurement services, machinery and equipment maintenance. Tactical plans are subject to periodic review during the year.

At the operational level, planning contributes to the assets distribution among units in order to meet current needs most effectively. Operational planning of MTM is a means of regulation and control.

The balance of material security is compiled taking into account the calculation of resource requirements. The Balance of material support of the organization is developed based on the established need for material resources. It compares the need for material resources with sources and dimensions of its coverage.

The basic balance equation in general form can be represented as follows (1):

Re,

$$R_b + S_r = R_u + R_e \quad (1)$$

where R_b – residual resources at the beginning of the period;

S_r – sources of resources' receipt for the analyzed period;

R_u – directions of resources' use for the analyzed period;

R_e – residual resources at the end of the period.

Residual resources at the beginning of the period are determined on the basis of actual availability. It should be noted that currently, in the scientific literature, there are several approaches to determining the size of residual resources at the end of the period under review, the most common of which is the normative approach.

The need for material resources can be calculated by different methods. In this case, it is proposed to use the statistical method. This method is mainly used with a large nomenclature of material resources and relatively low costs.

Statistical methods for determining the need for material resources are based on the use of data on the actual consumption of material resources for past periods, as well as the norms of resource costs, due to the use of new technology and the improvement of the management process.

The schematic diagram of material balances is a two-sided table, on the left side of which some sources of resources are reflected, and on the right side there are possible ways of their distribution.

The main condition for the correctness of the composition of any balance is the equality of its two parts – resource and distributive. After the completion of the preliminary calculations for individual items of the balance, it is necessary to carry out their mutual coordination.

The resulted balance of material and technical management serves as the tool of logistical management of material resources' in medical institutions movement.

Based on the balance of material and technical management, the amount of material resources that the organization needs to purchase is determined. This value is set as the difference between the total demand and internal sources of resources receipt.

After the balances of MTM are compiled, further planning is carried out for the distribution of material resources between the production units that make up the enterprise.

The results obtained during the balance of material and technical management preparation, are expedient to use in the analysis of material resources use efficiency. This type of analysis is carried out for:

monitoring the consumption of material resources in the work of the organization;

estimates of costs for the acquisition and storage of material resources;

control of the amount of stocks;

development of measures aimed at saving and rational use of material resources.

It should be noted that when planning MTM, the balance method can also be used as an auxiliary tool to check the initial data on the basis of which the planning is carried out, and also to verify the correctness of the actual analytical calculations. In this context, it is advisable to talk about the method of balance generalization, the essence of which is the double reflection of information about the analyzed object.

In particular, it is expedient to use the balance method when checking the correctness of determining the influence of various factors on the growth of the effective indicator. In deterministic analysis, the algebraic sum of the influence magnitude of individual factors must correspond to the magnitude of the overall change in the performance indicator. If such identity

is absent, then this indicates incomplete accounting of factors or errors in the calculations.

The balance method can be used to construct deterministic additive models.

The balance method can also be used to determine the degree of influence of individual factors on the growth of the performance indicator.

The complex developed by us allows:

The program is designed for the accounting in health care facilities of fixed assets, material values, individual items in the working capital, with the formation of report forms in accordance with the current legislation.

Features:

operative control of current balances in the context of FMS and OC

formation of report forms.

Personal authorization in the system is performed by setting a unique pair of user name/password values. The user of the system is an official who has an account in the system, endowed with certain rights that set the level of access to this or that information.

5. Conclusions

The article examined the automation of the process of collecting information on material and technical management of rural health care, which is necessary for making managerial decisions to improve it. Thus, the authors determined the regulatory framework for the creation of a formalized accounting form, developed a scheme for work organization on the collection and processing of data on MTM FMS and OC, developed an automated system "Monitoring of material and technical management of rural health care (FMS and outpatient clinics)".

The study shows that the balance method is a sufficiently effective tool, the use of which when planning MTM allows to realize the principle of balance and proportionality of the medical institution's needs in material resources, on one hand, and the ability to cover these needs by source of income on the other hand. Drawing up a balance of material and technical management allows the most effective way to form a set of activities aimed at the organization of material and technical management. The balance of material and technical management serves as an instrument for logistic management of the material resources movement. Also, the study showed that the possibility of using the balance method for the type of planning in question is not limited to the actual compilation of the balance sheet. The balance method has considerable potential as an auxiliary tool – when checking the output data; construction of deterministic additive models; conducting analysis of the effectiveness of the material resources' use; correctness of analytical calculations' verification of the various factors' influence on the resulting indicator.

Prospects for further research in this area may be related to the clarification of the mechanism for the balance sheet balance to be consistent with other planning tools, in particular, with optimal economic and mathematical models, which should be used in planning the material and technical management of the production process. Further studies aimed at clarifying the accounting of time parameters in the compilation of MTM balances in a dynamic form are also promising.

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University. Russian Federation. E-mail: mto_dzto@mail.ru

2. Ph. D. Associate Professor. Department of public health and healthcare, Tyumen State Medical University, Russian Federation. E-mail: brynzans@yandex.ru

3. Candidate of medical Sciences. Chief doctor. State autonomous institution of public health Tyumen region "Multifield clinical medical centre 'Medical city'". Russian Federation. E-mail: Kay110465@gmail.com

4. Candidate of medical Sciences. Assistant Professor. Department of public health and healthcare. Tyumen State Medical University. Russian Federation. E-mail: reshetnikovayul@mail.ru

5. Assistant Professor. Department of public health and healthcare. Tyumen State Medical University. Russian Federation. E-mail: sungatullina@tyumsmu.ru

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[Index]

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