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ORIGINAL ARTICLE

# Community Health Workers and the use of digital health: Transformations of a living work

## *Agentes Comunitárias de Saúde e o uso da saúde digital: transformações de um trabalho vivo*

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**ABSTRACT** Community Health Workers (CHWs) are immersed in technological transformation that directly impacts their knowledge and practices. This article aims to analyze the advantages of digital health based on the use of mobile technologies in Primary Health Care in the work of the CHWs. This qualitative research uses a triangulation of methods supported by interviews, focus groups, and non-participant observation involving union leaders, managers, and health professionals. The data collected were interpreted based on content analysis. The results indicate advantages of the work of the CHWs with digital technologies for the health system, such as expanding access and coverage, improved quality of collected information, territorial planning, and care. There were gains in social legitimacy for the professional category due to the technological densification of work. It is also noted that despite digital transformations, their territorial insertion should be guided by the production of care from the perspective of the social determination of health and living work. It is concluded that, although the fourth technological revolution is irreversible, the work and presence of CHWs in the daily life of the territory will remain indispensable.

**KEYWORDS** Accessibility to health services. Primary Health Care. Community Health Workers. Health policy. Digital health.

**RESUMO** *As Agentes Comunitárias de Saúde (ACS) estão imersas em um contexto de transformação tecnológica que incide diretamente em seus saberes e práticas. O objetivo deste artigo foi analisar as vantagens da saúde digital, a partir do uso de tecnologias móveis na Atenção Primária à Saúde, no trabalho das ACS. Trata-se de uma pesquisa qualitativa, com triangulação de métodos, apoiada em entrevistas, grupos focais e observação não participante envolvendo lideranças sindicais, gestores e profissionais da saúde. Os dados obtidos foram interpretados com base na análise do conteúdo. Os resultados apontam vantagens do trabalho das ACS com tecnologias digitais para o sistema de saúde, como ampliação do acesso e cobertura, qualificação da informação coletada, do planejamento territorial e do cuidado. Para a categoria profissional, houve ganhos de legitimidade social pelo adensamento tecnológico do trabalho. Sinaliza-se, também, que apesar das transformações digitais, sua inserção territorial deve ter como eixo orientador a produção do cuidado na perspectiva da determinação social da saúde e do trabalho vivo. Conclui-se que, embora a quarta revolução tecnológica seja irreversível, o trabalho e a presença das ACS no cotidiano do território ainda permanecerão indispensáveis.*

**PALAVRAS-CHAVE** *Acessibilidade aos serviços de saúde. Atenção Primária à Saúde. Agentes Comunitários de Saúde. Política de saúde. Saúde digital.*

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## Introduction

Health can be understood as an area of knowledge, a state of life or a service sector[1]. As a service sector, it is part of an economic-industrial complex that absorbs growing demands from society[2,3]. This reality implies a disproportionate cost for governments and national health systems, creating the need to seek and implement strategies that contribute to mitigate the impacts of this situation on the living and health conditions of populations[3,4].

As a service sector, health appears to be an open space that is favorable to technological-digital-informational dynamics through a new productive restructuring that is currently known as the fourth technological revolution[2,3,5]. It should be noted that, throughout history, humanity has undergone several technological revolutions, namely: 1st revolution, characterized by the emergence of the steam engine and the possibility of mechanical production in the 18th century; 2nd revolution, marked by the emergence of electricity, which resulted in a style of mass production in the 19th century; 3rd revolution, which emerged with the digital age, the use of the internet and its relationship with the means of production in the 20th century; and, the current, 4th revolution, known as 4.0, which allows the fusion of physical, digital and biological domains, having as premises greater flexibility, personalization and efficiency of the means and production[6,7].

The potential advantages of the 4.0 revolution in the healthcare field can be exemplified by: possibilities for real-time analysis of data in large information banks, using specific algorithms to identify outbreaks and diseases; use of sensors and biosensors as systems for assessing vital signs, conditions and diseases; 3D printing of medical-dental implants customized according to the patient's needs[4,7]; and other tools, such as electronic medical records, teleconsultation and tele-education, which enable greater access to healthcare services and training of professionals, forming a conglomerate of technologies known as digital health[8–10].

The current scenario of technological revolution has influenced health practices. Policymakers, managers and researchers have become aware of the importance of research that can identify and understand, in Primary Health Care (PHC), the contributions and challenges of technological absorption for health care[11,12].

