ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

Мировой опыт цифровой трансформации управления здравоохранением

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Аннотация: Цифровая трансформация управления здравоохранением – новое направление развития внутри медицинской отрасли. При больших возможностях телемедицины, систем с элементами искусственного интеллекта и др. процесс внедрения цифровых решений в медицине по-прежнему содержит большое количество технических и организационных сложностей. В работе представлены примеры применения современных технологий в различных медицинских специальностях, рассмотрены положительные и отрицательные стороны их внедрения. Кроме этого, авторы анализируют процессы цифровой трансформации на уровне различных городов и стран. Отдельно рассматриваются вопросы подготовки медицинских кадров к использованию технологических решений и проблемы организации и управления подобными инициативами.

Ключевые слова: цифровая трансформация, цифровая медицина, информационные технологии в медицине, анализ данных в медицине, госуправление

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Global experience in digitalizing healthcare management

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RESEARCH ARTICLE

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Abstract: One of the new developments in the healthcare sector is the digitization of healthcare management. Despite the enormous potential of telemedicine, artificial intelligence-based systems, etc., there are still many organizational and technical challenges in introducing digital solutions in medicine. The study examines the advantages and disadvantages of implementing contemporary technologies and provides examples of their use in various medical specialties. In addition, the authors investigate digital transformation processes at the city and national levels. The training of medical personnel in the use of technological solutions, as well as the issues associated with organizing and managing such initiatives, are addressed separately.

Keywords: digital transformation, digital medicine, information technology in medicine, data analysis in medicine, public administration

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Introduction

Digital transformation is progressively replacing mass digitalization, which involves providing people with computers and other technology. On the other hand, digital transformation happens when an organization introduces digital technologies while optimizing the management system of the primary technological processes [Mirzagayeva, Aslanov, 2022]. In terms of digital transformation, the banking and taxi industries are excellent examples, as they demonstrate how a mobile phone can be used to fulfill basic user tasks.

During the COVID-19 pandemic, public administrations around the world placed a lot of emphasis on using new digital technologies and creating innovative digital public services to respond to the pandemic and its consequences [Eom, Lee, 2022]. A crucial factor in this is the healthcare system. In treatment, diagnosis, training, and communication, digital transformation takes the form of a shift in established business procedures and the expedited organization of digital alternatives [Zugasti Murillo, Aguilar Sugrañes, Álvarez Hernández, 2022].

Modern digital developments allow specialists to significantly increase their efficiency. Digital assistants improve treatment efficiency and patient engagement (compliance) while also making the process more predictable and less expensive [Gollner, 2022].

Following the end of the pandemic, the question of how to keep using digital transformation technologies, increase their capacity, and discover new applications emerged. The application of digital transformation in various medical specialties will be further discussed in the study. The selection of these specific specialties was aided by the fact that their use of digital technologies is the most representative and accurately reflects the current and future state of the industry in general.

Digital transformation in various medical fields

Compared to other specialties, psychiatry has experienced less digital transformation because all of its methods have been moved online, but no digital substitutes have been developed [Goodday, Karlin, Friend, 2023]. Despite this, psychiatry was among the first professions to successfully scale their expertise and go online during the pandemic due to the increase in general anxiety in societies worldwide and the worsening of associated illnesses and conditions.

In surgery, artificial intelligence-based decision support systems have the potential to predict surgical outcomes. For patient care, predicting surgical outcomes is crucial for preoperative decision-making regarding which patients should have surgery first and postoperative risk assessment for complications. With new research, neural network models' performance keeps advancing as machine learning tools are used in surgery more often. These findings highlight the potential of machine learning as a significant instrument for surgical diagnosis and outcome prediction in the future [Marwaha, Raza, Kvedar, 2023]. Due to the high volume of surgeries performed in various specialties, which could result in a significant amount of data for analysis, data analysts are particularly interested in surgery.

