Enhancing Primary Healthcare Access in Brazil: The UBS+DIGITAL Telehealth Initiative

Celina de Almeida Lamas, Patrícia Gabriela Santana Alves, Luciano Nader de Araújo, Ana Beatriz de Souza Paes, Ana Claudia Cielo, Luciana Maciel de Almeida Lopes, André Longo Araújo de Melo, Thais Yokoyama, Clarice Pagani Savastano, Paula Gobi Scudeller, Carlos Carvalho, Digital Primary Health Unit HCFMUSP Study Group

Submitted to: Journal of Medical Internet Research
on: November 05, 2024

Table of Contents

Enhancing Primary Healthcare Access in Brazil: The UBS+DIGITAL Telehealth Initiative

Celina de Almeida Lamas[1, 2] MSci, PhD; Patrícia Gabriela Santana Alves[1]; Luciano Nader de Araújo[1] MD; Ana Beatriz de Souza Paes[3] MSc; Ana Claudia Cielo[3] MSc; Luciana Maciel de Almeida Lopes[3] MSci; André Longo Araújo de Melo[3] PhD; Thais Yokoyama[2, 1] MSc, PhD; Clarice Pagani Savastano[1, 2] MSci, PhD; Paula Gobi Scudeller[1] PhD; Carlos Carvalho[2, 1] PhD, Prof Dr Med; Digital Primary Health Unit HCFMUSP Study Group[1]

[1]Digital Health Technological Innovation Hub (InovaHC) Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP) São Paulo BR
[2]Pulmonary Division Heart Institute (InCor) Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP) São Paulo BR
[3]Agência Brasileira de Apoio à Gestão do Sistema Único de Saúde (AgSUS) Brasília BR

Corresponding Author:
Carlos Carvalho PhD, Prof Dr Med
Digital Health
Technological Innovation Hub (InovaHC)
Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP)
Av. Dr Eneas Carvalho de Aguiar, 44, Cerqueira Cesar
São Paulo
BR

Abstract

Background: Brazil faces significant inequities in healthcare access, particularly in remote communities. The Brazilian Unified Health System grapples with challenges in delivering adequate healthcare to its vast population. To address these issues, the Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP), a leading institution in Latin America, established the Digital Health Program. This initiative aims to enhance healthcare coverage and reduce disparities through technological innovation. In collaboration with the United Kingdom Government's Better Health Program, HCFMUSP developed a Digital Primary Care proof of concept in Santarem, Pará, Brazil. This initiative successfully conducted over 220 teleconsultations with higher patient satisfaction. Building on this success, the UBS+DIGITAL project was created, in partnership with the Agência Brasileira de Apoio à Gestão do Sistema Único de Saúde, to expand and test the model of telehealth services in different scenarios in primary healthcare across Brazil.

Objective: Describe the results of the UBS+DIGITAL project, a telehealth initiative focused on training healthcare professionals, teleconsultation, and KPIs monitoring, on primary healthcare units (PHU) in Brazil.

Methods: The study comprehended fifteen Brazilian PHUs by a multi-centric prospective design. Brazilian regulations for service improvement studies do not require ethics approval. Data were collected through anonymous surveys of patients and physicians, recorded in the RedCap® database. PHUs were selected based on criteria such as the absence of an on-site physician and existing technological infrastructure. Synchronous and asynchronous training was provided, focusing on digital health and teleconsultation skills. In loco training included workshops and community events to share experiences and foster local engagement. A community of practice facilitated ongoing knowledge exchange. Teleconsultations followed the Person-Centered Clinical Method and Calgary-Cambridge methodology. KPIs were monitored by a dashboard to guide continuous improvement. The transition of operations was managed based on physician availability and project duration. Microcosting analysis assessed the project's economic impact using Brazilian guidelines, with statistical analysis performed using Jamovi® software.

Results: From March to November 2023, the project conducted 6,312 teleconsultations. Training goals were met, with over 70% of targeted professionals trained. The Net Promoter Score (NPS) for teleconsultations was 97, indicating excellent service quality. Of the teleconsultations, 66% were pre-scheduled, and 34% were on-demand, depending on family health team organization. Teleconsultations resolved 85% of cases, with 15% requiring in-person referrals or emergency care. The average absenteeism rate was 15%, and consultation durations were between 15 to 20 minutes, suggesting potential adjustments in scheduling.

Conclusions: The results highlight the effectiveness of telehealth programs in primary care settings with limited medical professionals. The UBS+DIGITAL project demonstrated that telehealth can enhance healthcare access, presenting a pioneering model within the Brazilian Unified Health System for digital primary care.

(JMIR Preprints 05/11/2024:68434)
DOI: https://doi.org/10.2196/preprints.68434

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Enhancing Primary Healthcare Access in Brazil: The *UBS+DIGITAL* Telehealth Initiative

Celina de Almeida Lamas[1,2], Patrícia Gabriela Santana Alves[1], Luciano Nader de Araújo[1], Ana Beatriz de Souza Paes[3], Ana Claudia Cielo[3], Luciana Maciel de Almeida Lopes[3], André Longo Araújo de Melo[3], Thais Suemi Yokoyama[1,2], Clarice Pagani Savastano[1, 2], Paula Gobi Scudeller[1], Carlos R. R. Carvalho[1, 2], Digital Primary Health Unit HCFMUSP Study Group*

[1] Digital Health, Technological Innovation Hub (InovaHC), Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP), São Paulo, Brazil.
[2] Pulmonary Division, Heart Institute (InCor), Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP), São Paulo, Brazil.
[3] Agência Brasileira de Apoio à Gestão do Sistema Único de Saúde (AgSUS), Brasília, Brazil.

***Digital Primary Health Unit HCFMUSP Study Group:** Aline Carvalho de Azevedo, Amanda Cristina Machado Lustosa, Artur Gonçalves Machado, Bruna Nunes Vargas, Deoclécio Avigo, Flávia Regina de Andrade Varela, Jhenifer Melissa de Oliveira Correia, Joana Thaila Gomes Pinheiro Frésca, Juliana Cristina Watanabe, Larissa Santos Oliveira Gois, Luana de Souza Bento da Silva, Luciana Moribe Hataiama, Marcela Mitie Missawa, Natalia Caroline Peccin Gonçalves, Tarcys Mallony Teixeira Printes, Thays Almeida Costa de Carvalho, Vicente Souza Barreto Neto.

Correspondence to: Dr Carlos RR Carvalho, Pulmonary Division, Heart Institute (InCor), Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo (HCFMUSP), Av. Dr Eneas Carvalho de Aguiar, 44, Cerqueira Cesar, São Paulo, SP, 05403-900. E-mail: carlos.carvalho@hc.fm.usp.br. Fone: +55 11 26614505.

Abstract

Background: Brazil faces significant inequities in healthcare access, particularly in remote communities. The Brazilian Unified Health System grapples with challenges in delivering adequate healthcare to its vast population. To address these issues, the Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP), a leading institution in Latin America, established the Digital Health Program. This initiative aims to enhance healthcare coverage and reduce disparities through technological innovation. In collaboration with the United Kingdom

Government's Better Health Program, HCFMUSP developed a Digital Primary Care proof of concept in Santarem, Pará, Brazil. This initiative successfully conducted over 220 teleconsultations with higher patient satisfaction. Building on this success, the *UBS+DIGITAL* project was created, in partnership with the *Agência Brasileira de Apoio à Gestão do Sistema Único de Saúde,* to expand and test the model of telehealth services in different scenarios in primary healthcare across Brazil.

