DIGITAL TECHNOLOGIES IN THE PREVENTION OF ONCOLOGICAL DISEASES: CONTEMPORARY APPROACHES, TOOLS AND PROSPECTS FOR DEVELOPMENT

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INTRODUCTION

Oncological diseases rank among the leading causes of mortality worldwide, second only to cardiovascular conditions. According to the World Health Organization, more than 19 million new cancer cases are registered annually, with over 10 million deaths[1]. In Ukraine, cancer remains one of the most pressing medical and social challenges: incidence rates are rising, the average age of patients is decreasing, and late detection remains widespread. This places a considerable burden on the healthcare system, the economy, and the social sphere of the state.

In the global context, the focus is increasingly shifting from treatment to prevention of cancer. Timely identification of risk factors, screening, early diagnostics, and the promotion of healthy behavior can substantially reduce incidence and mortality rates. Traditional approaches to prevention, which relied primarily on medical check-ups and individual consultations, are now being increasingly complemented and transformed through digital technologies.

The digitalization of healthcare creates fundamentally new opportunities for cancer prevention[2]. The use of electronic health records, telemedicine, mobile health-monitoring applications, artificial intelligence in screening and diagnostics, as well as big data analytics, significantly increases the efficiency of preventive programs and makes them more accessible to broad population groups.

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[1] Елізабет Махасе. Cancer overtakes CVD to become leading cause of death in high income countries. September 2019The BMJ 366:l5368. http://dx.doi.org/10.1136/bmj.l5368

[2] Chinenye Lynette Ejezie. Use of Digital Health Interventions for Cancer Prevention Among People Living With Disabilities in the United States: A Scoping Review. Cancer Med. 2025 Jan 16;14(2):e70571. https://doi.org/10.1002/cam4.70571

Scientific interest in the issue of digital technologies in cancer prevention is driven by several factors. First, digital tools are increasingly integrated into everyday medical practice, necessitating a thorough analysis of their potential and limitations. Second, evidence-based medicine and interdisciplinary approaches–combining medical, informational, and social sciences–are gaining importance[3]. Third, the agenda includes issues of legal regulation, data protection, and ensuring equal access to innovations.

The purpose of this article is to provide a comprehensive analysis of digital technologies in cancer prevention, to determine their potential, practical results, and prospects for development in both domestic and international practice[4].

To achieve this aim, the following objectives are set:

– to examine the theoretical and methodological foundations of digital transformation in cancer prevention;

– to analyse contemporary digital tools in early diagnostics, screening, and the promotion of a healthy lifestyle;

– to review international and Ukrainian experiences of integrating digital technologies into preventive medicine;

– to identify ethical, legal, and social challenges in the use of digital innovations;

– to outline perspectives for further development and potential research directions.

Thus, this article emphasizes the integration of digital technologies into cancer prevention systems as a necessary condition for enhancing the effectiveness of combating oncological diseases amid global challenges and the ongoing reform of national healthcare

1. Theoretical and Methodological Foundations of the Study

The theoretical foundations of research on the use of digital technologies in the prevention of oncological diseases are based on the recognition of cancer as a multifactorial pathology that arises from a complex interplay of genetic, environmental, behavioural, and socio-economic determinants. Preventive strategies are therefore considered within the framework of a systemic approach, which combines biomedical, technological, and socio-political dimensions.

From the standpoint of preventive medicine, digital innovations are interpreted as an integral part of public health strategies aimed at reducing

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[3]   Bianca Vienni-Baptista. Interdisciplinary Collaboration Within Medicine-Based Informatics and Engineering for Societal Impact. In book: Medicine-Based Informatics and Engineering (pp.187-201) December 2021. http://dx.doi.org/10.1007/978-3-030-87845-0_11

[4]   Bradford W Hesse. Emerging digital technologies in cancer treatment, prevention, and control. Transl Behav Med. 2021 Nov 30;11(11):2009–2017. https://doi.org/10.1093/tbm/ibab033

the incidence of cancer through early risk identification, population-level interventions, and individualized preventive measures[5]. This aligns with the conceptual paradigm of evidence-based medicine, where the effectiveness of digital tools must be confirmed through rigorous clinical trials, epidemiological studies, and large-scale statistical analyses.

