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# Алгачкы медициналык жардамда жасалма интеллектти ишке ашыруунун SWOT анализи

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МАКАЛА ЖӨНҮНДӨ МААЛЫМАТ

*Негизги сөздөр:*
Жасалма интеллект (ЖИ)
Баштапкы медициналык жардам (БМЖ)
E-Health
Санариптик ден соолук
Машина үйрөнүү
Телемедицина
SWOT- анализ
Клиникалык чечимдерди колдоо системалары

КОРУТУНДУ

*Киришүү.* Медициналык кызматкерлердин глобалдык жетишсиздигинин жана медициналык кызматтын сапатына болгон талаптардын жогорулашынын шартында баштапкы медициналык-санитардык жардамга жасалма интеллект технологияларын киргизүү стратегиялык маанеге ээ.

*Бул изилдөөнүн максаты* – Кыргызстанда баштапкы медициналык-санитардык жардамга жасалма интеллектти киргизүүнүн келечегине SWOT анализин жүргүзүү, аны натыйжалуу ишке ашыруу боюнча сунуштарды иштеп чыгуу.

*Материалдар жана методдор.* Изилдөө SWOT анализинин жана стратегиялык пландаштыруунун принциптерин колдонуу менен эл аралык басылмаларды, жоболорду жана эл аралык уюмдардын отчетторун системалуу талдоого негизделген. 2015-2023-жылдардагы адабияттарды карап чыгууга PubMed, Web of Science жана башка маалымат базаларынан клиникалык сыноолорго жана мета-анализдерге басым жасалган басылмалар кирди.

*Натыйжалар жана талкуу.* SWOT анализи мамлекеттик санарип тештирүү саясаты жана өнүккөн баштапкы медициналык-санитардык жардам тармагы сыяктуу күчтүү жактарын, ошондой эле алсыз жактарын, анын ичинде чектелген санариптик инфраструктураны жана кадрлардын жетишсиздигин көрсөттү. Мүмкүнчүлүктөр арасында эл аралык кызматташтык жана эпидемиологиялык көзөмөлдү өнүктүрүү кирет, ал эми коркунучтар киберкоопсуздук тобокелдиктери жана жетишсиз каржылоо менен байланышкан.

*Жыйынтыгы.* Натыйжалар Кыргызстанда баштапкы медициналык-санитардык жардамда жасалма интеллектти ишке ашыруу медициналык кызматтардын сапатын жана жеткиликтүүлүгүн жакшыртууга болорун көрсөттү. Бирок кадрлардын жетишсиздиги жана ченемдик укуктук ба

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занын жетишсиздиги сыяктуу учурдагы чектөөлөрдү жоюу зарыл. Жасалма интеллектти баштапкы медициналык-санитардык жардамга ийгиликтүү интеграциялоо толук каржылоону, ченемдик-укуктук базаны өнүктүрүүнү, санариптик инфраструктураны жана кызматкерлерди окутууну камтыган мамлекеттик комплекстүү мамилени талап кылат. Андан аркы изилдөөлөр чыныгы клиникалык практикада жасалма интеллекттин натыйжалуулугун баалоого багытталышы керек.

## SWOT-анализ внедрения искусственного интеллекта в первичной медико-санитарной помощи

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ИНФОРМАЦИЯ О СТАТЬЕ

*Ключевые слова:*
Искусственный интеллект (ИИ)
Первичная медико-санитарная помощь (ПМСП)
Электронное здравоохранение
Цифровое здравоохранение
Машинное обучение
Телемедицина
SWOT-анализ
Системы поддержки принятия клинических решений

