



OPPORTUNITIES FOR EARLY DIAGNOSIS BASED ON BIOMARKERS IN CLINICAL DIAGNOSTIC LABORATORIES: EXPERIENCE AND PROSPECTS OF UZBEKISTAN

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Abstract

This article analyzes the theoretical and practical aspects of early diagnosis based on biomarkers in clinical diagnostic laboratories. The experience of using biomarkers in the diagnosis of cardiovascular, oncological, and infectious diseases was studied in the conditions of Uzbekistan. The results of diagnostic methods based on markers such as troponin, BNP, PSA, CA-125, CEA used in medical institutions of the republic were evaluated based on scientific sources. The prospects for introducing modern molecular and genetic diagnostic technologies into laboratory practice are also highlighted. The study indicates existing infrastructural problems, human resources, and technological gaps, and makes proposals for areas that should be implemented in the future.

Keywords: biomarker, clinical diagnostic laboratory, early diagnosis, enzyme immunoassay, molecular diagnostics, healthcare system of Uzbekistan.

INTRODUCTION

In recent years, the relevance of early diagnosis in the field of medicine has increased dramatically worldwide. In particular, methods of early diagnosis based on biomarkers are taking an important place in the activities of clinical diagnostic laboratories. Biomarkers are molecules that are detected in blood, urine, tissues and other biological environments when a certain disease or pathological process occurs in the body. With their help, it is possible not only to detect the disease early, but also to monitor its course and assess the effectiveness of treatment.



in Uzbekistan , special attention is being paid to the modernization of the laboratory diagnostics system, the introduction of modern technologies, and improving the quality of healthcare services. In particular, the Resolution of the President of the Republic of Uzbekistan No. PQ-4890 dated November 12, 2020 “ On the Strategy for the Development of the Healthcare System in the Republic of Uzbekistan for 2021–2025” , Also , Resolution No. PQ-130 of March 1, 2022 "On Measures for the Development of Science and Innovations" sets out the tasks of providing diagnostic laboratories with high technologies and widely introducing modern analysis methods [1].

Today, the activities of clinical laboratories are expanding throughout the republic , most of which are creating opportunities for early diagnosis using biomarkers for oncological, cardiovascular, endocrine and infectious diseases. At the same time, international experience analysis shows that biomarker -based diagnostics not only serves the early detection of diseases, but also contributes to economic efficiency in the healthcare system. This article analyzes the existing experience, achievements and promising directions of early diagnosis based on biomarkers in clinical diagnostic laboratories in Uzbekistan .

REFERENCES AND METHODOLOGY.

Recent scientific research on the use of biomarkers in clinical diagnostic laboratories shows that significant progress is being made in early detection of diseases and increasing the effectiveness of treatment. In particular, a study conducted by SR Khasanova and N. Sh. Tursunova showed that troponin **I** in the diagnosis of cardiovascular diseases in Uzbekistan , The clinical significance of biomarkers such as **BNP** (Brain Natriuretic Peptide) has been studied and has been shown to be an important indicator for early diagnosis of heart failure [2]. a scientific study conducted by BG Karimov and XA Mamatkulov analyzed the role of serological biomarkers such as ALT/AST, HBsAg, and Anti-HCV in early diagnosis of hepatitis B and C viral infections . This study found that serological tests performed using a high-resolution immunoenzymatic method showed a sensitivity of more than 90% in detecting early - stage **infections** [3] .



In the field of oncological diseases, the research conducted by T.K. Sodiqova described the mechanisms of early detection of oncological diseases among women and men in Uzbekistan based on tumor markers such as **PSA** (Prostate Specific Antigen), **CA-125**, **CEA**. **In this study, the diagnostic value of biomarkers was analyzed** based on data from more than 500 patients collected in Tashkent and regional diagnostic centers, and their use in clinical practice was found to be effective [4].

