

Digital Transformation in Primary Health Care: Teaching, Accessibility, Challenges and Opportunities

A Transformação Digital na Atenção Primária à Saúde: Ensino, Acessibilidade, Desafios e Oportunidades

La Transformación Digital en la Atención Primaria de Salud: Enseñanza, Accesibilidad, Retos y Oportunidades

RESUMO

O artigo analisa a transformação digital na Atenção Primária à Saúde (APS), destacando seus impactos, desafios e oportunidades no contexto da saúde pública brasileira. Com o avanço das tecnologias digitais, como a telemedicina, os prontuários eletrônicos e os aplicativos de monitoramento remoto, a APS passou por uma profunda reformulação, especialmente acelerada pela pandemia de COVID-19. Esse novo cenário evidenciou não apenas a urgência de expandir o acesso remoto aos serviços de saúde, mas também a necessidade de tornar tais soluções acessíveis para todos, inclusive em termos de letramento digital e inclusão tecnológica. A análise contempla a evolução histórica da digitalização na saúde e examina políticas públicas voltadas à melhoria do atendimento na APS. Entre os benefícios apontados estão o aumento da eficiência, a redução de filas e a ampliação do acesso a populações antes desassistidas. Entretanto, o estudo também problematiza os desafios da desigualdade digital, a necessidade de capacitação contínua dos profissionais de saúde, e as barreiras de acesso enfrentadas por pacientes com baixo nível de instrução ou limitações no uso de tecnologias, o que também inclui reflexões sobre acessibilidade digital no ensino a distância voltado à formação profissional em saúde. Além disso, são discutidas oportunidades promissoras, como o uso de inteligência artificial e big data para monitoramento populacional e personalização dos cuidados, e o fortalecimento de estratégias de educação em saúde mediadas por tecnologias acessíveis.

DESCRIPTORES: Saúde Pública. Atenção Primária. Transformação Digital. Acessibilidade Digital. Telemedicina.

ABSTRACT

The article analyzes the digital transformation of Primary Health Care (PHC), highlighting its impacts, challenges, and opportunities within the context of Brazilian public health. With the advancement of digital technologies—such as telemedicine, electronic health records, and remote monitoring applications, PHC has undergone a profound restructuring, particularly accelerated by the COVID-19 pandemic. This new scenario revealed not only the urgency of expanding remote access to health services but also the need to make such solutions accessible to all, including in terms of digital literacy and technological inclusion. The analysis covers the historical evolution of health digitalization and examines public policies aimed at improving PHC services. Among the identified benefits are increased efficiency, reduced waiting times, and expanded access for previously underserved populations. However, the study also addresses the challenges of digital inequality, the continuous need for health professionals' training, and the access barriers faced by patients with low educational levels or limitations in using digital technologies, which also includes reflections on digital accessibility in distance education for professional training in health. Moreover, promising opportunities are discussed, such as the use of artificial intelligence and big data for population monitoring and personalized care, as well as the strengthening of health education strategies mediated by accessible technologies.

DESCRIPTORS: Public Health. Primary Care. Digital Transformation. Digital Accessibility. Telemedicine.

RESUMEN

El artículo analiza la transformación digital en la Atención Primaria de Salud (APS), destacando sus impactos, desafíos y oportunidades en el contexto de la salud pública brasileña. Con el avance de las tecnologías digitales, como la telemedicina, las historias clínicas electrónicas y las aplicaciones de monitoreo remoto, la APS pasó por una profunda reformulación, especialmente acelerada por la pandemia de COVID-19. Este nuevo escenario evidenció no solo la urgencia de ampliar el acceso remoto a los servicios de salud, sino también la necesidad de tornar tales soluciones accesibles para todos, incluso en términos de alfabetización digital e inclusión tecnológica. El análisis contempla la evolución histórica de la digitalización en salud y examina las políticas públicas orientadas a la mejora de la atención en la APS. Entre los beneficios señalados se encuentran el aumento de la eficiencia, la reducción de filas y la ampliación del acceso a poblaciones previamente desatendidas. No obstante, el estudio también problematiza los desafíos de la desigualdad digital, la necesidad de capacitación continua de los profesionales de salud y las barreras de acceso enfrentadas por pacientes con bajo nivel de instrucción o limitaciones en el uso de tecnologías, lo que también incluye reflexiones sobre accesibilidad digital en la educación a distancia dirigida a la formación profesional en salud. Además, se discuten oportunidades prometedoras, como el uso de inteligencia artificial y big data para el monitoreo poblacional y la personalización de los cuidados, así como el fortalecimiento de estrategias de educación en salud mediadas por tecnologías accesibles.