Objective: Describe the results of the *UBS+DIGITAL* project, a telehealth initiative focused on training healthcare professionals, teleconsultation, and KPIs monitoring, on primary healthcare units (PHU) in Brazil.

Methods: The study comprehended fifteen Brazilian PHUs by a multi-centric prospective design. Brazilian regulations for service improvement studies do not require ethics approval. Data were collected through anonymous surveys of patients and physicians, recorded in the RedCap® database. PHUs were selected based on criteria such as the absence of an on-site physician and existing technological infrastructure. Synchronous and asynchronous training was provided, focusing on digital health and teleconsultation skills. *In loco* training included workshops and community events to share experiences and foster local engagement. A community of practice facilitated ongoing knowledge exchange. Teleconsultations followed the Person-Centered Clinical Method and Calgary-Cambridge methodology. KPIs were monitored by a dashboard to guide continuous improvement. The transition of operations was managed based on physician availability and project duration. Microcosting analysis assessed the project's economic impact using Brazilian guidelines, with statistical analysis performed using Jamovi® software.

Results: From March to November 2023, the project conducted 6,312 teleconsultations. Training goals were met, with over 70% of targeted professionals trained. The Net Promoter Score (NPS) for teleconsultations was 97, indicating excellent service quality. Of the teleconsultations, 66% were pre-scheduled, and 34% were on-demand, depending on family health team organization. Teleconsultations resolved 85% of cases, with 15% requiring in-person referrals or emergency care. The average absenteeism rate was 15%, and consultation durations were between 15 to 20 minutes, suggesting potential adjustments in scheduling.

Conclusion: The results highlight the effectiveness of telehealth programs in primary care settings with limited medical professionals. The *UBS+DIGITAL* project demonstrated that telehealth can enhance healthcare access, presenting a pioneering model within the Brazilian Unified Health System for digital primary care.

Keywords: telehealth, public health service, innovation, primary healthcare

1. INTRODUCTION

Universal and free access to healthcare is constitutionally guaranteed by Brazil's Federal Constitution of 1988 and its Unified Health System (UHS; *Portuguese: Sistema Único de Saúde - SUS*), established in 1990. Over its three-decade history, *SUS* has demonstrated significant advancements in promoting the Brazilian population's right to healthcare, annually attending over 190 million people at no cost and striving for higher quality service [1].

Healthcare services within *SUS* are organized according to the complexity needed to meet population demands: Primary Health Care (PHC), medium complexity, and high complexity services. In this regard, the Primary Health Unit (PHU; *Portuguese: Unidade Básica de Saúde -*

UBS) is a fundamental structure within the Brazilian healthcare system, designed to provide PHC and accessible, high-quality health services to the population. The Family Health Strategy (FHS) is a central component of this structure, emphasizing health promotion and disease prevention, treatment and management through a community-based approach. The FHS is composed of a multidisciplinary team of healthcare professionals. This team, which is the minimum required, consists of a physician, a nurse, a nursing technician, and at least one community health agent [2, 3]. The National Primary Care Policy determines that each Family Health Strategy (FHS) team should oversee no more than 4,000 individuals, with an ideal average of 3,000. This allocation should adhere to equity standards, as the number of individuals per team reflects the vulnerability levels of families in the region [4]. The PHC coverage in Brazil was reported at 78.56% as of September 2023, with more than 50 thousand accredited FHS teams [5]. Considering that approximately 71.5% of Brazilians lack private health insurance, *SUS* remains fundamental in medical treatments, health assistance, and comprehensive healthcare services [6]. In addition, the PHC serves as the primary gateway for patients, addressing more than 85% of the health needs expressed by the population [7]. Due to Brazilian geography, economic disparities, and diverse population densities, healthcare faces the challenge of offering higher quality health services [7]. Thus, telehealth initiatives have emerged to enhance healthcare accessibility by facilitating rapid diagnosis and early disease detection [10].

The Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP) is the best public hospital in Brazil and is considered a reference hospital in Latin America [11]. HCFMUSP develops relevant participation within *SUS*, encompassing over 200 million people and serving as one of the largest public health systems. To increase healthcare coverage for the Brazilian population and reduce disparities in medical care, HCFMUSP developed the Digital Health Program which has become a leading reference for telehealth services in Brazil. Although teleconsultation was only regulated in Brazil after the COVID-19 pandemic, HCFMUSP had already been conducting studies in digital health, which facilitated the integration and provision of teleconsultations as soon as this modality was officially authorized. Additionally, other telehealth projects have been developed by the HCFMUSP Digital Health Program based on its expertise, such as the Tele-ICU and the Smart ICU [9]. From a general perspective, the HCFMUSP Digital Health Program projects have been based on three pillars: training healthcare professionals, providing teleinterconsultation (consultations conducted by two or more professionals to discuss clinical cases) or teleconsultation (consultations performed between physicians and patients), and managing key performance indicators (KPIs).

In 2021, a collaborative initiative between HCFMUSP and the United Kingdom

Government's Better Health Program developed a Digital Primary Care proof of concept. This initiative focused on implementing telemedicine service in Santarem, Pará - Brazil, the lack of healthcare services in remote areas. This included teletraining medical and multi-professional teams to independently operate in telemedicine service, adapting to the specific challenges and realities of the Brazilian context [10]. Between September and December 2021, the proof of concept accomplished more than 220 teleconsultations, offering medical service to 111 patients; about 95% of the patients were satisfied with the medical service, and 76.6% of the patients reported that their needs were fully met. Based on these successful results, the HCFMUSP in partnership with the *Agência Brasileira de Apoio à Gestão do Sistema Único de Saúde (AgSUS),* created a project named *UBS+DIGITAL* (*English: PHU+DIGITAL*) to expand medical assistance in different localities of Brazil. Thus, the objective of the present study was to describe the results of the *UBS+DIGITAL* project, a telehealth initiative focused on teletraining of healthcare professionals, teleconsultation, and KPIs monitoring, on PHU in Brazil.

2. METHODS

2.1. Study Design

It represents a multi-centric prospective study that describes the implementation of a telehealth program at fifteen Brazilian PHUs. The Brazilian National Health Council resolution number 466/12, and 510/16 established that it is not necessary for the ethics committee to review studies with the sole objective of evaluating implementation and service improvement. In this study, we conducted an anonymous survey with patients and physicians, ensuring that no identifying or sensitive data was collected. All information was anonymously recorded in the RedCap® database.

2.2. Human Resources Structure

Family and Community Medicine physicians were scheduled for 18 hours per week. Each physician was responsible for attending one PHU, ensuring continuity of care. The physicians' weekly schedule included one hour for PHU team meetings, one hour for educational upgrading, and 16 hours for patient care (including teleconsultations, patient reception, prescribing and sending referral requests, and reviewing guidance with the patient).

The project team also included project managers, project coordinators, project analysts, research coordinators, data analysts, and information technology technicians, all of whom dedicated

40 hours per week to the project. In addition, a medical project coordinator and a nurse teletraining analyst dedicated 20 hours per week to the project. All professionals underwent a structured onboarding program developed by the Human Resources of Digital Health at HCFMUSP and completed a 20-hour “Digital Health at Primary Healthcare”.

The selected project manager and project coordinators should have experience in primary healthcare, both of whom were responsible for the overall management of the project. Their duties included financial planning, monitoring and improving collected KPIs and serving as the interface with stakeholders at the PHUs. The medical and project coordinators were responsible for selecting the operational team for the *UBS+Digital* project. Two key criteria guided the selection process: expertise in PHC and soft skills, such as decision-making, problem-solving, and leadership. The research team, including the research coordinator and the data analyst, was responsible for preparing reports, writing scientific materials, and managing the collected data. The teletraining team, composed of nurses, engaged with the PHU teams to design the lectures delivered during *in loco* visits and synchronous training. Finally, the information technology team was responsible for implementing the platform used for teleconsultations and training the PHU teams on the technology used.

