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PEC e-SUS APS online appointment scheduling system: a tool to facilitate access to Primary Care in Brazil

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Abstract *Barriers faced by health services providing scheduled care result in high no-show rates. This article describes the main characteristics of an online appointment scheduling system incorporated into the citizens' electronic health record system (PEC e-SUS APS). Developed by the Bridge Laboratory, Federal University of Santa Catarina, which also developed the PEC e-SUS APS, the system allows patients to schedule appointments using the national patient communications hub, Conecte SUS Cidadão. The PEC e-SUS APS includes a professional's agenda module that allows patients to view available time slots and book and cancel appointments. Unfortunately, despite the benefits of online scheduling systems, their potential has been poorly exploited in Brazil. The main reasons for this include lack of information and training of health professionals on how to use the system and its potential benefits for Primary Health Care (PHC) services. Wider dissemination is needed to improve the adoption of the system and promote the routine use of this tool in health services in order to facilitate access to primary health care.*

Key words *Electronic Health Records, Mobile Applications, Appointments and Schedules, Primary Health Care, Unified Health System*

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Introduction

Brazil's national health service, the Unified Health System (SUS, acronym in Portuguese), was created by the 1988 Federal Constitution and is underpinned by the principles of universal access to healthcare, comprehensiveness, equality, political and administrative decentralization, and the delivery of care across different integrated levels of health services[1]. The decentralization of health services has made municipal governments responsible both for providing services and structuring the health system in coordination with different government sectors and entities. The health care model adopted by the SUS seeks primarily to strengthen and expand the coverage of primary health care (PHC), considered the front door and cornerstone of the health system. According to Starfield[2], PHC is characterized by four key attributes: first contact, longitudinality, comprehensiveness, and coordination of care.

In Brazil, PHC services are provided in primary care centers (PCCs) by multidisciplinary health teams made up of doctors, nurses, dentists, nursing assistants, community health workers and other professionals[3]. There are two types of patient flows: unscheduled and scheduled.

Unscheduled care is for patients with acute conditions who require same-day care, while scheduled appointments are indicated primarily for long-term clinical follow-up, including assessment of test results, prescription renewal, or other non-urgent situations[4].

A*ppointment scheduling* is a common challenge in health services. In South America, the average no-show rate is 27%[5]. No-shows are common in primary care settings and adversely affect both health care professionals – wasting time and resources and reducing efficiency[6] – and patients – causing dissatisfaction due to increased waiting times and reduced quality of care, ultimately hindering access for other patients and leading to worsening health conditions[7].

In the SUS, this problem poses a daily challenge to the effective functioning of PHC services, with studies showing high no-show rates in primary care settings in Brazil. Silveira et al.[8] reported a no-show rate of 19.2%[8] in a PCC in Pelotas, while Ferreira and Espírito Santo[9] found a rate of 48% in a neighborhood in Rio de Janeiro[9]. This situation is common across Brazil, hampering the organization of health professionals' schedules and ultimately impacting the quality of care[10,11].

Studies show that the main reasons for missed appointments include forgetfulness, inconvenient appointment times, miscommunication, appointments booked weeks or months in advance, and difficulties getting to the care facility[5,9,12-17].

PHC services in Brazil are characterized by the formation of long early-morning queues to get a ticket from the queuing system, hindering patient access to care[18]. Patients who have trouble scheduling an appointment due to difficulties getting to the facility or working times that conflict with opening times often end up forgoing care. As a result, their condition can often worsen and they fail to create an affiliation with the health team. Online appointment scheduling may therefore be a way of facilitating access to health services[9,18].

Service user satisfaction with PHC services is related to their ability to book an appointment at the right time[19]. Studies show that appointment scheduling tailored to service users' needs tends to improve access to health services and quality of care, optimize follow-up, humanize care and reduce health care costs[20,21]. A study undertaken in 2007 identified the need for a scheduling system that facilitates the equitable distribution of unscheduled care slots as an interesting way of resolving, or at least significantly mitigating, scheduling problems[22].

The literature describes various appointment scheduling apps[23-26]. A study of young adults showed that cell phone reminders was the most preferred messaging platform in 64% of respondents[27]. The appointment systems found in the literature are used at different levels of care in both public and private systems and some are used by the SUS[28]. However, few initiatives are used by the SUS to provide a digital communication channel between service users and PHC services.

It is therefore necessary to rethink the organization of work in the SUS to facilitate user access, through efficient scheduling systems, after-hours care arrangements, home visits and other mechanisms[29]. Based on the above, it might be asked what strategies can facilitate user access to PHC services in Brazil? This article therefore describes an online scheduling system recently implemented through the citizens' electronic health record system (*Prontuário Eletrônico do Cidadão da Atenção Primária à Saúde* - PEC e-SUS APS) as a strategy to reduce no-show rates and improve access to PHC.

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Primary Care online scheduling system

The Primary Care online scheduling system is part of the PEC e-SUS APS. It is integrated into the SUS patient communication hub through the *Conecte SUS Cidadão* app, establishing an automated communication channel between patients and health facilities and offering a tool to PCCs to tackle the challenges mentioned.