In order to characterize the ethical and political implications of this research in the trajectory of scientific knowledge[13], and in the perspective of the thematic introduction presented by Almeida-Filho[14], the instrumental elements that demonstrate the importance of this manuscript in the field of public health are highlighted. This work, which is part of a set of articles produced, comes from a project entitled 'Work process of Community Health Workers (CHWs) in the context of the technological revolution 4.0'[15], which was concerned with questioning: what are the prospects for reconfiguring the work of CHWs in the context of the technological revolution 4.0, especially with the use of digital health in PHC? To what extent would the use of digital health and other tools of the revolution 4.0 by CHAs be favorable or unfavorable to society and to the category itself?

Initially, an international mapping of the use of digital health by CHWs was carried out, finding 24 experiences in countries in Africa, Asia and the Americas[4]. However, the authors drew attention to the almost non-existence of research in Brazil, with only one study addressing the topic. In conclusion, it was noted that, although the National Program of Community Health Workers in the country is one of the most robust in the world[16], reflections on the incorporation of technology in PHC have not reached CHWs, which implies important gaps in its management and regulation in work and education[4].

In a second movement, it was necessary to reflect on the specific reality of Brazil: the intersections of digital health that were listed by international studies, but that were not discussed in research in the country. Thus, the focus was on understanding the subjective and objective relations that working conditions impose on CHWs in the context of digital health, considering the elements of Marxist theory, such as analysis of the work process, social and technical division of labor, bureaucratization and control[17].

However, still considering the need to advance research and produce subsidies for policy makers, this article aimed to analyze the advantages of digital health from the use of mobile technologies in PHC in the work of CHWs.

## Material and methods

This is a qualitative cross-sectional study, with triangulation of methods to achieve greater credibility, reliability and rigor in understanding the meanings produced in a given social, cultural and historical context[18].

The research was carried out in the state of Bahia, with primary data collected from June to September 2023, involving health workers working in PHC and inserted in different professional contexts. At the state level, members of the Union of Community Health Workers and Endemic Disease Control Agents of Bahia (Sindacs-BA) were selected; at the municipal level, members of the State Council of Municipal Health Secretaries of Bahia (Cosems-BA) and the municipal PHC coordination of Salvador were included; and at the local level, professionals with higher education from PHC and ACS from the same Family Health Unit (USF)[15] (*table 1*).

As a criterion for eligibility of participants, those who had worked in the position for at least one year and were in active service were considered included; those who were on some type of leave or absence during the data collection period were excluded[15].

Data production was carried out using the following methodological strategies: 6 semi-structured interviews with key actors; 1 focus group with CHW; 30 hours of non-participant observation of the CHW work process; and field diary[15,18] (*table 1*).

Table 1. Organization of the production of empirical research data

| Actor | Position | Technique used |
|---|---|---|
| | **State Level** | |
| Sindacs-BA 1<br>Sindacs-BA 2 | CHW | Semi-structured interview, field diary |
| | **Municipal Level** | |
| Cosems-BA<br>Municipal coordination of PHC | Management | Semi-structured interview, field diary |
| | **Local Level** | |
| Nurse 1<br>Nurse 2 | Professionals with higher education in the unit | Semi-structured interview, field diary |

Table 1. Organization of the production of empirical research data

| Actor | Position | Technique used |
|---|---|---|
| CHW 1 | CHW | Focus group, non-participant observation and field diary |
| CHW 2 | | |
| CHW 3 | | |
| CHW 4 | | |
| CHW 5 | | |

Source: Prepared by the author.

The semi-structured interviews were intended to capture privileged information from key actors, based on their positions as managers, union leaders or professional supervisors, about digital transformations in the work process of CHW[18], with an average duration of 50 minutes each. The focus group was important in that the group interaction between CHW would reveal the collective subjectivity regarding perceptions, beliefs and attitudes regarding the researched topic, with a duration of 90 minutes[18].

It should be noted that, methodologically, this study addresses the CHW profession as female for two reasons: the first is due to the preponderance of the profession being female, a fact already widely known in the literature; and secondly because all participants who agreed to take part in this study are women, thus justifying the political option of emphasizing health work that follows a gender perspective[4,15-17].

Both techniques were carried out in places that allowed for privacy during the discussions, and two researchers were present in addition to the participants each time. A semi-structured script was used as a discursive guide, addressing the following topics[18]: digital health and technological communication and information tools used in the work process of the CHW; power relations, training and perspectives of the work process of the CHW with the use of digital health[15]. The data were recorded with the aid of a digital recorder and were later transcribed and reviewed[18].