2.3. Selection criteria of Primary Health Units

Initially, a mapping of Brazil’ regions with available vacancies in the *Médicos pelo Brasil* Program was carried out using the reports provided by *AgSUS*. Next, we identified FHS teams with open positions in municipalities within these regions by utilizing the *e-Gestor APS* system.

The first selection criterion was that the municipality must have at least one approved FHT with 50% suspension of resources registered. This FHT should be without a physician, in accordance with the registration in the National Health Establishment Registry (CNES). Furthermore, the municipality should utilize the Electronic Citizen Record (e-*SUS APS*), based on data from the PHC Information System. Priority was given to municipalities classified as remote rural areas, which have open physician vacancies.

The following criteria were used for PHUs selection flow for inclusion in the project:

1. Availability of a computer with audio and video capabilities, as well as a printer for printing medical prescriptions and issuing certificates;
2. Stable internet connection with sufficient speed for video calls;
3. Utilization of the videoconferencing platform provided by the project, which was installed in advance and for which professionals were trained in its use;

4. Availability of a private room for teleconsultations;
5. Support from a local technology team to address infrastructure and system-related issues.

2.4. Training program

2.4.1. Synchronous teletraining

The synchronous teletraining aimed to train the PHU professionals in using the technological tools necessary for teleconsultation operations, clarify the project's objectives and expected results, and demonstrate the patient's journey within the PHU in the context of teleconsultation. The project's operational flow was adjusted to align with the realities and characteristics of the healthcare service, team, territory, and community being served. The teletraining synchronous sessions were scheduled according to the availability of each PHU. Initially, the project team introduced the IConf®, the institutional videoconference platform used for teleconsultation. It facilitates communication between patients and physicians, physicians and FHT, and physicians and the management team, following Brazil's General Data Protection Law (*Lei Geral de Proteção de Dados - LGPD*). The IConf® features included audio and/or video sharing, screen sharing, presentations with whiteboard and document functions, as well as public and private chat options. Health agents, physicians, dentists, nurses, nursing technicians, PHU managers, and other professionals participated in the synchronous teletraining using the Google Meet platform. At the end, the participants provided anonymous feedback using the Net Promoter Score (NPS) system to assess their satisfaction and likelihood of recommending the service [12].

2.5.2. Asynchronous teletraining

The asynchronous teletraining aimed to provide basic qualifications on "Digital Health at Primary Healthcare". The 20 hours course was available on the HCX e-learning platform of the HCFMUSP and covered the following topics: introduction to Digital Health in PHU, regulatory aspects of telemedicine and telehealth, ethical considerations in Digital Health, legal aspects of Brazilian data protection law, effective patient communication, humanization and media training, humanization of teleconsultations, telepropaedeutics, telepediatrics, teleorthopedics, challenges in teleconsultation in mental health, telerehabilitation, and simulation of teleconsultations. Participants took a test at the end and provided anonymous feedback using the NPS [12] system to assess their satisfaction and likelihood of recommending the course.

2.5.3. *In loco* training

In loco training was offered to PHU professionals to increase engagement, facilitate the sharing of experiences, and exchange scientific knowledge. The *in loco* training included a workshop to discuss common clinical scenarios encountered in PHU, encompassing clinical issues, work processes, and community-specific aspects. The PHU participants first addressed the case from their respective roles, followed by a theoretical presentation based on their comments and the development of a personalized therapeutic plan for the case. Additionally, the *in loco* training included a community event aimed at promoting the project, strengthening relationships, and obtaining patient feedback. This event featured a real-time or recorded speech from the PHU physician, emphasizing the importance of medical follow-up. At the end, the participants provided anonymous feedback using the NPS [12] system to assess their satisfaction and probability of recommending the training.

2.5.4. Communities of practices

A community of practices was established for professionals involved in the *UBS+DIGITAL* project to share their knowledge and experiences related to their telehealth experiences. Through discussing successful cases, participants were able to enhance their understanding of telehealth and identify challenges and opportunities that emerged throughout the project. In order to facilitate this process, an instant group at a messaging app was created for FHT professionals and local managers to forward their questions. Additionally, synchronous meetings were organized to discuss telehealth experiences from the *UBS+DIGITAL* project, allowing teams from different PHUs to present their successful cases, meet external speakers, and further engage in collaborative learning. Promotion and dissemination of the event occurred through communication channels targeted at professionals within the PHU, emphasizing the importance of this learning opportunity and the exchange of experiences among participants.

2.6. Technical visits

The technical visit itinerary included a meeting at the Municipal Health Department aiming to strengthen relationships, update project stakeholders, and promote discussions about the project's

impact on the population and potential action plans. Additionally, the project management team observed the routine of PHU professionals to map out the patient and professional journeys.

2.7. Teleconsultation setting

In general, teleconsultations were conducted with patients at the PHU, where the professionals from the FHS team provided on-site assistance. In exceptional cases, home-based teleconsultations were arranged to assist not only bedridden or mobility-impaired patients but also those living in remote areas or who had not sought care at a PHU. The home visits were conducted using a mobile phone or tablet to enable teleconsultation.

Medical teleconsultation was scheduled either in advance or on the same day, based on the physicians' availability. If a patient did not attend the appointment, the slot was offered to another patient at the PHU.

The teleconsultations followed the Person-Centered Clinical Method and were guided by the Calgary-Cambridge methodology [13]. When receiving the patient at the online platform, the physician confirmed the patient’s full name and birth date. The initial few minutes of interaction were dedicated to establishing clear communication and building a connection. Figure 1 illustrates the teleconsultation process.

The projection indicated that teleconsultations would have an average duration of 30 minutes. With 16 hours allocated to this service, the PHU would offer approximately 32 teleconsultations *per* week. Although a time estimate for consultations was established, physicians had the autonomy to manage the teleconsultation according to the patient's needs, which could result in a duration shorter or longer than initially projected. Figure 1 illustrates the teleconsultation process.

At the end of each teleconsultation, patients provided anonymous feedback using the NPS system to assess their satisfaction and probability of recommending the service. The physicians completed an on-line form documenting relevant metrics such as consultation duration, number of sessions, unavailability service rate, patient no-shows, and the need for further medical referral.

In addition, teleconsultations and other telehealth care services were categorized, such as clinical case discussion, prescription renewal, reception, teleconsultation at patients’ houses, and counseling.

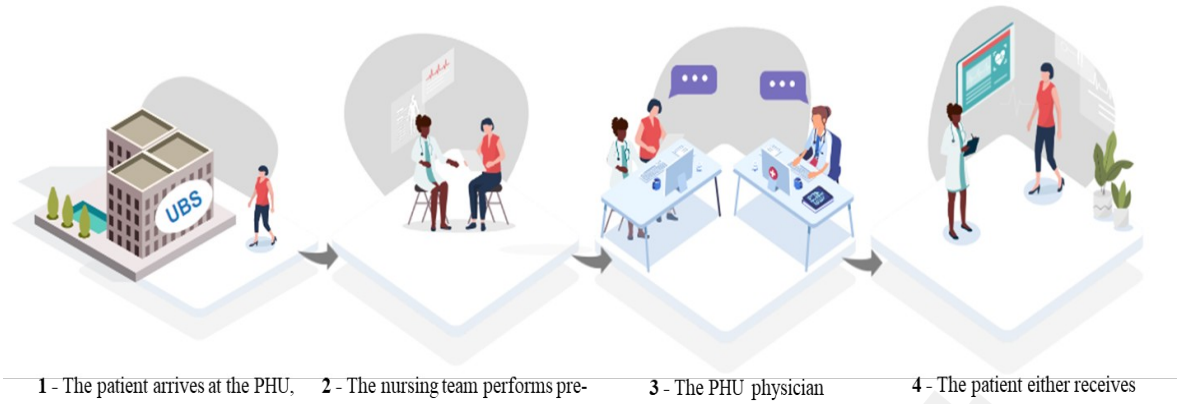


Figure 1. Patient's journey in PHU during the telehealth service delivery. PHU = Primary Health Unit.