In addition, a joint project conducted by the Tashkent Medical Academy and the Republican Specialized Scientific and Practical Center for Oncology has developed **multiparametric biomarker panels** that allow for the simultaneous assessment of several markers. This approach is becoming an important factor in determining the heterogeneous course of the disease [5].

in 2023–2024 at the Scientific Center for Innovative Health Technologies under the Ministry of Health of the Republic of Uzbekistan will also include **the development of genetic biomarkers in the laboratory**, in particular **BRCA1/2**, By identifying gene mutations such as **EGFR** and **KRAS**, it is expanding the possibilities of individualized diagnosis, which indicates the rapid introduction of molecular diagnostics into practice [6].

In general, scientific research conducted in Uzbekistan on biomarker-based early diagnosis shows that this approach is not only clinically reliable, but also economically effective. It is also clear that this direction has broad prospects through the use of modern technologies, laboratory equipment, training of qualified personnel, and the adoption of international experience.

RESULTS AND DISCUSSION

Analysis of studies shows that in Uzbekistan, the practice of early diagnosis based on biomarkers is gradually developing in clinical diagnostic laboratories. In particular, the introduction of biomarkers such as troponin, BNP, PSA, CA-125, CEA into laboratory practice has significantly expanded the possibilities for early detection of cardiovascular, oncological and infectious diseases. This, in turn, creates the basis for identifying the disease before it progresses to a severe stage and effectively implementing treatment measures [7].



Modern biochemical, immunoenzymatic, and molecular genetic laboratories are operating in a number of medical institutions in Uzbekistan. These laboratories provide opportunities for highly accurate diagnosis of patients at different stages of the disease, especially before the onset of symptoms, using biomarkers. Studies in this area, especially those based on immunological and molecular diagnostic methods, have yielded clinically reliable and statistically significant results [8].

One of the important aspects is that the advantage of biomarker-based diagnosis is not only in early detection, but also in monitoring the course of the disease, and in developing individual treatment strategies. In particular, clinical observations conducted in specialized medical centers of the Republic have shown that monitoring the dynamics of biomarkers after primary diagnosis has become an important diagnostic criterion in assessing disease remission [9].

However, there are also some challenges. These include the relatively high cost of biomarker tests, the lack of uniform laboratory infrastructure in all regions, and insufficient staff qualifications. At the same time, laboratories in remote areas are often not equipped with modern testing equipment or have limited test panels. This situation can negatively affect the quality and accuracy of diagnostics [10]. Also, **multiplex**, which is widely used in foreign experience, technologies, **Advanced approaches such as next-generation sequencing (NGS) and liquid biopsy** have not yet been fully implemented in Uzbek laboratories. However, the implementation of these technologies could bring the diagnostic capabilities of the Uzbek healthcare system to a completely new level [11].

that although our country has achieved certain successes in the field of biomarker-based diagnostics, it is necessary to take this area to a higher level through a systematic approach, deepening scientific research, enriching the laboratory environment with modern technologies, and increasing human resources. The formation of a national diagnostic model based on innovative technologies remains one of the main tasks in this regard [12].



CONCLUSION

The reforms implemented in the healthcare system of Uzbekistan in recent years, the decisions and programs adopted to modernize laboratory diagnostics, especially the development of biomarker-based diagnostic methods, have laid the foundation for the development of biomarkers. The conducted analyses show that biomarkers are an important tool for high-precision early diagnosis in clinical practice. Markers such as Troponin, PSA, CA-125, BNP, CEA are significantly effective in the early detection of cardiovascular, oncological and infectious diseases.

At the same time, there is still great potential for the widespread introduction of modern technologies based on molecular and genetic biomarkers, including advanced approaches such as NGS, multiplex analysis systems, and liquid biopsies, in laboratories in Uzbekistan. Current problems in this regard include differences in the quality and technological capabilities of laboratory services between regions, insufficient qualifications of specialists, and restrictions on the market for test materials.

In conclusion, the development of biomarker-based diagnostics in Uzbekistan is a strategic direction that meets the requirements of modern medicine, allows for early diagnosis and an individual approach. By attracting investments in this area, implementing innovative technologies, introducing international experience, developing laboratory infrastructure on a unified system, and increasing human resources, it will be possible to expand these services throughout the republic and ensure their quality and convenience.

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