DESCRIPTORES: Salud Pública. Atención Primaria. Transformación Digital. Accesibilidad Digital. Telemedicina.

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INTRODUCTION

Primary Health Care (PHC) is the first level of contact between individuals, families, and communities and the health system, and is essential for health promotion, disease prevention, and treatment of chronic conditions. Traditionally, PHC has been a fundamental pillar in the organization of health services, especially in countries with consolidated public systems, such as Brazil, where the Unified Health System (SUS) plays a central role¹.

In Brazil, important historical milestones have shaped PHC: the creation of the Special Secretariat for Public Health (SESP) in the 1940s; the advances of the Department of Preventive Medicine (DMP) in the 1960s; the municipal experiences of the 1970s and 1980s; and the creation of the Program for the Interiorization of Health and Sanitation Actions (PIASS). The 1988 Constitution consolidated this process, which was later reinforced with the creation of the Community Health Agents (PACS) and Family Health (PSF) programs in

the 1990s and with the National Primary Care Policies (PNAB) of 2006 and 2011. More recently, adjustments to socioeconomic and institutional conditions, such as the effects of PEC 55/2016, the PNAB of 2017, the Preventive Brazil program, and the impacts of the COVID-19 pandemic, have driven the consolidation of so-called digital PHC².

In recent years, digital PHC has gained relevance, integrating technologies such as telemedicine, mobile health applications, computerized systems, and electronic medical records. These innovations have contributed to making the system more agile, responsive, and closer to populations in remote or hard-to-reach areas. However, the incorporation of these tools also poses significant challenges, especially with regard to digital accessibility.

Digital accessibility, understood as the ability of all individuals to access and use technologies fully, equally, and autonomously, becomes a central issue in the implementation of digital PHC. The presence of technological barriers, such as lack of internet ac-

cess, adequate devices, or basic digital skills, can further widen health inequalities, affecting mainly the elderly, populations with low levels of education, and people with disabilities. In addition, unequal access to digital education, including continuing education for health professionals through distance learning, compromises the equity and effectiveness of the services offered.

In this sense, the digital transformation in PHC cannot be analyzed solely from the perspective of innovation and efficiency, but must be problematized in light of technological inclusion and social justice. It is essential to understand that the success of this new model depends on overcoming digital barriers, promoting digital literacy for patients and professionals, and strengthening public policies that prioritize accessibility as a structural element of digital health.

This paper will analyze the impacts of digitization on PHC, highlighting its potential benefits in terms of access to health, its capacity to reduce inequalities, and the main challenges faced in ensuring a truly uni-

versal, ethical, and citizen-centered healthcare system.

DEVELOPMENT

Historical Context and Evolution of Primary Care in Digital Health

The digitization of health began with the implementation of electronic medical record systems and the computerization of health services at the end of the 20th century, according to ³. However, the concept of digital PHC was strongly driven by technological demands and the challenges faced during the COVID-19 pandemic, when social distancing required quick solutions to keep medical care safe and functioning.

In Brazil, initiatives such as the Telessaúde Brasil Redes Program had already been promoting telemedicine and the exchange of information between health professionals and remote diagnosis facilitators. In the global context, countries such as Canada and the United Kingdom have also invested in digital health platforms, aiming to improve access and reduce the burden on health systems¹.

The pandemic acted as a catalyst for digital transformation, forcing the large-scale adoption of teleconsultations and increased use of digital technologies, more quickly integrating digital PHC into the daily routine of healthcare systems. This process was marked by the expansion of public policies that encouraged the use of these tools, as well as new regulations to ensure the safety and effectiveness of remote care, both for patients and the professionals involved⁴.

Tools and Technologies Used in Digital Primary Care

Digital PHC involves a range of technologies and tools that are being integrated into health systems to improve the provision of remote care. Among these, the following stand out:

Telemedicine and Teleconsultation: Telemedicine has become one of the main tools in digital PHC, enabling remote medical consultations, information exchange, and monitoring of patients in remote areas or without quick access to health services⁵. Teleconsultation, in particular, has been used to reduce pressure on in-person services and decrease waiting times for certain professionals.