2.9. Key Performance Indicators (KPIs) and project management

The project's performance was monitored using KPIs as shown in Table 1. Data was collected from patients and physicians through structured online forms and stored anonymously in the RedCap® database. A dashboard displaying the main project KPIs was developed using the Power BI platform to facilitate continuous monitoring. The ongoing data monitoring allowed the team to track the project's progress, reinforce existing strategies, and develop new ones. Weekly, the project management team reviewed the KPIs and established strategies for continuous improvement of the outcomes. Additionally, biweekly meetings with the entire project team were conducted to comprehensively analyze the data. A goal was set to achieve a minimum resolution rate of 50%.

Table 1. Key Performance Indicators (KPIs) evaluated during the *UBS+DIGITAL* project.

	Key Performance Indicators analyzed
1	NPS for teleconsultations [a]
2	NPS for asynchronous, synchronous and *in loco* training
3	Total number of teleconsultations
4	Number of patients attended via teleconsultation
5	Resoluteness rate
6	Percentage of service type (teleconsultation, teleinterconsultation, and other services [b])
7	Percentage of absenteeism

8	Appointment occupancy rate [c]

[a] NPS = Net Promoter Score; [b] Appointment occupancy rate = Occupancy rate (%) = (total time occupied/total available time) x100; [C] Others services = clinical cases discussion, prescription renewal, reception, teleconsultation at patients' home, and counseling.

2.10. Closure of Operations at PHUs

The closure of operations at the participating PHUs occurred gradually, with a reduction in the number of teleconsultations by the physician to ensure the continuity of care. The transition period lasted an average of 3 weeks, until the total cessation of the service. This process occurred in three possible situations: the arrival of a full-time on-site physician, the end of the project's execution period, or the lack of participation of essential PHU professionals and managers.

The closure of operations at the PHUs phase started with a meeting between the project team and the municipal health management team to present the transition operation process. During this meeting, data and progress of the specific PHU were reviewed. When applicable, the new physician serving the PHU in person was involved in the process and invited to access the online course "Digital Health at Primary Healthcare", to understand telehealth practices implemented prior to their arrival, thereby highlighting the importance of operational procedures and the quality of patient care.

2.11 Microcosting analysis

We conducted a microcosting evaluation to economically analyze the project's accounting data. The assessment was based on Social Return on Investment, 2019 [14]. Data was collected retrospectively since it was necessary to consolidate productivity data for cost mapping.

Resources quantification and costing were completed following the Brazilian Economic Evaluation Guidelines of the Ministry of Health [15]. This process involved three stages: 1. identifying relevant costs for the evaluation; 2. measuring the resources used and 3. valuing the resources. The analysis considered both the implementation and operational costs of the project. To determine these costs, the hours dedicated by each professional to the project were estimated and categorized as either implementation or operation phases. Relevant costs for the evaluation included the following implementation elements: human resources, infrastructure, e-learning platform, and project marketing services. For the project's operational phase, the costs considered were those related to human resources, the video conferencing platform, and travel expenses for conducting *in loco* training.

Different scenarios were considered for measuring costs. The calculation included the required operational time needed for the operational cost to combine the investment made in implementation. Each cost category was calculated using a specific formula, as outlined below:

1- Total Cost: was calculated by adding the implementation and operational costs of the project and dividing it by the number of teleconsultations performed;

2- Actual Cost was the actual cost per service provided, considering only the investment dedicated to operations;

3- Effective Cost was determined by dividing the operational costs by the number of teleconsultations scheduled, thus accounting for the potential reduced costs;

4- Optimized Cost was calculated by dividing the operational costs by the expanded number of teleconsultations;

5- T was the time needed for the operation cost to be equivalent to the amount invested in the project implementation.

2.12. Statistics analysis

All the data collected anonymously and recorded in the RedCap® databases were extracted to Excel 2023. Jamovi® software was used to perform the descriptive analysis of the results. the values were expressed in absolute values and percentage.

3. RESULTS

3.1 Mapping and Selection of Brazil’s Primary Health Units

All professionals from the project team completed the “Digital Health at Primary Healthcare" course, which explored digital health, including its historical development, definitions, regulatory law, and current challenges, aiming to standardize the knowledge among the professionals regarding the fundamental principles of telehealth services.

After searching for FHS teams with open positions in municipalities within the regions mapped for available vacancies in the *Médicos pelo Brasil* Program, 322 teams met the first selection criterion: having at least one approved FHS team with a 50% suspension of resources. Of these, 135 municipalities proceeded to a pre-selection based on additional inclusion criteria outlined for the project. Among these, 39 expressed interest in taking part in the project, and 25 municipalities representatives attended an online meeting to discuss the project and its requirements. Ultimately, 11

municipalities agreed to participate in the project. From January to December of 2023, the *UBS+DIGITAL* project served 15 PHU from four regions of Brazil (North, South, Northeast, and Southeast) (Figure 2). The median duration of PHU participation in the project was 5 (IQR 1,50-6) months, with the shortest and longest durations being 1 and 7 months, respectively. Figure 3 illustrates the flowchart of the *UBS+DIGITAL* project implementation at the selected PHUs.

Figure 2. Brazil's map showing the localization of the 15 selected PHUs.

