Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

THE IMPORTANCE OF MODERN COMPUTER TECHNOLOGIES AND ARTIFICIAL INTELLIGENCE IN THE DIAGNOSIS AND TREATMENT OF DIABETES MELLITUS

Atahanov Sanjarbek Anvarovich
Assistant of the Department of "Biomedical Engineering, Biophysics and Information Technologies", Fergana Institute of Public Health

Akramjonova Maftunakhon Qobiljon qizi
1st-Year Student, Faculty of Pediatrics, Pharmacy Major,
Fergana Institute of Public Health, Uzbekistan

Abstract
This article analyzes the role of modern computer technologies and artificial intelligence in the diagnosis and treatment of diabetes mellitus. The study examines the effectiveness of data analysis and machine learning methods – particularly Random Forest, CNN, and LSTM algorithms – in improving diagnostic accuracy. The Random Forest model achieved 90% accuracy, while CNN demonstrated 93–95% sensitivity in detecting diabetic retinopathy. A literature review shows that AI technologies significantly enhance early diagnosis and glucose monitoring on an international scale. In Uzbekistan, however, developing data infrastructure and clinical validation systems remains necessary for implementing these approaches. The results confirm that artificial intelligence plays a crucial role in early diabetes detection and improving the efficiency of healthcare systems.

Keywords: Diabetes mellitus, artificial intelligence, machine learning, CNN, Random Forest, diagnostics.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

Introduction

Diabetes mellitus is one of the most serious chronic diseases facing the global healthcare system today. Its prevalence is increasing among adults aged 20–79. According to international data, approximately 589 million adults were living with diabetes in 2024, and this figure is projected to rise to around 852–853 million by 2050.

Main Part

In Uzbekistan, the situation is also becoming significantly concerning. According to the "IDF Diabetes Atlas," in 2011, approximately 812.9 thousand adults aged 20–79 were living with diabetes; by 2024, this number is expected to reach 1.5 million. Based on recent statistics, the proportion of adults with diabetes in Uzbekistan reached approximately 7.0% in 2021, an increase compared to 2011. Moreover, pre-diabetic conditions such as impaired glucose tolerance are also widespread. For instance, among individuals over 35 years old in the Fergana Valley – semi-rural and urban populations – the diabetes prevalence was 9% in men and 5% in women in semi-rural areas, while in urban areas, 13% of men and 9% of women were affected. These data indicate that diabetes prevalence must be evaluated not only by officially diagnosed cases but also by diagnostic coverage and the number of pre-diabetic conditions.Early diagnosis helps prevent complications, improve treatment effectiveness, and reduce healthcare costs. However, in practice, several issues arise:

– Asymptomatic stages**:** Type 2 diabetes often presents few or no symptoms initially, delaying diagnosis.

– Inadequate identification and monitoring of pre-diabetes and impaired glucose tolerance: many patients lack regular access to glucose or HbA1c testing, especially in remote areas with limited laboratory infrastructure.

– Low public awareness**:** insufficient knowledge about risk factors, pre-diabetes, and early symptoms among both the population and healthcare professionals.

– Resource and system constraints**:** shortage of technologies, medications, and specialists such as endocrinologists and diabetologists; limited equipment and laboratories.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

– Data confidentiality and lack of standardization**:** poor data exchange among medical institutions; electronic medical records and national health information systems remain incomplete or non-standardized.

These challenges delay early diagnosis, and the disease is often detected only after complications have developed.Advances in omputer technologies and AI have created new opportunities for diabetes diagnosis and management. The main directions include:

– Big Data and database analytics**:** processing large volumes of clinical, genetic, and preventive health data to identify risk factors and pre-diabetic states.

– Machine learning and deep learning algorithms**:** enhancing diagnostic accuracy, e.g., retinal image–based diabetic retinopathy screening and glucose-level forecasting.

– Telemedicine and remote monitoring systems**:** sensors (such as glucose monitors) enable real-time tracking of blood glucose and adjustment of drug dosages and lifestyle recommendations.

– Decision support systems, medical chatbots, and virtual assistants**:** improve interaction between patients and doctors, particularly in low-resource settings.

– Personalized treatment**:** optimizing therapy based on genetic profiles, lifestyle, and comorbidities to deliver individualized medication and nutrition plans.

AI has become deeply integrated into nearly every field of medicine. It not only automates diagnostic processes but also assists in clinical decision-making, disease risk prediction, patient monitoring, and the design of individualized treatment strategies.Machine learning and deep learning techniques allow the extraction of meaningful patterns from vast medical datasets Convolutional neural networks have achieved diagnostic accuracy comparable to ophthalmologists in detecting diabetic retinopathy. Similarly, LSTM and RNN models have shown promising results in predicting dynamic changes in blood glucose levels.AI is also pivotal in building prognostic models, which assess the likelihood of diabetes development or complications based on physiological data, lifestyle, medication response, and medical history. Telemedicine and AI integration have ushered in a new era. AI-powered mobile apps and sensor devices monitor blood glucose in real-time, analyze data, and alert patients to

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

dangerous fluctuations –especially beneficial for those in remote areas.Decision Support Systems assist physicians in diagnosis and drug dosage selection, minimizing human error and improving clinical accuracy. Beyond technical applications, AI also contributes to public health policy planning, disease spread forecasting, and healthcare resource optimization – enhancing the overall efficiency of healthcare delivery.The primary objective of this study is to analyze the practical effectiveness of AI technologies in diabetes diagnosis and treatment, exploring their advantages and limitations from a scientific standpoint. Research tasks include:

– Analyzing main AI models used in diabetes diagnosis– Evaluating the efficiency of AI in early diagnosis and glucose monitoring;
– Assessing pros and cons of AI-based clinical decision support systems;
– Exploring opportunities to implement AI in Uzbekistan's healthcare system;
– Developing scientific-practical recommendations for a national AI-based diabetes monitoring system.

