From Global Best Practices to National Implementation: Digital Health Strategies for Azerbaijan

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Abstract: **The rapid evolution of digital technologies has created unprecedented opportunities for transforming healthcare systems worldwide. Experiences from countries such as Estonia, Sweden, Singapore, and China demonstrate how digital tools – including electronic health records, telemedicine, mobile health, and artificial intelligence – can enhance healthcare accessibility, quality, and efficiency. This thesis explores digital health's role in addressing healthcare challenges and its adaptation to the Azerbaijani context. Although Azerbaijan has initiated digital reforms like e-prescriptions and telemedicine, significant challenges remain, including infrastructural gaps, regulatory needs, and digital literacy barriers. This study analyses the current landscape, identifies key obstacles and opportunities, and offers strategic recommendations. By leveraging global best practices and investing in infrastructure, capacity building, and governance, Azerbaijan can build a resilient, equitable digital health ecosystem that advances public health goals.**

Keywords: Digital Health, Health system, Telemedicine, Public Health, Azerbaijan.

1. INTRODUCTION

The growing significance of healthcare is driven by a range of global concerns, including an ageing population, rising rates of child illness and mortality, the emergence of epidemics and pandemics, the increasing prevalence of chronic illnesses, and the impact of socio-economic factors such as poverty and racial discrimination on access to healthcare. The overarching goals of "Universal Health Coverage (UHC)" and "Health for All" appear to be ambitious, and the ambition of a healthcare system that is affordable, accessible, equitable, and of high quality remains unfulfilled [1].

The integration of technology into healthcare delivery systems has the potential to effect radical change, with the adoption of technology playing a pivotal role in addressing existing gaps and accelerating progress towards the Sustainable Development Goals [2]. Consequently, to address the diverse and growing healthcare demands, it is recommended that the digitization of healthcare is prioritized.

The term "digital healthcare" refers to a broad, multidisciplinary concept that encompasses elements from the confluence of technology and healthcare. The World Health Organization (WHO) defines digital health as the cost-effective and secure use of information and communication technologies (ICTs) in health and health-related fields. The overarching objective of technology in healthcare should be to promote health, manage health emergencies, and serve the vulnerable. Should these digital health systems be implemented in a strategically integrated manner, they have the potential to become powerful tools that will assist us in achieving the goal of health and well-being for all.

The WHO Global Strategy on Digital Health 2020-2025 asserts the potential for the development of digital health initiatives to be guided by a set of core principles, including transparency, accessibility, scalability, replication, interoperability, privacy, security, and confidentiality [3].

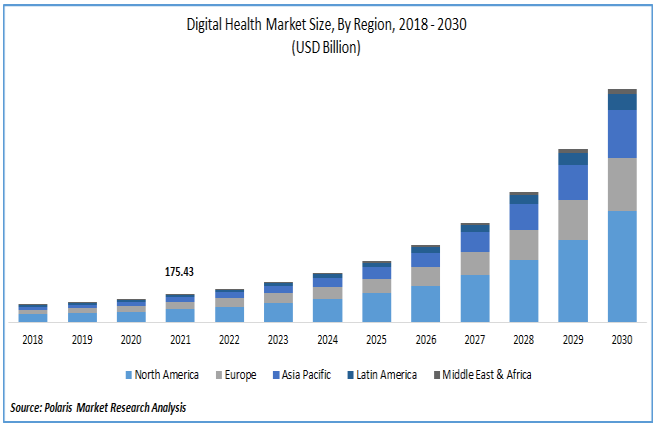

Figure 1. Digital Health Market [4].

II. BACKGROUND

A. Standards, Interoperability, and Regulatory frameworks

It is acknowledged that a variety of standards may be in place, with privacy and security standards being a notable example. These standards establish administrative and technical rules with the objective of preventing unauthorized access, abuse, or disclosure of sensitive health data. It is evident that the standards may be categorized into various types, including but not limited to terminology standards, content standards, data exchange or transport standards, and so on. In a similar manner, a plethora of regulatory frameworks exist, encompassing regulations pertaining to drugs and cosmetics, telemedicine, personal data, and numerous others.

