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Application of clinical and economic analysis to substantiate the inclusion of noninvasive ventilation in the list of high-tech medical care

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ABSTRACT

BACKGROUND: The inclusion of the method of noninvasive ventilation in the list of high-tech medical care has both a social and economic aspect and needs financial justification.

AIM: To justify the cost of medical care for patients with chronic obstructive pulmonary disease, when using the method of noninvasive lung ventilation, to prove the need to include this method of treatment in the list of high-tech medical care with calculations of financial support for this area of medical activity and its social significance.

MATERIALS AND METHODS: The article presents research data implemented using the following methods: interdisciplinary, comparative, qualitative and quantitative content analysis.

RESULTS: The cost of medical care for patients with chronic obstructive pulmonary disease is calculated, when using the method of noninvasive ventilation of the lungs, one of the generalizing methods for calculating the economic efficiency of a clinical hospital in the system of compulsory medical insurance in order to improve the health of patients and ensure the availability of high-tech medical care provided by the federal medical organization.

CONCLUSION: The medical and sociological analysis of the economic activity of a medical organization allowed us to justify the wider use of medical care standards, propose ways to improve them not only to control the quality of medical care provided, but also to strengthen the economic foundations of healthcare organizations and increase the effectiveness of both the treatment methods themselves and state financing of innovations.

Keywords: economic sociology; sociology of medicine; clinical and economic analysis; standard of medical care; noninvasive ventilation; cost of medical care.

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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ

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Применение клинико-экономического анализа для обоснования включения неинвазивной вентиляции лёгких в перечень ВМП

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АННОТАЦИЯ

Обоснование. Включение метода неинвазивной вентиляции лёгких в перечень высокотехнологичной медицинской помощи (ВМП) имеет как социальный, так и экономический аспект и нуждается в финансовом обосновании.

Цель. Обосновать стоимость медицинской помощи пациентам с хронической обструктивной болезнью лёгких при применении метода неинвазивной вентиляции лёгких, доказать необходимость включения этого метода лечения в перечень ВМП с расчётами финансового обеспечения данного направления медицинской деятельности и обоснованием её социальной значимости.

Материалы и методы. В статье представлены данные исследований, реализованных с помощью следующих методов: междисциплинарного, сравнительного, качественного и количественного контент-анализа.

Результаты. Рассчитана стоимость медицинской помощи пациентам с хронической обструктивной болезнью лёгких при применении метода неинвазивной вентиляции лёгких, определён один из обобщающих способов расчёта экономической эффективности клинической больницы в системе обязательного медицинского страхования в целях улучшения здоровья пациентов и обеспечения доступности ВМП, оказываемой федеральной медицинской организацией.

Заключение. Медико-социологический анализ экономической деятельности медицинской организации позволил обосновать более широкое использование стандартов медицинской помощи, предложить пути их совершенствования не только с целью контроля качества оказываемой медицинской помощи, но и с целью укрепления экономических основ организаций здравоохранения и повышения эффективности как самих методов лечения, так и государственного финансирования инноваций.

Ключевые слова: экономическая социология; социология медицины; клинико-экономический анализ; стандарт медицинской помощи; неинвазивная вентиляция лёгких; стоимость медицинской помощи.

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INTRODUCTION

Economic sociology can be defined as the study of the human dimensions of economic processes. The higher the level of civilization and development of a country's economy, the greater the expectations for the quality of life of its population. Quality of life, as a medical sociology category, represents quality of social aspects based on health status, which depends on the ability to meet the material, social, and cultural needs of people. In addition to the quality of food, clothing, and housing, these needs include the quality of healthcare.

The field of health economics is confronted with several initial challenges. These include the question of how to meet the social needs of individuals, in particular those pertaining to health, in a manner that is both equitable and efficient. Additionally, there is the challenge of ensuring that the economic efficiency of healthcare is increased while simultaneously improving the health of the population. The economy is primarily social as people are the target and obligatory participants of all economic processes. The achievement of this aim requires adequate economic support, including state guarantees of free medical care. The results of economic activity are evident outside the economy, particularly in the social sphere and healthcare. However, healthcare can contribute to the economic development by maintaining and improving the health of the labor force. The productivity of the healthcare industry is manifested by the expansion of the range of medical products and high-quality medical services. This can be achieved if citizens demonstrate social responsibility for the results of economic development, their health, and healthy lifestyle.

