J. Health Inform. *2023 Janeiro-Março; 15(1): 9-14*

Artigo Original

DOI: https://doi.org/10.59681/2175-4411.v15.i1.2023.967

JHI JOURNAL OF HEALTH INFORMATICS

Digital inclusion analysis for Brazil's unified health system

Análise da inclusão digital para o Sistema Único de Saúde do Brasil

Análisis de inclusión digital para el Sistema Único de Salud Brasileño

Shirley Karolina da Silva Ferreira[1], Iwens Gervasio Sene Junior[2]

Keywords: Digital Inclusion; Public Health; Internet

ABSTRACT

Objective: Analyzes the coverage of the digital inclusion programs in health units. **Method:** The public data of the Cidades Digitais and Wi-fi Brasil programs were analyzed, extracting the number and type of health units supported by the programs, for each Brazilian region and state. **Results:** The North and Northeast regions have the largest number of health units attended by the programs. The collected data shows that 4.4% of the Wi-fi Brasil's total access points are in health units and mainly in Indigenous Health Centers (28%), whilst Cidades Digitais corresponds to 4.3%, supporting the Basic Health Units (33%). **Conclusion:** To recognize the community's level of access to the internet it is important to propitiate the digital inclusion in health units and then contribute to the National Health Data Network, following the Digital Health Strategy 2020-2028 guidelines.

Descritores: Inclusão Digital; Saúde Pública; Internet

RESUMO

Objetivo: Analisar a cobertura de programas de inclusão digital em unidades de saúde. **Método:** Análise dos dados públicos dos seguintes programas: Cidades Digitais e Wi-fi Brasil, extraindo as unidades de saúde atendidas, de cada região e estado do Brasil. **Resultados:** As regiões Norte e Nordeste possuem maiores números de unidades de saúde atendidas pelos programas de inclusão digital. Os dados coletados mostram que 4,4% do total dos pontos de acesso do programa Wi-fi Brasil estão em unidades de saúde e em grande maioria em Pólos de Saúde Indígena (28%), enquanto para o Cidades Digitais é de 4,3%, atendendo principalmente as Unidades Básicas de Saúde (33%). **Conclusão:** Reconhecer o nível de acesso à internet é importante para proporcionar a inclusão digital de unidades de saúde e dessa forma permitir que os estabelecimentos possam contribuir e se beneficiar com a Rede Nacional de Dados em Saúde, seguindo a Estratégia de Saúde Digital 2020-2028.

Descriptores Inclusión Digital; Salud Pública; Internet

RESUMEN

Objetivo: Analizar la cobertura de los programas de inclusión digital en las unidades de salud. **Metodología:** Análisis de datos públicos de los siguientes programas: Cidades Digitais y Wi-fi Brasil. **Resultes:** Las regiones Norte y Nordeste tienen el mayor número de unidades de salud atendidas por los programas. Los datos recogidos muestran que el 4,4% de los puntos de acceso del programa Wi-fi Brasil están en estabelecimientos de salud y la mayoría en Centros de Salud Indígenas, mientras que para el Cidades Digitais es el 4,3%, atendiendo principalmente as Unidades Básicas de Salud. **Conclusión:** Reconocer el nivel de acceso a internet es importante para propiciar la inclusión digital de las unidades de salud y así contribuir a la Red Nacional de Datos e Salud, siguiendo la Estrategia de Salud Digital 2020-2028 en el Brasil.

[1] Mestre em Engenharia Elétrica, Universidade Federal do Pará - UFPA, Belém, (PA) Brasil.

[2] Doutor em Engenharia Elétrica, Professor Associado do Instituto de Informática, Universidade Federal de Goiás - UFG, Goiânia, (GO) Brasil.

Autor Correspondente**: Shirley Karolina da Silva Ferreira**
e-mail: **shirley_karolina@discente.ufg.br**

Artigo recebido: **03/06/2022**
Aprovado: **24/03/2023**

INTRODUCTION

Digital Health refers to the use of information and communications technologies (ICT) to improve diagnosis, health outcomes, and treatments, and has a key role in health condition management by patients and practitioners[1]. The use of tools in this context has increased due to the coronavirus disease (COVID-19) pandemic, resulting in important research in and use experiences of telemedicine[2], artificial intelligence on diagnosis[3-4], mobile applications for remote patient monitoring, and chatbots for triage[5]. However, most of these technologies are internet-based systems, which increase the digital disparities around the world. Also, the use of the patient and practitioner portals, for instance, requires a digital literacy by users, which involves filling out a personal information form for access, navigability on the application user interface, and being careful with the security of personal health data. Thus, providing an equitable impact by using digital health tools turns out a challenge for the health care systems that have been irreversibly impacted by these technologies.