It is imperative to acknowledge the pivotal role that standards and interoperability play in ensuring the success of digital health systems. For disparate systems to be interoperable or to meaningfully exchange information with one another, it is essential that procedures and data standards are established. These standards must ensure a common language and facilitate data interchange. As patients interact with the health system at various points of service, interoperability is essential for supporting continuity of care as well as driving cost efficiencies and reducing fragmentation across various digital systems.

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B. Challenges in Global Healthcare

The healthcare sector is of significance for every nation. Nevertheless, the sector has been grappling with numerous challenges over the years, including mounting healthcare expenditures, ineffective procedures, constrained access to care, substandard care quality, and an absence of patient-centered care. Significant challenges currently exist that impact the operations of both patients and healthcare providers. However, the development of new technology may enable the overcoming of these challenges within the current decade.

III. International Experiences in Digital Health Transformation

3.1. Turkey

Turkey has made significant strides in digital health, aligning itself with the global shift toward Health 4.0. The country's "e-Nabız" Personal Health Record System, launched by the Ministry of Health, enables citizens to access their medical information securely online and manage their healthcare digitally. Telemedicine services, electronic prescriptions (e-Reçete), and hospital information systems (HIS) are widely implemented across public and private healthcare institutions. The introduction of artificial intelligence in diagnostic imaging and smart hospital projects, such as the large-scale city hospitals, reflect Turkey's commitment to integrating emerging technologies into healthcare. Moreover, Turkey's Health Information Systems General Directorate continues to work on expanding interoperability, cybersecurity, and the use of big data analytics to improve public health management. These developments position Turkey as a growing player in the field of Health 4.0 within the region [5]. The e-Nabız platform includes 38 distinct homepage components and organized content sections. Based on the content analysis, the platform's components were organized into 11 subgroups—healthcare, patient, wearable devices, index calculation, monitoring, donation, facilitating access, appointment, sharing, securing, and feedback—and further classified into four main categories: treatment, prevention and health promotion, healthcare services, and additional services [5].

In 2018, a total of 11 million citizens used e-Nabız; this number steadily increased over the years, reaching 68 million active users by 2022, representing 80% of the population. Additionally, e-Nabız achieved an adoption rate of 84% among users aged 0–4 years [5].

3.2 Estonia

The healthcare system of Estonia has undergone a significant transformation over the past three decades, during which it has emerged as a leader in the field of e-health. The objective of the project was to introduce and continuously develop a health information exchange platform (HIE). X-Road (DPG) is an open-source software and ecosystem solution that facilitates secure and unified data exchange between private and public sector organizations, constituting the foundational infrastructure of e-Estonia. The Electronic Health Record (e-Health Record) is a nationwide system that integrates data from Estonia's various healthcare providers, thereby creating a common record that is accessible online by every patient [6].

The first nation to implement blockchain technology in the healthcare sector was Estonia. In Estonia, the digitization of medical records has been accomplished, with the implementation of blockchain security measures. Since 2015, 97% of hospital discharge letters have been transferred to the central database, and 99% of health data has been converted to digital format. The entire nation has access to unified health information, including X-rays, and electronic ID can be used to acquire prescriptions on demand. In 2023, it is anticipated that the digital health industry in Estonia will generate revenue amounting to US$ 46.96 million [7]. This sector encompasses a wide range of technologies, including mobile health applications, connected wearable devices, and telemedicine services.

The Estonian Electronic Health Record represents a comprehensive health initiative and constitutes a component of the Estonian National Health Information System, which was initiated in 2000 with the objective of enhancing and expanding health services for patients and citizens. The project was initiated in December 2008. The implementation of electronic health records represented a significant challenge for Estonia [8].

3.3 Sweden

Sweden is recognized as having one of the best and most advanced healthcare systems in the world. In Sweden, the population has universal access to healthcare, with minimal or non-existent co-payments. The Swedish healthcare system is characterized by its decentralized nature, with responsibility for health and medical care being distributed among the central government, the regions, and the municipalities. The primary responsibility for the provision of health and medical services is entrusted to the regions. The municipalities are responsible for the administration of nursing facilities, home healthcare for the aged, and the disabled. Furthermore, they supervise the provision of medical treatment within educational institutions, provide support and assistance to patients who are being discharged from hospitals, and deliver care to individuals experiencing psychiatric concerns. In Sweden, healthcare is provided by both public and private organizations, and all are subject to the same laws. The delivery of healthcare is funded by the council, yet its provision is undertaken by private entities when regional councils procure services from private healthcare providers. Sweden allocates approximately 11% of its GDP to health and medical services, a figure consistent with most other European countries [9]. It has been determined that out-of-pocket medical expenses account for approximately 14% of total costs [9].