The digital revolution in toxicology is being driven by advancements in data analysis, risk assessment, and record-keeping through mobile apps, sensors, artificial intelligence (AI), and machine learning. Additionally, the burden of laboratory testing has decreased due to more accurate predictions of chemical hazards brought by computational toxicology and numerical risk assessment. Through the provision of information and resources that can assist in identifying and mitigating potential food safety risks, digital technologies in toxicology significantly support decision-making related to food safety.

Laboratory medicine is already heavily dependent on technology, so it has become a site of intense technological innovation. Examples include the adoption of digitally enabled rapid laboratory tests in primary care, the use of point-of-care testing and dry chemical reagents, the use of artificial intelligence and the integration of various medical specialties, the introduction of next-generation sequencing, and the use of social media in publications, education, and clinical practice [Jovičić, Vitkus, 2023].

The implementation of telemedicine technologies in neuro-ophthalmology has significantly improved the efficiency of interaction between physicians as well as between doctors and patients, even in the extended term. Neuro-ophthalmologists, particularly those with training in neurology, are more likely to consult with neurological patients via telemedicine technologies than in their regular ophthalmic practice, according to data from the 2021 survey. Tele-neuro-ophthalmology has become a standard practice, as evidenced by the 49,6 % of cases that continued using synchronous telemedicine one year after the pandemic [Lai, Ko, 2023].

Technological advancements in neurosurgery have made operations on sensitive brain areas safer. Robotics and machine learning algorithms have significantly increased the effectiveness of surgical procedures. Digital imaging and intraoperative neuronavigation software have become commonplace in practice. Currently, robotics in clinical neurosurgery is primarily limited to automatic trajectory adjustments. Neurosurgery has fundamentally transformed due to digital transformation, with computer-assisted procedures becoming more dependable and efficient than non-computer-assisted procedures [Picht, Vajkoczy, 2023].

Recent advances in digital technology, molecular analysis, and computational methods have created a unique opportunity to transform cytology from a sub-

jective assessment of morphology to a more objective one. The application of artificial intelligence to histological tissue images is a current area of active research in digital pathological anatomy, especially concerning cancer detection [Kim, Rao, 2023]. Such advancements and technologies can drastically reduce the time needed to work with digital images since they can count cells on different slices and in more fields of view without losing efficiency. Therefore, instead of manually counting cells as was previously, the cytologist only needs to download the image and analyze the resulting report.

When it comes to interdisciplinary interactions, the example of diabetes mellitus demonstrates up to six technologies that are used to manage, treat, and ensure safety: telemedicine, the development of diabetic electronic health records, high-quality artificial intelligence-powered hypoglycemia alarms, cybersecurity of diabetic devices, and diabetes registries [Klonoff et al., 2023]. However, since algorithms develop far more quickly than hardware, monitoring devices in conjunction with AI provide more accurate measurements, increasing the speed at which such developments are improved and brought to market.

Digital transformation is impacting healthcare management as well as applied medical fields. For example, the New York Metropolitan Health System demonstrates how digital transformation strategies in healthcare offer creative ways to attract and retain patients. Patients can use a friendly digital front door to check in, find a healthcare provider, make an appointment with a doctor, and get comprehensive information about their visit. The introduction of asynchronous electronic communication and video meetings, as well as the integration of electronic health record systems with online scheduling, telemedicine, and text messaging, are all made possible using modern technology. These strategies improve treatment satisfaction and encourage patients to return to a specific clinic, which has a positive economic impact [Mammen, 2022].

Digital transformation in telemedicine

The case of India demonstrates how telemedicine, one of the main instruments for digital transformation, can help address enduring obstacles to primary care in the post-COVID-19 environment, including a shortage of qualified healthcare professionals, problems with access, and the cost of in-person care. Telemedicine has strengthened primary health care while accelerating the universal provision of health treatment. The gap between people and those who provide basic health services widens as the population grows and life expectancy rises. Telemedicine assists in palliative care, early detection, better treatment, prevention, and rehabilitation in cancer care. The most important finding is that telemedicine was cost-effective [Maroju et al., 2023]. We can find a similar case in Spain, where telemedicine has been effectively applied to the field of hepatology [Crespo et al., 2023].