Electronic Medical Records: The use of electronic medical record systems (EMR) has facilitated the management of patient data, allowing information to be accessed by different healthcare professionals in an integrated and secure manner, as well as the secure transfer and storage of information⁵.

Mobile applications: Applications for monitoring chronic diseases, such as diabetes and hypertension, have allowed patients to track their own health indicators and communicate directly with their doctors, promoting self-care and facilitating early interventions. Digital health document applications provide health information at your fingertips when needed⁶.

Sensors and wearables: Wearable devices, such as smartwatches and physical activity monitors, are being integrated into digital PHC, enabling the continuous collection of health data, such as heart rate, activity levels, and sleep patterns, for more effective monitoring. The data can be transferred to the EHR via Wi-Fi⁷.

Impacts on the Quality of Digital Care and Pathways to Accessibility

The digital transformation in PHC has generated a series of positive impacts on the quality of care provided to patients and on the daily lives of the professionals involved in the process:

Improved access to healthcare: Digital technologies, especially telemedicine, allow people in remote

areas or with mobility difficulties to access medical consultations and care without the need to travel, reducing geographical barriers and unnecessary travel⁸.

Increased efficiency: Digitization facilitates the management of health services, thus reducing the time spent on administrative processes and allowing health professionals to focus more on direct patient care, obtaining structured data and more accurate indicators through data collection technology⁹.

Reduced queues: With the expansion of remote consultations and the possibility of remote monitoring, the pressure on in-person services decreases, resulting in shorter queues and waiting times, allowing in-person services to focus on more urgent cases. In countries such as the United Kingdom, the implementation of digital health technologies in PHC has reduced waiting times for consultations by up to 30%, in addition to speeding up diagnosis and treatment initiation¹.

Promoting digital accessibility as a pillar of equity: Despite these advances, the benefits of digitization do not yet reach everyone equally. Digital accessibility emerges as a critical challenge to be addressed.

People with disabilities, the elderly, low-income populations, and residents of regions without adequate digital infrastructure find it difficult to take full advantage of digital health resources. The absence of policies aimed at the accessibility of digital platforms, such as interfaces compatible with screen readers, simple language, videos with interpretation in American Sign Language, and usability adapted to different profiles, can lead to the exclusion of precisely those who most need care^{10,11}.

In this sense, for the positive impacts of digital PHC to be widely distributed, it is essential to incorporate accessibility as a structuring principle

of digital health. Pathways such as the development of inclusive technologies, digital training for users and professionals, and investment in connectivity infrastructure in vulnerable regions are indispensable strategies for making digital PHC truly universal, participatory, and equitable^{10,12}.

Challenges and limitations in accessibility in digital health

Despite its benefits, digital PHC faces some challenges both in its use and in the acceptance of the service:

Digital inequality: Access to digital technologies is still not equal for all populations, which can increase health disparities between lower socioeconomic groups or areas without adequate infrastructure, as well as between different intellectual classes¹¹.

Training of healthcare professionals: Not all healthcare professionals are prepared or familiar with the use of new technologies, which requires continuous and effective training so that the technologies are used correctly and provide consistent data⁶.

Patient adaptation: Not all patients are willing or familiar with the use of digital technologies for healthcare, which can be an obstacle to adherence to new forms of care. Some patients are reluctant to provide confidential data or even start digital care¹³ (Luz, 2019).

Future Opportunities for Digital Health in Primary Care

The digitization of primary health care opens up a range of opportunities for innovation and expansion of health care in both urban and rural areas¹⁴. Below are some of the main opportunities for the future of digital PHC:

Expansion in rural areas and hard-to-reach communities: Digital PHC has the potential to significantly expand access to healthcare in rural communities and hard-to-reach re-

gions. With telemedicine and remote monitoring, healthcare professionals can provide quality care without the need for physical travel, reducing inequalities in access. Developing countries, such as Brazil, with vast rural areas, benefit immensely from this transformation⁹.

Integration of Artificial Intelligence (AI) and Big Data: AI can revolutionize the way digital PHC analyzes and manages health data. Machine learning algorithms can be used to predict disease outbreaks, identify health patterns in populations, and personalize treatments according to patient profiles. Big Data allows large volumes of patient information to be used to optimize public policies, making healthcare more efficient and proactive.