3.4 Singapore

Singapore is widely known as the primary healthcare and medical epicenter of the region, offering what is widely regarded as the most advanced healthcare system in Asia. The Ministry of Health of the Government of Singapore is responsible for the oversight of healthcare in the country. The healthcare system is primarily characterized by a government-run, publicly funded universal healthcare system,

complemented by a substantial commercial healthcare industry. Government hospitals account for 80% of all hospital beds in Singapore, while the private sector accounts for 20% of the total [10]. The estimated share of healthcare spending in GDP is 5.9%, with a potential increase to 9.0% by 2030 [11]. Meanwhile, out-of-pocket expenditure constitutes 30.15% of current health expenditure [12]. This growth is primarily attributable to rising government healthcare expenditure, as well as increased utilization of healthcare services by local populations, largely due to an ageing population and rising prevalence of chronic illness, regular monitoring and follow-up of chronic illnesses, and increased usage of sophisticated technology.

To guarantee safety, effectiveness, and privacy, mHealth apps and other AI-based health solutions need to meet certain legal requirements. In the United States, four primary federal laws regulate mHealth applications. The Health Insurance Portability and Accountability Act (HIPAA) safeguards the privacy and security of health information and mandates that certain entities report any breaches of health data. Enforcement of HIPAA falls under the Office for Civil Rights within the U.S. Department of Health and Human Services. The Federal Food, Drug, and Cosmetic Act oversees the safety and effectiveness of medical devices, including specific mHealth apps. The Food and Drug Administration (FDA) focuses its regulatory efforts on a limited subset of mHealth applications that could pose significant risks if they malfunction. Additionally, the Federal Trade Commission (FTC) Act prohibits deceptive or unfair practices, including false or misleading claims regarding an app's safety or performance [13].

In the European Union (EU) and the European Economic Area (EEA), mHealth applications and AI-based health solutions are classified as medical devices and must comply with the corresponding regulatory requirements. Medical devices are categorized based on their risk level into Class I, IIa, IIb, and III, representing low, medium, medium/high, and high risk, respectively. General safety requirements include, at a minimum, clinical and/or performance evaluations. The latest EU regulation governing medical devices, Regulation 2017/745, came into effect on 26 May 2021. This regulation is further supported by several guidelines issued by the European Commission. mHealth apps classified as medical devices must aim to influence individuals' health, avoid unauthorized handling of population data, and adhere to medical device regulations. Additionally, the regulation mandates the establishment of a medical device database to enhance transparency for both patients and healthcare providers [13].

IV. The Role of Telemedicine

Telemedicine has demonstrated potential to revolutionize the delivery of healthcare. It is evident that the initiative supports the enhancement of accessibility and effectiveness in healthcare delivery [14]. This is achieved by the reduction of travel requirements, the elimination of geographical barriers, the provision of clinical support, the utilization of a variety of communication tools, and the improvement of patient outcomes. It has become an appealing solution to successfully satisfy the demands of today's patients [14]. Several countries have adopted telemedicine to address their challenges in delivering healthcare services. The advent of this technology has facilitated enhanced communication and continuity of care, even in remote locations, thereby reducing the necessity for physical travel within the country. To provide healthcare, governments have utilized the expanding mobile and satellite phone networks.

Telemedicine is implemented not only for the purposes of remote monitoring, diagnosis and treatment, but also for the effective transfer of knowledge. The experience of telemedicine in China offers a promising model for addressing health inequities. The healthcare sector in China is undergoing a significant transition towards full digitization, driven by the pervasive adoption of digital technologies such as artificial intelligence (AI), robotics, 5G, blockchain, big data and 3D printing in daily clinical practice. The advent of emerging technologies has led to their integration into a wide range of medical disciplines, including disease prevention, diagnosis, surgery, hospital management, health management, and healthcare data analysis and processing.

Telemedicine services have undergone a significant transformation, resulting in a paradigm shift in conventional medical practices. Recent technological developments in the field of communication technology, medical equipment technology, hospital information management technology and a series of core technologies in telemedicine have been shown to have a significant impact on the delivery of healthcare services, with the potential to make such services more accessible and equitable.