To better understand the reality, the technique of non-participant observation of the daily work process was also adopted. The aim was to identify how digital technologies are used in the contextual act of the daily life of CHWs, based on which territorial triggers (needs) and with which objective or subjective expressions[18].

In a transversal manner, in all phases of the study, the researchers recorded in a field diary their reflections on the approaches, challenges or limitations regarding the territory and the study subjects, which also helped in the interpretation of the data. The collections were carried out until the theoretical saturation of the information from the fieldwork[18].

The data obtained were interpreted based on the content analysis of the empirical material, whose operational procedures were: selection of texts, skimming, coding, categorization, classification and organization of results according to Bardin's assumptions[19], converging into two analytical categories: advantages of using technologies; and essentiality of the work of the CHW.

The research met the requirements of Resolutions No. 466 of December 12, 2012[20], and No. 510 of April 7, 2016[21], of the National Health Council, which provide guidelines and regulatory standards for studies involving human beings. Furthermore, it is registered on the Plataforma Brasil under the Certificate of Presentation of Ethical Appreciation (CAAE) No. 68844323.3.0000.5030, with opinion No. 6,112,147 registered with the Research Ethics

Committee of the Institute of Public Health of the Federal University of Bahia.

## Results and discussion

Understanding the impact of digital technologies on the organization and production of CHW health work will be done from two perspectives: first, the advantages of technological incorporation and its inherent challenges in a context of digital transformation will be discussed; and then, the tension between knowledge, practices and territory in the organization of work that has historically been produced in person and in action will be debated.

### Advantages of using digital technologies: between potential and challenges

Health work is historical and contextual, according to the theory of the health work process[22], obeying the conformations of the health-disease-care process of the populations and the increase of new instruments, material or immaterial, to fulfill a given purpose. The work of the CHW has been crossed by a range of transformations, whether of its work object, or of the instruments and technologies that mediate the relationship between the work object, its purpose and its agents[22,23].

The challenges of contemporary transformations in the work of CHWs are enormous and multiple, and it is pertinent to focus attention on those related to the organization and maintenance of quality and efficient health work, given the growing increase in socio-epidemiological demands associated with the high cost of service provision, such as that experienced during the COVID-19 pandemic[23,24]. Thus, understanding strategies that maximize the health work process[22], contributing to its resilience[25], becomes an important issue for strengthening health systems, especially those guided by PHC[26].

In the observation triggered by this study, it became clear that, in the work of CHWs, two instruments are central to the incorporation of new attributions: the cell phone and the tablet (*figure 1*). These instruments are associated with a set of resources to be activated according to territorial demand: internet, communication applications, camera, health information systems, among others[4].

As discussed in other studies, the expansion of healthcare coverage through the incorporation of technological resources[4] indicates, according to municipal management, an advantage to be considered strategic:

> *We often encountered obstacles in the agent's work at times, as they were unable to access the territory or travel around the territory in person. So, with the inclusion of tablets and digital technologies in general, such as cell phones, their work became easier, because it would be another alternative for them to access this user, even if only temporarily.* (Municipal management).

International studies are in line with this perception in national context, as they demonstrate that, in areas with wide territorial distribution, CHWs that use digital instruments to monitor users with low risk stratification appear to obtain good results in expanding coverage[27,28].

National research indicates the growing increase in violence in the country, a social phenomenon characteristic of territories with high social vulnerability and greater need for CHWs to act. However, this scenario of violence has impacted the quality of life and work of professionals[29]. Thus, in order to fulfill the attributes of a PHC with coordination and longitudinality of care, alternative reorganizations need to be implemented, such as the use of communication applications to access these families and communities in situations of violence, ensuring the safety of professionals and users.

The qualification of care provided to PHC users also emerges as an important dimension

of technological incorporation, given the possibilities of real-time interaction with the USF multidisciplinary team:

> *Issues related to a wound, sometimes we find a patient with a wound, something very serious, often bedridden or having difficulty getting to the unit, we need to bring this information to the team, so you can take a picture of the serious situation with your cell phone and bring it to facilitate treatment, care [...].* (CHW 2).

> *There are many cases where we receive a call and say 'look, when you get out there, when you have some time, stop by Mrs. Maria's house, she has a condition that needs to be monitored even more closely or [...] that needs to be monitored to take medication', so this is always requested of the agents [...].* (Sindacs 1).

The discourses presented also converge with the experiences observed in the CHW work process, whose digital technologies enable greater speed in the collection and transmission of information that reaches the team, supporting territorial planning and guidelines around health promotion and disease prevention[16] (*figure 1*).