Population monitoring and preventive actions: Digital PHC enables large-scale monitoring of chronic diseases and the implementation of prevention programs. Health apps and wearable devices can send alerts to healthcare professionals when there are changes in patient parameters, allowing for rapid interventions before the health condition worsens. In addition, prevention campaigns can be tailored based on digitally collected population data¹⁵.

Personalization of care: The integration of health data with digital technologies enables the personalization of treatments, tailoring care to the individual needs of patients. This can significantly improve clinical outcomes and increase patient satisfaction⁴.

Improved workflow: Digital tools that automate bureaucratic processes, such as scheduling appointments and administering medications, can free up healthcare professionals' time to focus on patient care, increasing efficiency and reducing occupational stress⁴.

Collaboration between multidisciplinary teams: Digital PHC facilitates

communication and collaboration between different healthcare professionals, such as doctors, nurses, pharmacists, and social workers. The use of integrated digital platforms allows all professionals involved in patient care to have quick access to information, improving care coordination.

Health education and patient engagement: Digital PHC offers the opportunity to further engage patients in their own care through educational apps, informational videos, and other digital tools. More informed patients tend to have better health outcomes, as they become more active in the prevention and treatment of their conditions⁹.

Digital Accessibility in Primary Health Care Education

The digital transformation in the field of health is not limited to the provision of clinical services; it also imposes profound changes in the training processes of professionals working in Primary Health Care (PHC). In this context, teaching mediated by digital technologies, especially in the form of distance learning (DL), becomes a relevant strategy for the continuous updating of multidisciplinary teams. However, for this modality to fulfill its function equitably, it is essential to discuss digital accessibility as a structuring element of the educational process¹⁶.

Digital accessibility in PHC education involves the right of all individuals, regardless of their physical, cognitive, socioeconomic, or geographic conditions, to access and use the technological and pedagogical resources available in virtual learning environments. This includes everything from access to the internet and compatible devices to the presence of adapted platforms with accessibility features, such as screen readers, videos with subtitles and sign language, responsive interfaces, and content in simple language.

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The absence of these elements can reinforce historical inequalities, hindering access to knowledge and compromising the quality of training for professionals working at the base of the healthcare system¹¹.
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According to the IBGE¹² there is still a significant number of professionals in peripheral or rural regions with limited access to basic digital infrastructure. This has a direct impact on the effectiveness of distance learning, especially when there are no public policies to guarantee connectivity, digital training, and ongoing technical support. In addition, professionals with disabilities face additional barriers due to the lack of usability of educational platforms and the scarcity of inclusive materials¹⁰.

Furthermore, it is important to recognize that digital accessibility does not only concern people with disabilities, but any condition that interferes with full access to the virtual learning environment. Older adults in training, professionals with low digital literacy, and users of outdated technologies also face limitations that are often invisible in educational proposals¹¹. Thus, accessibility should be understood as a pedagogical and ethical principle that guarantees not only equal access, but also the permanence and educational success of all individuals involved.

Therefore, ensuring digital accessibility in PHC education is an indispensable condition for consolidating a fair, inclusive educational model committed to the comprehensive training of health professionals. Overcoming these challenges depends on the coordination of public policies for digital inclusion, investments in infrastructure, and the promotion of an institutional culture that values diversity and equity in the field of education^{12,16}.

CONCLUSION

The digitization of Primary Health Care represents a transformative milestone in public health policies in Brazil. Throughout this article, we have demonstrated that digital technolo-

gies, such as telemedicine, electronic medical records, and mobile applications, have been expanding access, optimizing care flows, and promoting new forms of care. However, the gains from this transformation cannot be fully enjoyed without a structured approach to addressing the barriers that still limit accessibility and equity in services.

Digital accessibility has emerged as a central and non-negotiable dimension for digital PHC to become a truly inclusive space. Without it, there is a risk of reinforcing historical inequalities, especially among people with disabilities, peripheral populations, professionals with low digital literacy, and users excluded from the dominant technological culture. It has become clear that the presence of technological resources alone does not guarantee fair and universal access: these tools must be designed, applied, and evaluated based on principles of usability, inclusion, and social justice.