The Eight Guiding Principles of Digital Transformation of the Health Sector, published by the Pan American Health Organization (PAHO), in 2021, highlights the strategic actions for the advancing digital health transformation, including Strategy 1 - Universal Connectivity in the health sector by 2030 and Strategy 3 – Inclusive Digital Health, involving actions for providing appropriate access, digital skills, and usability and navigability, with emphasis on the most vulnerable[6]. For the health care system, it is important to recognize the community's level of access to devices and internet access, to promote future strategies for digital inclusion and, consequently, universal digital health coverage. Moreover, promoting educational actions focusing on initial users is important for digital literacy. Both digital inclusion and digital literacy factors have been called "Super Social Determinant of Health (SDO)", due to this achieving all other SDO which influence the individual's health, such as education, food, economic sustainability, and social context[7].

In Brazil, the digital health initiative was marked by the creation of the National Health Data Network (RNDS), being an interoperable platform of health data, services, and connectivity, following the Digital Health Strategy[8] guidelines, under the National Health Information and Informatics Policy[9-10]. Considering the consolidation of the digital transformation, national efforts have been promoting actions to increase internet access in public schools, public health units, *Quilombola* communities, and federal universities, for instance. In this context, we have the Cidades Digitais, and Wi-fi Brasil, both these two programs are managed by the Ministry of Communications (MCom). These initiatives focus on areas that lack broadband support, often in the North and Northeast Brazilian regions. The Wi-fi Brasil is a branch of the Electronic Government – Citizen Support Service (GESAC) program in the access point modality and provides connectivity via satellite and terrestrial, with priority for socially vulnerable communities[11-12]. The Cidades Digitais, instituted by the Directive Nº 4.019/2021[13], in the alteration from Directive Nº 376/2011[14], promotes digital inclusion for public organizations and provides access points for the public spaces[15].

Therefore, the present survey analyzes the initiatives in digital inclusion by the Brazilian Government, focusing on the coverage of the programs in health units, especially, of Brazil's unified health system (SUS), being an essential step for the Digital Health Strategy by 2028. The public data were used to collect quantitative information about the Cidades Digitais, and Wi-fi Brasil programs, extracting from them how many healthcare centers are (or were) benefited from the point of access for internet connectivity. The summary coverage of these programs in the health units has not yet been reported.

METHODS

The data from the Monitoring Integrated System (SIMMC/MCTIC) and the official sites of each project have been analyzed to collect quantitative information about the coverage of the Brazilian digital inclusion programs in health units. The SIMMC is a web-based application for online monitoring of the digital inclusion programs implemented by the MCTIC and the application is maintained in partnership with the Federal University of Paraná (UFPR), under the Access to Information Law (12.527/2011). The system is accessible to users via the link: https://simmc.c3sl.ufpr.br/index.html and provides reports, graphs, maps, and the register for points of digital inclusion for the GESAC, *Cidades Digitais*, and Telecentro Brasil programs.

The SIMMC provides a user-friendly interface to select the target program (GESAC, Cidades Digitais, or Telecentros Brasil), the type of report (disponibility or network usage), the Brazilian region (South, Southeast, Center-West, Northeast, or North), and their respective city (municipality) with the access point. Moreover, the system identifies the contact frequency of each access point, labeled as a green circle (last contact less than 4 days), red square (last contact in 4 days or more), and black triangle (never has contacted), in accordance with the last source information date (2021). The system enables the data exportation in .pdf or .csv extensions.