Figure 1. CHW collecting information on medication use from users with chronic diseases and promoting healthy habits

Source: Prepared by the author.

These results are examples of the new possibilities for CHWs to act in a digital reality, in which telemonitoring, teleconsultation and telesurveillance tools encourage the development of new practices for these workers. However, it is necessary to further analyze the influence of this technological incorporation on the attributes of PHC. Countries with similar CHW experiences, such as South Africa, Rwanda, India and the United States of America, point to gains for the health system and its epidemiological

indicators, especially with advances in the health planning processes of the territories[4], corroborating the report below:

> *Technology can bring us closer to the dynamics of the territory. I think this is a great advantage. They make changes during the visit, at the end of the day they arrive at the unit, the tablet synchronizes via the internet and then, the next day, sometimes 48 hours later, we already have this change on the portal. So today we can be closer to reality. So, how many registered patients, what are the main comorbidities, how many are bedridden, age group, how many children, what is our population of women eligible for prevention, for example.* (Nurse 2).

The efficiency in data collection emerges in the speeches and highlights greater accuracy in the information that is collected and entered into the tablet information systems (*figure 1*), with the possibility of real-time transfer to databases, while reducing the use of paper and associated gaps, both due to filling out manual forms and their subsequent typing and the possibility of information loss its accumulation:

> *They stopped carrying paper [...] which they sometimes used to fill out the forms, the volume was large, but they weren't the ones who typed it, they just filled it out manually, then it was passed on to some department to be typed up and the information was lost. So, now they do it directly on the tablet, there is no risk of loss, they have greater control over the information that is recorded.* (Municipal management).

In the work of PHC teams, the incorporation of technologies into the Unified Health System (SUS) represents the achievement of many benefits, such as supporting decision-making, planning, monitoring and evaluation of actions implemented in each territory[4]. For health, the territory is the space where the health-disease-care process takes place and goes beyond the physical extension, constituting itself through historical, political, cultural, economic, environmental and social accumulations in processes of constant transformation[30]. Digital technologies enable the identification of territorial characteristics, linking them to dialogue with different actors, in a work process that impacts reality, operationalized by the data-information-decision-action aspect in real time and based on an expanded conception of territory[31].

One gain experienced by CHWs, from working with digital technologies, is the social legitimacy that these instruments seem to impose on collective symbology:

> *I think it gives them more confidence when you open* [the tablet] *and ask questions – the patient sees that it is beeing recorded there – than if you ask the questions on paper. [...].* (CHW 3).

The technological densification of the work process of these professionals invites us to revisit the historicity of their practices, with the transformation of their knowledge and skills, initially tied to the minimum requirements of knowing how to read or write, to others with digital technological skills and technical training knowledge. This process is influenced by the disputes and needs of society, the State, capital and the category itself, which has achieved important labor achievements over the more than 30 years of existence in the SUS[32]. However, even with these achievements, there is still little social recognition among the community for these workers[23] – although digital technologies seem to give visibility, power and affirmation to the category as health professionals before the users they serve[4].

The transformations in which CHWs appear to be immersed, in the current phase of post-industrial capitalism with the incorporation of technology, make it urgent for them to acquire new cognitive domains. The formation of critical technological

competence is pointed out as a necessary path that needs to be part of the profession of CHWs, not only as an option for collecting data and extracting information, but also as reflective workers aligned with the project of society that the SUS defends[17,33].

> *When they first received it, they received training [...] for a week* [40 hours], *they came at a specific time to receive the tablet.* (Municipal management).

> *[...] The resistance we encountered, which still prevails today, is in the way the implementation process is conducted. [...] You don't leave there immediately with all the knowledge. [...] there is no skill or patience in the way of explaining for the worker how to use it.* (Sindacs 2).

Critical technological competence in health is a training approach advocated by Almeida-Filho[33] as an alternative for the construction of a new social and political profile of health workers immersed in the digital transformation, such as CHWs. To this end, continuing education is a structuring axis of the health work process[34], the vector capable of problematizing professional practices, making the needs of workers and the community be seen from the social determination of health, the daily needs of services and communities, in addition to the growing absorption of technology. The incorporation of new technologies implies the reorganization of work, stimulating other ways of achieving the purpose of care, which requires adaptability, creativity, flexibility and critical thinking[22,33,35].

Finally, the use of digital technologies in public health and their incorporation by the SUS have raised discussions regarding their ethical implications, both for the care of users and for the privacy and security of the data generated[36,37]. In an era of globalization in which information means capital, there are risks that need to be assessed in the implementation, such as digital health, since the closest destination seems to be the 'platformization' of the State with the following characteristics: data monopoly, patients reallocated in the digital contemporary world to be merely consumers of products and sources of information, in addition to the privatization of public infrastructures[15].