Telemedicine is gradually moving from doctor-»patient at home» to doctor-»patient in a home hospital», as demonstrated in Italy. This is because using therapeutic and diagnostic devices in the home significantly reduces the time needed for recovery and rehabilitation following illness. In this case, the primary motivator for treatment can also be seen as the patient's compliance or involvement in treatment. Its improvement has received great emphasis [Esposito et al., 2023]. The shift to home hospitals can be viewed as the next phase of telemedicine development, which will eventually lessen the load on the healthcare system and have a favorable economic impact.

Vietnam's experience with the digital transformation of healthcare speaks to the advantages of using personal mobile applications to enhance patient outcomes and quality of life, increase treatment self-management, and improve access to healthcare. At the system level, the following advantages are emphasized: less time spent on medical tasks by nursing staff; less strain on the health care system (easier monitoring, quicker examination results, home medical care, patient distribution by care regime); and patient-centricity (clinic business process adaptation to shorten diagnosis times and increased treatment efficiency) [Kosowicz et al., 2023].

Digital transformation in medical training

Digital transformation is also having a beneficial effect on staff training. The importance of digital health literacy for efficient doctor-patient communication is becoming increasingly evident. The move to online learning has allowed students to experiment with a new teaching style and gain new computer-related skills. Tests verified the effectiveness of material assimilation in the learning process, which was higher than that of conventional teaching methods [Nitsche, Busse, Ehlers, 2023]. Virtual microscopy labs, available on personal devices or in school computer labs, have supplanted fixed labs with common specimens, slide boxes, and microscopes for students. Other technologies used in modern teaching include archives that link to additional resources like general and radiological images and supplemental teaching materials that enhance the learning experience in the new virtual environment. Course administrators and instructors find this scenario appealing because it is simple to «digitize» new clinical cases or update current materials [Hassell et al., 2023].

However, if users lack or receive inadequate training, using modern technology does not ensure greater efficiency. According to a study by S. Frennert, if clinic employees are not adequately trained in the use of medical applications, it is evident that the quality of work

performed by medical staff – particularly nursing staff –degrades significantly [Frennert, Petersson, Erlingsdottir, 2023]. This implies the necessity of establishing quality control standards for medical organizations and more professional development programs.

Budgetary restrictions, a lack of standardized regulations, poor stakeholder communication, lacking management focus, and a shortage of qualified personnel are further obstacles to strategic change in digital healthcare systems. New IT solutions take more time and effort than those initially provided. The cause of implementation failure could be a poor technical solution that does not meet the needs or support the current working method. Furthermore, long hours of training can be stressful. Additionally, the solution will not be used if it does not offer clear and immediate value [Frisinger, Papachristou, 2023].

Conclusion

Many initiatives are not standardized or synchronized internationally because the digital transformation of healthcare is still a relatively new process for the industry. The abundance of solutions causes subsequent disputes and technical issues (the absence of standardized, openly accessible data exchange protocols makes system integration challenging); transitional challenges (developers do not always create user-friendly and functional interfaces for medical systems because there is no single standard for interface design specifically for medical software); medical staff members are becoming less motivated to use new technical tools due to a combination of concerns about new technology (not all users understand the benefits of new technical solutions and can be convinced of their effectiveness only after some time on their own and colleagues' experience) and increased workload (training to use new software takes a lot of time; there are many software solutions, but there is often no mechanism of encouragement from the clinic administration). These issues can be resolved by developing unified management strategies for developing and integrating contemporary technical solutions, accelerated training programs for medical institution staff on innovations, and unified standards for long-term growth in the digital health space.