The adequate financing of healthcare is an economic condition that the state is obliged to fulfil in order to meet its social obligations. This is primarily presented as state guarantees of free medical care provision to citizens, given that market relations cannot fully form in the social sphere and are subject to several limitations. Furthermore, the market mechanism does not have a "built-in social orientation". Part of the object of medical care is "collective consumption", especially for preventing infectious diseases. Another limitation is the lack of "market self-adjustment" of the patient who does not have medical knowledge and is dependent in choosing medical services. The social significance of the healthcare system requires state financing, restricts market relations, and gives rise to a quasi-market, where the expenses are poorly represented or completely absent for the consumer (patient). This is particularly the case in situations where the choice of a treatment program is not individual, sufficiently informed, and economically motivated. Thus, various countries have taken measures to transform the financing party (the state, the compulsory health insurance fund, and health insurance organizations) into a collective buyer of medical care, capable of selecting the most effective paths to provide medical care. Moreover, it should be emphasized that a medical service is a socially charged good, a credence good, whose true value is known only to a doctor. Thus, medical care standards and clinical protocols play a crucial role in protecting the rights of the doctor and the patient, creating an opportunity to control the quality of medical care, scientifically substantiating the cost of medical care for a given nosology and determining the price of treatment. By determining the price of treatment, standards of care help to scientifically substantiate the volume of funding.

Main objectives

This study aimed to investigate the possibilities of using standards of medical care to identify the cost of treating a specific nosology based on scientific literature and data provided by large medical centers, recommend ways to improve standards of medical care, and evaluate the amount of financing required for medical care in the field of pulmonology to improve the quality of medical services provided by clinical hospitals.

MATERIALS AND METHODS

Study design

Interdisciplinary, comparative, and qualitative methods and quantitative content analysis were used.

Study setting

The study was conducted in 2023 at the Institute of Social Sciences and the National Medical Research Center for Pulmonology of the I.M. Sechenov First Moscow State Medical University (Sechenov University).

RESULTS

The inclusion of the noninvasive pulmonary ventilation method in the list of high-tech medical care (HTMC) was confirmed.

Name of the treatment method proposed for inclusion in the list of HTMC types

Respiratory support by noninvasive pulmonary ventilation in pulmonology departments.

Scientific substantiation of the treatment method efficiency

Noninvasive positive pressure pulmonary ventilation (NIPPV) using various modes of the respiration is critical to treatment respiratory system diseases and extrapulmonary pathologies with respiratory failure. Additionally, the method is applicable for hypoxemic respiratory failure with damage to the lung parenchyma. Currently, NIPPV is considered as first-line therapy for the exacerbation of chronic obstructive pulmonary disease (COPD) during the development

of hypercapnic acute respiratory failure [1]. This respiratory support method has been proven effective in patients after extubation, as its use facilitates weaning from the respirator as well as in the prevention and treatment of post-extubation respiratory failure [1]. Further, NIPPV is used for sleep apnea syndrome and pneumonia as well as in the early postoperative period after chest interventions. The most effective strategy of respiratory support in COPD is reduction of the partial pressure of carbon dioxide in arterial blood, also called "high-intensity NIPPV". The use of portable NIPPV devices developed in recent years can reduce the treatment time of exacerbations in patients with severe COPD, increase tolerance to physical activity, and reduce the risk of cardiovascular events.

Target patients in pulmonary hospitals

NIPPV is required during exacerbations of COPD and the development of acute respiratory failure. This is currently the most common use of NIPPV in the hospital setting, and it is in this condition that the greatest experience in the use of NIPPV has been accumulated worldwide [2].

Description of the novelty, uniqueness, and complexity of the treatment method

NIPPV was mainly used in the resuscitation and intensive care units, where intensive care and invasive pulmonary ventilation (IPV) were primarily provided in the event of NIPPV therapy failure. However, as experience and training are accumulated, the use of NIPPV can be transferred to therapeutic departments. The uniqueness and effectiveness of the method have been confirmed in large-scale cohort studies and meta-analyses and are supported by various professional societies and organizations [3]. NIPPV has been shown to reduce the need for tracheal intubation and associated complications, as well as IPV, and to decrease hospital length of stay and mortality in COPD exacerbations [1, 3]. Particularly, high efficiency of NIPPV has been demonstrated in patients with COPD exacerbation and respiratory acidosis with Ph < 7.30, with a 34% reduction in the risk of tracheal intubation and an absolute reduction in the duration of hospitalization by 5–6 days [4].

The effects of NIPPV in patients with chronic respiratory failure can be associated with various mechanisms, including improved respiratory muscle function, reduced load on the respiratory apparatus, restoration of the sensitivity of chemoreception of the respiratory center, and improved sleep quality. In addition, the risks associated with nosocomial systemic and local infections [3] and hospital mortality [5, 6] are significantly lower.

Professional training and experience of medical personnel are significant in performing NIPPV. The complexity of this method involves the need to select an individual ventilation mode considering nosology and parameters of the patient. Additionally, this method requires monitoring the acid–base state of arterial blood, careful medical supervision, and the auxiliary supervisory role of nursing staff.

