Application of Artificial Intelligence in National Mandatory Health Insurance Systems: Review of Opportunities and Payment Practices

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Abstract

Issues of reimbursement for medical care are gaining increasing importance due to the expansion of national guarantee programs, an aging population, and the prolonged treatment of costly diseases. This document systematizes international experiences of incorporating artificial intelligence technologies into health insurance systems and proposes best practices.

The aim: The integration of artificial intelligence (AI) in healthcare systems has catalyzed the evolution of various payment models for AI-driven medical services. This article aims to present a comprehensive review of the diverse payment models implemented across different countries, with a focus on promoting technological advancement, maintaining healthcare system standards, and ensuring guaranteed clinical outcomes.

Methods. This study employs a systematic review methodology, analyzing existing literature on AI-driven healthcare service payment models. The analysis includes categorization of these models into three main types with potential hybrid variations. Sources were selected based on relevance, peer-review status, and contribution to the understanding of AI reimbursement in healthcare. Data was extracted and synthesized to identify patterns and gaps in current payment practices.

Results. The review identifies three primary categories of AI-enabled healthcare service payment models: fee-for-service, bundled payments, and value-based payments. Hybrid models combining elements of these categories are also discussed. Key findings highlight the strengths and limitations of each model in terms of promoting innovation and achieving clinical outcomes. Despite the rapid advancements in AI technologies, the study reveals a scarcity of systematic research comparing the effectiveness of different reimbursement schemes.

Conclusion. This article underscores the critical need for further studies to navigate the evolving technological landscape and international regulatory frameworks. Significant directions in the development of reimbursement models for AI in healthcare are explored, including the adaptation of Software as a Service (SaaS) payment models, the implementation of anticipatory funding mechanisms, and the differentiation between AI registration and its inclusion in insurance reimbursement programs as a distinct service. These insights are essential for policymakers, healthcare providers, and technology developers to optimize payment strategies and enhance the integration of AI in healthcare.

Keywords: artificial intelligence, healthcare, payment models, reimbursement, technology, clinical outcomes, regulatory activities.

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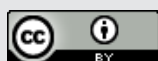Adress: C/ d'Aragó, 366, Edificio Oficina 24, L'Eixample
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Introduction

(i) Issues related to reimbursement for healthcare services occupy a central place in current healthcare discussions. The rapid expansion of national healthcare guarantee programs, an aging population, and an increasing number of patients requiring long-term and costly treatments are putting substantial pressure on the financial sustainability of healthcare systems [1-3].

(ii) In this context, it is important to explore the potential of artificial intelligence (AI), including computer vision technologies, as tools for reducing healthcare costs and optimizing the financial burdens of illness. There is a need to systematize international experience and develop recommendations for best practices in this area.

(iii) The aim of this study is to analyze and systematize the potential of artificial intelligence, including computer vision technologies, to reduce healthcare costs and enhance the financial sustainability of healthcare systems through insights from international experiences and recommendations for best practices.

Materials and Methods

A narrative analysis of medical literature in peer-reviewed journals was conducted, focusing on issues related to the organization of insurance reimbursement for services provided with the help of artificial intelligence in national healthcare systems. Due to the lack of systematized data on the application of insurance programs involving AI, the high pace of AI integration into clinical practice, and the absence of specific questions that would allow for structured scientific information, a narrative research design was chosen. This approach made it possible to synthesize a significant and diverse body of material regarding the funding methods for AI technologies in national insurance systems worldwide.

Results. Geography of AI Application in National Healthcare Systems

Currently, AI is included in reimbursement programs involved in Russia, Germany, France, the United Kingdom, the Netherlands, Belgium, Spain, Greece, the United States, Canada, Japan, [5-7]. Despite the active promotion of the AI agenda, the registration of hundreds of medical products using it, and the presence of special mechanisms for pre-registration reimbursement of breakthrough technologies, only a small portion of AI solutions receive insurance reimbursement [5].

United States of America

In the USA, there are stable mechanisms for reimbursing of AI in inpatient and outpatient care settings. They are regulated by provisions developed by the Centers for Medicare and Medicaid Services (CMS) as part of a comprehensive strategy aimed at encouraging the use of innovative technologies by healthcare organizations that do not fit into more conservative "permanent" tariff systems [6]. These provisions are of a short-term nature (up to 4 years) and allow motivating healthcare organizations to implement such systems, evaluate their clinical and population effectiveness, determine the costs associated with their widespread implementation, regulate pricing for AI services, and attract competitors of the first registered company to enter the market.