Methodologically, the study relies on a multidisciplinary perspective. The biomedical component focuses on the applicability of artificial intelligence, machine learning, and bioinformatics in early cancer diagnostics and risk modeling. The technological dimension addresses the development of electronic health systems, mobile applications, telemedicine services, and digital registries. The socio-political perspective highlights the regulatory framework, ethical issues of personal data protection, and the equitable distribution of innovative tools across different population groups.

The systemic approach also requires consideration of preventive oncology in the context of digital health transformation. According to the World Health Organization's framework on digital health, technologies are not only instruments of medical intervention but also strategic resources for optimizing healthcare systems. This implies the necessity of integrating digital prevention measures into national health strategies, including cancer control programs.

The methodological basis of the study further involves comparative analysis, which allows the evaluation of international experiences in applying digital technologies for cancer prevention and the identification of best practices adaptable to the Ukrainian context. Systemic analysis enables a holistic assessment of how digital tools influence preventive measures at the individual, community, and institutional levels. In addition, prognostic methods are employed to outline the potential trajectories of development for digital innovations in oncology prevention, considering both technological advances and socio-economic constraints.

Thus, the theoretical and methodological framework of this research combines systemic, interdisciplinary, and evidence-based approaches. It creates the foundation for a comprehensive examination of how digital technologies contribute to cancer prevention, identifying both opportunities and challenges in their implementation[6].

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[5]   Katherine De la Torre. The Application of Preventive Medicine in the Future Digital Health Era. J Med Internet Res. 2025 Feb 27;27:e59165 https://doi.org/10.2196/59165

[6]   Annette John. A systematic review of AI as a digital twin for prostate cancer care. Computer Methods and Programs in Biomedicine. Volume 268, August 2025, 108804. https://doi.org/10.1016/j.cmpb.2025.108804

1.1. Digital Transformation of the Healthcare System and Its Impact on Cancer Prevention

Digital transformation has become one of the most decisive trends in modern healthcare, reshaping the way health systems function and redefining strategies for disease prevention. Cancer, as one of the leading causes of morbidity and mortality worldwide, is at the centers of this transformation. The prevention of oncological diseases requires complex, multidimensional interventions that integrate clinical, technological, and social approaches. Digital health technologies, ranging from electronic health records to artificial intelligence, play a crucial role in advancing early detection, improving accessibility of preventive programs, and enhancing public awareness[7]. Thus, understanding the systemic impact of digitalization on cancer prevention is not only a scientific necessity but also a practical imperative for healthcare policy and practice.

The concept of digital transformation in healthcare is grounded in the integration of digital tools into medical processes, clinical decision-making and population-level health management. Electronic health records (EHRs) and digital registries are fundamental components that enable the systematic collection and analysis of patient data, including risk factors for cancer. Such platforms make it possible to track patients across the continuum of care, facilitate longitudinal studies, and develop predictive models of cancer occurrence.

Beyond data management, telemedicine has become a cornerstone of modern preventive strategies. Virtual consultations and remote diagnostic tools expand access to healthcare services for populations in rural or underserved areas, thereby reducing disparities in cancer prevention and screening programs. By bridging geographic and social barriers, telemedicine contributes to equity in healthcare delivery and ensures that preventive interventions are not restricted to urban centers alone.

Artificial intelligence (AI) and machine learning algorithms significantly expand the possibilities of preventive oncology[8]. These technologies are able to process vast datasets, identify subtle correlations, and detect patterns invisible to human specialists. In cancer prevention, AI systems are being applied in predictive modelling of risk groups, analysis of genetic predispositions, and image recognition for early diagnostics. Big data analytics further enhances these capabilities, allowing healthcare institutions to monitor epidemiological trends, evaluate the effectiveness of public health campaigns, and design targeted

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[7]   Hassan Mumtaz. Current challenges and potential solutions to the use of digital health technologies in evidence generation: a narrative review. Front Digit Health. 2023 Sep 28;5:1203945. https://doi.org/10.3389/fdgth.2023.1203945

[8]   William Lotter. Artificial Intelligence (AI) in Oncology: Current Landscape, Challenges, and Future Directions. Cancer Discov. Author manuscript; available in PMC: 2024 Nov 1. https://doi.org/10.1158/2159-8290.CD-23-1199

interventions for specific populations. In addition, mobile health applications (mHealth) are becoming an important tool for primary prevention.

Apps that monitor lifestyle factors, track physical activity, or encourage smoking cessation not only provide individuals with personalized feedback but also integrate their data into broader preventive frameworks. Such approaches contribute to population-level cancer risk reduction by promoting healthier behaviors and encouraging early medical consultations.