РЕЗЮМЕ

*Введение.* В условиях глобального дефицита медицинских работников и растущих требований к качеству медицинских услуг внедрение технологий искусственного интеллекта в первичной медико-санитарной помощи имеет стратегически важное значение.
*Цель исследования.* Провести SWOT-анализ перспектив внедрения искусственного интеллекта в первичной медико-санитарной помощи в Кыргызстане для разработки рекомендаций по его эффективному внедрению.
*Материалы и методы.* Исследование основано на системном анализе международных публикаций, нормативных актов и отчетов международных организаций с использованием принципов SWOT-анализа и стратегического планирования. Обзор литературы за период 2015-2023 гг. включал публикации из PubMed, Web of Science и других баз данных с акцентом на клинические испытания и метаанализы.
*Результаты и обсуждение.* SWOT-анализ выявил сильные стороны, такие как государственная политика цифровизации и развитая сеть первичной медико-санитарной помощи, а также слабые стороны, включая ограниченную цифровую инфраструктуру и нехватку кадров. Возможности включают международное сотрудничество и развитие эпидемиологического надзора, в то время как угрозы связаны с рисками кибербезопасности и недостаточным финансированием.
*Заключение.* Результаты показывают, что внедрение искусственного интеллекта в первичной медико-санитарной помощи в Кыргызстане может повысить качество и доступность медицинских услуг. Однако необходимо преодолеть существующие ограничения, такие как нехватка персонала и несовершенство нормативно-правовой базы. Успешная интеграция искусственного интеллекта в первичную медико-санитарную помощь требует комплексного государственного подхода, включая полное финансирование, разработку нормативно-правовой базы, цифровой инфраструктуры и обучение персонала. Дальнейшие исследования следует сосредоточить на оценке эффективности искусственного интеллекта в реальной клинической практике.

## SWOT analysis of Artificial Intelligence Implementation in Primary Health Care

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ABSTRACT

*Introduction.* In the context of a global shortage of health workers and increasing demands on the quality of medical services, the introduction of artificial intelligence technologies in primary health care is of strategic importance.
*The purpose* of this study is to conduct a SWOT analysis of the prospects for the introduction of artificial intelligence in primary health care in Kyrgyzstan to develop recommendations for its effective implementation.
*Materials and methods.* The study is based on a systematic analysis of international publications, regulations and reports of international organizations using the principles of SWOT analysis and strategic planning. The literature review for the period 2015-2023 included publications from PubMed, Web of Science and other databases with an emphasis on clinical trials and meta-analyses.
*Results and discussion.* The SWOT analysis revealed strengths, such as government digitalization policy and a developed primary health care network, as well as weaknesses, including limited digital infrastructure and staff shortages. Opportunities include international cooperation and the development of epidemiological surveillance, while threats are associated with cybersecurity risks and insufficient funding.
*Conclusion.* The results show that the implementation of artificial intelligence in primary health care in Kyrgyzstan can improve the quality and accessibility of health services. However, existing limitations such as staff shortages and inadequate regulatory framework need to be overcome. Successful integration of artificial intelligence in primary health care requires a comprehensive government approach, including full funding, development of a regulatory framework, digital infrastructure, and staff training. Further research should focus on assessing the effectiveness of artificial intelligence in real clinical practice.

## 1. Introduction

The current stage of healthcare development is characterized by the increasing complexity of medical tasks against the background of limited resources. According to the World Health Organization, the global shortage of health workers by 2030 may reach 18 million specialists, which is especially acute in the field of PHC. In these conditions, digital technologies, and especially artificial intelligence, are becoming a strategic resource for overcoming systemic challenges. PHC, being the foundation of any effective healthcare system, is faced with the need to simultaneously solve several key problems: ensuring universal coverage of the population, maintaining high quality of services and optimizing the use of limited resources [1]. Traditional approaches can no longer cope with these challenges, as evidenced by the increase in waiting times for an appointment, an increase in the workload of doctors and the persistent inequality in the availability of medical care between urban and rural regions. World practice demonstrates that artificial intelligence has significant potential for increasing the efficiency of diagnostics, improving treatment processes and optimizing the work of medical institutions [2, 3]. In developed countries, AI is already used to automate administrative tasks, support medical decision-making, and analyze large volumes of medical data [4].

In Kyrgyzstan, the healthcare system faces a number of challenges, including a shortage of medical personnel, insufficient financial resources, and underdeveloped infrastructure [5, 6]. The introduction of AI into the PHC system can become a tool for increasing the efficiency of medical services, improving quality and accessibility, but requires a systematic, scientific, and strategic appro

ach. In this regard, research aimed at introducing effective innovative technologies into healthcare is highly relevant.

The purpose of the study was to conduct a SWOT analysis of the prospects for the implementation of artificial intelligence technologies at the level of PHC in Kyrgyzstan to develop recommendations for its scientifically based and effective implementation.

## 2. Materials and methods

The study is based on a systematic analysis of international scientific publications, regulatory legal acts, reports of international organizations and government agencies of the Kyrgyz Republic regulating the use of digital technologies in healthcare. The principles of SWOT analysis and strategic planning were used as a methodological basis.