In the inpatient segment, such functionality is implemented through the New Technology Add-on Payment (NTAP) system. New payment systems are also being developed, such as Medical Coverage of Innovative Technology (MCIT), which, among other things, allow for the earlier introduction of "breakthrough" treatment methods into clinical practice [8].

In the USA, medical services are grouped into diagnosis-related groups (DRGs) based on the conditions of care and diagnosis. DRG represents a list of allowable procedures and their maximum price within a specific clinical situation. NTAP allows for the inclusion of an additional parameter (e.g., AI application) in certain DRGs, with the possibility of increasing the maximum cost of the tariff itself [9].

As of 2023, the total number of registered medical products for which reimbursement is provided as a separate line within insurance mechanisms was only 2 out of more than 200 approved for use [5].

Russian Federation

In the Russian Federation, three payment circuits for medical care using artificial intelligence (AI) technologies have been formed. The first and earliest circuit is represented by an experiment conducted under the auspices of the Scientific and Practical Clinical Center of the Moscow Department of Information Technology and is aimed at stimulating the mass use of AI through free connections for medical organizations to an online library of services, the payment for which in the "fee-for-service" format is made by the Department of Information Technology [10].

The second payment circuit was formed by a Decree, making it mandatory for all subjects of the Russian Federation in 2023 to apply at least three AI technologies in the healthcare system; funds for their purchase are sought by the regions independently . Finally, since 2023, the first services for radiological AI have appeared, directly included in the compulsory medical insurance (CMI) as an independent payment unit.

In the CMI system of the Russian Federation, there are two payment principles - for medical service and for attachment in outpatient organizations. The first type includes both individual types of visits, examinations, and procedures (for example, an oncologist's examination or CT of the chest), and services requiring hospitalization in day or round-the-clock hospitals. The per capita part of the CMI tariff currently does not mention the use of artificial intelligence.

In hospitals, medical services are paid in the form of clinical-statistical groups (hereinafter referred to as CSGs). The formation of CSGs is based on medical services included in a single federal nomenclature. All medical services that can be provided under the CMI system are listed in a single list. Groups of medical services with similarity in clinical tasks, conditions of provision, and approximate costs are assigned a unifying code of a clinical-statistical group.

Clinical-statistical groups are standardized groups for assessing the costliness of treatment. In addition to the code of the medical service, they may include other parameters, some of which are mandatory, and some may be used as additional modifiers affecting the final tariff. Such modifiers include, for example, the ICD disease code (which, in some cases, affects the possibility of setting the tariff, and

in some cases, determines its cost), the number of bed-days, or the application of specific technologies, including AI.

The structure of CSGs is determined by the Methodological Recommendations on Methods of Payment for Medical Care from the CMI Funds, developed by the Federal State Budgetary Institution "Center for Expertise and Quality Control of Medical Care" of the Ministry of Health of Russia and approved by the Ministry of Health of the Russian Federation and the Federal Compulsory Medical Insurance Fund on an annual basis depending on the annual content of the State Guarantees Program.

The addition of a new functional feature to the tariff can be carried out at the level of any region or the Russian Federation as a whole. For this purpose, there is a number of mechanisms, including but not limited to:

• creation of a new CSG code;

• reorganization of the clinical-statistical group (formation of a specific subgroup with special financial and organizational properties within the higher technology - for example, allocation from the CSG for drug therapy in oncology of separate groups for more expensive or cheaper drugs);

• addition of enhancing coefficients of the clinical-statistical group depending on the application of a specific technology (for example, the use of certain types of robotic therapy in rehabilitation);

• formation of the institution's level coefficient in relation to institutions with a specific type of technology [11].

So-called "simple services" (procedures, interventions, and outpatient visits, paid for each service separately) are not federally standardized and are established by each region independently depending on its financial provision and organizational needs. The first AI circuit in the CMI is currently launched in Moscow, where since 2023, the outpatient service of mammography is evaluated using AI. This service is invoiced similarly to any other service, and the basis for its provision is the presence of a medical organization's connection to the corresponding software [12].

A summary of the existing insurance regimes in the United States and Russia is presented in Table 1.