The impact of digital transformation on cancer prevention extends beyond technological innovations to systemic changes in healthcare delivery. In primary prevention, digital platforms enable personalized health education campaigns that can be adapted to cultural and demographic contexts[9]. By using mobile notifications, social media, and interactive applications, public health institutions are able to deliver targeted messages about cancer risk factors such as tobacco use, unhealthy diet, or lack of physical activity.

In secondary prevention, digital technologies revolutionize screening programs. AI-enhanced imaging techniques, such as digital mammography or low-dose computed tomography, improve the accuracy of diagnostics and reduce the number of false positives. Moreover, automated reminders and digital scheduling systems increase participation in screening programs, ensuring higher coverage rates. In tertiary prevention, digital tools assist in long-term monitoring of cancer survivors.

Remote devices and wearable sensors provide continuous data on patient conditions, enabling the early identification of relapses or complications. These innovations not only improve survival rates but also enhance the quality of life for patients undergoing post-treatment monitoring[10].

Despite the substantial benefits, digital transformation also introduces new challenges. One of the most pressing issues is digital inequality. Access to innovative technologies is not uniform, and marginalized populations often face barriers to participation in digital health programs. Such disparities may exacerbate existing health inequalities, undermining the goals of preventive oncology. Another challenge lies in data protection and privacy.

The collection of sensitive medical information through digital platforms raises concerns about cybersecurity, informed consent, and potential misuse of data. Ethical dilemmas also emerge in predictive analytics, particularly regarding the disclosure of genetic risks or the psychological consequences of

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[9]   Sunil Jain. Digital Health Technology & Cancer Care: Conceptual Framework Leading Comprehensive Fruitfulness. J Healthc Leadersh. 2024 Dec 8;16:525–535. https://doi.org/10.2147/JHL.S486263

[10]   Gioacchino D. De Sario Velasquez. Economic Perspective of the Use of Wearables in Health Care: A Systematic Review. Mayo Clinic Proceedings: Digital Health Volume 2, Issue 3, September 2024, Pages 299-317. https://doi.org/10.1016/j.mcpdig.2024.05.003

risk prediction for patients and their families[11]. Policymakers and healthcare providers must therefore ensure that ethical standards, legal frameworks, and data security protocols keep pace with technological innovations.

The global experience demonstrates both opportunities and limitations in the application of digital technologies to cancer prevention. In high-income countries, comprehensive electronic health infrastructures and advanced AI systems are already integrated into public health strategies. For example, large-scale screening programs supported by digital platforms have significantly improved early cancer detection rates in several European states.

In contrast, low- and middle-income countries face resource constraints that limit the adoption of such innovations. Nevertheless, even in these contexts, mobile health applications have proven effective for health education campaigns and behavioral interventions. The Ukrainian healthcare system, which is currently undergoing digital transformation as part of its reform agenda, faces a unique set of challenges and opportunities. On the one hand, limited resources, infrastructural deficits, and unequal access to digital technologies hinder the rapid implementation of innovative tools. On the other hand, the adoption of digital health strategies is included in national health policies, and ongoing collaborations with international partners provide a foundation for the integration of best practices into cancer prevention programs.

The systemic impact of digital transformation on cancer prevention underscores the importance of adopting a holistic perspective. Digital technologies should not be viewed merely as auxiliary tools but as integral components of a restructured healthcare ecosystem[12]. The transition to digital health must involve not only technological innovation but also institutional reform, capacity building, and the development of a supportive regulatory environment.

Future success in cancer prevention depends on the ability of healthcare systems to combine cutting-edge technologies with equitable access, ethical safeguards, and sustainable implementation strategies. Only through such a comprehensive approach can digital transformation realize its potential to reduce the global burden of cancer and contribute to the advancement of public health.

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[11]   M L Di Pietro. This person is not on ResearchGate, or hasn't claimed this research yet. Ethical implications of predictive DNA testing for hereditary breast cancer. February 2004Annals of Oncology 15 Suppl 1(suppl_1):I. http://dx.doi.org/10.1093/annonc/mdh662
[12]   Claudiu George Bocean. Health status in the era of digital transformation and sustainable economic development. BMC Health Services Research volume 25, Article number: 343 (2025). https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-025-12498-y

2. Socio-economic and ethical challenges of using digital technologies in cancer prevention

The integration of digital technologies into healthcare has created unprecedented opportunities for the prevention of oncological diseases. From artificial intelligence–based predictive analytics to mobile health applications and telemedicine platforms, these innovations have redefined preventive medicine and allowed healthcare systems to respond more effectively to the rising burden of cancer. However, the application of such tools is not without serious socio-economic and ethical challenges.