Despite more than 20 years of experience with the use of NIPPV in global medical practice, many pulmonologists in Russia do not use this method or use it in a limited way, which reduces the efficiency of medical care for patients with respiratory failure. Currently, the method is being implemented by an interdisciplinary team of the Pulmonology and Respiratory Medicine Clinic of the National Medical Research Center of Pulmonology of the Sechenov University under the guidance of the Chief Pulmonologist of the Russian Ministry of Health.

DISCUSSION

The use of the NIPPV method involves organizational, clinical, and economic aspects.

Organizational and clinical aspects of the treatment method

In recent years, the method of NIPPV has been mastered by doctors of therapeutic and specialized pulmonological, cardiological, and neurological hospitals, with its use extending beyond the intensive care units. The implementation of the method in the post-COVID period is made possible by the substantial acquisition of equipment by medical organizations at the secondary and tertiary care levels. The further rational use of this equipment is economically justifiable. The method is economically preferable owing to the effective and timely relief of respiratory failure syndrome, which helps reduce the time of hospital stay, associated risks from the cardiovascular system, and nosocomial infections. In some cases, it is the only way to save a patient's life.

The specificity of NIPPV and ventilation mode selection is associated with the need for active dynamic monitoring of the patient's condition and blood gas composition, which requires more active involvement of trained medical personnel.

Profile of medical care and name of the type of HTMC, during the provision of which the treatment method will be applied, including the code of nosological units based on the International Statistical Classification of Diseases and Related Health Problems, as well as the patient model

Pulmonology:

- chronic obstructive pulmonary disease: J44
- diaphragmatic paralysis: J98.6
- acute respiratory distress syndrome: J80.

Interdisciplinary nosologies:

- respiratory failure associated with obesity hypoventilation syndrome: J96 and E66.2
- obstructive sleep apnea syndrome: G47.3.

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Neurology:
- amyotrophic lateral sclerosis: G12.2
- central sleep apnea: G47.3.

Cardiology:
- acute left ventricular failure and cardiogenic pulmonary edema: I50.1.

In Russia, *2,000 patients* require medical care using the treatment method.

Organizational and economic aspects of using the treatment method

Peculiarities of tariffication in the compulsory health insurance system

Calculation of the cost of public services, which includes medical services in the compulsory health insurance (CHI) system, remains a problem in formation and financial support for the implementation of state (municipal) tasks. Various factors influence the amount of tariffs in the CHI system, namely, the level of public health, which determines the need for medical care; the collection of CHI contributions depending on the level of economic development of the region; decisions indicated in the Tariff Agreement of the CHI system; established standards for the scope of medical care per insured person based on medical statistics; selected priority areas in the provision of medical care; and resource availability of a particular type of medical care.

Pricing decisions are based on the pricing methodology, which involves defining the purpose of the medical organization, knowledge of the regulatory framework for pricing, selection of the price unit, availability of a medical care standard, knowledge of the cost-intensity structure by clinical statistical groups (CSG) (for inpatient hospital), determining expenses by cost elements, determining the amount of profit in the price (for paid medical services), and taking into account the inflation rate when determining the tariff and considering the patient treatment complexity coefficients and other coefficients indicating the level and quality of medical care. The organizational basis for pricing is the approval provided by the head of the "Regulation on the tariff policy of the medical organization", which regulates the procedure for determining the cost of services, methods of payment by individuals and legal entities, and liability for improper execution of this regulatory local document and special conditions. This regulation should include the applied methodology for calculating prices for medical and other services based on the components cost, methods for calculating depreciation of medical equipment (for paid services), complexity and intensity coefficients of medical work, and the basic cost of a unit of medical care. Additionally, the document should present the current regulatory framework for pricing in healthcare. However, the document format is established independently. The prepared document is approved by the chief physician. It is used to more accurate calculate and justify expenses in the price structure of a healthcare service or other services provided in a specific unit, identify areas of inefficiency, and determine priorities for the development of paid medical activities (in excess of the state assignment for the volume of services performed under CHI). To generate this document, the chief physician instructs the economic service, within the framework of management accounting, to collect information on expenses for each medical unit of the organization. Furthermore, the chief physician instructs the accounting department to provide the economic service reports for the last three years on the expenses of the organization. In addition, the chief physician orders to determine the amount of estimated and standard costs for the provision of medical services by the institution for the main types of activities and for the maintenance of the institution's property. The economic service is responsible for analyzing the actual costs incurred by the institution for the provision of medical services across the main types of activity in previous periods. In addition, it utilizes predictive information on the dynamics of changes in the price level (tariffs) as part of the costs, including state-regulated prices. The analysis also encompasses the tariffs for goods, works, and services provided by natural monopoly entities. Furthermore, it examines the existing and projected volume of market offerings for analogous services, along with the associated price levels (tariffs) and the existing and projected demand for such services. Justification of calculations for the CHI system is beneficial for introducing uniform tariffs for medical insurance organizations into the tariff agreement, valid for the purpose of paying for medical care. Uniform tariffs are in force for all medical insurance organizations located in the territory of a constituent entity of Russia and paying for medical care within the territorial CHI program.