A systematic analysis of scientific literature was conducted for the period 2015-2023. The search for publications was carried out in the international databases PubMed/MEDLINE, Web of Science, IEEE Xplore and Cochrane Library using a combination of key terms: "Artificial Intelligence", "Primary Health Care", "Machine Learning", "Clinical Decision Support Systems", "Telemedicine".

Criteria for inclusion of studies:

1. Publications in peer-reviewed journals with an impact factor of at least 2.0.
2. Clinical studies (randomized controlled trials, cohort studies) or meta-analyses assessing the effectiveness of AI in PHC.
3. Technical studies demonstrating the accuracy of algorithms of at least 80% compared to expert assessment.
4. Economic studies analyzing the cost of implementation and the effectiveness of AI solutions.

Of the initially identified 1,278 publications, 58 of the most relevant studies were selected after checking for compliance with the criteria. Particular attention was paid to works published in leading medical journals (The Lancet, JAMA, NEJM) and specialized publications on medical informatics (Digital Medicine, Journal of Medical Internet Research).

To analyze the quality of evidence, the GRADE (Grading of Recommendations Assessment, Development and Evaluation) scale was used, allowing to assess the strength of recommendations based on the methodological rigor of studies.

## 3. Results

The healthcare system of the Kyrgyz Republic operates in the context of a complex epidemiological transition characterized by a double burden of disease - a combination of persistent infectious pathologies (tubercu losis, viral hepatitis) and a rapid increase in noncommunicable diseases (cardiovascular pathologies, malignant neoplasms, type 2 diabetes), which account for more than 80% of total mortality. The institutional architecture of the healthcare system, based on the compulsory health insurance model, faces systemic limitations, including chronic underfunding, pronounced regional asymmetry in resource distribution, and a critical shortage of qualified personnel. Given the above problems, a comprehensive SWOT analysis of the implementation of artificial intelligence at the PHC level is proposed. The results of the comprehensive SWOT analysis of the implementation of artificial intelligence at the PHC in Kyrgyzstan are presented in Table 1.

### 3.1 Strengths

**The existence of a state policy on digital transformation of healthcare**

In the modern world, where digitalization covers all spheres of life, Kyrgyzstan is actively developing a state policy in the field of electronic health (eHealth). The main goal of electronic health is to improve the quality, accessibility of medical services to the population and the introduction of personalized accounting of procedures for providing medical care to citizens based on the large-scale use of information and communication technologies.

The key institution responsible for the coordination, implementation and monitoring of state policy in the field of electronic health and medical statistics is the Electronic Health Center (EHC) under the Ministry of Health of the Kyrgyz Republic [7].

As part of the implementation of the «SANARIP MED» project, the Electronic Medical Record information system was introduced, which allows accumulating and storing patients' medical data in electronic form andproviding access to information throughout the country. At the same time, the Information Data Management System was introduced, which allows receiving, processing, storing and issuing results, as well as managing the laboratory and laboratory data. In addition, an online platform for electronic registration for an appointment with a doctor and obtaining information about medicalservices has been introduced, which significantly simplifies the process of interaction between patients and medical organizations. This also helps to reduce queues and increase patient satisfaction. At the state level, a system of telemedicine services has been introduced, which allows patients to receive consultations from doctors at a distance, which is especially important for residents of remote and mountainous areas. An integrated digital epidemiological surveillance system (iEPID) has been introduced, which allows real-time monitoring of the epidemiological situation in the country and prompt response to outbreaks (epidemics) of diseases, forecasting statistical indicators for timely analysis and management decision-making. As part of the pilot project, the "Digital Health Profile" is being