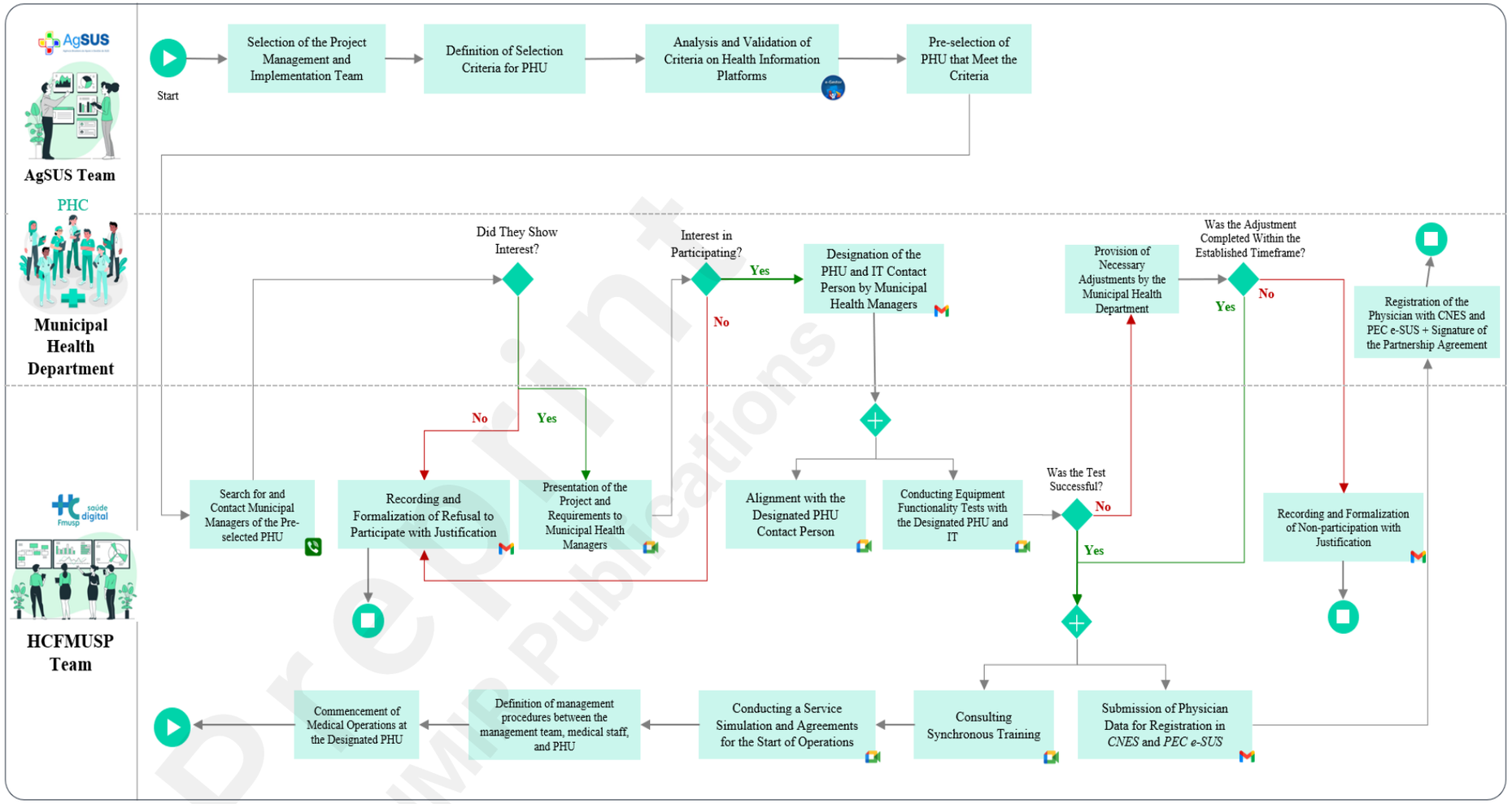


Figure 3: Project implementation workflow. PHU = primary health unit; PHC = Primary Health Care; CNES = National Registry of Health Establishments (*Cadastro Nacional de Estabelecimentos de Saúde*); PEC e-*SUS* = Electronic Citizen's Medical Record (*Prontuário Eletrônico do Cidadão*).

3.2 PHUs' training program

A total of 153 professionals were synchronously teletrained to use the technological tools necessary for teleconsultation operations. The majority of the professionals were community health agents, community health coordinators, and nursing technicians (Table 2). Approximately, 40% of professionals responded to the NPS questionnaire, and the NPS score achieved was 100, classified as excellent.

Asynchronous teletraining was offered to a total of 91 professionals, consisting mainly of community health agents' coordinators, as well as nursing technicians, nurses, managers, and other professionals (buccal health agents, secretaries, administrative and information technician, community health agent, and dentist) (Table 2). Approximately, 19% of professionals responded to the NPS questionnaire. The NPS score for this training was 84, classified in the zone of excellence.

Additionally, nine *in loco* training were conducted between July and September 2023. Of the 15 PHUs participating in the project, two withdrew before the *in loco* training, three joined the project without available time to undergo this training and one preferred to complete the training online. These training sessions educated 87 professionals, including community health agents, community health coordinators, and nursing technicians (Table 2). The NPS score for this training was 99, classified as excellent.

Table 2. Categories of the healthcare professionals that participated in the synchronous, asynchronous, and *in loco* training.

Percentage Professional	Synchronous	Asynchronous	*In loco*
Health community agent (%)	50	53	44
Nursing technician (%)	14	19	17
Nurse (%)	10	11	9
Managers (%)	9	1	19
Dentist (%)	2	2	2
Physician (%)	1	1	3
Others (%)	14	13	5

*Others: buccal health agents, secretaries, and administrative and information technicians.

The communities of practice strategy were implemented to increase the visibility

of the *UBS+DIGITAL* project and to establish an environment where the professionals involved in the project could share their knowledge and experiences related to telehealth services. To facilitate this, a group was created on an instant messaging app, and virtual meetings were held, with the presence of external speakers. Four meetings were conducted, addressing topics identified by participants as relevant for enhancing teleconsultation practices, such as telemedicine for integrated logistics and telehealth, digital empathy, home care services, hybrid practices linked to health care delivery, and project closure. The first twenty minutes of each session were dedicated to university professors or FHS team professionals who shared successful teleconsultation cases or theoretical topics related to digital health. Following the presentations, a discussion was opened to all participants. It was noted that participants preferred topics related to PHC over more technological subjects. The communities of practice involved PHC managers, healthcare professionals, the project manager, the teletraining team, the medical project coordinator, physicians, and the project team.

3.3. Implementation and impact of teleconsultation

Initially, the teleconsultation schedule began with a limited offering, and after evaluating the PHU participant adaptation to the teleconsultation system, it was expanded to full capacity (100%). The methodology applied was designed to implement the solution gradually, reducing the necessity for major changes to existing workflows and minimizing the risk of resistance from the local team and patient adherence challenges.

During the telehealth program, a total of 6.312 sessions were conducted. Of these, 6.140 were teleconsultations (97.3%), 96 were teleinterconsultations (1.5%), and 76 were other services such as home visit, renew medical prescription, and medical advice (1.2%). The teleconsultations served 4.279 patients, out of which 1.842 patients (43%) returned for follow-up treatment. The teleconsultations had a resolution rate of 85%, and a 15% absenteeism rate. Teleconsultations majoritarily lasted 10 to 20 minutes and were previously scheduled. This service achieved the NPS score of 97, classified as excellent. These results are summarized in Table 3.

During the teleconsultation program, nine technical visits were carried out simultaneously with the *in loco* training. Initial findings were presented to local stakeholders as health department managers, PHU coordinators, and PHU focal points,

providing a project overview and a brief on outcomes from other PHU locations involved.

The operation transition plan was implemented at the end of the teleconsultation operations. Among 15 participating PHUs, 7 ended their operation due the arrival of the physician in person, 4 concluded their participation due to the project's finalization, and 4 lacked engagement. During the teleconsultation transition and arrival of the physician in person, the 7 physicians joining PHUs for in-person activities were able to participate in a teleconsultation and access the online course “Digital Health at Primary Healthcare”. The transition process also involved the project physician transferring complex cases, detailing interventions, and setting patient care expectations.

Table 3. Results of telehealth service offered on the *UBS+DIGITAL* project.

Telehealth service	
Teleconsultation %(n/N)	97.3 (6140/6312)
Teleinterconsultation %(n/N)	1.5 (96/6312)
Others service* %(n/N)	1.2 (76/6312)
Average teleconsultation time	
0-10 min %(n/N)	7.5 (461/6140)
10-20 min %(n/N)	66.1 (4054/6140)
>20 min %(n/N)	26.4 (1623/6140)
Previous or same-day teleconsultation	
Previously scheduled teleconsultation %(n/N)	65.3 (4006/6140)
Same-day scheduled teleconsultation %(n/N)	34.7 (2132/6140)
Teleconsultation resoluteness rate %(n/N)	85 (6140/6312)

The results were presented as percentages (%), case counts (n), and the total number of samples for each metric (N). *Other services: clinical cases discussion, prescription renewal, reception, teleconsultation at patients’ house, and counseling.