Table 1 - Comparison of Characteristics

	USA	Russia
Structural payment element in inpatient care	Diagnosis-related group	Clinical-statistical group
Expenses within the structural element	Decomposed each time and submitted separately for each treatment case	Averaged, calculated only when forming a new tariff
Authorities responsible for forming the structure of expenses in inpatient care	Centers of Medical Services for Medicare and Medicaid	Center for Medical Care Expertise and Quality Control, Federal Fund of Compulsory Medical Insurance, Ministry of Health of the Russian Federation
Authorities entitled to adjust coefficients at the regional level	Centers of Medical Services for Medicare and Medicaid	Territorial Fund of Compulsory Medical Insurance (TF-CMI), executive bodies of the subjects of the Federation
Implemented technological solutions at the inpatient level in the Compulsory Medical Insurance (CMI)	VIZ.AI, Rapid ASPECTS	Medical systems "Cels", "Third Opinion" (CT of the chest and upper abdomen)
Implemented technological solutions at the outpatient clinic level in the Compulsory Medical Insurance (CMI)	IDx-DR, Optellum Lung Cancer Prediction (LCP), HeartFlow	Description and interpretation of mammographic study data using artificial intelligence
Implemented technological solutions at any level with non-insurance providers	Individual solutions at the level of research-oriented hospitals	The Research and Development Center Program (with over 50 providers and over 100 solutions for CT of the chest and upper abdomen, MRI of the pelvis and kidneys, CT of the lower abdomen and pelvis, MRI of the brain and other modalities)

France

In France, the evaluation of market entry strategies and cost compensation for AI-supported medical devices is carried out by the National Health Directorate. Pricing for such devices is negotiated with the Ministry of Health, and the amount of compensation depends on the classification system, which establishes the level of device cost reimbursement. In 2023, a new reimbursement mechanism for AI-managed medical devices was introduced [13]. Additionally, there are special regulatory mechanisms that expedite the reimbursement process for such devices:

1. The Innovation Package, which provides preliminary funding for clinical trials of medical products, existing in various forms.

2. Pre-insurance, allowing the use of the product for a year before applying for its inclusion in the national insurance system.

3. Early support program, providing early reimbursement of expenses before official approval based on proven clinical effectiveness and safety [14].

Once the price of a digital medical solution is determined, it is added to the list of reimbursable products, and the National Health Union sets the reimbursement rate for the next five years. The amount of reimbursement is directly related to the assessment of the clinical effectiveness of the digital solution, which is carried out jointly with the supplier [15, 16].

In 2023, the French Ministry of Health and Prevention introduced an innovative mechanism for early access to cost reimbursement for advanced digital medical devices, including mobile health applications, through the PECANd program. This initiative provides temporary, one-year special financial coverage within the French national healthcare system. The funding methodology allows manufacturers to receive reimbursement while they complete the process of confirming the clinical or organizational effectiveness of their developments [17].

United Kingdom

In the United Kingdom, reimbursement of costs for medical devices based on artificial intelligence is carried out by the National Health Service (NHS) after approval by the National Institute for Health and Care Excellence [18]. Products meeting the criteria for digital technology assessment can be included in the NHS catalog, but this does not necessarily mean automatic reimbursement of their costs. The government allocates funds to support the National Institute for Health Research and the NHS Innovation Accelerator. Access to innovative medical technologies, including AI-based technologies, is provided through a specialized route. Funding for the implementation of such devices is provided through the Innovation and Technology Financing Program and the Technology Mandate [19].

The main object of payment in the United Kingdom is the financing of individual medical services using AI (Software as a Service, SaaS model) [20].

Japan

While Japan remains the second-largest market for medical devices in the world after the United States, the process of regulatory adaptation of any products, including AI, to the peculiarities of the healthcare system, is lengthy and complex [14]. One possible reason is the highly cautious and thorough analysis of the capabilities and risks of AI by the professional community in Japan [21].

By 2020, Japan had already registered 11 products that utilize artificial intelligence in their operations. While 6 of them were understandably related to radiology, 5 were intended for patients with gastrointestinal profiles [22].

Germany

According to the provisions of mandatory health insurance, digital health applications may be reimbursed if they have been approved by the Federal Institute for Drugs and Medical Devices and have been registered in the national digital health registry [23]. The cost calculation for such applications is based on a pay-per-service model [24].

For the first 12 months of an application being placed in the digital medical applications registry, the manufacturer is granted the right to independently set the selling price and choose the pricing model. After this period, the price is determined through negotiations between the manufacturer and the National Association of Health Insurance Funds [23].