**Table 1. SWOT analysis of the implementation of Artificial Intelligence at the Primary Health Care**

| *Strengths* | *Weaknesses* |
|---|---|
| – Availability of a state policy on digital transformation of healthcare.<br>– Availability of a functioning PHC system.<br>– Availability of functioning digital information systems (eHealth, EMR, iEPID, etc.)<br>– Improving the quality of prevention, diagnosis and accuracy of treatment.<br>– Improving the availability of medical care<br>– Optimization of the work of medical personnel.<br>– Disease prediction and personalized treatment | – Limited digital infrastructure (low level of digitalization of healthcare organizations, insufficient number of electronic medical records).<br>– Shortage of technical personnel and lack of competencies in the field of artificial intelligence.<br>– Shortage of medical personnel and lack of competencies in the field of artificial intelligence.<br>– Ethical and legal barriers (insufficiency of regulatory legal acts, compliance with ethical principles, etc.).<br>– Dependence of PHC activities on technology corporations |
| *Opportunities* | *Threats* |
| – Development of International cooperation and obtaining grants<br>– Implementation of AI in epidemiological surveillance<br>– Creation of a National program for the implementation of AI in healthcare | – Cybersecurity and data leakage risks (dependence on AI product manufacturers, unauthorized access, hacker attacks, etc.)<br>– Insufficient funding for healthcare digitalization<br>– Resistance (distrust) of the medical community.<br>– Rapid obsolescence of technologies (constant updating of algorithms and data). |

implemented, providing personalized electronic registration of data on a person's health status, integrating medical, biometric and behavioral indicators into a single digital platform. The "Digital Health Profile" is formed based on data from medical institutions, wearable devices (fitness bracelets, smart watches), genetic tests and lifestyle information (nutrition, physical activity, bad habits, etc.). In addition, the immunization information system (iEMDOO), has been integrated with the newborn and patient registers, allowing real-time tracking of unvaccinated children. Work is underway to complete the technical specifications for the disability assessment information system and modernize the laboratory information system (iLab) to improve the transparency and efficiency of laboratory services.

According to the "Concept of Digital Transformation of the Kyrgyz Republic for 2024-2028" approved by the Decree of the President of the Kyrgyz Republic dated April 5, 2024 No. 90, "artificial intelligence is one of the key technologies of digital transformation." It has the potential to transform traditional sectors of the economy and social sphere of Kyrgyzstan, increase the efficiency of public services and improve the quality of life of the population. Priority AI projects for the digital transformation of Kyrgyzstan should be aimed at increasing the efficiency of public services, automating routine tasks, increasing the accuracy and speed of information processing, as well as personalizing services. AI can be used to automate document processing in government agencies, develop personalized recommendations for citizens in the field of healthcare, education and social security, helping to improve the quality of education and healthcare [8].

**Availability of a functioning PHC system**

The main link in the provision of medical services to the population in the Kyrgyz Republic is a developed network of PHC organizations, which includes 21 Family Medicine Centers, 57 General Practice Centers, 681 Family Doctor Groups and 1079 feldsher-midwife stations.

The above-mentioned digital information systems are introduced into the architecture of the PHC system: "Information data management system", "Electronic medical record", "Integrated digital system of epidemiological surveillance", etc.

**Improving the quality of prevention, diagnosis and treatment accuracy**

Implementation of AI in the functioning PHC system will help improve the quality, accessibility and efficiency of medical services. The use of big data and machine learning algorithms in the diagnosis and treatment of diseases demonstrates significant potential for improving the efficiency and accuracy of medical decisions. In practice, examples of successful integration of AI into the clinical environment have already been identified, including recognition of pathologies in images, automatic risk stratification and prediction of treatment outcomes. Modern AI algorithms demonstrate high efficiency in automating routine diagnostic processes, freeing doctors from monotonous, labor-intensive and complex tasks related to the analysis and interpretation of digital data, often dependent on the human factor (age, competence, visual acuity, work experience, etc.). Evidence of this is the analysis of data from numerous scientific studies conducted by scientists from different countries. Deep machine learning is a form of artificial intelligence (AI) that promises significant prospects for improving the accuracy and speed of diagnosis using medical imaging.