The implementation of digital health strategies is accompanied by structural inequalities, issues of affordability, cultural barriers, questions of data security, and dilemmas related to autonomy, consent, and justice. A comprehensive understanding of these factors is necessary for evaluating the real-world impact of digital technologies in oncology prevention and for ensuring that innovation serves the broader public good rather than deepening existing disparities.

One of the most significant socio-economic barriers is digital inequality. Access to digital health solutions, such as telemedicine consultations, electronic health records, or mobile applications, is highly dependent on infrastructure, socioeconomic status, and geographical location. In many low- and middle-income countries, where cancer prevention is already underfunded, the absence of reliable internet connectivity, limited availability of modern diagnostic equipment, and a shortage of trained specialists impede the adoption of advanced technologies.

Even in high-income countries, disadvantaged groups–including the elderly, rural populations, and low-income households–are often excluded from digital innovations due to lack of digital literacy or financial resources. This exclusion creates a paradox: the groups most vulnerable to cancer may remain the least likely to benefit from preventive digital interventions[13].

Addressing this inequity requires not only technological investment but also the development of inclusive policies that prioritize vulnerable populations and bridge the digital divide.

Affordability represents another central socio-economic challenge. Digital innovations such as AI-supported diagnostics or genomic testing for cancer pre-disposition often carry high costs of development, implementation, and main-tenance. Healthcare systems with limited budgets may prioritize curative rather than preventive interventions, perceiving digital prevention tools as secondary.

For individuals, the costs of devices, applications, or specialized consulta-tions may represent a significant barrier, particularly when such services are not

13   Farooq Mubarak. Elderly Forgotten? Digital Exclusion in the Information Age and the Rising Grey Digital Divide. April 202259(101311):469580221096272. http://dx.doi.org/10.1177/00469580221096272

covered by public insurance schemes[14]. This raises broader questions about the economic sustainability of digital health solutions. Without mechanisms of public financing, subsidies, or cross-sector partnerships, digital cancer prevention risks becoming an exclusive service for affluent groups rather than a universal health-care strategy. The sustainability challenge is further complicated by the rapid pace of technological innovation, which makes digital tools quickly outdated and requires continuous investment in updates, training, and infrastructure.

Cultural and behavioral factors also play a significant role in determining the effectiveness of digital cancer prevention programs. Even when technologies are accessible, individuals may not use them due to mistrust, low health literacy, or resistance to behavioral change. For example, mobile health applications designed to promote smoking cessation or dietary monitoring require user engagement and motivation. Without adequate educational campaigns or culturally sensitive content, these applications may remain underutilized.

Moreover, in societies where discussions of cancer are stigmatized or associated with fear, digital interventions may face additional resistance. Overcoming these barriers requires integrating technology with broader community-based strategies, patient education initiatives, and public health campaigns that build trust and normalize preventive care.

Beyond socio-economic constraints, ethical challenges raise profound questions about the use of digital technologies in cancer prevention. Data privacy and security are at the forefront of these concerns[15]. Digital tools inevitably involve the collection, storage, and processing of sensitive medical information, including genetic data, lifestyle records, and health histories.

The misuse, leakage, or unauthorized access to such data poses serious risks not only to individual privacy but also to social trust in healthcare institutions. Cybersecurity breaches in health systems have already demonstrated the vulnerability of electronic health records to hacking and fraud. In the context of predictive oncology, where genetic predisposition is analyzed, the stakes are even higher, as such information may affect not only individuals but also their relatives.

Ensuring robust cybersecurity measures, transparent data governance, and strict compliance with international standards such as the General Data Protection Regulation (GDPR) is therefore essential for maintaining the ethical legitimacy of digital prevention programs.