Before initiating price discussions, the manufacturer of a medical device sends the following information to the regulator:

1. Confirmation of compliance with general requirements and evidence of positive health impact.

2. Results of studies conducted during the potential trial phase.

3. Information on costs for self-paying individuals.

4. Pricing information from other European countries.

5. A full report from the Federal Institute for Drugs and Medical Devices on the inclusion of the application in the national registry.

6. The number of activation codes or prescriptions used for the application since its registration in the registry up to five days before submitting the application.

Developers of digital health applications may qualify for financial support from Germany's Innovation Fund, funded by the German statutory health insurance company (Gesetzliche Krankenversicherung).

Discussion

Globally, several non-exclusive models and vectors of payment for healthcare services involving artificial intelligence (AI) have emerged. These payment models can be divided into two primary categories based on their purpose:

• Payment aimed at ensuring technological advancement and maintaining the technological level of the healthcare system.

• Payment intended to guarantee clinical outcomes.

In some countries, such as the United Kingdom and France, the distinction between these two purposes is blurred, with many models encompassing elements of both.

Regarding the scope of payment (or insurance reimbursement) for AI-assisted services, three main classes can be identified, with intermediate, mixed options possible:

Payment for a distinct AI service, which exists in several forms:

• Payment for the use of AI as an integral or optional component of a comprehensive healthcare service.

• Payment based on the integration of AI within a healthcare organization's system for specific service types.

Currently, however, there is a lack of comparative studies in the literature assessing the effectiveness of different reimbursement models. Existing publications fall short of systematically capturing both the technological boom driven by machine learning in healthcare and the accompanying global regulatory activities. The most comprehensive systematic review on AI reimbursement, published in April 2024, identified only 40 publications on this topic within the European Union — regions traditionally noted for their academic focus on financial policy in healthcare [25].

Conclusions

Currently, the insurance medical systems of the world's most developed economies are implementing, in one form or another, payments for healthcare technologies associated with artificial intelligence (AI). The methodological diversity of healthcare systems, along with the relatively recent introduction of these technologies, does not yet allow for the identification of the most effective payment methods or the overall assessment of the appropriateness of such payments. The most significant and well-developed vectors for the advancement of insurance reimbursement for AI in healthcare are:

• Adaptation of the Software as a Service (SaaS) payment model for medical solutions that incorporate artificial intelligence.

• Implementation of "advanced financing" technologies, including various experimental-legal regimes, where certain financial support for AI initiatives is provided even before their registration as medical devices.

•Delineation of the concepts of registration of medical devices utilizing artificial intelligence with the inclusion of artificial intelligence in insurance reimbursement programs as a separate service.

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Түйіндеме

Медициналық көмекті өтеу мәселелері ұлттық кепілдік бағдарламаларының кеңеюіне, тұрғындардың қартаюына және шығынды ауруларды ұзақ уақыт емдеуге байланысты маңызды бола түсуде. Бұл мақалада жасанды интеллект (ЖИ) технологияларын денсаулық сақтау жүйелеріне енгізу жөніндегі халықаралық тәжірибе жүйелендіріліп, ең үздік тәжірибелер ұсынылған.

Зерттеудің мақсаты: ЖИ-тің денсаулық сақтау жүйелеріне интеграциясы ЖИ негізіндегі медициналық қызметтерге арналған әртүрлі төлем модельдерінің дамуына ықпал етті. Яғни, мақаланың мақсаты - әртүрлі елдерде жүзеге асырылған төлем модельдерінің жан-жақты шолуын ұсыну, технологиялық прогресті ілгерілетуге, денсаулық сақтау жүйесінің стандарттарын сақтауға және кепілдендірілген клиникалық нәтижелерге қол жеткізуге назар аудару.

Әдістері. Бұл зерттеу жүйелі шолу әдістемесін қолданады, ЖИ негізіндегі медициналық қызметтерге арналған төлем модельдері бойынша қолданыстағы әдебиеттерді талдайды. Талдау осы модельдерді негізгі 3 түрге және мүмкін болатын аралас вариацияларға жіктеуді қамтиды. Деректер таңдалған дереккөздердің релеванттығына, рецензиялау мәртебесіне және денсаулық сақтау саласындағы ЖИ үшін өтемақы алуды түсінуге қосқан үлесіне негізделген. Деректер алынып, төлемнің қазіргі тәжірибелеріндегі үлгілер мен олқылықтарды анықтау үшін синтезделді.