It is worth mentioning the potential use of user information by the pharmaceutical industry, for example, violating ethical aspects; leaking confidential data on general health status and health conditions; or even promoting dystopian scenarios, with health information being used to create barriers to access the job market for users with certain morbidities. Thus, these technologies presuppose new relations between the State and the private sector, because they constitute an area intensely disputed by the financial market for the generation of added value to the data of SUS users[38].

The informational context is characterized by the real-time sharing of sensitive information about users of health systems between professionals and services, thus ensuring greater efficiency and effectiveness of clinical decisions and health care based on greater connectivity. On the other hand, this flow can allow for a commercialization of the sector that favors the private sector and its business models, as in the case of private health plans. A breakthrough in this discussion was recently made in Brazil and the European community with the approval of General Data Protection Laws (LGPD), with Brazil's law being known as Law No. 13,709/2018[39].

In addition to issues related to user privacy[38], it is also worth noting that the regulated opening of health data can bring significant benefits in terms of producing evidence and discoveries that help in understanding health outcomes and organizing care practices, as well as in managing health systems and services[40].

## The essentiality of living and territorial work for the production of care

The field observations and the speeches of the subjects interviewed here show that, with the help of digital technologies, given the particularities of the territories, the identification of demographic, epidemiological, economic and social profiles is carried out, through consultation of official databases, in addition to geoprocessing, which enables the execution of structured planning for the actions and practices of the PHC[41].

Although digital technologies bring advantages to the work process of CHWs in terms of new skills associated with the daily life of the territory, these professionals are essential in the context of the community, in the space where life happens, reinforcing the importance of relational technologies[42] in building bonds between CHWs and families accompanied in the territory, based on dialogue, listening and sharing of experiences[43]. In other words, a relational dimension, characteristic of a soft technology, which is strengthened in meetings and in person, is essential for the valorization of individual and family subjectivities and trajectories, based on live and active work inserted in the particularities of the territory[42] (*figure 2*), because:

*It is necessary to establish a bond, the CHW enters into the intimacy of that family, that user, and this is built over time. A single phone call or a WhatsApp message is not enough to develop it. I think it is difficult for someone to open up completely through a WhatsApp message [...].* (Municipal management).

*The greatest mediation we need is to bring the reality of the home that we cannot visit everyone [...] When we discuss the case of Mrs. Maria here [...] to find out why she does not sleep, it is because she has 8 grandchildren living with her, because of this, because of that, and bringing that reality so that we can think about Mrs. Maria's health, it is the CHW who does this. So this is a mediation that artificial intelligence [...] will not be able to bring to us.* (Nurse 2).

*We can no longer live the way we did in 1997, in 2000, today with technology, but we also cannot lose the essence of the work, which is the question of the visit, which is the question of contact, it is the question of freedom of communication between the agent and the family [...] So this is what we need to maintain, the community worker, even with technology, even with the different way of working today, cannot lose the essence of this*. (Sindacs 1).

Figure 2. CHW moving around the territory under her responsibility in a peripheral community in the city of Salvador-BA, Brazil


Source: Prepared by the author.

These discourses and *figure 2* reveal the meanings of a work that has as one of its main characteristics the territorial action to capture the reality, demands and needs of users. *Figure 2* also exemplifies the territorial contradiction between the center and the periphery: in the foreground, streets and alleys between narrow houses with poorly finished masonry; and in the background, vertical buildings, a symbol of capitalist development.

Brazil is one of the most unequal nations in the world[44], with a significant concentration of income and a high prevalence of food insecurity, aggravated in recent years by fiscal austerity policies and setbacks in social policies, intensifying the situation of profound social inequities existing in the country[45]. In this context, the work of CHWs is even more central to the production of care and health based on a broader understanding[24,30,32].

The discourses of the interviewed actors and the field observations of the work of the CHWs point to a future of work in which, regardless of digital absorption and the new possibilities of professional performance in the fourth technological revolution, the relational dimension and face-to-face encounters will be preserved as structuring and irreplaceable elements. The knowledge and practices of the CHWs configure a uniqueness for health care in PHC, and the soft technologies that give meaning to their work, with positive impacts on epidemiological indicators, demonstrate that there is no way to discuss the health of populations without knowing where people are born, live, grow, work, eat, get sick and die; something that only the in-person element of live work in action allows us to experience[42,46].