In the dataset (.csv), the health units were identified as Basic Health Units or only by UBS (acronymous of *Unidades Básicas de Saúde*), *Posto de Saúde*, Health Center (*Centro de Saúde*), Family Health Program or only by PSF (acronymous of *Programa Saúde da Família*), Hospital, *Santa Casas,* Family Health Units or only by USF (acronymous of *Unidades de Saúde da Família*), Emergy Care Units or only by UPA (acronymous of *Unidades de*

Pronto Atendimento), Family Health Strategy or only by ESF (acronymous of *Estratégia de Saúde da Família*), Indigenous Health Center (*Pólos de Saúde Indígena*), *Casa de Saúde Indígena*, Secretary of Health (*Secretaria de Saúde*), *Farmácia Popular* program, Prehospital Emergency Medical System (SAMU), *Ambulatório Municipal*, and *Policlínica*.

Furthermore, there are Microsoft Power Business Intelligence (BI) web applications, for the Wi-fi Brasil[16] and Cidades Digitais[17], that were used to complement the analysis of how many health units benefited from the programs. The power BI's visualization tool of the Cidades Digitais possibility select the Brazilian state, city, and year, but does not specifies the typology of the access points, such as health unity, schools, or community centers, as the Power BI reports to the Wi-fi Brasil program, facilitating the data extraction.

RESULTS

In total, there are 198 cities supported by the Cidades Digitais program in Brazil, and of the total, 90 'digital cities' have health units with the access point to the program. As seen in Figure 1 a), most of these health units are in the Northeast region, followed by the Southeast

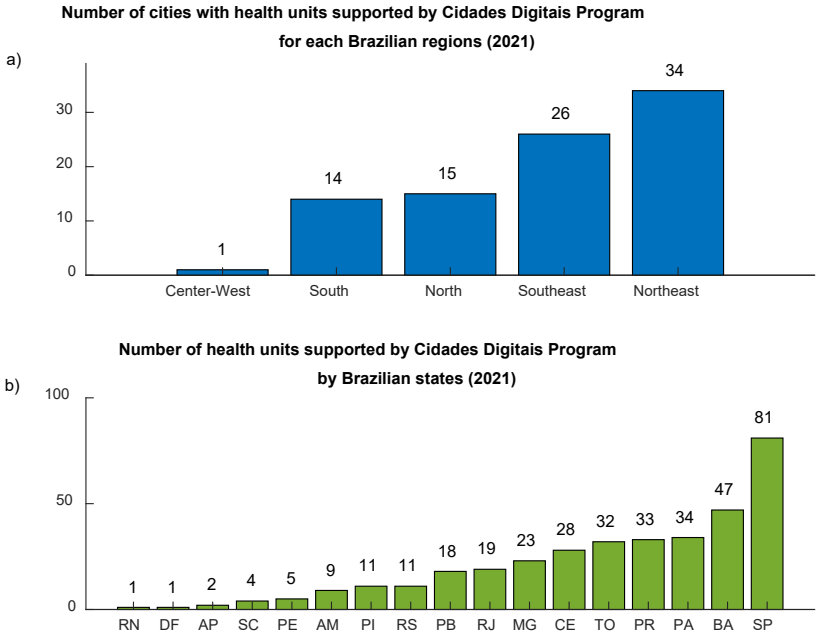

Figure 2 - Distribution, in numbers, of the cidades digitais program over brazil.