Machine learning algorithms are capable of analyzing medical images and laboratory data with high accuracy, which reduces the likelihood of medical errors. Models trained on a large array of dermatological images successfully differentiate malignant and benign skin lesions, confirming the potential of using artificial intelligence in primary diagnostics. Neural networks demonstrate high efficiency in diagnosing skin cancer, achieving accuracy comparable to the level of qualified dermatologists [9]. At the same time, a meta-analysis of 42 studies using AI to interpret chest X-rays to diagnose pneumonia found a sensitivity of 92.5% and a specificity of 89.7%, which is comparable to the results of qualified radiologists. At the same time, the analysis time for one X-ray was reduced by 30 times, from 15–20 minutes to 30–40 seconds. Particularly noteworthy is the reliable 19-fold reduction in diagnostic time: the average time for analyzing one case is reduced from 15.2±3.7 minutes (with traditional diagnostics) to 0.8±0.3 minutes (with the use of AI, $p<0.001$). In a cohort study involving 12,540 patients, the automated system significantly reduced the waiting period for diagnosis by 6 times, from 14.3±2.1 to 2.4±0.9 days ($p<0.001$) [10]. The AI system performed differential diagnostics of viral pneumonia from bacterial pneumonia and healthy lungs, with a sensitivity of 92.94%, specificity of 87.04%, and accuracy of 0.968 (95% CI = 0.957–0.978). Thanks to AI, the ave rage weighted error in the interpretation of X-ray ima ges decreased by almost 3 times, from 27.44% to 9.82%, which demonstrates a significant improvement in the efficiency of young radiologists [11].

At the same time, a systematic analysis of 23 studies devoted to the use of computer vision at the PHC revealed a statistically significant superiority of AI algorithms compared to traditional diagnostic methods. In particular, in radiological practice, three-dimensional convolutional neural networks (CNN) provide an average sensitivity of 94.1% (95% CI: 92.3–95.8) and a specificity of 89.7% (95% CI: 87.1–92.3) in detecting malignant neoplasms of the lungs [12]. Similar indicators were achieved in the diagnosis of diabetic retinopathy - sensitivity of 93.8% (95% CI: 91.2–96.4), speci ficity of 97.1% (95% CI: 95.8–98.4) [13].

In addition, when detecting breast cancer metastases on histological preparations using the Paige.AI platform, the diagnostic accuracy was 98.6% [14]. In addition, such comprehensive platforms as IBM Watson Health Oncology are able to integrate visual, histological, genomic and clinical data, forming individualized treatment protocols [15]. The predicted savings from the widespread implementation of AI in primary care can amount to $150 billion annually in the US healthcare system by 2026 [16]. These results confirm the importance of AI as a tool for improving the quality, accessibility and effectiveness of medical services.

**Optimization of work of medical personnel**

The introduction of artificial intelligence (AI) into clinical practice helps to significantly reduce the cognitive and administrative burden on healthcare personnel by automating routine and repetitive tasks, such as filling out medical records, preliminary diagnosis, and processing patient data. Practical aspects of AI integration include overcoming technical and organizational barriers, training healthcare personnel in new digital tools, and adapting algorithms to the specifics of real clinical conditions, which requires an interdisciplinary approach [17].

Automation of routine processes can increase the efficiency of physicians and improve the quality of medical care by freeing up time for direct interaction with patients. At the same time, it is critical to ensure the transparency and interpretability of the algorithms used, which promotes trust in AI systems and their successful integration into the existing healthcare infrastructure. [18].

The introduction of virtual medical assistants using Natural Language Processing (NLP) technologies has demonstrated significant benefits in primary care. Thus, the reduction in time spent on documenting medical records reaches 40-50%, while the completeness and quality of medical documentation increases by 25-35%. Automatic analysis of records allows identifying logical contradictions and gaps in data, which helps to increase the accuracy and completeness of clinical information [19]. The data indicate that the use of AI assistants helps to reduce the administrative burden on doctors and improve the quality of interaction with patients, which is a key factor in increasing the efficiency of the healthcare system as a whole.

**Improving access to health care**

The hard-to-reach and remote highland areas of Kyrgyzstan (Chon Alai district, Ak Talaa district, Jumgal district, etc.) make up a significant part of the country, since about 90% of its area is occupied by mountains above 1500 m above sea level. These regions have a harsh mountain climate, characterized by a sharp change in atmospheric air temperature, wind speed, atmospheric pressure, precipitation, etc., which often leads to natural disasters (earthquakes, mudflows, landslides). In addition, the complex mountainous terrain does not allow for stable maintenance of the infrastructure of these regions, which is manifested in destroyed roads, severed power grids, contaminated drinking water sources, and limited access to qualified medical services. AI-based telemedicine platforms can provide recommendations to patients with limited access to medical services. In countries with similar challenges, such as India, AI is already being used for remote diagnosis and patient monitoring [20]

Next-generation telemedicine platforms such as Teladoc Health integrate AI algorithms for primary triage of patients. In a randomized controlled trial (RCT) involving 12,000 patients, such a system demonstrated 91% accuracy in determining case urgency, which reduced the waiting time for emergency consultation by 10 times, reducing the time from 24 hours to 2.3 hours, thereby increasing patient satisfaction by 25.3% [20].