Литература

Crespo J., Cabezas J., Mateo Soler M., de la Cuadra-Grande A., Casado M.Á., Lazarus J.V., Calleja J.L. Current state of telemedicine in the field of Hepatology in Spain: challenges, threats and next steps to follow for an intelligent digital transformation. *Revista Espanola De Enfermedades Digestivas*. 2023. No. 115(5). P. 248–258. https://doi.org/10.17235/reed.2022.8918/2022. PMID: 36043546. In English

Eom S.J., Lee J. Digital government transformation in turbulent times: Responses, challenges, and future direction. *Government Information Quarterly*. 2022. No. 39(2) (April): 101690. https://doi.org/10.1016/j.giq.2022.101690. PMID: 35291492; PMCID: PMC8914696. In English

Esposito S., Rosafio C., Antodaro F., Argentiero A., Bassi M., Becherucci P., Bonsanto F., Cagliero A., Cannata G., Capello F., Cardinale F., Chiriaco T., Consolaro A., Dessì A., Di Mauro G., Fainardi V., Fanos V., Guarino A., Li Calzi G., Lodi E., Maghnie M., Manfredini L., Malorgio E., Minuto N., Modena M.G., Montori R., Moscatelli A., Patrone E., Pescio E., Poeta M., Ravelli A., Spelta M., Suppiej A., Vai S., Villa L., Zanini R., Botti R., Gaddi A.V.. Use of Telemedicine Healthcare Systems in Pediatric Assistance at Territorial Level: Consensus Document of the Italian Society of Telemedicine (SIT), of the Italian Society of Preventive and Social Pediatrics (SIPPS), of the Italian Society of Pediatric Primary Care (SICuPP), of the Italian Federation of Pediatric Doctors (FIMP) and of the Syndicate of Family Pediatrician Doctors (SIMPeF). *Journal of Personalized Medicine*. 2023. No. 13(2). P. 198. https://doi.org/10.3390/jpm13020198. PMID: 36836432; PMCID: PMC9964859. In English

Frennert S., Petersson L., Erlingsdottir G. «More» work for nurses: the ironies of eHealth. *BMC Health Services Research*. 2023. No. 23(1). P. 411. https://doi.org/10.1186/s12913-023-09418-3. PMID: 37106404; PMCID: PMC10136406. In English

Frisinger A., Papachristou P. The voice of healthcare: introducing digital decision support systems into clinical practice – a qualitative study. *BMC Primary Care*. 2023. No. 24(1). P. 67. https://doi.org/10.1186/s12875-023-02024-6. PMID: 36907875; PMCID: PMC10008705. In English

Gollner M.G. Digital transformation: analog expertise and digital optimization. *International Journal of Computerized Dentistry*. 2022. No. 25(4). P. 407–419. https://doi.org/10.3290/j.ijcd.b3555715. PMID: 36426841. In English

Goodday S.M., Karlin D.R., Friend S.H. The digital redesign of mental health: leveraging connected digital technologies for agency-driven patient-focused care. *The British Journal of Psychiatry*. 2023. No. 222(2). P. 51–53. https://doi.org/10.1192/bjp.2022.152. PMID: 36408682. In English

Hassell L.A., Absar S.F., Chauhan C., Dintzis S., Farver C.F., Fathima S., Glassy E.F., Goldstein J.A., Gullapalli R., Ho J., Koch L.K., Madory J.E., Mirza K.M., Nguyen P.N., Pantanowitz L., Parwani A., Rojansky R., Seifert R.P., Singh R., ElGabry E.A., Bui M. Pathology Education Powered by Virtual and Digital Transformation: Now and the Future. *Archives of Pathology & Laboratory Medicine*. 2023. No. 147(4). P. 474–491. https://doi.org/10.5858/arpa.2021-0473-RA. PMID: 35878400. In English

Jovičić S.Ž., Vitkus D. Digital transformation towards the clinical laboratory of the future. Perspectives for the next decade. *Clinical Chemistry and Laboratory Medicine*. 2023. No. 61(4). P. 567–569. https://doi.org/10.1515/cclm-2023-0001. PMID: 36628420. In English

Kim T., Rao J. «SMART» cytology: The next generation cytology for precision diagnosis. *Seminars in Diagnostic Pathology*. 2023. No. 40(2). P. 95–99. https://doi.org/10.1053/j.semdp.2023.01.001. PMID: 36639316. In English

