Training Biomedical and Medical Informatics Specialists in Azerbaijan

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***Abstract*— Education in biomedical and health informatics plays a critical role in supporting modern healthcare systems, connecting medical practice with information technology, and meeting the growing digital demands of the healthcare sector. This paper examines the current state of biomedical and health informatics education both in Azerbaijan and around the world and offers recommendations for its future advancement. In order to investigate global trends and both domestic and international educational examples, we examined data from reports and articles. The thoughts of the experts were also used to discuss Azerbaijan's problems and potential solutions**.

Keywords*— *Biomedical and health informatics, electronic health records, Europe set criteria, training of trainers.

I. INTRODUCTION

In today's digital era, health informatics has become a key pillar of the healthcare system, fundamentally driven by the collection, analysis, and application of data. As technology continues to evolve rapidly, there is a broad consensus among healthcare professionals, policymakers, and researchers that the industry must urgently accelerate its digital transformation [1]. The traditional methods of managing healthcare information are no longer sufficient to meet the demands of modern medical practice, where timely access to accurate data can significantly impact patient outcomes.

Biomedical and health informatics (BMHI) has emerged as a critical field that addresses these challenges by facilitating the effective management, sharing, and utilization of health-related data. BMHI is an interdisciplinary domain that combines elements of information science, computer science, technology, and socio-behavioral sciences with the practice of medicine and public health. It focuses not only on the technical aspects of data storage, retrieval, and analysis but also on the human and organizational factors that influence the successful implementation of information systems in healthcare settings.

By integrating advanced technologies such as electronic health records (EHRs), telemedicine platforms, big data analytics, and artificial intelligence, health informatics aims to improve the quality, safety, and efficiency of healthcare delivery. Furthermore, BMHI plays a crucial role in supporting evidence-based medicine, enabling healthcare providers to make more informed clinical decisions based on comprehensive patient data and the latest research findings.

As the healthcare landscape continues to evolve, the importance of health informatics will only grow. It offers the potential to enhance patient engagement, streamline healthcare operations, and drive innovation across the entire healthcare ecosystem. Ultimately, the effective use of health informatics contributes to better health outcomes, reduced costs, and a more patient-centered approach to care, marking it as an indispensable component of the future of healthcare.

The pervasive influence of information technology, compounded by issues like the 2019 pandemic of coronavirus disease and demographic shifts like aging populations, emphasizes the need for healthcare workers to acquire more than just basic computer skills. They must also become proficient in data management, have knowledge of advanced digital healthcare strategies, and be committed to providing individualized care [2, 3].

By 2030, the World Health Organization predicts a startling shortage of 18 million medical personnel [4]. This situation is particularly severe in Azerbaijan that are aging quickly. Innovations in robotics and artificial intelligence have the potential to completely transform the healthcare industry. In order to improve patient experiences, the industry is about to move beyond the basic usage of electronic health records to a more sophisticated interaction with health data.

This highlights the need for thorough BMHI educational frameworks, which are frequently overlooked in conventional pedagogies. Given that healthcare is inherently data-centric and that living things are essentially information processors, technological advancement will propel the development of health informatics [5, 6].

In order to guarantee better care delivery as the healthcare industry becomes more digitalized and connected, professionals need to possess a thorough understanding of informatics. Understanding the intricacies of contemporary healthcare systems, fostering interdisciplinary collaboration, and meeting the field's growing digital requirements all require a solid foundation in BMHI.

The purpose of this report is to clarify the concept, evolution, and worldwide trends of biomedical and health informatics education. The paper suggests future plans for advancing BMHI education in Azerbaijan in light of this knowledge.

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II. PROGRESS AND INNOVATION IN BMHI EDUCATION

Hospital information systems were the starting point for the development of BMHI. Since BMHI is a recently recognized and developing field, its nomenclature has changed. Prior to 2000, "medical informatics" was a widely used word in the US.

The phrase "medical informatics" gave way to "biomedical informatics," a more inclusive word that now includes a variety of healthcare and life science fields, as a result of the rise of bioinformatics.

The term "biomedical informatics," which covers all fields such as clinical practice, healthcare, and biomedical research, is currently more widely used in the US. Biomedical informatics, imaging, and public health are subfields of clinical informatics, which focuses on fields including medicine, nursing, and dentistry [7].

The BMHI curriculum has been defined through international cooperation. In 1973, German organizations took the lead in these activities. Europe set criteria through EDUCTRA by 1992. In 1998, the International Medical Informatics Association (IMIA) created nursing competencies [8].

The American Medical Informatics Association (AMIA) introduced the 10×10 program in 2005, and IMIA offered guidelines for health informatics programs in 2000 [9].

The essential capabilities for BMHI were delineated by AMIA by 2012 [10].

Other initiatives included AMIA's joint efforts in 2015 and 2019 and TIGER's contributions to the clinical field curriculum [11].