The units of calculation used in the context of medical care pricing, predominantly employed within the CHI framework, encompass a range of elements. These include the tariff for a singular visit, the tariff for an isolated encounter, the tariff for an individual case of hospitalization, taking into account both the CSG/CPG (clinical and profile groups), and the tariff for a single ambulance call. Additionally, there is the tariff associated with a single instance of hospitalization in a day hospital setting. Furthermore, there are the conventional units of the labor involved, especially within the domain of dentistry, yet within a broader framework that includes other specialized forms of medical care.

The standard of medical care is a critical document, which serves the purposes of pricing and various other functions, namely, the quality control of medical care, protection of patient rights, insurance of professional liability of a doctor, and determination of the amount of financing of medical care.

In the CHI system, the tariff is typically set at the standard level of expenses and does not include profit. The Federal Law of November 29, 2010, No. 326-FZ, "On Compulsory Health Insurance in the Russian Federation" (Chapter 7, Art. 35, cl. 7), clarifies the structure of the full tariff for a medical service in the CHI system, namely "The structure of the tariff for

payment of medical care includes direct expenses for wages, accruals for labor costs, other payments, purchase of drugs, consumables, food, soft inventory, medical instruments, reagents and chemicals, other material supplies, expenses for payment of laboratory and instrumental studies conducted in other institutions (in the absence of a laboratory and diagnostic equipment in the medical organization), meal arrangements (in the absence of organized meals in the medical organization), and expenses for the purchase of equipment worth up to one hundred thousand rubles per unit".[1] Indirect costs of the CHI system include costs of communication and transportation services, utilities, works, and services for property maintenance, rent for the use of property, payment for software and other services, social security of employees of medical organizations established by the legislation of Russia, and other costs.

In inpatient hospitals, the primary unit of calculation for pricing (CHI tariff) is based on the case of hospitalization. This is a case of treatment in inpatient settings and in day hospital conditions within which a single medical record is maintained for each inpatient. This record represents a unit of medical care volume within the implementation of the territorial CHI program. In considering the cost, structure of expenses, and set of resources used, cost-intensity coefficients that correspond to the CSG of diseases included in the CPG were introduced.[2] In the CHI system, the base rate is calculated as the average volume of financial support for medical care per one treated patient, which is determined using the standards for the scope of medical care and for financial costs per unit of medical care or the average cost of a completed case of treatment. The average cost of a completed case of treatment (base rate) is established by the tariff agreement adopted in the territory of a constituent entity of Russia. The applied correction factors specify the cost of one completed case for a given nosology. Such factors include the cost intensity (defined for each CSG), medical organization level (range: 0.95–1.7), patient treatment complexity (maximum: 1.8), medical care specificity, and differentiation for the per capita standard, if any. For example, to calculate the cost of outpatient medical care provided to individuals aged ⩾65 years, a differentiation factor for the per capita financing standard for individuals registered in a medical organization of 1.6[3] is used.

Accordingly, the calculation of the cost of a completed case of treatment under CSG or CPG is based on the following economic parameters: the average standard of financial costs per unit of the volume of medical care; the coefficient of conversion of the average standard of financial costs per unit of the volume of medical care in terms of conditions of its provision to the base rate and the previously listed correction factors approved by the Tariff Agreement.

Calculations and structure of the average standard of financial costs per unit of volume of medical care, taking into account the specific treatment method to be used

The cost of treatment (excluding the volume of drug and diagnostic care and food costs) for a specific nosology can be obtained using a method such as "expenses +" based on the standard of medical care. In the CHI system, the tariff is traditionally determined at the level of costs, which is calculated as the sum of direct costs associated with the treatment process and indirect expenses (not directly related to the treatment process).

According to the recommended methodology for calculating tariffs for payment of medical care under the CHI,[4] calculation options using the example of the Center for Pulmonology and Respiratory Medicine (Moscow) were offered (Table 1).

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[1] Currently, it is permitted to purchase medical equipment worth up to RUB 1 million using CHI funds in accordance with RF Government Resolution No. 346 of March 12, 2022, "On Amending the Program of State Guarantees for Free Provision of Medical Care to Citizens for 2022 and for the Planning Period of 2023 and 2024". Available at: http://publication.pravo.gov.ru/Document/View/0001202203140026?index=1. See also the RF Government Resolution No. 2090 of November 18, 2022, "On Amending the Classification of Fixed Assets Included in Depreciation Groups". Available at: http://publication.pravo.gov.ru/Document/View/0001202211210003.