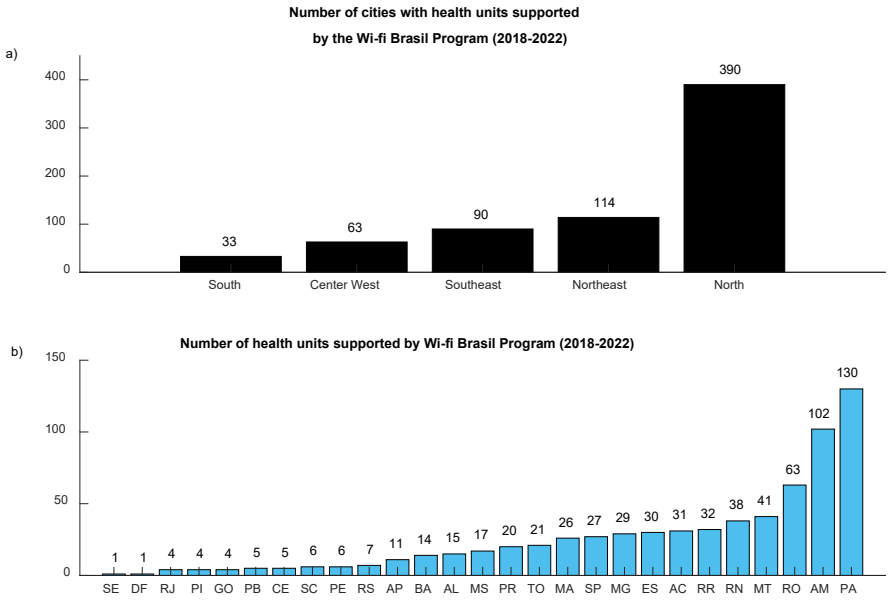

Figure 1 - Presence of the Wi-fi Brasil Program in health units.

and North regions. Moreover, the São Paulo state con-centrates the highest number of health units connected by the program (see Figure 1 b).

The Wi-fi Brasil program supports 690 public health units in 366 municipalities, and of the total, 467 are in the rural area and 223 in the urban region. As seen in

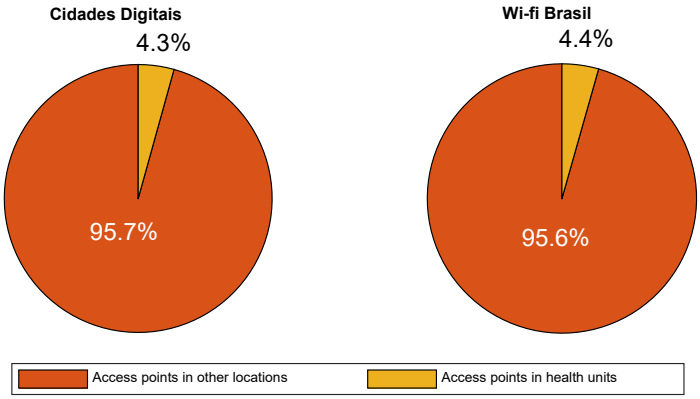

Figure 4 - Overview of the digital inclusion programs in health units.

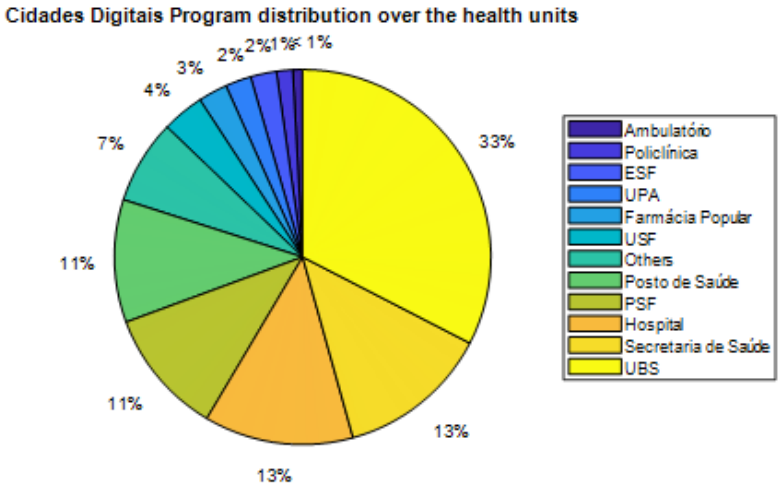

Figure 3 - Cidades Digitais distribution, for the year 2021.

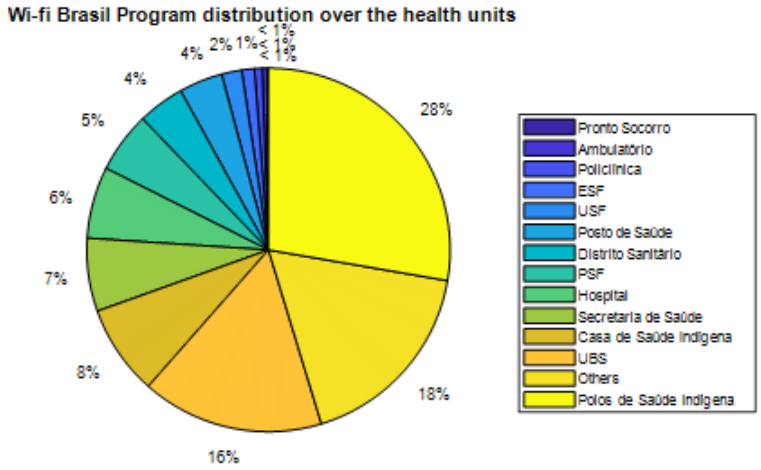

Figure 5 - Wi-fi Brasil in different types of health units, for the year 2021.