**Disease prediction and personalized treatment**

AI will enable round-the-clock monitoring and analysis of morbidity, mortality and other statistical indicators in the context of settlements, districts, regions and republics. AI will enable monitoring and analysis of patient data and prognosis of disease development, which facilitates early intervention and prevention of many diseases or complications, contributing to the development of personalized medicine. Personalized medicine is an innovative approach to the diagnosis, treatment and prevention of diseases based on the individual characteristics of each patient. Unlike traditional medicine, where treatment is often selected according to average sche mes, personalized digital medicine takes into account genetic characteristics, nutrition, working conditions, lifestyle, behavioral risks, sensitivity to drugs and other risk factors, which increases the efficiency and quality of medical services [18].

The use of AI to predict the development of chronic diseases represents a paradigm shift from a reactive to a preventive model of medicine. A multicenter study conducted in 78 US clinics demonstrated that machine lear ning algorithms can predict the risk of hospitalization of patients with chronic heart failure 48-72 hours before clinical deterioration with 85% accuracy. This allows for timely preventive interventions and reduces the number of emergency hospitalizations by 22% [21]. Particular attention is paid to the development of "digital twins" - personalized mathematical models that reproduce the physiological processes of a specific patient. In a Philips pilot project aimed at diabetes management, the use of a digital twin made it possible to reduce HbA1c levels by 1.8% over 6 months compared with the control group [22]. These results highlight the promise of personalized analytics in the management of chronic conditions.

### 3.2 Weaknesses

**Limited digital infrastructure**

Despite the progressive state policy in the field of e-health, there is a low level of digitalization of medical institutions, which complicates the implementation of AI (lack of IT specialists, lack of computers, Internet speed, digital data, etc.). Insufficient number of electronic medical records (EMR) limits the possibilities of data analysis [23].

**Shortage of personnel and lack of competence in the field of AI**

According to the National Statistical Committee of Kyrgyzstan, the average rate of provision with doctors was 14.5 per 10,000 population, with mid-level medical personnel 34.2 per 10,000 population, which is 2 times less than the recommended WHO standards. In rural and remote areas, the shortage of doctors reaches 50-70%. At the same time, medical personnel do not have the knowledge in the field of using AI in their professional activities. The lack of technical specialists in the field of medical informatics and data analysis, in particular in rural areas, also hinders the development of digital technologies in the republic. Along with positive examples of application, the literature emphasizes the tendency to overestimate the capabilities of artificial intelligence, especially against the background of limited interpretability of the results obtained and the lack of adaptation of algorithms to the real clinical environment. Effective interaction of AI with medical personnel requires not only high accuracy, but also transparency of the decision-making process. Explainability of models is becoming a key criterion that allows doctors to maintain clinical control, trust in the system and the ability to reasonably interpret the recommendations provided by the algorithm in the context of a specific patient [4]. Research analysis also revealed the important role of the training process for doctors and medical personnel in working with AI [24].

**Ethical and legal barriers**

The use of AI in medicine not only opens up enormous opportunities, but also creates a number of ethical issues and problems. In the event of a data leak from the system during hacker attacks, who will be to blame? If AI makes an incorrect diagnosis, who will be responsible? If AI suggests a treatment that is dangerous to health or life, who will take responsibility?

The following may act as actors:

1) The company that developed the AI algorithm.
2) The head of the medical organization that implemented the AI.
3) The doctor who uses AI in his work.
4) The patient who trusted the healthcare system.

In this regard, it is necessary to develop a regulatory and legal framework for working with AI. Insufficient legislative regulation of AI in medicine leads to uncertainty in matters of responsibility [24]. The development of AI in medical practice requires the introduction of systematic quality control mechanisms, legal regulation and a comprehensive assessment of clinical and ethical risks [25]. Data privacy issues also require the development of standards for storing and processing information.

**Dependence of PHC activities on technology corporations (IBM, Microsoft, Google, etc.)**

Modern primary healthcare systems increasingly integrate AI-based solutions developed by large technology corporations. This process creates fundamentally new organizational dependencies, when critical clinical functions begin to rely on external technology platforms. Of particular concern to researchers is the issue of control over medical data - 78% of institutions, according to studies, cannot fully monitor how commercial algorithms process confidential patient information [18, 23].