[2] Methodological recommendations on methods of paying for medical care using compulsory medical insurance funds—Letter of the Ministry of Health of Russia dated December 30, 2020, No. 11-7/И/2-20691, and Letter of the Federal Compulsory Health Insurance Fund dated December 30, 2020, No. 00-10-26-2-04/11-51. Available at: https://legalacts.ru/doc/pismo-minzdrava-rossii-n-11-7i2-20691-ffoms-n-00-10-26-2-0411-51-ot/ Order of the Ministry of Health and Social Development of Russia dated May 17, 2012, No. 555n "On Approval of the Nomenclature of Hospital Beds by Medical Care Profiles". Available at: https://oms-meshalkin.ru/wp-content/uploads/2020/07/prikaz-minzdravsoczrazvitiya-rossii-ot-17_05_2012-n-555n.pdf Letter of the Ministry of Health of Russia dated January 26, 2023, No. 31-2/I/2-1075 (as amended on May 11, 2023) "On Methodological Recommendations on Methods of Paying for Medical Care at the Expense of Compulsory Health Insurance" (together with the "Methodological Recommendations on Methods of Paying for Medical Care at the Expense of Compulsory Health Insurance", approved. by the Ministry of Health of Russia No. 31-2/I/2-1075, Federal Compulsory Medical Insurance Fund No. 00-10-26-2-06/749 on January 26, 2023). Available at: https://legalacts.ru/doc/pismo-minzdrava-rossii-ot-26012023-n-31-2i2-1075-o-metodicheskikh/

[3] Appendix No. 3 to the Program of State Guarantees for Free Provision of Medical Care to Citizens for 2023 and for the Planning Period of 2024 and 2025 entitled "Regulations on the establishment of tariffs for the provision of specialized medical care, including high-tech treatments, provided by medical organizations, the functions and powers of the founders of which are exercised by the Government of the Russian Federation or federal executive authorities, in accordance with the uniform requirements of the basic program of compulsory health insurance". Available at: http://static.government.ru/media/files/FQATIOfojXIUYX8cwI2X7ugkeKRrRGjb.pdf

[4] Order of the Ministry of Health of Russia dated February 28, 2019 (as amended on December 13, 2022), No. 108n, "On Approval of the Rules of Compulsory Health Insurance: XII. Methods for Calculating Tariffs for Medical Care under Compulsory Health Insurance". Available at: https://normativ.kontur.ru/document?moduleId=1&documentId=442322

Table 1 defines the actual cost of treatment using the NIPPV method; this is a calculation of expenses in current prices, which reflects the prime cost. Progress in the field of information technology accelerates the improvement of the calculation systems. An improved costing system will facilitate better tracking and measuring of indirect expenses incurred by a clinical hospital unit in the implementation of specific medical work and provision of services. The use of digital platforms is limitless. They are being implemented in all fields of medicine from management accounting in a healthcare institution to the search for novel treatment methods for various diseases and improving the efficiency of the healthcare system [7–9]. In clinical and economic analysis, which contributes to the creation of improved standards of medical care, a large array of statistical material (big data) requires processing. This systematization becomes possible with the use of systems, such as EGISZ (Uniform State Health Information System), MIS "Interin", Dashboard, ES MedAudit, "MedOffice", and "Ristar". There is a pressing need to supplement the digital infrastructure of EGISZ with an expert-analytical add-on that solves the problems of decision-making support.

Example of calculating the cost of treatment based on the standard of medical care in the field of pulmonology

Calculating the cost based on the standard of medical care for adults with COPD (diagnostics, treatment, and case follow-up)[5] enables the justification of payment volumes required to finance healthcare organizations specializing in this field of activity (Table 2).

This is a labor-intensive method of determining the cost of treatment, but the most accurate and justified in economic and

Table 1. The cost of treatment by noninvasive ventilation of lungs, 2023

Type of expenses	Amount of expenses, RUB / unit cost, RUB	Number of days of hospitalization / amount of consumables	Total expenses, RUB
Direct expenses, including:			
Wages[6] of medical personnel, including:		One case of hospitalization	58,900
Doctor	45,300	One case of hospitalization	45,300
Nursing staff and medical attendants	13,600	One case of hospitalization	13,600
Charges for wages		One case of hospitalization	17,670
Total wages		One case of hospitalization	**76,570**
Expenses for the acquisition of material supplies consumed in the process of providing medical care, including:			**91,580**
Mask	20,000	1 pc.	20,000
Air hose	5,000	1 pc.	5,000
Antibacterial filters	470	14 days	6,580
Syringe for collecting arterial blood	3,000	20 pcs.	60,000
Expenses for depreciation of equipment, including:		10% per year on average; 14 days of hospitalization	**8,631**
NIPV apparatus	250,000	25,000 RUB: 365 days × 14 days	960
Gas analyzer	2,000,000	200,000 RUB: 365 days × 14 days	7,671
Indirect costs, including:			
Utility payments, maintenance of facilities, communication services, transportation services, other general business expenses	100,153,080 per year	274,392 RUB per day: 300 beds × 14 days (in case of hospitalization)	**12,805**
Total expenses			**189,586**

