International Conference of
Economics, Finance and Accounting Studies

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DIGITAL HEALTH MANAGEMENT IN TRANSITION ECONOMIES: ENHANCING GASTROINTESTINAL DIAGNOSTICS THROUGH AI-DRIVEN SALIVA-BASED SYSTEMS

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ABSTRACT
In the context of ongoing digital transformation, healthcare systems in transition economies face the dual challenge of modernizing diagnostic capabilities and ensuring accessibility to high-quality services. This study explores an innovative approach to gastrointestinal diagnostics through the integration of AI-driven saliva-based systems, focusing on the example of Uzbekistan. The research analyzes the effectiveness of the "Saliva" digital device, which utilizes machine learning algorithms—particularly the Random Forest classifier—for the early detection of gastrointestinal diseases. Through empirical testing, economic modeling, and scenario-based simulations, the study demonstrates the potential of such technology to improve diagnostic accuracy, reduce costs, and increase coverage in underserved regions. The findings highlight how digital tools, when strategically embedded into national healthcare systems, can drive institutional efficiency, preventive care, and sustainable medical service delivery in transition economies.

Keywords:
Digital healthcare, gastrointestinal diagnostics, AI in medicine, saliva-based testing, Random Forest algorithm, transition economies, healthcare innovation, Uzbekistan, preventive diagnostics, e-health.

INTRODUCTION
The rapid evolution of digital technologies is reshaping healthcare systems across the globe, particularly in transition economies where the need for cost-effective, scalable, and innovative solutions is especially acute. These nations face structural limitations in healthcare financing, a shortage of qualified personnel, and regional disparities in access to diagnostic services. In such contexts, digital health management offers transformative potential by enabling data-driven decision-making, personalized care, and preventive diagnostics.
One of the pressing medical concerns in many developing and transition economies, including Uzbekistan, is the timely and accurate diagnosis of gastrointestinal (GI) disorders. These diseases

often go undetected until advanced stages, leading to significant public health burdens and increased treatment costs. Traditional diagnostic tools such as endoscopy and biopsy, while effective, are resource-intensive, invasive, and limited in accessibility—especially in rural and underserved areas.

This research introduces a novel solution to these challenges through the deployment of an AI-powered, saliva-based diagnostic system known as **"Saliva."** The device leverages non-invasive biosensor technology combined with machine learning algorithms—particularly the Random Forest classifier—to analyze saliva samples and identify early signs of gastrointestinal disorders. By integrating this approach within the broader digital health infrastructure, the study aims to demonstrate how such innovations can enhance diagnostic reach, improve health outcomes, and strengthen the operational efficiency of healthcare systems in transition economies.

Through an interdisciplinary methodology involving clinical data analysis, economic evaluation, and simulation modeling, this study provides empirical evidence on the feasibility and economic viability of AI-driven saliva diagnostics. The findings contribute to the growing body of knowledge on digital health strategies that align technological innovation with sustainable healthcare delivery in the context of developing nations.

MAIN PART

Digital health innovation has become a strategic tool in addressing systemic healthcare inefficiencies in transition economies, where traditional diagnostic infrastructures are often underdeveloped or unevenly distributed. The integration of artificial intelligence (AI) with non-invasive diagnostic technologies is proving particularly impactful in expanding access to early-stage disease detection, reducing reliance on centralized facilities, and improving care continuity in remote regions.

This study focuses on the practical implementation and evaluation of **"Saliva"**—a digital diagnostic device designed to detect early signs of gastrointestinal (GI) disorders using biosensor-based saliva analysis. The system incorporates a supervised machine learning model—Random Forest—which is trained on clinical datasets to identify patterns indicative of GI dysfunctions. Unlike conventional methods, the "Saliva" device operates in a non-invasive, user-friendly manner, enabling point-of-care testing even in primary care settings and rural clinics.

The empirical evaluation of the device was conducted through pilot testing in Uzbekistan's regional medical institutions. Diagnostic accuracy was compared against traditional methods, revealing an AI-based sensitivity rate above 85% for early-stage gastrointestinal conditions. Furthermore, a Monte Carlo simulation was applied to assess the economic feasibility of large-scale deployment. The model indicated that by increasing the annual usage of the "Saliva" device by 10–15% and integrating it into digital health platforms, overall healthcare expenditures related to GI diseases could be reduced by up to 20%.

In addition to diagnostic performance, the study evaluated the scalability and health system integration of the technology. Key metrics included infrastructure compatibility, training requirements, and patient satisfaction. The device demonstrated high interoperability with existing electronic health record (EHR) systems and required minimal onboarding time for medical personnel. User surveys indicated high acceptance rates due to the non-invasive nature and speed of results delivery.

The integration of the "Saliva" system into the national e-health framework presents a viable model for other transition economies facing similar diagnostic challenges. By combining digital diagnostics with machine learning, healthcare systems can move from reactive to proactive care models, ultimately reducing disease burden and enhancing public health outcomes.

CONCLUSION

The findings of this study underscore the transformative potential of integrating AI-driven, non-invasive diagnostic technologies into digital health systems within transition economies. The implementation of the **"Saliva"** device for gastrointestinal diagnostics represents not only a technological innovation but also a strategic step toward enhancing healthcare accessibility, accuracy, and cost-efficiency in resource-constrained environments.

By leveraging machine learning algorithms—specifically the Random Forest classifier—and

saliva biosensor analysis, the proposed system has demonstrated promising results in early disease detection, with high diagnostic reliability and favorable economic indicators. The approach enables decentralization of medical services, reduces diagnostic latency, and facilitates preventative care—key priorities for modernizing public health in transitional contexts.

Moreover, the integration of such tools into national digital health infrastructure fosters more resilient and adaptive healthcare systems capable of responding to both epidemiological and institutional challenges. As shown through empirical analysis and scenario modeling, the adoption of AI-powered diagnostics like "Saliva" can significantly improve health outcomes while optimizing financial and operational resources.

In conclusion, this research highlights the critical role of digital innovation in shaping the future of healthcare in transition economies. Scalable, affordable, and intelligent diagnostic platforms are essential not only for improving clinical efficiency but also for achieving long-term goals of health equity, technological sovereignty, and sustainable development.

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