Informed consent is another critical ethical issue. The complexity of digital systems often makes it difficult for patients to fully understand how their data

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[14]   Qingqing Li. Health Insurance Payment for Telehealth Services: Scoping Review and Narrative Synthesis. J Med Internet Res. 2024 Dec 9;26:e56699. https://doi.org/10.2196/56699
[15]   Vinden Wylde. Ethical Challenges in the Use of Digital Technologies: AI and Big Data. In book: Digital Transformation in Policing: The Promise, Perils and Solutions (pp.33-58). January 2023. http://dx.doi.org/10.1007/978-3-031-09691-4_3

will be used, stored, or shared. Predictive algorithms may rely on secondary data processing or be integrated into research databases without the explicit awareness of participants[16]. In cancer prevention, this problem is amplified by the sensitive nature of predictive analytics. For instance, individuals may consent to cancer risk assessment without realizing the psychological, social, and economic consequences of being labelled as high-risk.

This raises fundamental questions about autonomy, transparency, and fairness. To address these dilemmas, healthcare providers and policymakers must ensure that informed consent processes are not reduced to formalities but are supported by clear, comprehensible communication tailored to diverse patient populations.

Equity and justice are further ethical principles at stake in the digitalization of cancer prevention. The unequal distribution of technological benefits across socio-economic groups, regions, or nations raises the risk of a new form of health injustice – "digital injustice." If digital tools are systematically available only to urban, affluent, or technologically literate populations, the existing disparities in cancer prevention outcomes will deepen.

Ethical considerations therefore demand that innovations be distributed fairly, with particular attention to marginalized and high-risk groups. In practice, this requires targeted investment in rural areas, community-based training programs, and policies that ensure universal access to preventive technologies. At the global level, this principle translates into the responsibility of high-income countries to support the digital capacity building of low- and middle-income regions, thereby preventing the global cancer divide from widening further.

Predictive analytics and artificial intelligence introduce unique ethical dilemmas related to the potential misuse or misinterpretation of results. AI models can identify individuals or groups at high risk of developing cancer, but the disclosure of such information may have unintended consequences[17]. Psychological distress, discrimination in employment or insurance, and stigmatization are possible outcomes of premature or mismanaged communication of predictive results. Furthermore, algorithmic bias represents a serious concern.

If AI systems are trained on datasets that lack diversity or are biased toward certain populations, the predictive accuracy may be significantly lower for underrepresented groups. This not only reduces the effectiveness of cancer prevention but also perpetuates systemic inequities. Addressing algorithmic bias requires transparent model development, continuous validation across diverse

[16]   Khadijeh Moulaei. Patient consent for the secondary use of health data in artificial intelligence (AI) models: A scoping review. March 2025International Journal of Medical Informatics 198(1):105872. http://dx.doi.org/10.1016/j.ijmedinf.2025.105872
[17]   Maria L Wei. Artificial intelligence and skin cancer. Front Med (Lausanne). 2024 Mar 19;11:1331895. https://doi.org/10.3389/fmed.2024.1331895

populations, and ethical oversight mechanisms that ensure accountability in AI-driven healthcare.

Another critical ethical issue is the commercialization of digital health. Many preventive technologies are developed by private companies whose primary motivation may be profit rather than public health. The collection of health data for commercial purposes, the promotion of costly subscription-based applications, or the prioritization of affluent markets may conflict with the principles of equity and justice.

The commodification of cancer prevention risks undermining its role as a universal public good. Regulatory frameworks must therefore balance the need for private innovation with the responsibility to safeguard public health interests. Mechanisms such as public-private partnerships, corporate social responsibility initiatives, and strict oversight of commercial practices can mitigate these risks.

The socio-economic and ethical challenges of digital cancer prevention also intersect with broader issues of healthcare governance[18]. The success of digital transformation depends not only on technological innovation but also on the development of regulatory frameworks, institutional capacity, and ethical oversight mechanisms.

Policymakers must address questions such as: Who owns the data? Who is responsible in cases of algorithmic error? How should liability be distributed between technology developers, healthcare providers, and regulators? The absence of clear answers to these questions may undermine trust in digital prevention systems and discourage both patients and providers from engaging with them.

Finally, these challenges underscore the importance of adopting a human-centered approach to digital cancer prevention. Technology must be designed not only for efficiency but also for equity, respect, and dignity. Ethical principles should not be treated as secondary considerations but as central components of innovation.

This implies involving patients, communities, and stakeholders in the design, implementation, and evaluation of digital interventions. By embedding ethical reflection into every stage of the innovation process, healthcare systems can ensure that digital transformation enhances, rather than undermines, the goals of cancer prevention.