[5] Order of the Ministry of Health of Russia dated March 10, 2022, No. 151n "On Approval of the Standard of Medical Care for Adults with Chronic Obstructive Pulmonary Disease (Diagnostics, Treatment, and Case Follow-Up)". Available at: https://rulaws.ru/acts/Prikaz-Minzdrava-Rossii-ot-10.03.2022-N-151n/ Order of the Ministry of Health of the Russian Federation dated October 13, 2017, No. 804n "On Approval of the Nomenclature of Medical Services (as Amended on September 24, 2020)". Available at: https://normativ.kontur.ru/document?moduleId=1&documentId=381903 Order of the Ministry of Health of Russia dated June 28, 2019, No. 472n "On Amendments to the Procedure for Developing Standards of Medical Care, Approved by the Order of the Ministry of Health of the Russian Federation dated February 8, 2018, No. 53n". Available at: http://publication.pravo.gov.ru/Document/View/0001201909160036

Table 2. Calculation of the cost of treatment based on the standard medical care for adults with chronic obstructive pulmonary disease (diagnosis, treatment, and follow-up)

Medical service code*	Name of medical service	Average frequency of provision**	Average frequency of use	Market price, RUB	CHI price, RUB	Total, RUB
1. Medical services for diagnostics of disease or condition						
1.1. Appointment (examination, consultation) with a specialist						259.6
1.2. Laboratory research methods						68.7
1.3. Instrumental research methods						1,134.55
2. Medical services for treatment of disease and monitoring of treatment						
2.1. Appointment (examination, consultation) and follow-up by a medical specialist						6,649.7
2.2. Laboratory research methods						423
2.3. Instrumental research methods						1,170
2.4. Non-drug methods of prevention, treatment, and medical rehabilitation						3,566
3. List of medicinal products for medical use registered in the Russian Federation, indicating average daily and course doses						

Code	Anatomical, therapeutic, and chemical classification	Name of the medicinal product***	Average frequency of provision	Units of measurement	ADD****	ACD*****	Pharmacy price	Total, RUB
Total 40,377.3								
4. Types of therapeutic nutrition, including specialized therapeutic nutrition products								
4.1. Therapeutic nutrition								

Name of the type of therapeutic nutrition	Average frequency of provision	Number of days	Price per week, RUB	Per day, RUB	Total, RUB
Basic version of a standard diet	0.17	10	2000	286	486
Total Cost of the standard					**54,134.85**
Payroll budget, 14 days of hospital stay (with accruals)					76,570
Costs of purchasing other material stocks					91,580
Indirect costs, per 1 bed, ×14 days					12,805
Cost of treatment					**235,089.85**
Price with a profit of 20% (for paid medical activities)					**282,107.82**

* International statistical classification of diseases and related health problems, 10th revision.
** The probability of providing medical services or prescribing drugs for medical use (medical products) included in the standard of medical care, which can take values from 0 to 1, where 1 means that this activity is performed for 100% of patients corresponding to this model, and numbers less than 1 correspond to the percentage of patients specified in the standard of medical care who have the corresponding medical indications.
*** International non-proprietary, or grouping, or chemical name of the drug, and in cases of their absence, the trade name of the drug.
**** Average daily dose.
***** Average course dose.

medical aspects. Although the primary information is initially entered into the electronic system manually, in subsequent work, this "big data" can be clarified, transformed, and improved, helping managers make appropriate management decisions. In the CHI system, one case of hospitalization in 2023 cost an average of 41,920.3 rubles, as the average standards of financial costs per unit of medical care for the purposes of forming a territorial CHI program. However, the given calculation examples are based on expensive HTMC for COPD patients, whereas 216 of individuals are treated in only one federal clinical hospital per year. In general, 725,995 people in Russia need treatment for this disease annually, and the total amount of required standard financial investments, according to the authors' calculations, is 30,015,951.45 rubles (data for 2022). Payment for medical care for adult patients with COPD in accordance with the standard would require financial investments in the amount of 170.6 billion rubles per year or 5.7 times higher.