3.5. *UBS+DIGITAL* project microcosting analysis

To calculate the costs of teleconsultations, a total of 6,312 telehealth services were considered. The effective cost was determined based on the availability of 4,752 hours for the teleconsultation schedule and a maximum operation capacity of 9,504 teleconsultations. The optimized cost was calculated based on a teleconsultation time of 15 minutes, and therefore an increased capacity of 19,008 teleconsultations within 4,752 hours. The 15-minute teleconsultation time was based on the observation that 66.1% of teleconsultations occurred within 10-20 minutes. The implementation cost was determined using the actual price and an average of 23.6 telehealth services per day. The

results of the microcosting evaluation are described in Table 4.

Table 4. Project microcosting analysis in different scenarios.

Microcosting Indices	Value (USD/teleconsultation)	Time (Days)
Total Cost	137*	-
Real Cost	85*	-
Effective Cost	57*	-
Optimized Cost	28*	-
Time	-	161.5

*These results were presented in dollars based on the exchange rate at the time of the project's implementation.

4. DISCUSSION

This study describes the *UBS+DIGITAL* project, which assessed the implementation and feasibility of a telehealth program in PHUs of the Brazilian Unified Health System, specifically in facilities lacking physicians. The results indicate a high-resolution rate of teleconsultations, with a relatively low medical infrastructure cost *per* consultation. This approach showcased the project's capability to surmount geographical and economic barriers, particularly in remote areas with limited medical care, physical infrastructure, and internet.

The data showed high patient satisfaction, with returning for continuing treatment, reinforcing their engagement with digital care. The return of patients for the continuity of treatment was fundamental in building a resolutive primary health care system. One of the main challenges of the *UBS+Digital* project was establishing the physician-patient relationship that could be enhanced despite geographical distance and the use of technology to access services. Additionally, the project faced the challenge of training and engaging healthcare professionals, including physicians, nurses, nursing technicians, and other professionals, focusing on teleconsultation technology and specific clinical themes requested by the PHUs.

A study on the evolution of PHC from 2014 to 2018 documented the increasing implementation of Information and Communication Technologies (ICT) in healthcare services [16]. It described the access to the internet and its role in enhancing care quality and process efficiency. The introduction of these technologies has improved

professional practice and healthcare management. The study also highlighted significant disparities, with a higher concentration of ICT usage in areas with better Human Development Index (HDI) and stronger PHC coverage. However, the North and Northeast regions, which face more challenging economic and social conditions, continue to struggle with inadequate infrastructure and a lack of technological resources. This inequality is exacerbated by Brazil's vast territorial expanse and variable socioeconomic conditions, underscoring the urgent need for increased investments in ICT to ensure more equitable coverage.

In addition, Brazilian heterogeneity, reflected in significant variations in the HDI by Municipality (HDI-M), makes the availability of physicians in remote regions a persistent challenge. The HDI-M measures longevity, education, and income, with values ranging from 0 to 1, where values closer to 1 indicate better development. In the present project, the HDI-M of the assessed PHU ranged from 0.565 to 0.778, indicating a need for increased medical resource allocation [17].

The *UBS+DIGITAL* project showcased the potential of telehealth in addressing healthcare access challenges in remote areas with limited infrastructure. High-resolution rates and positive patient feedback demonstrated the telehealth's effectiveness in overcoming geographic and economic barriers, improving access, and ensuring continuity of care. Despite ongoing regional disparities and the need for increased investment in ICT, the project emphasizes telehealth as a viable solution for underserved areas. However, its scalability is currently limited, and successful implementation requires a balanced approach that integrates technological advancements with targeted public policies and strategic investments to reduce regional inequalities and ensure equitable healthcare coverage. We could highlight that the human resources and team engagement involved in the project, such as municipal managers and family health teams, were of great importance to the project's success.

A comparison between Canada and Brazil highlights shared challenges in healthcare access due to their vast geographic areas. In both countries, residents of remote areas must travel long distances at significant costs to reach urban centers where medical specialists are concentrated. In Canada, 19% of the rural population faces restricted access to specialized care leading to high socioeconomic burdens and travel-related risks, along with lower availability of medical services [18].

Value-based healthcare strategy aims to improve patient outcomes by enhancing capacity, comfort, and calm, aligning with the Institute for Healthcare Improvement’s

"triple aim" of improving patient and clinician experiences, population health, and reducing per capita costs [19]. Evidence supports telehealth as a cost-effective model within this framework, as seen in China’s telemedicine program for eye disease screening, which achieved an incremental cost-effectiveness ratio of 34% for traditional methods. In England, telemedicine for acute stroke care led to $500,000 in cost savings compared to conventional services [19].

While the initial investment in implementation is significant, evidence indicates that the cost *per* teleconsultation tends to decrease, reflecting increasing efficiency [20]. Beyond the economic benefits, the project brought significant social value to various stakeholders, including patients, the community, FHT, the *AgSUS* and HCFMUSP Digital Health team, and health department managers. For patients and the community, the project raised awareness of the importance of teleconsultations and promoted digital inclusion, enhancing healthcare access and equity. The project improved the skills of teams at PHUs, *AgSUS* and HCFMUSP, particularly in telehealth, applied to PHC, project management, and data analysis. The medical team enhanced their telemedicine skills through courses in Digital Health for PHC, while also increasing their acceptance of telehealth for medical consultations. For the teams at both AgSUS and HCFMUSP, the project provided valuable insights into the local realities of primary care, enabling more informed decision-making regarding the implementation of telehealth services. Moreover, for municipal health managers, the project offered crucial learning opportunities and insights into training professionals in digital health care. This knowledge significantly strengthens the municipal health system's ability to effectively adapt to and integrate telehealth solutions.

The implementation of the *UBS+Digital* project at a PHU in an isolated riverside district exemplifies a significant advancement in healthcare accessibility with environmental benefits. Previously, a single patient faced a 236 km journey, taking up to 12 hours in one day, to receive in-person medical care in another city. Within just seven months, the telehealth initiative facilitated 872 teleconsultations at this PHU, achieving a NPS of 96 and resulting in savings of 205,792 km in travel that these individuals would have otherwise needed to undertake by boat and car. Furthermore, the 86% resolution rate observed at this PHU indicates that the majority of health issues were effectively addressed, thereby preventing the need for additional travel for follow-up appointments and potentially reducing the carbon footprint associated with such journeys. By minimizing commuting, the project also led to reductions in transportation

costs, environmental impact, and risks related to transport accidents. These findings underscore the importance of telehealth services in enhancing care for patients in remote areas.

The study faced limitations that may affect its applicability. Conducted in a limited number of PHU, it may not fully capture regional variability across Brazil; however, we have made efforts to include PHU from different regions of the country to minimize this impact. Also, another challenge arises from issues related to physical infrastructure, internet access, and logistical limitations within these units.

5. CONCLUSION

The *UBS+DIGITAL* project exemplifies how telehealth initiatives can effectively address healthcare disparities, particularly in underserved regions with limited medical infrastructure. By offering teleconsultations, this project has improved access to healthcare services, demonstrated a high-resolution rate, and achieved notable patient satisfaction that could be considered similar to the model in-person PHC. The training of healthcare professionals further ensured the sustainability and quality of these services. These findings highlight the potential for telehealth to mitigate geographic and economic barriers, enhancing healthcare access in regions where traditional medical resources are scarce. The findings from this study also provide a solid foundation for future research on optimizing telehealth to meet the diverse needs of the Brazilian population. The experience acquired can inform health policies and telehealth implementation strategies in similar global contexts. The microcosting approach used in this study is particularly useful for future evaluations of digital health projects and supports the development of public policies aimed at expanding access to quality healthcare. Given Brazil's vast territorial area and significant socioeconomic disparities, telehealth relevance highlights the ongoing need for innovative solutions to improve healthcare access and quality of the services.