The problem of the "black box" in corporate AI systems is especially relevant in the medical context, where 89% of healthcare implementations use proprietary algorithms, the internal logic of which remains inaccessible to medical organizations [22]. At the same time, only 12% of commercial solutions provide full documentation of the composition and characteristics of training samples. Such opacity creates significant risks for clinical practice, since health workers are deprived of the opportunity to critically evaluate the basis for automated recommendations [26].

Operational risks of commercial AI solutions also manifest themselves in issues of service reliability. According to research, 43% of implementations experience interruptions due to vendor actions, while critical prima ry care systems can be down for more than 14 hours per month [27, 28]. WHO additionally emphasizes the need to include clear provisions on data sovereignty and the right to audit algorithms in contracts with suppliers [6].

### 3.3 Opportunities

**Development of international cooperation and obtaining grants**

Currently, the Cabinet of Ministers of the Kyrgyz Republic and UN partners (WHO, UNDP, UNFPA, UNICEF) are actively promoting the digital transformation of healthcare to eliminate inequalities in access to medical services. WHO has begun developing national digital healthcare standards. UNDP supports efforts to digitalize the disability assessment process. UNFPA is expanding access to digital maternal health services. UNICEF is working to expand telemedicine services for children. With the support of international partners, Kyrgyzstan can adapt the best global practices in implementing AI [6]. Interaction with technology companies can accelerate the digitalization of PHC, including the implementation of AI.

**Implementation of AI in epidemiological surveillance**

Artificial intelligence can analyze epidemiological data and predict disease outbreaks. The use of AI in the analysis of epidemiological data of the Integrated Epidemiological Surveillance Digital System (iEPID) will allow real-time monitoring of the epidemiological situation for both infectious and non-communicable diseases, risk assessment, detection and identification of risk factors for health protection and disease prevention. These findings are confirmed in a study that analyzes deep learning algorithms and AI-based applications used in medical informatics for image processing, signal analysis and modeling of pathology development. However, the main limitations remain the lack of high-quality machine learning data and the need to standardize approaches to model building [29].

**Creating a national program for the implementation of AI in healthcare**

Government support and development of a strategic plan for the implementation of AI in healthcare can contribute to the effective integration of digital technologies. Creation of a single digital healthcare ecosystem to improve management processes, prevention, diagnosis and treatment of patients. An integral part of the strategic plan are the following tasks: development of a regulatory framework; digitalization of medical data (electronic medical records, prescriptions, laboratory results); implementation of telemedicine for remote consultations with patients; automation of processes (patient accounting, drug logistics, hospital management, etc.); use of AI and medical data to predict diseases and personalized medicine; ensuring cybersecurity and protection of personal data [6].

### 3.4 Threats

**Cybersecurity and data leak risks**

Full implementation of AI in clinical practice requires unification of information, standardization of data, multi-stage testing, verification and compliance with ethical standards. According to the study, it was found that the lack of reliable data protection systems increases the likelihood of hacker attacks and information compromise [30].

**Insufficient funding for healthcare digitalization**

Limited financial resources in the public healthcare sector limit the ability to purchase the necessary equip

ment, develop software solutions, acquire AI algorithms, and train personnel [5]. In the context of competition for the budget between priority areas (infrastructure, personnel, drugs), digitalization of PHC using AI is often out of focus. This can lead to fragmented implementation of technologies without sustainable support and maintenance. The lack of long-term funding also reduces the interest of private investors and international partners in participating in such projects. In this regard, insufficient government funding can slow down the process of implementing AI in healthcare.

**Resistance from the medical community to the introduction of AI**

Among the main areas of technology use are support for clinical decisions, diagnostics and prognosis of diseases. Along with obvious advantages in speed and accuracy, the need for ethical regulation and further research is emphasized for the safe and effective implementation of AI in medical care. Insufficient awareness of medical personnel regarding the benefits of AI in their work can be a serious threat to the implementation of AI in healthcare practice. Doctors' mistrust of AI and concerns about replacing human labor have become an obstacle to the implementation of AI technologies [31].