This is not to romanticize the work experienced by these professionals, since, over the years, technical, political and institutional challenges persist for the valorization and strengthening of this category[23,32]. However, it is in the live work of CHWs, carried out with

autonomy and valorization of their subjectivity, that care occurs in the most elementary and necessary form for the subjects, occupying a place that other health professionals cannot access due to the sine qua non condition of constructing their own strictly scientific knowledge, often displaced from the community and territorial experiences[15]. In this conformation, the future of the work of CHWs seems to have a tendency in which one of its fundamental pillars, the social interaction provided by live work in action[42], with relational technologies, proves to be irreplaceable in a State in which the right to health is an extension of the condition of citizenship.

## Final considerations

The study revealed that, in the context of the fourth technological revolution and the domains of digital health, the digital instruments most used by CHWs in their work process are: cell phones, tablets, their applications and associated software, through the internet, for the establishment of actions and practices of telemonitoring, telesurveillance and territorial planning. Nevertheless, the use of such technologies seems to strain a new gain in social legitimacy in the community. However, it is also pointed out that professional training needs to incorporate new technological skills from a critical perspective.

Even with the incorporation of technology, the future of this professional is still firmly rooted in face-to-face and territorial work. In this sense, knowing the demands of communities, families and users is the substance of the work of CHWs. To this end, it is necessary to produce complex technological arrangements that incorporate equipment, knowledge and relationships in an articulated, contextualized way and committed to the defense of life.

The limitations of this study include: the absence of CHW professionals and managers at the federal level who could bring their perceptions of the national context to the analyses; and the fact that the experiences in the city of Salvador (BA), in an urban area, may not be representative of other territories. Such limitations require future studies that can investigate the use of digital technologies in the work of CHWs in the contexts of rural, forest and water populations; as well as an increase in the number of strategic actors in the interviews/focus groups, such as the Ministry of Health, the National Health Council, the National Council of Municipal Health Departments and the National Confederation of Community Health Workers.

## Collaborators

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## References


1. Paim JS, Almeida-Filho N, organizadores. Saúde coletiva: teoria e prática. 2ª ed. Rio de Janeiro: MedBook; 2023.

2. Belluzzo LG. Enigmas do capitalismo e o mundo da vida. Cad Desenvolv. 2021;16(28):19-24.

3. Gadelha CG. O Complexo Econômico-Industrial da Saúde 4.0: por uma visão integrada do desenvolvimento econômico, social e ambiental. Cad Desenvolv. 2021;16(28):25-49.

4. Santos RC, Silva LIM, Santos LDPJ, et al. O uso de tecnologias digitais nas práticas de trabalhadores comunitários de saúde: uma revisão internacional de escopo. Trab Educ Saúde. 2023;21:e02146220. DOI: https://doi.org/10.1590/1981-7746-ojs2146

5. Celuppi ICL, Lima GS, Rossi E, et al. Uma análise sobre o desenvolvimento de tecnologias digitais em saúde para o enfrentamento da COVID-19 no Brasil e no mundo. Cad Saúde Pública. 2021;37(3):e00243220. DOI: https://doi.org/10.1590/0102-311X00243220

6. Pereira A, Simonetto EO. Indústria 4.0: conceitos e perspectivas para o Brasil. Rev Univ Vale Rio Verde. 2018;16(1):1-9. DOI: http://dx.doi.org/10.5892/ruvrd.v16i1.4938

7. Venturini FGP, Pinto LFR, Oliveira Neto GC. Aplicação de tecnologias habilitadoras de Indústria 4.0 na área da saúde: uma revisão sistemática. Rev Valore. 2021;6:e2015. DOI: https://doi.org/10.22408/reva602021561%25p

8. Hellmann A, Emmons A, Stewart Prime M, et al. Digital Health: Today's Solutions and Tomorrow's Impact. Clin Lab Med. 2023;43(1):71-86. DOI: https://doi.org/10.1016/j.cll.2022.09.006

9. Petretto DR, Carrogu GP, Gaviano L, et al. Telemedicine, e-Health, and Digital Health Equity: A Scoping Review. Clin Pract Epidemiol Ment Health. 2024;20:e17450179279732. DOI: https://doi.org/10.2174/0117450179279732231211110248

10. André S, Ribeiro P. E-health: as TIC como mecanismo de evolução em saúde. Gest Desenvolv. 2020;(28):95-116. DOI: https://doi.org/10.34632/gestaoedesenvolvimento.2020.9467