Digital technologies help solve another management problem, i.e., calculating the break-even point of a clinical hospital as a whole before the start of its activities under CHI contracts.

Table 3 presents the expenses of a clinical hospital for the year; this data can be used to calculate the break-even point of the clinic in the CHI system when the number of patients receiving treatment under the CHI policy per year is 14,936.

Let us independently classify expenses that change in the short term based on the varying number of hospitalization cases as variable costs; thus, the greater the number of hospitalization cases during a period, the more expenses are required, whereas other things being equal (VC), such as wages and accruals (796,693,415.64 rubles), social benefits and compensation to personnel in cash (1,112,200.00 rubles), increase in the cost of inventories (209,013,706.81 rubles), and increase in the cost of fixed assets (500,000.00 rubles), i.e., a total of 1,007,319,322.45 rubles. Fixed expenses in the short term do not depend on the volume of activity (FC) and amount, in this case, to 192,900,462.65 rubles per year. The sum of these costs, in economic essence, represents the total cost of the hospital's activities for the year (TC=1,200,219,785.1 rubles), i.e., the tariff for one case of hospitalization is equal to the cost. The total number of hospitalization cases planned in a clinical hospital in the CHI system is 14,936. In the calculation, the denominator is the value per one case of hospitalization (i):

Break-even point (T)=192,900,462.65 rubles FC / (80,357.5 rubles P*i* – 67,442.4 rubles VCi) = 14,936 hospitalizations.

At an average tariff of 80,357.5 rubles, this clinic breaks even with the planned number of hospitalizations of all profiles (14,936), indicating the effective use of CHI funds and a fair assessment of the cost of medical care. However, if the tariff is reduced, an increase in the number of hospitalizations per year is required to cover the planned costs. This will result in an undesirable increase in the work performed by medical personnel and possible professional burnout.

Table 3. Structure of actual expenses of a clinical hospital with a pulmonology department in 2023

Expenditure items	Total for the year, RUB	Share of total expenses per year, %
Wages and accruals	796,693,415.64	66.4
Communication services	1,258,992.42	0.1
Transportation services	368,600	0.03
Utilities	34,349,439.26	2.9
Property maintenance services	40,462,230.34	3.4
Other works, services	22,341,896.87	2
Insurance	65,648.00	0.01
Social benefits and compensation to personnel in cash	1,112,200.00	0.09
Taxes, duties, and charges	9,657,806.00	0.81
Other current payments to organizations	218,493.00	0.02
Increase in the cost of fixed assets	500,000.00	0.04
Increase in the cost of inventories, including	209,013,706.81	17.5
Medicinal agents	76,171,456.96	6.3
Medical gases	5,678,006.25	0.5
Consumables	73,988,206.00	6.2
Reagents and chemicals, glass and chemical glassware	5,940,758.03	0.5
Medical instruments	10,290,576.43	0.9
Food	27,200,800.00	2.3
Other	362,826.40	0.03
Soft inventory and personal protective equipment	5,393,925.19	0.45
Other current stocks (materials)	3,978,080.56	0.33
Other current stocks of single use (strict reporting forms)	9,070.00	0.0008
Disposals from budget accounts, including:	80,841,571.14	6.7
Clinic development fund (HTMC, extra-budgetary)	62,284,077.00	5.2
Deductions for the maintenance of paraclinics and administrative and economic segment	18,557,494.14	1.5
Total expenses	1,200,219,785.10	100

CONCLUSION

The use of information technology in medicine and healthcare simplifies calculations. A medical and sociological analysis of the potential for the integration of information technology into the economic activities of a medical organization could reveal further avenues for its deployment within the broader social institution of medicine. This could provide a rationale for a more extensive application of medical care standards, facilitating the monitoring of the quality of medical care provided and the reinforcement of the economic foundations of healthcare organizations. This could also lead to an expansion of the list of HTMC at the expense of CHI funds.

ADDITIONAL INFORMATION

Author's contribution. Concept and design — all authors; collection and processing of materials — all authors; writing the text — all authors; editing — N.G. Shamshurina. All authors made a substantial contribution to the conception of the work, drafting and revising the work, final approval of the version to be published and agree to be accountable for all aspects of the work.