6. REFERENCES

[1] Brasil. Maior sistema público de saúde do mundo, SUS completa 31 anos [Internet]. Brasília: Ministério da Saúde; 2022 [cited 2023 Nov 23]. Available from: https://www.gov.br/saude/pt-br/assuntos/noticias/2021/setembro/maior-sistema-publico-

de-saude-do-mundo-sus-completa-31-anos.

[2] Martins CP. O uso da telemedicina na atenção primária pós-pandemia da COVID-19. Perspectivas Experimentais e Clínicas, Inovações Biomédicas e Educação em Saúde (PECIBES). 2023;9(1):18-24.

[3] Mendes EV. A construção social da atenção primária à saúde. Brasília: Conselho Nacional de Secretários de Saúde – CONASS; 2015. 193 p.: il. ISBN 978-85-8071-034-2.

[4] Canterle J. Aumenta o número de equipes de Saúde da Família completas no DF [Internet]. Brasília: Secretaria de Saúde do Distrito Federal; 2020 Sep 23 [cited 2024 Fev 5]. Available from: https://www.saude.df.gov.br/web/guest/w/aumenta-o-numero-de-equipes-de-saude-da-familia-completas-no-df#:~:text=Conforme%20a%20Pol%C3%ADtica%20Nacional%20da%20Aten%C3%A7%C3%A3o%20B%C3%A1sica%2C%20cada,vulnerabilidade%2C%20mais%20equipes%20devem%20estar%20consistidas%20naquele%20territ%C3%B3rio

[5] Brasil. Informação e Gestão da Atenção Básica. e-Gestor. Histórico de Cobertura [Internet]. Brasília: Ministério da Saúde; 2023 [cited 2023 Dez 23]. Available from: https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCobertura.xhtml.

[6] Brasil. Estratégia Saúde da Família, Diário Oficial da União. Portaria de consolidação nº 1, de 2 de junho de 2021/2023 [Internet]. Brasília: Ministério da Saúde; 2021/2023 [cited 2023 Nov 30]. Available from: https://www.gov.br/saude/pt-br/acesso-a-informacao/acoes-e-programas/estrategia-saude-da-familia.

[7] Pan American Health Organization (PAHO). Primary Health Care [Internet]. World Health Organization; 2023 [cited 2023 Nov 30]. Available from: https://www.paho.org/pt/topicos/atencao-primaria-saude.

[8] Andrade MV, Noronha K, de Sá EB, Piola S, Vieira FS, Vieira RS, de Sá e Benevides RP. Desafios do sistema de saúde brasileiro. In: Di Negri JA, de Araújo BCP, Bacelette RG, editors. Desafios da nação: artigos de apoio. Vol. 2. Brasília: Instituto de Pesquisa Econômica Aplicada (Ipea); 2018. ISBN 978-85-7811-322-3.7

[9] Scudeller PG, Lamas CA, Alvarenga AM, Garcia ML, Amaral TF, de Oliveira MR, de Macedo BR, Testa CB, Baptista FS, Francisco RPV, de Carvalho CRR. Tele-Intensive Care Unit Program in Brazil: Implementation and Expansion. Telemed Rep. 2023 May 25;4(1):109-117. Doi: 10.1089/tmr.2023.0017. PMID: 37283854; PMCID: PMC10240323.

[10] Bin KJ, Santana Alves PG, Costa R, Eiras PC, Nader de Araujo L, Pereira AJR, Carvalho C, Malik AM. User Experience Regarding Digital Primary Health Care in Santarém, Amazon: Evaluation of Patient Satisfaction and Doctor's Feedback. JMIR Form Res. 2023 Jan 11;7:e39034. Doi: 10.2196/39034. PMID: 36630164; PMCID: PMC9878359.

[11] Newsweek.World’s Best Hospitals 2024 [Internet]. New York: Newsweek; 2024 [cited 31 Oct 2024]. Available from: https://www.gov.br/saude/pt-br/assuntos/noticias/2021/setembro/maior-sistema-publico-de-saude-do-mundo-sus-completa-31-anos.

[12] Reichheld F. The One Number You Need to Grow. Harvard Business Review, Harvard Business School Press; 2023. [cited 18 April 2023]. Available from: https://hbr.org/2003/12/the-one-number-you-need-to-grow.

[13] Kurtz S, Silverman J, Benson J, Draper J. Marrying content and process in clinical method teaching: enhancing the Calgary-Cambridge guides. Acad Med. 2003 Aug;78(8):802-9. Doi: 10.1097/00001888-200308000-00011. PMID: 12915371.

[14] Teisberg E, Wallace S, O'Hara S. Defining and Implementing Value-Based Health Care: A Strategic Framework. Acad Med. 2020 May;95(5):682-685. Doi: 10.1097/ACM.0000000000003122. PMID: 31833857; PMCID: PMC7185050.

[15] Brasil. Ministério da Saúde. Secretaria de Ciência, Tecnologia e Insumos Estratégicos. Departamento de Ciência e Tecnologia. Diretrizes metodológicas: diretriz de avaliação econômica. 2. ed. Brasília: Ministério da Saúde; 2014.

[16] Bender JD, Facchini LA, Lapão LMV, Tomasi E, Thumé E. Evolution of the availability of Information and Communication Technologies in primary health care in Brazil, 2012 to 2018. Rev Bras Epidemiol. 2024 Apr 19;27:e240021. Doi: 10.1590/1980-549720240021. PMID: 38655947; PMCID: PMC11027431.

[17] Instituto Brasileiro de Geografia e Estatística (IBGE). Panorama dos municípios: Índice de Desenvolvimento Humano [Internet]. Brasília: IBGE; 2010 [cited 2023 Nov 30]. Available from: https://cidades.ibge.gov.br/brasil/sp/suzano/panorama.

[18] Agarwal P, Kithulegoda N, Umpierre R, Pawlovich J, Pfeil JN, D'Avila OP, Goncalves M, Harzheim E, Ponka D. Telemedicine in the driver's seat: new role for primary care access in Brazil and Canada: The Besrour Papers: a series on the state of family medicine in Canada and Brazil. Can Fam Physician. 2020 Feb;66(2):104-111. PMID: 32060190; PMCID: PMC7021340.