In sum, the socio-economic and ethical challenges of digital cancer prevention are multifaceted and deeply interrelated. Inequalities in access, affordability, and digital literacy coexist with concerns about privacy,

[18]   Ivana Paccoud. Socio-ethical challenges and opportunities for advancing diversity, equity, and inclusion in digital medicine. Digit Health. 2024 Oct 1;10:20552076241277705. https://doi.org/10.1177/20552076241277705

informed consent, and justice. Predictive analytics and AI, while offering powerful tools for risk assessment, also generate dilemmas of bias, misuse, and psychological impact.

Commercialization introduces additional tensions between public health priorities and market interests. Addressing these issues requires a balanced approach that combines technological progress with ethical safeguards, inclusive policies, and sustainable financing. Only through such a comprehensive strategy can digital innovations fulfill their potential to reduce the burden of cancer without creating new forms of inequality or injustice.

3. Global and Ukrainian Perspectives on Digital Cancer Prevention

Cancer prevention in the era of digital transformation is increasingly understood as a global challenge requiring both international cooperation and locally adapted solutions. Digital technologies have created an unprecedented opportunity to reframe cancer prevention strategies, enabling earlier detection, more accurate risk prediction, and broader dissemination of health education. At the same time, their implementation has revealed profound disparities between countries and within societies. The examination of global experiences allows for the identification of best practices, lessons learned, and common obstacles, while the Ukrainian context demonstrates the specific challenges and opportunities of adopting such innovations in a healthcare system undergoing reform and modernization.

Globally, high-income countries have taken the lead in integrating digital tools into cancer prevention programs. In many European states, electronic health records (EHRs) are already embedded into national healthcare systems, allowing physicians and policymakers to monitor population health trends, identify at-risk groups, and evaluate the outcomes of preventive measures[19]. The Nordic countries, for instance, have developed comprehensive cancer registries supported by digital infrastructures, which provide high-quality data for both clinical decision-making and epidemiological research.

These registries enable real-time monitoring of cancer incidence and survival, and their integration with digital screening programs facilitates the identification of gaps in preventive coverage.

The United States has advanced particularly in the use of artificial intelligence and big data analytics for oncology prevention. AI-supported imaging systems are applied in breast cancer and lung cancer screening, increasing the accuracy of diagnostics and reducing the burden on radiologists[20]. Predictive models

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[19]   Tugce Schmitt. Implementing Electronic Health Records in Germany: Lessons (Yet to Be) Learned. March 2023International Journal of Integrated Care 23(1). http://dx.doi.org/10.5334/ijic.6578
[20]   Ellen N. Huhulea. Artificial Intelligence Advancements in Oncology: A Review of Current Trends and Future Directions. Biomedicines 2025, 13(4), 951; https://doi.org/10.3390/biomedicines13040951

based on large-scale datasets allow for individualized risk stratification, ensuring that high-risk populations receive timely interventions.

Mobile health applications targeting behavioral risk factors, such as obesity or smoking, have also gained wide popularity and are increasingly integrated into public health campaigns. However, even in technologically advanced contexts, issues of inequality and access remain pressing. Rural populations, low-income groups, and ethnic minorities are often less likely to benefit from digital innovations due to infrastructural, economic, or cultural barriers.

In middle-income countries, the adoption of digital cancer prevention technologies is uneven but rapidly expanding. India, for example, has piloted mobile health platforms that deliver cancer education and reminders for screening participation to millions of users, particularly in rural areas. These platforms demonstrate that mobile technology can overcome structural barriers where physical healthcare infrastructure is limited.

Brazil and South Africa have implemented telemedicine networks that connect specialists in urban centers with patients in remote regions, allowing for earlier diagnosis and referral of suspected cancer cases. These examples show that digital technologies can serve as cost-effective solutions for expanding preventive coverage in resource-constrained settings. Yet, they also highlight the need for sustainable financing, political commitment, and public-private partnerships to ensure scalability and long-term impact.

At the global level, international organizations such as the World Health Organization (WHO) and the International Agency for Research on Cancer (IARC) emphasize the strategic importance of digital health in reducing the global cancer burden. The WHO's digital health strategy underscores the role of technologies in strengthening health systems, enhancing health information, and promoting equitable access to preventive interventions.

Collaborative projects, such as the Global Initiative for Cancer Registry Development, aim to support countries in building digital infrastructures for cancer surveillance and prevention. These initiatives reveal the growing recognition that digital health is not an optional addition but an essential component of global cancer control strategies.

