



THE ROLE OF MODERN COMPUTER TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF CHILDREN'S DISEASES

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ABSTRACT

This article explores the role of modern computer technologies and artificial intelligence (AI) systems in the early detection and effective treatment of childhood diseases. Based on scientific evidence, the paper analyzes the rapid integration of AI algorithms, digital diagnostic tools, telemedicine, remote monitoring, and medical data analysis into pediatric practice. The study also discusses the development of the digital healthcare infrastructure in Uzbekistan and the prospects for using intelligent systems in protecting children's health.

Introduction

In recent years, medicine has entered an unprecedented stage of digital transformation. This process is particularly vital in pediatrics, as the physiological characteristics of the child's body and the specific nature of childhood diseases often make traditional diagnostic methods insufficiently effective. For this reason, the introduction of modern computer technologies and artificial intelligence into medical practice has become one of the most relevant priorities of modern healthcare.

The use of AI in pediatrics improves diagnostic accuracy, reduces human-related errors, optimizes the treatment process, and allows for continuous monitoring of patients' conditions. Especially important are such areas as telemedicine, remote monitoring, neural network-based diagnostic systems, and electronic medical databases.

In Uzbekistan, digital transformation in pediatrics is being implemented step by step. Within the framework of the “**Digital Medicine – 2030**” concept developed by the Ministry of Health, efforts are being made to integrate AI technologies into the healthcare system to improve child health protection. These reforms determine the strategic direction for the future development of national healthcare.

Medicine is currently experiencing a digital revolution. Today, physicians rely not only on traditional methods of diagnosis and treatment but also actively employ computer technologies, digital analysis systems, and AI algorithms. The implementation of these

innovations, especially in pediatrics, has fundamentally changed the concept of medical care. The child's body differs significantly from that of an adult — it is in a continuous state of growth, development, and metabolic transformation. Therefore, each diagnosis, treatment plan, or medication dosage requires an individualized approach, which is precisely what artificial intelligence makes possible.

AI systems have already proven effective in dozens of areas. For example, the **Face2Gene** program can identify more than 200 rare genetic syndromes using facial photographs or genetic test data. The **AI-PED** system analyzes a child's heart rhythm with 96% accuracy and alerts the pediatrician in case of irregularities. Such technologies minimize the human factor and enable early disease detection.

In Uzbekistan, similar approaches are being introduced gradually. The **"E-Pediatrics"** project, for instance, connects regional and district clinics with the Republican Pediatric Center through a unified electronic network, facilitating teleconsultations and long-term child health monitoring. AI-based algorithms automatically analyze patient data — medical history, laboratory tests, and physiological indicators — and provide doctors with analytical recommendations for decision-making.

Modern computer technologies also play a crucial role in visual diagnostics. Algorithms capable of analyzing ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) can detect even the smallest pathological changes. For example, **Convolutional Neural Network (CNN)**-based models can identify pneumonia, bronchiolitis, or tuberculosis in X-ray images with exceptional accuracy — sometimes beyond the ability of the human eye. These technologies increase diagnostic precision by 15–20%, especially when clinical symptoms are not clearly visible.

In addition, smart sensors and wearable devices designed for children are widely used to monitor physiological parameters such as heart rate, respiration, body temperature, and blood oxygen levels. The collected data is transmitted online to a centralized system and analyzed by AI. Any abnormal changes trigger alerts to parents or physicians, which is especially vital for children with cardiovascular or respiratory disorders, as timely response can save lives.

AI also plays an important role in preventive pediatrics. Modern applications track vaccination schedules, nutrition, sleep quality, and physical activity. For example, programs such as **AI BabyCare**, **SmartMom**, and the Uzbek version **"Onajon yordamchisi"** provide personalized recommendations based on a child's age and developmental pace. Thus, AI not only treats diseases but also contributes to their prevention.

Thanks to these advancements, pediatrics is evolving from a **reactive** approach (responding to illness) to a **proactive** one (preventing disease). The data on each child are compiled into unified electronic systems, allowing comprehensive analysis and identification of national health trends, social influences, and environmental factors. This serves as an essential foundation for evidence-based health policy.