In accordance with the stipulations set out in the WHO global policy on digital health, nations worldwide are obligated to prioritize the delivery of healthcare in a manner that is ethical, egalitarian, and sustainable on a global scale, with the utilization of technological advancements playing a pivotal role in this endeavor. Furthermore, the global acceleration and improvement of such solutions has been aided by the epidemic of the novel corona virus (SARS-CoV-2). To enhance accuracy and outcomes, nations planning to go digital might benefit from incorporating the lessons learned from those who have already adopted digital methods.

In the modern world, nations with technologically advanced healthcare systems and a well-developed innovation ecosystem are better equipped to address current challenges and are also better prepared for unexpected health threats. The implementation of leading practices, including telemedicine, EHRs, and e-health wallets, has resulted in a significant enhancement in the accessibility of high-quality healthcare for the public. The generation of substantial data within hospital settings has enabled the facilitation of extensive research collaborations on a broader scale. The potential of artificial intelligence to transform healthcare delivery and medical practice is significant. Innovative start-ups across the globe are developing ground-breaking digital health solutions, including cloud-based hospitals, solar-powered hearing aids, and digital emergency platforms. Blockchain technology represents a further such advancement that has the potential to be used in the healthcare sector to ensure the accuracy of retrieved electronic medical information and system access logs.

The experiences of countries such as Estonia, Sweden, Singapore, and Turkey demonstrate that the successful integration of digital technologies into healthcare systems requires strategic planning, strong governance, and sustained investment. While each nation's journey reflects its unique socio-economic and infrastructural context, common principles such as interoperability, data security, and patient-centered care emerge as universal foundations. It is imperative to examine how Azerbaijan, with its distinctive healthcare landscape and evolving digital initiatives, can harness similar strategies to accelerate its healthcare transformation. The following section will explore the status, challenges, and prospects of digital health development in Azerbaijan.

V. The Digital Health Landscape in Azerbaijan

Azerbaijan, a country located at the geographical intersection of Europe and Asia, is currently experiencing a period of significant transformation within its healthcare system. The healthcare ecosystem in Azerbaijan is a comprehensive network (Figure 2) that brings together public, semipublic, and private entities to deliver a broad spectrum of health services [15]. The State Agency for Mandatory Health Insurance plays a pivotal role by funding healthcare services and ensuring universal coverage. The adoption of mandatory health insurance marked a fundamental step in Azerbaijan's healthcare transformation, aimed at ensuring universal access to a wide range of services, including the management of chronic diseases [15]. The government has recognized the potential of digital technologies to modernize healthcare services and address persistent challenges, including geographical disparities in healthcare access, shortages of specialized healthcare professionals, and the rising burden of non-communicable diseases.

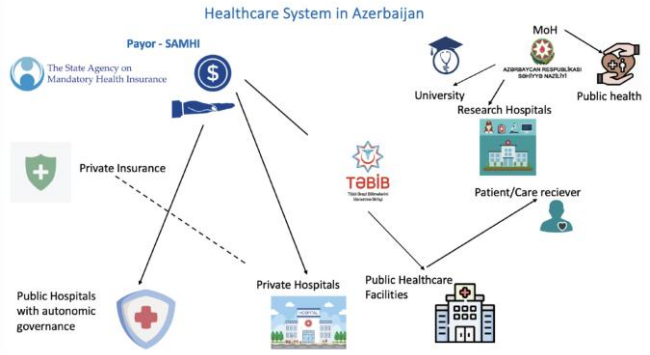

Figure 2. The healthcare ecosystem in Azerbaijan [15].

The mandatory health insurance program has significantly expanded coverage and lowered out-of-pocket expenses, enhancing the population's ability to access timely and appropriate health care. Nevertheless, disparities in service quality between urban and rural areas, along with variations in healthcare provider expertise, remain substantial challenges [15]. This disparity underscores the need for a more proactive strategy focused on ensuring continuity of care across different healthcare settings and stages of disease management. Achieving this goal requires the use of digital tools to monitor patients and collect health data, including continuous tracking through wearable devices, integration with remote patient management platforms, and ensuring interoperability between providers and systems throughout the patient journey nationwide. These efforts align with the Healthcare Digitalization Strategy of the Ministry of Health and TABIB's initiatives to enhance accessibility and improve the management of chronic conditions.