Klonoff A.N., Andy Lee W.A., Xu N.Y., Nguyen K.T., DuBord A., Kerr D. Six Digital Health Technologies That Will Transform Diabetes. *Journal of Diabetes Science and Technology*. 2023. No. 17(1). P. 239–249. https://doi.org/10.1177/19322968211043498. PMID: 34558330; PMCID: PMC9846384. In English

Kosowicz L, Tran K, Khanh TT, Dang TH, Pham VA, Ta Thi Kim H, Thi Bach Duong H, Nguyen TD, Phuong AT, Le TH, Ta VA, Wickramasinghe N, Schofield P, Zelcer J, Pham Le T, Nguyen TA. Lessons for Vietnam on the Use of Digital Technologies to Support Patient-Centered Care in Low- and Middle-Income Countries in the Asia-Pacific Region: Scoping Review. *Journal of Medical Internet Research*. 2023. No. 25: e43224. https://doi.org/10.2196/43224. PMID: 37018013; PMCID: PMC10132046. In English

Lai K.E., Ko M.W. Can Tele-Neuro-Ophthalmology Be Useful Beyond the Pandemic? *Current Neurology and Neuroscience Reports*. 2023. No. 23(2). P. 15–23. https://doi.org/10.1007/s11910-022-01248-w. PMID: 36609726; PMCID: PMC9825065. In English

Mammen A. The Digital Transformation of a Metropolitan New York Health System. *Frontiers of Health Services Management*. 2022. No. 38(3). P. 10–15. https://doi.org/10.1097/HAP.0000000000000134. PMID: 35191856. In English

Maroju R.G., Choudhari S.G., Shaikh M.K., Borkar S.K., Mendhe H. Role of Telemedicine and Digital Technology in Public Health in India: A Narrative Review. *Cureus*. 2023. No. 15(3): e35986. https://doi.org/10.7759/cureus.35986. PMID: 37050980; PMCID: PMC10085457. In English

Marwaha J.S., Raza M.M., Kvedar J.C. The digital transformation of surgery. *npj Digital Medicine*. 2023. No. 6(1). P. 103. https://doi.org/10.1038/s41746-023-00846-3. PMID: 37258642; PMCID: PMC10232406. In English

Mirzagayeva Sh., Aslanov H. The digitalization process: what has it led to, and what can we expect in the future? Baku city. *Metafizika Journal*. 2022. No. 5(4). P. 10–21. EDN: LESIQZ. In English

Nitsche J., Busse T.S., Ehlers J.P. Teaching Digital Medicine in a Virtual Classroom: Impacts on Student Mindset and Competencies. *International Journal of Environmental Research and Public Health*. 2023. No. 20(3). P. 2029. https://doi.org/10.3390/ijerph20032029. PMID: 36767393; PMCID: PMC9915008. In English

Picht T., Vajkoczy P. Robotik und computergestützte Verfahren in der kranialen Neurochirurgie. *Chirurgie (Heidelb)*. 2023. No. 94(4). P. 299–306. https://doi.org/10.1007/s00104-022-01783-9. PMID: 36629923

Zugasti Murillo A., Aguilar Sugrañes L., Álvarez Hernández J. Transformación digital en la relación entre industria y colectivo sanitario. *Nutrición Hospitalaria*. 2022. No. 38. P. 14–18. https://doi.org/10.20960/nh.04064. PMID: 35137592

References

Picht T., Vajkoczy P. Robotics and computer-assisted procedures in cranial neurosurgery. *Chirurgie (Heidelb)*. 2023. No. 94(4). P. 299–306. https://doi.org/10.1007/s00104-022-01783-9. PMID: 36629923. In German

Zugasti Murillo A., Aguilar Sugrañes L., Álvarez Hernández J. Digital transformation in the relationship between industry and healthcare community. *Nutrición Hospitalaria*. 2022. No. 38. P. 14–18. https://doi.org/10.20960/nh.04064. PMID: 35137592. In Spanish

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