In 2019, the Baccalaureate Education Community focused on fundamental skills, and in 2023, they presented findings from a master's-level study [12].

Core competencies for nursing education were proposed by the American Association of Colleges of Nursing in 2021 [13].

III. KEY DEVELOPMENTS IN BMHI EDUCATION IN AZERBAIJAN

As of 2025, Azerbaijan is actively advancing its biomedical and health informatics (BMHI) education to meet the growing demands of digital healthcare transformation. While specific statistics on BMHI education programs are limited, several initiatives and developments highlight the country's commitment to this field.

In 2022, AMU established the Department of Medical and Health Sciences Education (DMHSE) to modernize medical education.

By 2023, over 500 faculty members participated in training programs focusing on teaching skills, clinical proficiency, and emergency care management [14].

Implemented a Training of Trainers (ToT) model in 2022, engaging over 100 participants to enhance teaching methodologies in health professional education.

AMU collaborates with the Azerbaijan National Academy of Sciences on projects like developing intelligent methods for early diagnosis of liver cancer and establishing a Population Health Observatory.

Baku State University and Azerbaijan Medical University are recognized for their research in bioinformatics and computational biology, ranking #1361 and #1425 in Asia, respectively [15-17].

Table 1 highlights Azerbaijan's strategic focus on enhancing BMHI education to align with global healthcare advancements. The integration of modern technologies and interdisciplinary collaboration positions the country to effectively address contemporary healthcare challenges.

It is also presents a structured overview of the current state and recent developments in Biomedical and Health Informatics education in Azerbaijan. It highlights the initiatives undertaken by key educational and medical institutions to modernize and enhance the quality of health informatics education [15-17]

Azerbaijan Medical University is spearheading initiatives by launching new divisions devoted to emergency medicine and contemporary medical education.

Innovative clinical training techniques, like Objective Structured Clinical Examinations (OSCE), have been implemented to enhance the competency of aspiring healthcare professionals, and more than 500 faculty members have received training.

Azerbaijan State Advanced Training Institute for Doctors has adopted a "Training of Trainers" approach with the goal of modernizing and updating healthcare educators' teaching methods in order to raise the standard of medical education as a whole.

The Azerbaijan National Academy of Sciences highlights the strategic necessity of educating experts in digital medicine, health data science, and medical informatics in order to facilitate the development of a national medical information system.

Baku State University supports bioinformatics and computational biology research and produces noteworthy academic outputs in these fields, which helps to advance the field of health informatics.

TABLE 1. THE INITIATIVES UNDERTAKEN BY KEY EDUCATIONAL AND MEDICAL INSTITUTIONS TO MODERNIZE AND ENHANCE THE QUALITY OF HEALTH INFORMATICS EDUCATION

Institutions, Programs, Key Results Table Column Head		
Institution	***Program/ Initiative***	***Key Developments***
Azerbaijan Medical University	Department of Medical and Health Sciences Education	Established in 2022 to modernize medical education. - Over 500 faculty members participated in training programs focusing on teaching skills, clinical proficiency, and emergency care management. - Integration of competency-based clinical skills training and objective structured clinical examinations (OSCE) for DMHSE and nursing students during the 2022-2023 academic year. - Launch of the Emergency Medicine Clerkship Programme, a pioneering initiative in undergraduate emergency medical care education in Azerbaijan.
Azerbaijan State Advanced Training Institute for Doctors	Training of Trainers (ToT) Model	Implemented in 2022, engaging over 100 participants to enhance teaching methodologies in health professional education. - Focus on updating teaching methodologies and promoting ongoing professional growth among the faculty. - Establishment of the Medical Education Department to improve educational approaches through the "Faculty Development Program."
Azerbaijan National Academy of Sciences	Emphasis on Training in Medical Informatics	Highlighted the necessity of training highly qualified specialists in medical informatics, data science, and digital medicine. - Emphasized the importance of forming a unified medical information space in the country.
Baku State University	Bioinformatics and Computational Biology Research	Recognized for research in bioinformatics and computational biology. - Ranked #1361 in Asia for bioinformatics research.
Azerbaijan Medical University (AMU)	Bioinformatics and Computational Biology Research	Recognized for research in bioinformatics and computational biology. - Ranked #1425 in Asia for bioinformatics research.

IV. CONCLUSION

Building on recent efforts, the Biomedical and Health Informatics education system in Azerbaijan is expected to expand significantly

We can anticipate that competency-based learning and clinical skills training will continue to be prioritized in medical education after the Azerbaijan Medical University established contemporary educational departments and the Azerbaijan State Advanced Training Institute for Doctors adopted creative teaching models.

Azerbaijan National Academy of Sciences and other organizations will probably continue to advocate for the establishment of a single national medical information space, which will result in the inclusion of medical informatics courses in more IT and healthcare programs. Azerbaijan will be positioned as a new participant in digital healthcare research as research-focused universities like Baku State University are anticipated to boost academic production in bioinformatics and computational biology.

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