Figure *2* a), the Brazilian North region has the largest number of health units supported by the program, with 130 only in the State of Pará (PA) (see Figure 2 b)).

In Figure 3, the overview, in percentage (%), of the coverage in health units, for each program, that supports as well as schools, universities, public organizations, *Quilombola* communities, and *telecentres*.

Figure 4 presents the types of health units that have the Cidades Digitais program's access points and, as seen, the UBS is the group that has the largest number of access points to the program, followed by *Secretaria de Saúde* (13%), *Posto de Saúde* (11%), and PSF (11%). 'Others' corresponding to *Pronto Socorro*, *Ambulatório* and SAMU.

Figure 5 details the types of health units supported by the Wi-fi Brasil program, following the names identified in the dataset. The *Pólos de Saúde Indígena* corresponding to 29% of the total access points, followed by UBS (23%), USF (8%), and *Casa de Saúde Indígena* (8%).

DISCUSSION

The Brazilian Digital Health Strategy 2020-2028 (ESD28)[8] addresses seven priorities, which the Priority 2 – Informatization of the three levels of health care, involving the formulation of public policies to informatization process of health systems, to adopt Electronic Health Records and Hospital Management systems. It is important to highlight that the Priority 2 contemplates connectivity stages, including the use of optic fiber, satellite, or radio technologies to support those who do not have internet access. Moreover, the ESD28 addresses the Priority 4 – User engagement, promoting actions focusing on the development of free instructional courses for end-users about the use of digital health applications, contributing to digital literacy, and the engagement of citizens in digital health. To achieve these goals for all country regions, it is salient to recognize the level of internet and device access by the patients[7], identifying the locations that still have a lack or absence of internet coverage and ICT usage.

The National Education and Research Network (RNP) and MCom carrying out the Norte Conectado[18] and Nordeste Conectado[19] projects, that bring connectivity to the North and Northeast Brazilian regions, respectively. In special, the *Norte Conectado* program will benefit 9424 basic health units, and in 2022 February the launch of the optical fiber cables was concluded, connecting Macapá (AP), Almerim (PA), Monte Alegre (PA), Santarém (PA), and Alenquer (PA) cities[20].

Furthermore, it is important to highlight the user-friendly interface, maps, reports, graphs, or Power BI web applications, such as those of the Wi-fi Brasil[16] and Cidades Digitais[17] Programs, exemplify their importance to facilitate the data extraction and coverage analysis. These tools may be used by a unified system that identifies the health units with internet and computer/device access.

CONCLUSION

In the present research, the coverage of the digital inclusion projects carried out by the Brazilian Government was analyzed, under the digital health transformation context. The described programs are installed in health units, mainly in the North and Northeast regions that are characterized by the existence of remote communities and hard-to-reaches areas. These initiatives have a key role to the achieve impact equality of the digital transformation and providing a feasible environment for the RNDS usage and benefits.

ACKNOWLEDGMENT

The author acknowledges the Digital Health Postgraduate Program of the Federal University of Goiás (UFG), supported by the Ministry of Health and the SUS Department of Informatics (DATASUS).