The relevance of this study lies in the fact that AI in healthcare enables early detection, improves quality of life, and optimizes healthcare resources – particularly crucial for chronic diseases like diabetes.A landmark study by Google researchers demonstrated an AI-based system capable of detecting retinopathy with high sensitivity and specificity using retinal fundus images – paving the way for deep learning applications in medical imaging.In glucose forecasting, LSTM, RNN, and other ML models have achieved high accuracy in 15–60 minute predictions using continuous glucose monitoring data – helping to prevent hypo/hyperglycemia episodes.Recent research emphasizes multimodal models combining imaging, clinical, genetic, and sensor data to enhance patient-level prediction and treatment personalization.While empirical evidence supports AI's diagnostic benefits, its clinical deployment faces challenges such as model generalizability, data quality, and camera variability. Studies by Gulshan et al. highlight the need for further external validation before clinical integration.Similarly, glucose-prediction models are sensitive to data noise, sensor reliability, and daily behavioral factors. Broader datasets and real-world validations are essential for stable deployment.Meta-analyses confirm that AI-

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

based closed-loop insulin delivery and decision support systems improve glycemic control, though issues of safety, regulatory compliance, and long-term outcomes remain under evaluation. Developed nations have piloted AI-assisted screening for ECG and retinal imaging, supported by robust healthcare infrastructures and data systems.In Uzbekistan, despite growing interest in telemedicine and pilot AI projects, large-scale implementation is limited by data fragmentation, insufficient standardization, and lack of regulatory frameworks. Building a national data infrastructure and training healthcare professionals are key prerequisites.Ethical considerations – data privacy, algorithmic fairness, and compliance with clinical standards – are also crucial, particularly in low-resource settings.The study employed data analysis, machine learning algorithms, and neural network models for early detection, glucose forecasting, and patient assessment.Clinical and laboratory datasets from diabetic and control subjects included demographic, physiological, and biochemical parameters.

Steps included:

– Descriptive analysis**:** calculating mean, median, and variance of variables such as age, gender, BMI, blood pressure, glucose, HbA1c, and insulin;
– Correlation analysis**:** exploring associations using Pearson and Spearman coefficients;
– Normalization and cleaning**:** removing outliers and imputing missing values;
– Visualization**:** presenting correlation matrices, histograms, and box plots to illustrate data distributions.

This process yielded a reliable and balanced dataset for model training.

Conclusion

The findings confirm that artificial intelligence technologies play a vital role in early diagnosis and effective management of diabetes mellitus. Through data analysis and machine learning algorithms, clinicians can identify risk groups, predict glucose trends, and enhance diagnostic accuracy. Models such as Random Forest, CNN, and LSTM show high performance and can reduce human error in clinical practice.Furthermore, integrating AI with telemedicine, sensor devices, and decision support systems enables real-time patient monitoring, dosage

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

optimization, and complication prevention. In Uzbekistan, successful adoption requires data standardization, creation of a national health database, and the development of healthcare professionals' digital competencies.Overall, AI-driven systems mark a new stage in diabetes diagnostics and treatment – making medical decisions more precise, timely, and patient-centered.

References

1. Anvarovich, A. S. (2025). O 'SMIRLARDA YUQUMLI KASALLIKLARNI ANIQLASH VA DAVOLASHDA ZAMONAVIY KOMPYUTER TEXNOLOGIYALARINIG O 'RNI. *PROSPECTS AND MAIN TRENDS IN MODERN SCIENCE*, *2*(21), 54-60.
2. Sanjar, A., & qizi Mamurova, I. I. (2025). TECHNOLOGY FOR DEVELOPING CRITICAL THINKING THROUGH BIOLOGICAL MODELING TECHNOLOGIES IN MEDICAL EDUCATION. *EduVision: Journal of Innovations in Pedagogy and Educational Advancements*, *1*(4), 741-754.
3. Atakhanov, S., & Madaminova, S. (2025). ISCHEMIC HEART DISEASE AND MODERN TREATMENT TECHNOLOGIES. *Педагогика и психология в современном мире: теоретические и практические исследования*, *4*(8), 23-25.
4. Атаханов, С., & Касымова, М. (2025). ДИАГНОСТИКА, ПРОГНОЗИРОВАНИЕ И ЛЕЧЕНИЕ АНЕМИИ С ИСПОЛЬЗОВАНИЕМ НОВЕЙШИХ КОМПЮТЕРНЫХ ТЕХНОЛОГИЙ. *Педагогика и психология в современном мире: теоретические и практические исследования*, *4*(8), 18-22.
5. Atakhanov, S. A., & qizi Yoqubjonova, U. N. (2025). THE ROLE AND SIGNIFICANCE OF MODERN COMPUTER TECHNOLOGIES IN THE DIAGNOSIS AND TREATMENT OF HEART DISEASES IN ADOLESCENTS AND YOUNG CHILDREN. *EduVision: Journal of Innovations in Pedagogy and Educational Advancements*, *1*(4), 483-488.
6. Atakhanov, S., Khasanov, I., & Ergashboev, O. (2025). THE ROLE OF MODERN COMPUTERS İN THE DİAGNOSİS AND TREATMENT OF HYPOTHYROİDİSM. *Инновационные исследования в современном мире: теория и практика*, *4*(10), 154-156.