11. Silva CRDV, Lopes RH, Martiniano CS, et al. Conceito de saúde digital na atenção primária à saúde (2020-2022): um estudo baseado no método evolucionário de Rodgers. Bol Conjunt (BOCA). 2024;17(49):432-454. DOI: https://doi.org/10.5281/zenodo.10565467

12. Rodrigues PLF, Menezes ELC, Scherer MDA, et al. Organização do trabalho em saúde e as transformações digitais: uma perspectiva comparada entre Brasil e Portugal. Trab Educ Saúde. 2025;23:e03078285. DOI: https://doi.org/10.1590/1981-7746-ojs30781

13. Schraiber LB. Engajamento Ético-Político e Construção Teórica na Produção Científica do Conhecimento em Saúde Coletiva. In: Baptista TWF, Azevedo CS, Machado CV, organizadores. Políticas, Planejamento e Gestão em saúde: abordagens e métodos de pesquisa. Rio de Janeiro: Editora Fiocruz; 2015. p. 33-57.

14. Almeida Filho N. Metapresencialidade, saúde digital e saúde coletiva. Interface (Botucatu). 2024;28:e230473. DOI: https://doi.org/10.1590/interface.230473

15. Santos RC. Processo de trabalho das agentes comunitárias de saúde no contexto da revolução tecnológica 4.0 [dissertação]. Salvador: Instituto de Saúde Coletiva, Universidade Federal da Bahia; 2024.

16. Méllo LMBD, Santos RC, Albuquerque PC. Agentes Comunitárias de Saúde: o que dizem os estudos internacionais? Ciênc saúde coletiva. 2023;28(2):501–20. DOI: https://doi.org/10.1590/1413-81232023282.12222022

17. Santos RC, Ribeiro LF, Amado CF, et al. Condições de trabalho dos agentes comunitários de saúde em um contexto de saúde digital: velhos e novos desafios. Interface (Botucatu). 2024;28:e230548. https://doi.org/doi:10.1590/interface.230548

18. Minayo MCS. O desafio do conhecimento: pesquisa qualitativa em saúde. 8ª ed. São Paulo: Hucitec; 2004.

19. Bardin L. Análise de conteúdo. São Paulo: Edições 70; 2011.

20. Ministério da Saúde (BR); Conselho Nacional de Saúde. Resolução nº 466, de 12 de dezembro de 2012. Diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Diário Oficial da União, Brasília, DF. 2013 jun 13; Edição 112; Seção I:59-62.

21. Conselho Nacional de Saúde (BR). Resolução nº 510, de 7 de abril de 2016. Dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais. Diário Oficial da União, Brasília, DF. 2016 maio 24; Edição 98; Seção I:44-46.

22. Ayres JRCM, Santos L. Saúde, sociedade e história: Ricardo Bruno Mendes-Gonçalves. São Paulo: Hucitec; Porto Alegre: Rede Unida, 2017.

23. Méllo LMBD, Albuquerque PC, Santos RC, et al. Agentes comunitárias de saúde: práticas, legitimidade e formação profissional em tempos de pandemia de Covid-19 no Brasil. Interface (Botucatu). 2021;25:e210306. DOI: https://doi.org/10.1590/interface.210306

24. Méllo LMBD, Santos RC, Albuquerque PC. Agentes Comunitárias de Saúde na pandemia de Covid-19: scoping review. Saúde debate. 2022;46(esp1):368-84. DOI: https://doi.org/10.1590/0103-11042022E125

25. Santos RC, Gurgel AM, Domingues RC, et al. Práticas das agentes comunitárias de saúde em contextos de emergências sociossanitárias e ambientais: revisão de escopo. Hygeia Rev Bras Geogr Méd Saúde. 2025;21:e2118. DOI: https://doi.org/10.14393/Hygeia2174759

26. Bellas HC, Castro-Nunes P, Bulhões B, et al. Desempenho resiliente da longitudinalidade da atenção primária durante a pandemia da Covid-19: um estudo transversal em territórios vulneráveis do município do Rio de Janeiro. Saúde debate. 2022;46(esp8):75-88. DOI: https://doi.org/10.1590/0103-11042022E806

27. David N, Utulu SCA, Tyndall J. mHealth: a mediating tool for community health workers' transformation in armed conflict zones. Afr J Inf Syst. 2021;13(4):493-513.