The Ukrainian perspective on digital cancer prevention must be considered within the context of systemic healthcare reform, socio-economic constraints, and the broader process of digital transformation. Ukraine has made significant progress in recent years in developing digital health infrastructures. The introduction of the eHealth system and the expansion of electronic medical records represent important steps toward modernizing healthcare delivery. These tools provide the foundation for more comprehensive cancer

prevention strategies by enabling systematic data collection, patient tracking, and integration of preventive programs into broader public health initiatives[21].

However, the Ukrainian healthcare system faces several challenges in fully realizing the potential of digital cancer prevention. Resource limitations are a central issue. The availability of advanced diagnostic technologies, such as AI-enhanced imaging systems or genomic testing, remains limited to a few specialized centers. Many regional hospitals lack the necessary infrastructure, equipment, and trained personnel to implement cutting-edge digital tools. The disparities between urban and rural areas are particularly pronounced, with rural populations often excluded from preventive programs due to infrastructural deficits and lower digital literacy.

Another challenge lies in the uneven adoption of digital tools by healthcare professionals. While younger physicians may be more open to technological innovations, older generations of medical staff often encounter difficulties in adapting to new digital systems. This slows down the pace of integration and creates inconsistencies in the quality of preventive care across regions. Moreover, patients themselves may experience barriers to engaging with digital technologies, including limited internet access, lack of awareness, or mistrust of electronic platforms. These factors underline the importance of comprehensive training, public education, and user-friendly design in the implementation of digital health programs.

Despite these obstacles, Ukraine has significant opportunities to leverage global best practices and adapt them to its national context. The experience of countries with limited resources demonstrates that cost-effective digital solutions–such as mobile health platforms, telemedicine networks, and community-based digital education campaigns–can play a transformative role in cancer prevention. By focusing on scalable, low-cost interventions that combine technology with public health strategies, Ukraine can expand preventive coverage even in resource-constrained environments. International cooperation and partnerships with global health organizations provide an additional source of support, knowledge exchange, and technical expertise.

The ongoing digitalization of the Ukrainian healthcare system is further reinforced by national policies that prioritize innovation and transformation. The integration of digital tools into cancer prevention aligns with broader strategies for healthcare reform, including the emphasis on evidence-based medicine, patient-centered care, and systemic efficiency[22]. Moreover, the rapid

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21   Denalee M O'Malley. Cancer prevention, risk reduction, and control: opportunities for the next decade of health care delivery research. Transl Behav Med. 2021 Nov 30;11(11):1989–1997. https://doi.org/10.1093/tbm/ibab109

22   Shivank Garg. Clinical Integration of Digital Solutions in Health Care: An Overview of the Current Landscape of Digital Technologies in Cancer Care. June 2018JCO Clinical Cancer Informatics 2(2):1-9. http://dx.doi.org/10.1200/CCI.17.00159

development of Ukraine's information technology sector creates a favorable environment for the creation of locally adapted digital health solutions. Collaborations between medical institutions, IT companies, and public authorities can accelerate the development of innovative platforms that address the specific needs of Ukrainian patients and healthcare providers.

A critical factor in shaping the Ukrainian perspective on digital cancer prevention is the ongoing socio-political context, including the challenges posed by war and economic instability. These conditions place additional strain on the healthcare system, limiting resources for innovation while simultaneously increasing the urgency of improving preventive care. In such circumstances, digital technologies can provide flexible and resilient solutions. Telemedicine, for example, allows continuity of preventive services despite disruptions in physical healthcare infrastructure. Mobile health platforms can disseminate preventive information to populations displaced by conflict, ensuring that cancer prevention remains a priority even under crisis conditions.

Ultimately, the global and Ukrainian perspectives on digital cancer prevention converge on the recognition that digital transformation is both an opportunity and a challenge. International experience shows that digital tools can significantly enhance cancer prevention, but their success depends on equitable access, sustainable financing, and robust governance.

For Ukraine, the path forward involves not only adopting global best practices but also tailoring them to national realities, strengthening institutional capacity, and fostering innovation through local expertise. By combining global knowledge with national commitment, Ukraine can build a digital cancer prevention system that is both effective and equitable, contributing to the global fight against oncological diseases while addressing the unique needs of its population.

CONCLUSIONS

The digital transformation of healthcare has fundamentally redefined the possibilities of preventing oncological diseases. Over the past two decades, the introduction of electronic health records, mobile health applications, telemedicine, artificial intelligence, and big data analytics has shifted the paradigm of cancer prevention from reactive measures to proactive, personalized, and population-oriented strategies.