Hence, modern computer technologies and artificial intelligence have ushered in a new era in the diagnosis and treatment of pediatric diseases — improving accuracy, speed, and safety of medical care while easing physicians' workload and enhancing the quality of children's lives.

The introduction of AI technologies in pediatrics has brought the field into a new era. Whereas in the past doctors relied mainly on clinical signs and laboratory data, today's medical decisions are based on multi-layered information — genomic analyses, imaging diagnostics, electronic medical records, and even biosignals from the child's daily activities. Analyzing such massive data manually is nearly impossible, but artificial intelligence has proven remarkably efficient in this regard.

Currently, **intelligent treatment systems** are being widely adopted in pediatrics. For instance, the **AI-PediatricCare** program serves as a clinical decision support system. It considers the child's medical history, allergic reactions, liver and kidney functions, and suggests the most appropriate drug combinations. As a result, pharmacological errors decrease by 30–40%. Such systems are particularly valuable in minimizing adverse drug reactions and addressing polypharmacy — simultaneous use of multiple medications.

Another innovative area involves remote rehabilitation and monitoring systems. Programs like **AI-RehabKids** and **SmartSpeech** are designed for children with speech impairments or motor coordination disorders. These platforms analyze a child's movements or pronunciation using AI and adjust exercise complexity to match developmental progress. Reports are generated automatically for parents, while doctors can monitor rehabilitation remotely. Such systems proved invaluable during the pandemic, allowing home-based rehabilitation for children with disabilities.

AI-based speech recognition systems are also used to assess communication skills in children with autism spectrum disorders. The software analyzes tone of voice, speech rate, and vocabulary choice to detect early signs of psychological or neurological deviations, providing therapists with detailed recommendations. Simplified versions of these systems are already being tested in rehabilitation centers across Uzbekistan.

Another key area is the use of AI in **genomics and biomedical data analysis**. Genetic testing allows for the detection of significant biological variations, assessment of disease predisposition, and development of preventive strategies. For example, the international **Deep Genomics** platform predicts the likelihood of congenital disorders based on genetic mutations. Similar initiatives are being gradually implemented in Uzbekistan — through the **BioData Kids** platform developed by the Tashkent Medical Academy and the Agency for Innovative Healthcare, early-stage data on hereditary diseases are being analyzed.

However, alongside these advancements, challenges and risks remain. One of the most crucial issues in pediatric medicine is **data privacy**. Each child's medical history, genetic code, and health information must be securely protected. According to **WHO** recommendations, AI-based medical systems must follow a **“human-centered approach”** — technology should never replace a physician's decision but rather support it. The **Digital Medicine Concept of Uzbekistan (2023)** emphasizes that digitalization in medicine must comply with ethical norms and humanistic values.

Moreover, clinical decision-making involving children requires not only technological but also psychological and social responsibility, as the child's body is more sensitive and any intervention may have long-term consequences. Therefore, AI-driven recommendations must always be applied under expert supervision.

Looking ahead, AI and computer technologies are expected to become even more deeply integrated. The **“Virtual Doctor” (AI-Doctor Assistant)** concept being developed worldwide aims to create a digital assistant capable of observing real consultations, learning from medical records, and generating new recommendations. AI also plays a role in controlling **3D printing technologies** to produce customized prosthetics and orthopedic devices for children.

All of these developments illustrate that technology and human expertise are forming a complementary system in pediatrics. The doctor’s experience, empathy, and compassion combined with AI’s analytical power create the optimal conditions for child health.

Conclusion

Modern computer technologies and artificial intelligence have launched a new stage in medical practice. They enable early diagnosis, personalized treatment approaches, risk-group identification, and remote patient monitoring. Most importantly, these technologies enhance — rather than diminish — the humanity of medicine by supporting doctors, improving decision-making, and ensuring better healthcare outcomes.

In Uzbekistan, scientific research in AI and medical informatics is expanding, with growing attention to the development of digital health infrastructure. In the near future, artificial intelligence is expected to evolve from an auxiliary tool into a full-fledged diagnostic and rehabilitative partner in pediatric care.

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