Нәтижелері. Шолу ЖИ мүмкіндіктері бар медициналық қызметтердің төлем модельдерінің 3 негізгі санатын анықтайды: қызмет көрсету үшін төлем, топтамалық төлемдер және құндылыққа негізделген төлемдер. Осы санаттардың элементтерін біріктіретін аралас модельдер де талқыланады. Негізгі қорытындылар әрбір модельдің инновацияларды дамытудағы және клиникалық нәтижелерге қол жеткізудегі күшті және әлсіз жақтарын көрсетеді. ЖИ технологияларының тез дамуына қарамастан, зерттеу әртүрлі өтемақы схемаларының тиімділігін салыстыратын жүйелі зерттеулердің жеткіліксіздігін көрсетеді.

Қорытынды. Бұл шолу дамып келе жатқан технологиялық ландшафт пен халықаралық нормативтік базаларда бағдарлау үшін қосымша зерттеулердің қажеттілігін көрсетеді. Денсаулық сақтаудағы ЖИ үшін өтемақы алу үлгілерін әзірлеудегі маңызды бағыттар, соның ішінде қызмет ретінде бағдарламалық қамтамасыз ету (SaaS) төлем модельдерін бейімдеу, қаржыландыру механизмдерін алдын ала жүзеге асыру және ЖИ тіркеуі мен оны жеке қызмет ретінде сақтандыру өтемақы бағдарламаларына

енгізу арасындағы айырмашылық зерттеледі. Бұл түсініктер саясаткерлер, денсаулық сақтау қызметтерін жеткізушілер және технология әзірлеушілер үшін төлем стратегияларын оңтайландыру және денсаулық сақтауда ЖИ интеграциясын жақсарту үшін маңызды.

Түйін сөздер: жасанды интеллект, денсаулық сақтау, төлем модельдері, өтемақы, технологиялар, клиникалық нәтижелер, нормативтік қызмет.

Применение искусственного интеллекта в национальных системах обязательного медицинского страхования: Обзор возможностей и практик оплаты

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Резюме

Вопросы организации возмещения за оказанную медицинскую помощь приобретают все большее значение из-за роста программ национальных гарантий, старения населения и длительного лечения дорогостоящих заболеваний. В данном исследовании систематизирован международный опыт включения технологий искусственного интеллекта (ИИ) в системы медицинского страхования и предложены наилучшие практики.

Цель исследования: Интеграция ИИ в системы здравоохранения привела к эволюции различных моделей оплаты за медицинские услуги на основе ИИ. Цель данной статьи - представить всесторонний обзор разнообразных моделей оплаты, реализованных в разных странах, с акцентом на продвижение технологического прогресса, поддержание стандартов системы здравоохранения и обеспечение гарантированных клинических результатов.

Методы. Исследование использует метод систематического обзора, анализируя существующую литературу по моделям оплаты медицинских услуг на основе ИИ. Анализ включает классификацию этих моделей на 3 основных типа с возможными гибридными вариациями. Источники отбирались на основе релевантности, статуса рецензирования и вклада в понимание возмещения за ИИ в здравоохранении. Данные извлекались и синтезировались для выявления закономерностей и пробелов в текущих практиках оплаты.

Результаты. Обзор выявляет три основные категории моделей оплаты за медицинские услуги на основе ИИ: оплата за услугу, пакетные платежи и оплата на основе ценности. Также обсуждаются гибридные модели, сочетающие элементы этих категорий. Ключевые результаты подчеркивают сильные и слабые стороны каждой модели в плане продвижения инноваций и достижения клинических результатов. Несмотря на быстрый прогресс в технологиях ИИ, исследование выявляет нехватку систематических исследований, сравнивающих эффективность различных схем возмещения.

Выводы. Обзор подчеркивает необходимость дальнейших исследований для навигации в развивающемся технологическом ландшафте и международных нормативных рамках. Исследуются значительные направления в разработке моделей возмещения за ИИ в здравоохранении, включая адаптацию моделей оплаты за программное обеспечение как услугу (SaaS), внедрение механизмов предвосхищения финансирования и различие между регистрацией ИИ и его включением в программы страхового возмещения как отдельной услуги. Эти выводы важны для политиков, поставщиков медицинских услуг и разработчиков технологий для оптимизации стратегий оплаты и улучшения интеграции ИИ в здравоохранение.

Ключевые слова: искусственный интеллект, здравоохранение, модели оплаты, возмещение, технологии, клинические результаты, нормативная деятельность.