REFERENCES

1. Kostkova P**.** *Grand challenges in digital health.* s.l. : Frontiers in public health. 2015; Vol. 3.
2. Outcomes of telemedicine care during the COVID-19 pandemic. Experience from an intervetion program designed for vulnerable population in Brazil. Carneiro A. C., de Pinho G. S., Belo, J. V., Bolonhini S., Carneiro Neto M. B., Mallet Toueg A., Fernandes A. G**.** *Journal of Telemedicine and Telecare.* 2022.
3. *Artificial Intelligence for the detection of COVID-19 pneumonia on chest CT using multinational datasets.* Harmon S. A., Sanford T. H., Xu S., Turkbey E. B., Roth H., Xu Z., Yang D. Myronenko A., Anderson V., Amalou A., Blain M. 1, s.l. : Nature Communications. 2020; Vol. 11.
4. Huang S., Yang J., Fong S., Zhao Q**.** Artificial Intelligence in the diagnosis of COVID-19: Challenges and perspectives. *International Journal of Biological Sciences.* 2021; Vol. 17, 6.
5. Fagherazzi G., Goetzinger C., Rashid M. A., Aguayo G. A., Huiart L**.** Digital health strategies to fight COVID-19 worldwide: challenges, recommendations, and a call for papers. *Journal of Medical Internet Research.* 2022; Vol. 22, 6.
6. Pan American Health Organization (PAHO)**.** *8 Principles for Digital Transformation of Public Health.* 2021.
7. *Digital inclusion as social determinant of health.* Sieck C. J., Sheon A., Ancker J. S., Castek J., Callahan B., Siefer A**.** 1, s.l. : NPJ Digital Medicine. 2021; Vol. 4.
8. Brasil. Ministério da Saúde**.** Estratégia para Saúde Digital do Brasil 2020-2028, Departamento de Informática do SUS. 2021.
9. Brasil, Ministério da Saúde**.** Política Nacional de Informação e Informática em Saúde (PNIIS). 2016.
10. *The Brazilian digital health system: Building the digital transformation to engage country citizens.* de Fátima Marin H.,

de Souza Zinader J. P., da Silva Pires F. J., de Barros J. V. s.l. : In Roadmap to Successful Digital Health Ecosystems. Academic Press. 2022.

11. Brasil. Obter Conexão de internet (GESAC). [Online] 2022. [Acessed 2022 Mar 20]. Available from: https://www.gov.br/pt-br/servicos/obter-conexao-de-internet-gesac.

12. Brasil. Ministério das Comunicações. *Wi-fi Brasil*. [Online] 2022. [Acessed 2022 Mar 1]. Available from: https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/wi-fi-brasil. .

13. Brasil. Ministério das Comunicações. Portaria Número 4.019. de 5 de Novembro de 2021. [Online]. Available from: https://in.gov.br/en/web/dou/-/portaria-mcom-n-4.019-de-5-de-novembro-de-2021-357707492.

14. Brasil. Ministério das Comunicações. Portaria Número 376, de 19 de Agosto de 2011. . [Online]. Available from: https://pesquisa.in.gov.br/imprensa/jsp/visualiza/index.jsp?jornal=1&pagina=76&data=22/08/2011.

15. Brasil. Ministério das Comunicações. Cidades Digitais. [Online] Novembro 2020. [Acessed 2022 Apr 15]. Available from: https://www.gov.br/mcom/pt-br/acesso-a-informacao/acoes-e-programas/cidades-digitais.

16. Brasil. Ministério das Comunicações. *Wi-fi Brasil - Panorama Geral*. [Online] Maio 2022. [Acessed 2022 May 1]. Available from: https://app.powerbi.com/view?r=eyJrIjoiNzQwYzM4OTItNjYyZS00ZDYyLTg0NjgtNTA3ZGNhM2Y5YjZmIiwidCI6ImExMTIwMGVkLTNhYTctNDFhMy05M2UxLTcwYWU4ZmMxZWMxYSJ9.

17. Brasil. Ministério das Comunicações. *Cidades Digitais*. [Online] Abril 2022. [Acessed 2022 May 15]. Available from: https://app.powerbi.com/view?r=eyJrIjoiMGNiNjM5MDctZGNjOC00NjZiLTgzOWYtMzk4ZGRmMDEyNjVkIiwidCI6ImExMTIwMGVkLTNhYTctNDFhMy05M2UxLTcwYWU4ZmMxZWMxYSJ9.

18. Rede Nacional de Ensino e Pesquisa. Projeto Norte Conectado. [Online] 2022. [Acessed 2022 Apr 20]. Available from: https://www.rnp.br/projetos/norte-conectado.

19. Rede Nacional de Ensino e Pesquisa. [Online] 2022. [Acessed 2022 Apr 20]. Available from: https://www.rnp.br/projetos/nordeste-conectado.

20. Rede Nacional de Ensino e Pesquisa. [Online] 2020. [Acessed 2022 Apr 20]. Available from: https://www.rnp.br/inovacao/norte-conectado/sobre-o-programa.