28. Shah MK, Gibbs AC, Ali MK, et al. Overcoming the Digital Divide in the Post-COVID-19 "Reset": Enhancing Group Virtual Visits with Community Health Workers. J Med Internet Res. 2021;23(7):e27682. DOI: https://doi.org/10.2196/27682

29. Vieira-Meyer APGF, Ferreira RGLA, Albuquerque GA, et al. Gender and Violence in the Daily Routine of Community Health Workers in Fortaleza, Brazil. J Community Health. 2023;48(5):810-818. DOI: https://doi.org/10.1007/s10900-023-01221-9

30. Santana MM, Medeiros KR, Monken M. Processo de trabalho da Estratégia Saúde da Família na pandemia no Recife-PE: singularidades socioespaciais. Trab Educ Saúde. 2022;20:e00154167. DOI: https://doi.org/10.1590/1981-7746-ojs00154

31. Faria RM. A territorialização da Atenção Básica à Saúde do Sistema Único de Saúde do Brasil. Ciênc saúde coletiva. 2020;25(11):4521-30. DOI: https://doi.org/10.1590/1413-812320202511.30662018

32. Santos RC, Méllo LMBD, Santos NRNTV, et al. Agente comunitário de saúde ou "técnico de enfermagem comunitária"? dilemas e disputas na profissionalização. Tempus Actas Saude Colet. 2021;15(01):247.

33. Almeida-Filho N. Competência tecnológica crítica em Saúde. Interface (Botucatu). 2018;22(66):667-71. DOI: https://doi.org/10.1590/1807-57622018.0257

34. Silva CLF, Jorge TM. Educação Permanente em Saúde na atenção primária: percepções de trabalhadores sobre conceito e prática. Medicina (Ribeirão). 2023;56(2):e-196780. DOI: https://doi.org/10.11606/issn.2176-7262.rmrp.2023.196780

35. Chagas MS, Abrahão AL. Produção de cuidado em saúde centrado no trabalho vivo: existência de vida no território da morte. Interface (Botucatu). 2017;21(63):857-67. DOI: https://doi.org/10.1590/1807-57622016.0262

36. Castells M. A sociedade em Rede. São Paulo: Editora Paz e Terra; 2000.

37. Leal Neto OB, Albuquerque J, Souza WV, et al. Inovações disruptivas e as transformações da saúde pública na era digital. Cad Saúde Pública. 2017;33(11):e00005717. DOI: https://doi.org/10.1590/0102-311X00005717

38. Rachid R, Fornazin M, Castro L, et al. Saúde digital e a plataformização do Estado brasileiro. Ciênc saúde coletiva. 2023;28(7):2143-53. DOI: https://doi.org/10.1590/1413-81232023287.14302022

39. Pinto HA, Santana JSS, Chioro A. Por uma transformação digital que assegure o direito à saúde e à proteção de dados pessoais. Saúde em Redes. 2022;8(2):01-11. DOI: https://doi.org/10.18310/2446--4813.2022v8n2p361-371

40. Kostkova P, Brewer H, Lusignan S, et al. Who Owns the Data? Open Data for Healthcare. Front Public Health. 2016;4:7. DOI: https://doi.org/10.3389/fpubh.2016.00007

41. Ministério da Saúde (BR), Secretaria de Ciência, Tecnologia e Insumos Estratégicos, Departamento de Gestão e Incorporação de Tecnologias em Saúde. Entendendo a incorporação de tecnologias em saúde no SUS: como se envolver. Brasília, DF: Ministério da Saúde; 2016.

42. Merhy EE. Saúde: a cartografia do trabalho vivo. 2ª ed. São Paulo: Hucitec; 2005.

43. Lima JG, Giovanella L, Fausto MCR, et al. O processo de trabalho dos agentes comunitários de saúde: contribuições para o cuidado em territórios rurais remotos na Amazônia, Brasil. Cad Saúde Pública. 2021;37(8):e00247820. DOI: https://doi.org/10.1590/0102-311X00247820

44. Gaspar RS, Rossi L, Hone T, et al. Income inequality and non-communicable disease mortality and morbidity in Brazil States: a longitudinal analysis 2002-2017. Lancet Reg Health Am. 2021;2:100042. DOI: https://doi.org/10.1016/j.lana.2021.100042

45. Méllo LMBD, Albuquerque PC, Santos RC. Conjuntura política brasileira e saúde: do golpe de 2016 à pandemia de Covid-19. Saúde debate. 2022;46(134):842-56. DOI: https://doi.org/10.1590/0103-1104202213418

46. Almeida-Filho N. Mais além da determinação social: sobredeterminação, sim! Cad Saúde Pública. 2021;37(12):e00237521. DOI: https://doi.org/10.1590/0102-311X00237521

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