PEC e-SUS APS

The PEC e-SUS APS contains a medical record function structured in accordance with the problem-oriented medical record (POMR) approach[30], which includes the Subjective, Objective, Assessment and Plan, or SOAP note, as shown in Figure 1. The data shown are fictitious and were generated using version 4.0.9 of the training installation available on the Ministry of Health's official website[31].

The PEC e-SUS APS has other tools besides the functionality of the electronic health record to help manage and organize the activities developed in PHC services, such as generating reports, registering staff, sending and receiving clinical data, listing appointments, and organizing health professionals' schedules. The health professional schedule module allows professionals to record booked and cancelled appointments and other commitments in the system, allowing service users to view available time slots. The module is integrated into the *Conecte SUS Cidadão* app through the online scheduling system.

Online Scheduling is enabled using a function in the *PEC e-SUS APS*, as shown in Figures 2 and 3. When the system is enabled in the *PEC e-SUS APS*, information on booked and/or cancelled appointments is automatically sent to *Online Scheduling*. The scheduling system then notifies the user via the *Conecte SUS Cidadão* app, permitting communication between patients and health care professionals.

Conecte SUS Cidadão App

The *Conecte SUS Cidadão* app was also developed by the Ministry of Health and works on both iOS and Android devices[32]. The aim of the application is to allow patients to access personal and clinical information contained in various systems, including the National Health Data Network (RNDS), SUS User Registration System (CADSUS), National Registry of Health Facilities (CNES), National Immunization Program Information System (SIPNI) and PEC e-SUS APS (all acronyms in Portuguese). The integration of the patient communications hub into these systems allows patients to access their personal vaccination data, COVID-19 test results, prescription history and *dispensed medications*, appointment history, blood donation history, and current status on the national organ donation system, as shown in Figure 4.

To book an appointment online, the user checks the available time slots in the health professional's schedule, chooses a day and time and finalizes the appointment scheduling request. An appointment confirmation notification is then sent via the app. The user also receives notifications when the appointment is registered and/or cancelled in the health facility[32].

Online scheduling architecture

The PEC e-SUS APS online scheduling service permits automated communication between PHC professionals and patients via the *Conecte SUS Cidadão* app. The aim of the system is to facilitate appointment scheduling without the patient needing to go to the health facility to check appointment bookings and cancelations.

Figure 5 shows the architecture of the online scheduling system, which comprises four platforms: *Conecte SUS Cidadão* app, the online scheduling server, *Portal e-Gestor* and *PEC e-SUS APS*.

The server is the central component of the system. Its main function is to mediate communication between the *Conecte SUS Cidadão* app and PEC e-SUS APS. The server is also responsible for storing appointment scheduling data and service configurations, ensuring that messages are only exchanged between the *Conecte SUS Cidadão* app and enabled PEC e-SUS APS installs, thus guaranteeing secure data transmission and storage.

The *Portal e-Gestor*, a platform that provides access to various PHC information systems, is responsible for enabling/disabling the functionality of the online scheduling system and informing the server which PEC e-SUS APS installs are authenticated and authorized to use the service[33]. The *Conecte SUS Cidadão* app provides *check appointments*, *check available times*, and *register and update appointments* services and receives notifications about the registration of and changes in scheduled appointments. Booked appointments are only confirmed when the request is received by the PEC e-SUS APS and the server is informed

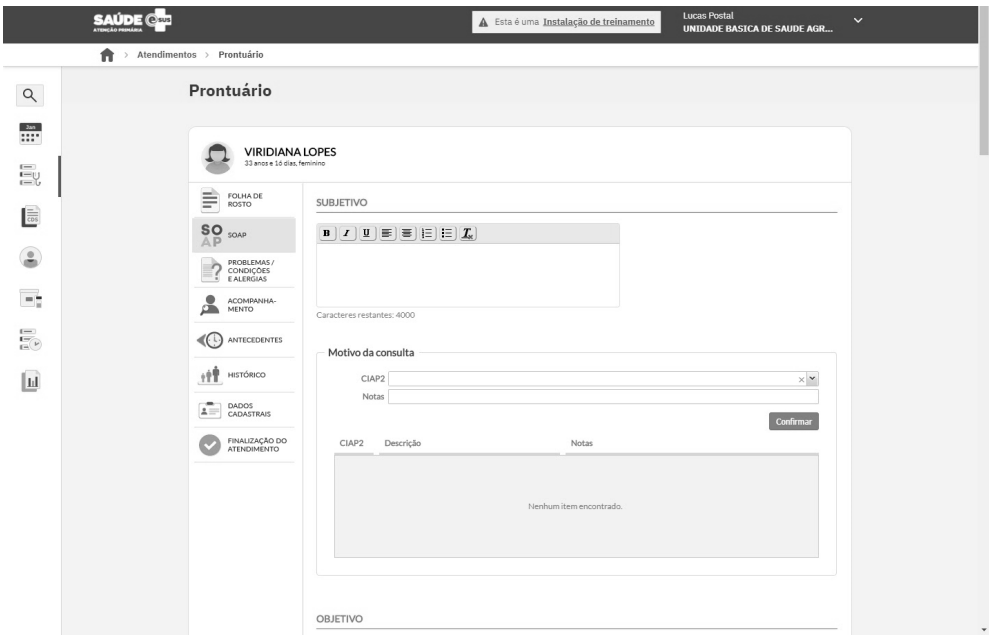

Figure 1. Screen for registering an individual appointment via the PEC e-SUS APS.