Another crucial aspect addressed was the role of continuing education for health professionals. Technology-mediated teaching, especially through distance learning, plays a strategic role in the qualification of PHC workers. However, the effectiveness of these programs depends directly on the existence of accessible virtual environments, with technical support, adapted materials, and inclusive methodologies.

The analysis also showed that there are numerous opportunities for the advancement of digital PHC, such as the use of big data, artificial intelligence, integration of remote monitoring devices, and personalization of care. However, such advances will only be effective if accompanied by public policies that prioritize investments in infrastructure, connectivity, and training for the ethical, safe, and accessible use of technologies.

It can therefore be concluded that the digital transformation in Primary Health Care must be based not only on the pursuit of efficiency and innovation, but also on a firm commit-

ment to equity, accessibility, and citizen-centered care. The consolidation of participatory and inclusive digital PHC requires coordination between technology, policy, and pedagogy,

where each person is recognized as the protagonist of their own care and training. The future of digital health will depend, above all, on our ability to ensure that no one is left behind.

References

1. Paim J, Travassos C, Almeida C, Bahia L, Macinko J. O sistema de saúde brasileiro: história, avanços e desafios. *Lancet*. 2011;377(9779):1778-97.
2. Coicera M. Saúde digital no Brasil: avanços e desafios da atenção primária. *Rev Bras Saúde Digit*. 2020;4(1):15-28.
3. Brasil. Ministério da Saúde. Telessaúde Brasil Redes. Brasília: Ministério da Saúde; 2021. Disponível em: www.saude.gov.br. Acesso em: 10 nov. 2023.
4. Silva SN, Moura NF. Teleconsulta na atenção primária: avanços e limitações. *Rev Saúde Tecnol*. 2022;18(2):55-70.
5. Santos AP, Ferreira MC. Prontuário eletrônico do paciente na gestão da APS. *Rev Gestão Saúde*. 2020;12(1):33-47.
6. Kroemer AF, Rodrigues L. Aplicativos digitais em saúde: análise da experiência brasileira. *Rev Bras Inov Saúde*. 2022;14(3):102-18.
7. Silva CE, Mello NF. Implementação de tecnologias em saúde no Brasil: análise de orientações federais para o sistema público de saúde. *Ciênc Saúde Coletiva*. 2024;29(1):08-15. Disponível em: <https://doi.org/10.1590/1413-81232024291.00322023>. Acesso em: 02 fev. 2024.
8. World Health Organization (WHO). Digital health and primary care. Geneva: WHO; 2020.
9. Levin D. Digital transformation and equity in primary care. *J Health Policy*. 2021;45(2):210-26.
10. Brasil. Lei n. 13.146, de 6 de julho de 2015. Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). Diário Oficial da União. Brasília (DF); 7 jul. 2015.
11. Cristóvam JSS, Saikali LB, Sousa TP. Governo digital na implementação de serviços públicos para a concretização de direitos sociais no Brasil. *Seqüência*. 2020;43(84):209-42. Disponível em: <https://doi.org/10.5007/2177-7055.2020v43n84p209>. Acesso em: 14 maio 2025.
12. Instituto Brasileiro de Geografia e Estatística (IBGE). Dados sobre inclusão digital no Brasil. Rio de Janeiro: IBGE; 2023.
13. Luz PL. Telemedicina e a relação médico-paciente. *Arq Bras Cardiol*. 2019;113(1):100-2. Disponível em: <https://doi.org/10.5935/abc.20190117>. Acesso em: 10 jun. 2024.
14. Freitas LFN, Santos EB. A teletriagem como ferramenta para a gestão de filas de espera em um hospital universitário. *Res Soc Dev*. 2024;13(6):e11713646183. Disponível em: <http://dx.doi.org/10.33448/rsd-v13i6.46183>. Acesso em: 02 fev. 2024.
15. Lisboa KO, Hajjar AC, Sarmento IP, Sarmento RP, Gonçalves SHR. A história da telemedicina no Brasil: desafios e vantagens. *Saúde Soc*. 2023;32(1). Disponível em: <https://doi.org/10.1590/S0104-1290202210170pt>. Acesso em: 10 jun. 2024.
16. World Health Organization (WHO). Global strategy on digital health 2020–2025. Geneva: WHO; 2021. Disponível em: <https://www.who.int/publications/i/item/9789240020924>. Acesso em: 14 maio 2025.