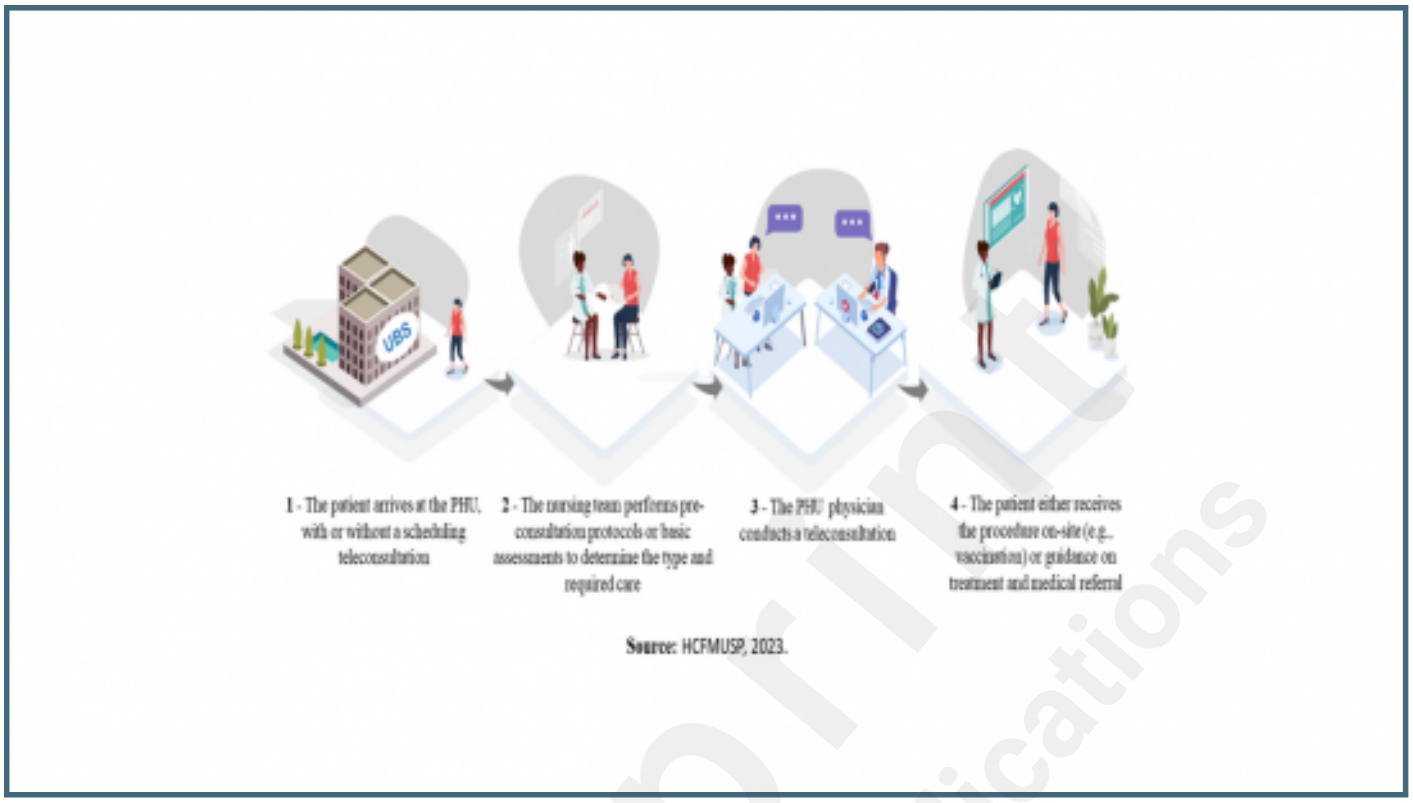
[19] Teisberg E, Wallace S, O'Hara S. Defining and Implementing Value-Based Health Care: A Strategic Framework. Acad Med. 2020 May;95(5):682-685. Doi: 10.1097/ACM.0000000000003122. PMID: 31833857; PMCID: PMC7185050.

[20] Huguet M, Sarazin M, Perrier L, Augusto V. How We Can Reap the Full Benefit of Teleconsultations: Economic Evaluation Combined With a Performance Evaluation Through a Discrete-Event Simulation. J Med Internet Res. 2022 May 20;24(5):e32002. doi: 10.2196/32002. PMID: 35594065; PMCID: PMC9166645.

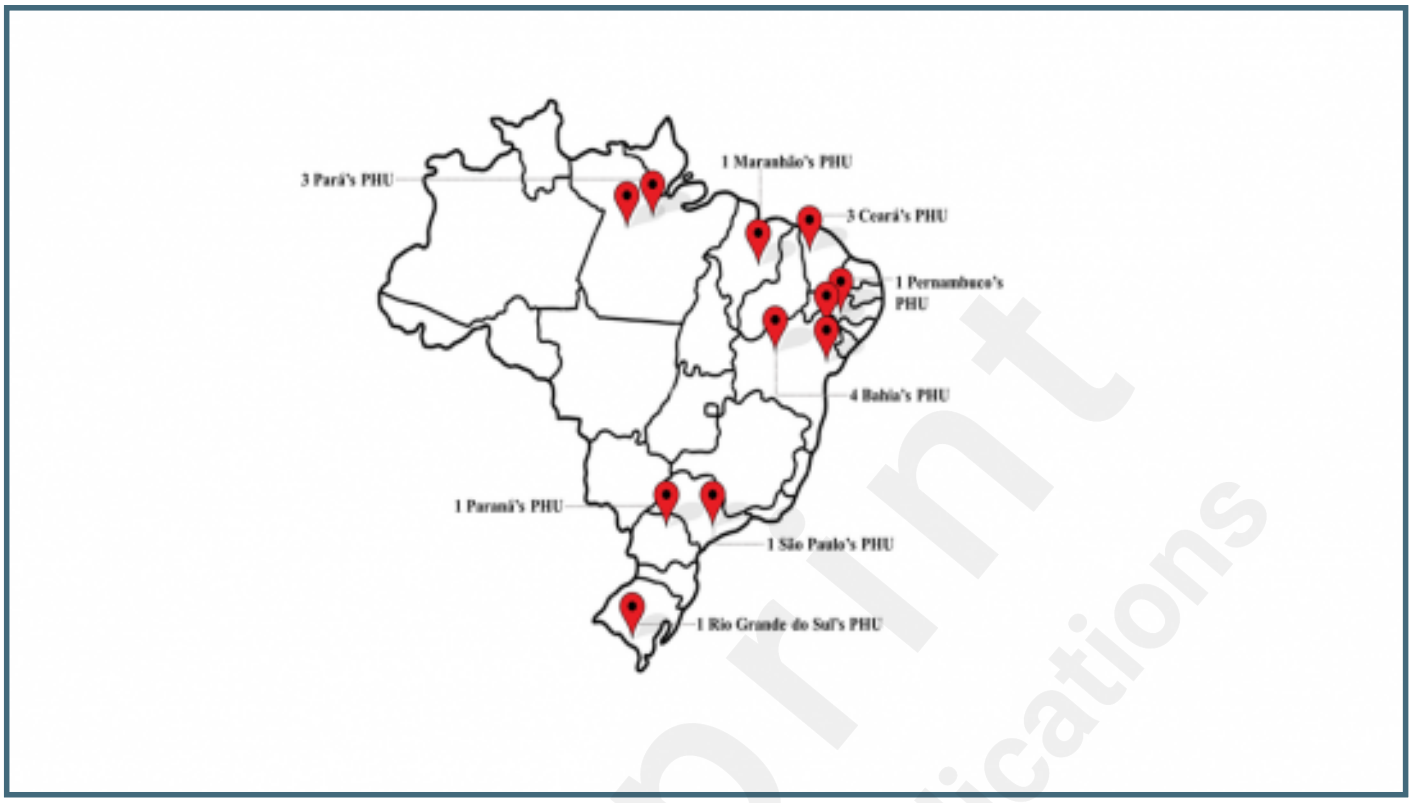
Supplementary Files

Figures

Patient's journey in PHU during the telehealth service delivery. PHU = Primary Health Unit.



Brazil’s map showing the localization of the 15 selected PHUs.



Project implementation workflow. PHU = primary health unit; PHC = Primary Health Care; CNES = National Registry of Health Establishments (Cadastro Nacional de Estabelecimentos de Saúde); PEC e-SUS = Electronic Citizen's Medical Record (Prontuário Eletrônico do Cidadão).