The "Strategy for the Development of Health in Azerbaijan" identifies digital transformation as a principal component. The strategy highlights the necessity for the following:

- The expansion of e-health infrastructure is a key priority.
- The development and promotion of telemedicine, with a particular focus on rural and remote regions, is of crucial importance.
- The enhancement of digital competencies among healthcare professionals is a crucial aspect of contemporary healthcare delivery.
- The primary objective is to ensure the protection of patient data and cybersecurity.
- The Compulsory Health Insurance system, which was initiated on a national scale in 2020, incorporates digital components, including centralized patient records and electronic claims processing. The objective of this initiative is to enhance the efficiency of healthcare financing and service delivery.

The initial phase of digital health integration in Azerbaijan provides a valuable opportunity for the country to draw upon global best practices and circumvent potential challenges. The following opportunities are available:

- The establishment of a National Health Information Exchange (HIE) Inspired by the X-Road platform developed in Estonia, Azerbaijan is in the process of developing an integrated digital system that will connect hospitals, clinics and pharmacies.
- Leveraging Mobile Penetration: Azerbaijan has a high rate of mobile phone usage, which could support mHealth solutions, particularly in remote communities.
- Fostering Innovation: It is submitted that a potential incentive mechanism for startups focused on AI-based diagnostics, remote monitoring devices and personalized medicine could be the implementation of targeted government programs.
- International Collaboration: The establishment of partnerships with international organizations and technology companies has been identified to accelerate capacity building and infrastructure development.

VI. Discussion

The integration of digital technologies into healthcare systems has emerged as a transformative force, offering the potential to address long-standing challenges and accelerate progress towards achieving Universal Health Coverage and the Sustainable Development Goals. A review of global experiences from countries such as Estonia, Sweden,

Singapore, and Turkey demonstrate that, when strategic planning is employed, robust infrastructure is in place, regulatory frameworks are in place, and patient-centered approaches are adopted, digital health initiatives have the potential to significantly enhance the accessibility, quality, and efficiency of healthcare services.

Azerbaijan finds itself at a critical juncture in this global transformation. Recent initiatives to implement electronic health records, telemedicine platforms, and e-prescription systems indicate a growing commitment to utilizing technology for the modernization of healthcare. Nevertheless, there are still critical challenges to be addressed, including infrastructural gaps, digital literacy limitations, regulatory needs, and public trust issues. To address these challenges, it is essential that there is sustained political will, strategic investment, and a coordinated effort among government agencies, healthcare providers, and the private sector.

The successful development of digital health in Azerbaijan requires a structured and phased approach, tailored to the country's current healthcare capacities and future aspirations. To achieve this objective, a strategic action plan has been formulated. This plan provides a detailed outline of the priorities to be addressed in the short, medium and long term. In the short term, the focus should be on strengthening foundational infrastructure, such as expanding broadband access, launching pilot telemedicine initiatives, and improving digital health literacy among healthcare professionals. Medium-term goals emphasize the deployment of a nationwide interoperable Electronic Health Record system, the establishment of comprehensive legal and regulatory frameworks, and the promotion of innovation through public-private partnerships. In the long term, Azerbaijan should aim to fully integrate advanced technologies, including blockchain and big data analytics, into its healthcare ecosystem, positioning itself as a regional leader in digital health innovation. This phased strategy will enable Azerbaijan to systematically build a resilient, inclusive, and technology-driven healthcare system that is aligned with global best practices.

VII. Conclusion

Azerbaijan's success will be predicated on the adoption of a dual-pronged approach, incorporating both international best practice and the adaptation of solutions to suit national requirements. The establishment of a robust, interoperable health information system, the fostering of digital innovation, the promotion of public-private partnerships, and the enhancement of digital competencies among healthcare workers and patients are all essential steps toward the creation of a sustainable digital health ecosystem. By prioritizing the development of digital health, Azerbaijan has the opportunity not only to modernize its healthcare system but also to create a more inclusive, resilient, and equitable model of care for its citizens. In an era of increasing global interconnectedness, the adoption of digital health strategies by Azerbaijan holds considerable potential for enhancing the effectiveness of its health system, thereby contributing to the improvement of population health outcomes. Furthermore, this initiative will play a pivotal role in ensuring the country's preparedness for future public health challenges.

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