These tools allow for early risk identification, facilitate timely screening, and support healthier lifestyle choices, thereby reducing the global burden of cancer. However, the journey toward fully realizing the potential of digital cancer prevention remains incomplete, marked by structural challenges, ethical dilemmas, and socio-economic inequalities that must be systematically addressed.

The evidence accumulated from global experience demonstrates that digital technologies can enhance all levels of cancer prevention–primary, secondary, and tertiary. At the primary level, mobile health platforms and digital campaigns empower individuals to adopt healthier lifestyles, targeting major risk factors such as tobacco use, obesity, and physical inactivity. At the secondary level, AI-enhanced imaging technologies and automated screening systems increase diagnostic accuracy and improve coverage.

Nevertheless, the success of these technologies is uneven and heavily conditioned by the socio-economic context. Inequalities in access to digital infrastructure, differences in digital literacy, and disparities in resource allocation create a persistent "digital divide." High-income countries with robust infrastructures have demonstrated significant advances, while many low- and middle-income countries struggle to implement even basic digital solutions.

The Ukrainian case reflects these tensions. On the one hand, reforms and digitalization initiatives have created a foundation for innovation; on the other hand, infrastructural deficits, economic instability, and regional disparities hinder the full integration of digital tools into preventive oncology. Thus, the future of digital cancer prevention depends not only on technological progress but also on political will, sustainable financing, and inclusive governance.

Ethical challenges further complicate the trajectory of digital cancer prevention. Issues of privacy, data security, informed consent, and algorithmic bias require urgent attention. The predictive potential of artificial intelligence, while promising, also raises dilemmas about autonomy, justice, and possible stigmatization. Without proper safeguards, digital technologies may risk undermining public trust, thereby limiting their adoption and effectiveness. Future strategies must therefore place ethical principles at the center of digital health innovation, ensuring that technological progress aligns with human rights and the values of dignity, equity, and justice.

For Ukraine, the path ahead requires combining global best practices with local innovation. Investments in digital infrastructure, training of healthcare professionals, and development of patient-centered platforms are crucial. At the same time, policies must ensure equitable access to digital tools, particularly for vulnerable populations such as the elderly, rural residents, and those affected by socio-economic instability or displacement. By prioritizing inclusivity and sustainability, Ukraine can not only improve national cancer prevention outcomes but also contribute to international efforts in reducing the global cancer burden.

SUMMARY

The rapid digitalization of healthcare has significantly transformed the approaches to cancer prevention, shifting the focus from reactive responses to proactive, patient-centered, and data-driven strategies. This article explores

the role of digital technologies in reducing the global burden of oncological diseases, highlighting their contribution to early risk detection, behavioral modification, and effective health system management. It emphasizes how tools such as electronic health records, mobile health applications, wearable devices, telemedicine platforms, artificial intelligence, and big data analytics contribute to the development of multilevel prevention strategies, including primary, secondary, and tertiary measures.

At the primary level, digital platforms enable wide-scale dissemination of evidence-based information, encourage behavioral changes, and support population-wide health promotion campaigns. At the secondary level, artificial intelligence and advanced imaging technologies enhance the precision and accessibility of diagnostic procedures, improving the detection of precancerous and early-stage malignant conditions. At the tertiary level, digital monitoring systems and telehealth services play an essential role in ensuring continuity of care, rehabilitation, and psychological support for cancer survivors. These advances collectively demonstrate that digital innovation has become an indispensable instrument in contemporary cancer control policies.

The article further addresses the systemic barriers that hinder the effective integration of digital technologies into oncology, with a focus on ethical dilemmas, data security, algorithmic transparency, and socio-economic inequalities. The persistence of the digital divide–especially in low- and middle-income countries–remains a key challenge to the equitable distribution of benefits derived from digital health innovations. Special attention is given to the Ukrainian healthcare system, where ongoing reforms and digitalization initiatives create both opportunities and constraints for advancing preventive oncology in conditions of infrastructural limitations and socio-political instability.

Conclusions emphasize that the future of digital cancer prevention will depend on three interrelated dimensions: personalization of preventive strategies through advanced analytics, integration of digital tools into healthcare systems at all levels, and international collaboration to reduce disparities in access and implementation. By aligning technological innovation with ethical imperatives, equity, and sustainable development, digital health can not only modernize preventive oncology but also significantly reduce the global cancer burden.

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