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REFERENCES

1. Avdeev SN. Non-invasive ventilation in patients with chronic obstructive pulmonary disease in a hospital and at home. *Pulmonologiya.* 2017;27(2):232–249. doi: 10.18093/0869-0189-2017-27-2-232-249

2. Hoo GW. The role of noninvasive ventilation in the hospital and outpatient management of chronic obstructive pulmonary disease. *Semin Respir Crit Care Med.* 2015;36(4):616–629. doi: 10.1055/s-0035-1556074

3. Demoule A, Girou E, Richard JC, Taillé S, Brochard L. Increased use of noninvasive ventilation in French intensive care units. *Intensive Care Med.* 2006;32(11):1747–1755. doi: 10.1007/s00134-006-0229-z

4. Keenan SP, Sinuff T, Cook DJ, Hill NS. Which patients with acute exacerbation of chronic obstructive pulmonary disease benefit from noninvasive positive-pressure ventilation? A systematic review of the literature. *Ann Intern Med.* 2003;138(11):861–870. doi: 10.7326/0003-4819-138-11-200306030-00007

5. Osadnik CR, Tee VS, Carson-Chahhoud KV, et al. Non-invasive ventilation for the management of acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease. *Cochrane Database Syst Rev.* 2017;7(7):CD004104. doi: 10.1002/14651858.CD004104.pub4

6. Hartley T, Lane ND, Steer J, et al. The Noninvasive Ventilation Outcomes (NIVO) score: prediction of in-hospital mortality in exacerbations of COPD requiring assisted ventilation. *Eur Respir J.* 2021;58(5):2054042. doi: 10.1183/13993003.54042-2020

7. Reshetnikov A, Frolova I, Abaeva O, et al. Accessibility and quality of medical care for patients with chronic noncommunicable diseases during COVID-19 pandemic. *NPJ Prim Care Respir Med.* 2023;33(1):14. doi: 10.1038/s41533-023-00328-9

8. Reshetnikov A, Berdutin V, Zaporozhtsev A, et al. Predictive algorithm for the regional spread of coronavirus infection across the Russian Federation. *BMC Med Inform Decis Mak.* 2023;23(1):48. doi: 10.1186/s12911-023-02135-1

9. Berdutin VA, Abaeva OP, Romanova TE, Romanov SV. Achievements and prospects for the application of artificial intelligence technologies in medicine: an overview. Part 1. *Sociology of Medicine.* 2022;21(1):83–96. doi: 10.17816/socm106054

СПИСОК ЛИТЕРАТУРЫ

1. Авдеев С.Н. Неинвазивная вентиляция лёгких у пациентов с хронической обструктивной болезнью лёгких в стационаре и домашних условиях // Пульмонология. 2017. Т. 27, № 2. С. 232–249. doi: 10.18093/0869-0189-2017-27-2-232-249

2. Hoo G.W. The role of noninvasive ventilation in the hospital and outpatient management of chronic obstructive pulmonary disease // Semin Respir Crit Care Med. 2015. Vol. 36, N 4. P. 616–629. doi: 10.1055/s-0035-1556074

3. Demoule A., Girou E., Richard J.C., Taillé S., Brochard L. Increased use of noninvasive ventilation in French intensive care units // Intensive Care Med. 2006. Vol. 32, N 11. P. 1747–1755. doi: 10.1007/s00134-006-0229-z

4. Keenan S.P., Sinuff T., Cook D.J., Hill N.S. Which patients with acute exacerbation of chronic obstructive pulmonary disease benefit from noninvasive positive-pressure ventilation? A systematic review of the literature // Ann Intern Med. 2003. Vol. 138, N 11. P. 861–870. doi: 10.7326/0003-4819-138-11-200306030-00007

5. Osadnik C.R., Tee V.S., Carson-Chahhoud K.V., et al. Non-invasive ventilation for the management of acute hypercapnic respiratory failure due to exacerbation of chronic obstructive pulmonary disease // Cochrane Database Syst Rev. 2017. Vol. 7, N 7. Article no. CD004104. doi: 10.1002/14651858.CD004104.pub4

6. Hartley T., Lane N.D., Steer J., et al. The Noninvasive Ventilation Outcomes (NIVO) score: prediction of in-hospital mortality in exacerbations of COPD requiring assisted ventilation // Eur Respir J. 2021. Vol. 58, N 5. Article no. 2054042. doi: 10.1183/13993003.54042-2020

7. Reshetnikov A., Frolova I., Abaeva O., et al. Accessibility and quality of medical care for patients with chronic noncommunicable diseases during COVID-19 pandemic // NPJ Prim Care Respir Med. 2023. Vol. 33, N 1. Article no. 14. doi: 10.1038/s41533-023-00328-9

8. Reshetnikov A., Berdutin V., Zaporozhtsev A., et al. Predictive algorithm for the regional spread of coronavirus infection across the Russian Federation // BMC Med Inform Decis Mak. 2023. Vol. 23, N 1. Article no. 48. doi: 10.1186/s12911-023-02135-1

9. Бердутин В.А., Абаева О.П., Романова Т.Е., Романов С.В. Применение искусственного интеллекта в медицине: достижения и перспективы. Обзор литературы. Часть 1 // Социология медицины. 2022. Т. 21, № 1. С. 83–96. doi: 10.17816/socm106054

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