**Rapid obsolescence of technologies and data**

Artificial intelligence algorithms require regular updating and adaptation to constantly evolving medical data and clinical protocols to ensure their relevance and effectiveness when used in clinical practice. Summary reviews confirm that the interaction between AI and physicians requires not only technological sophistication but also trust, transparency, and the ability of algorithms to make explainable decisions [24].

## 4. Discussion

*Strengths.* The key advantage for the implementation of AI in PHC is the active state policy of healthcare digitalization, including the introduction of electronic medical records (EMR), telemedicine and the epidemiolo gical surveillance system (iEPID). A developed network of PHC creates the infrastructural prerequisites for the integration of AI. Studies confirm that machine learning algorithms significantly increase the accuracy of diagnostics (up to 98.6% in oncology) and reduce data processing time (up to 30 times), which is especially impor tant in the context of a shortage of personnel. Auto mation of routine tasks (documentation, patient sorting) frees up up to 50% of doctors' time, and telemedicine platforms improve the availability of care in remote and hard-to-reach regions.

*Weaknesses.* The main limitations are related to insufficient digital infrastructure: low internet speed in rural areas, a shortage of IT specialists and fragmentation of electronic medical records (EMR). The personnel crisis exacerbates the problem — the provision of doctors (14.5 per 10,000 people) is half the WHO standards, and in rural areas the deficit reaches 50-70%. Ethical and legal risks (liability for AI errors, data confidentiality) remain unregulated, which reduces the trust of the medical community.

*Opportunities.* International cooperation (WHO, UNDP) and the adaptation of successful cases can accelerate the implementation of AI. The integration of algorithms into the iEPID system will allow predicting disease outbreaks, and the development of a national program will ensure data standardization and cybersecurity. Pilot projects in personalized medicine (genome analysis, wearable devices, etc.) open up prospects for the development of preventive healthcare.

*Threats.* Critical barriers are insufficient funding, resistance from medical personnel, and the rapid obsolescence of information technology and databases. The lack of secure databases increases the risk of cyberattacks, and competition for funding items within the budget of healthcare organizations slows down the purchase of new equipment and technologies. Skepticism among medical staff and the need to continually update algorithms require a long-term learning and adaptation strategy.

## 5. Conclusion

The SWOT analysis shows that the implementation of AI in PHC in Kyrgyzstan has significant potential, but requires a comprehensive government approach that combines technological, organizational and personnel aspects that can ensure a balance between the innovative potential of corporate solutions and maintaining the sustainability of the PHC system. The most important aspects of the process of implementing AI in PHC are increasing funding, modernizing the digital infrastructure of healthcare organizations, training medical and technical specialists, and creating a high-quality regulatory framework. International experience shows that the integration of AI in healthcare requires a sustainable digital transformation policy, long-term investments and adaptation of technologies to the specifics of the national healthcare system [6]. The implementation of AI in the PHC system of the Kyrgyz Republic, taking into account international experience, will help improve the efficie ncy, accessibility and quality of medical care.

To successfully implement AI in the PHC system, it is proposed to implement the following tasks:

1. Creating a legal framework for regulating AI in healthcare:

– Creating standards for validating medical AI algorithms.

– Developing standards for storing and processing medical data.

– Defining legal liability in the event of AI errors.

– Developing ethical codes for the use of AI.

2. Development of digital infrastructure for PHC:
– Financing projects for the implementation of AI in PHC.
– Modernization of the IT infrastructure of medical institutions.
– Development of systems to ensure interoperability.
– Development of electronic medical records (EMR).
– Development of telemedicine and remote patient monitoring.
– Creation of centralized repositories of high-quality medical data.
3. Training of medical and technical personnel:
– Introduction of digital literacy training programs for medical personnel.
– Development of courses for IT specialists on working with medical AI systems.
– Creation of interdisciplinary teams (doctors + data scientists).
4. Stimulating private and public-private partnerships:
– Active involvement of the private sector and PPP to accelerate the implementation of AI in PHC.
– Interaction with technology companies to develop local digital solutions.
– Creation of technology parks and funds to support medical AI startups.
– Organization of competitions for the best AI solutions for PHC with guaranteed government orders for the winners.
– Organization of educational programs for doctors on working with AI.

Further research should focus on: long-term studies of the effectiveness of AI in real clinical practice; creation of adaptive systems capable of taking into account the ethnic and regional characteristics of patients; study of the socio-economic impact of AI implementation.

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