Source: PEC e-SUS APS version 4.0.9[31].

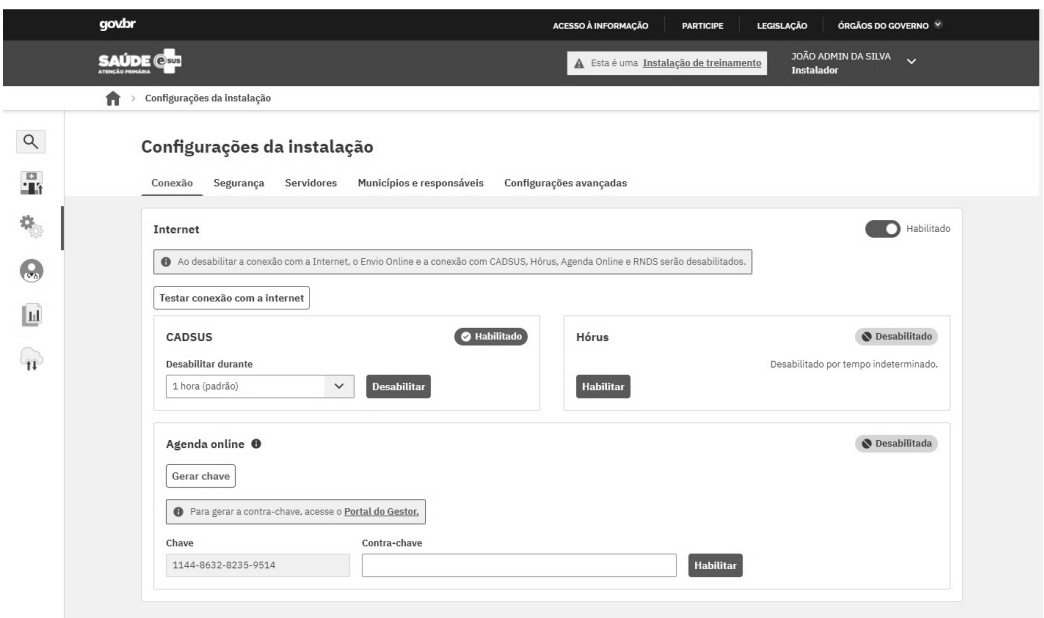

Figure 2. Screen for enabling Online Scheduling.

Source: PEC e-SUS APS version 4.0.9[31].

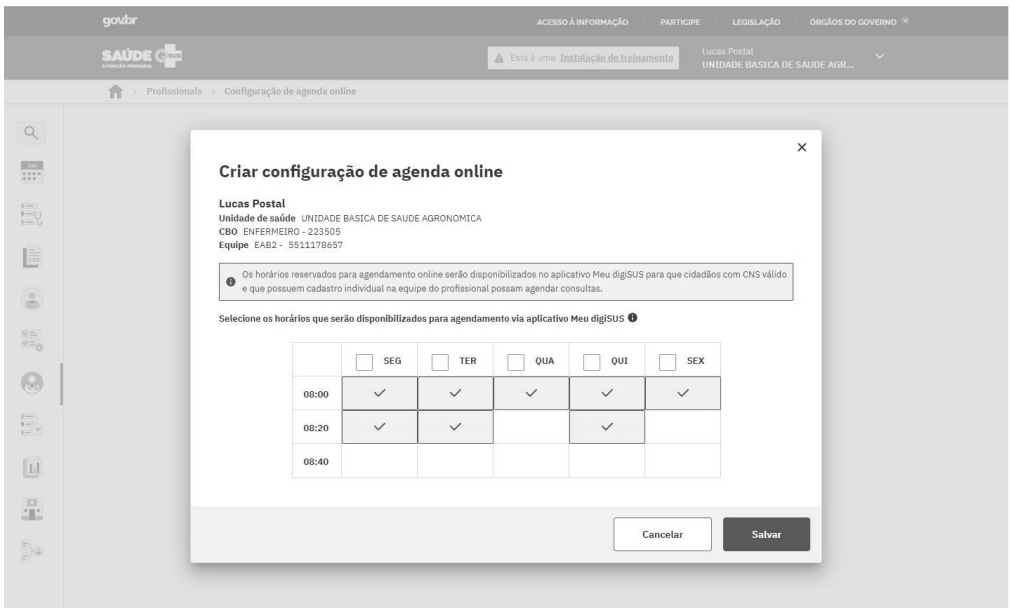

Figure 3. Screen for setting up the professional's schedule.

Source: PEC e-SUS APS version 4.0.9[31].

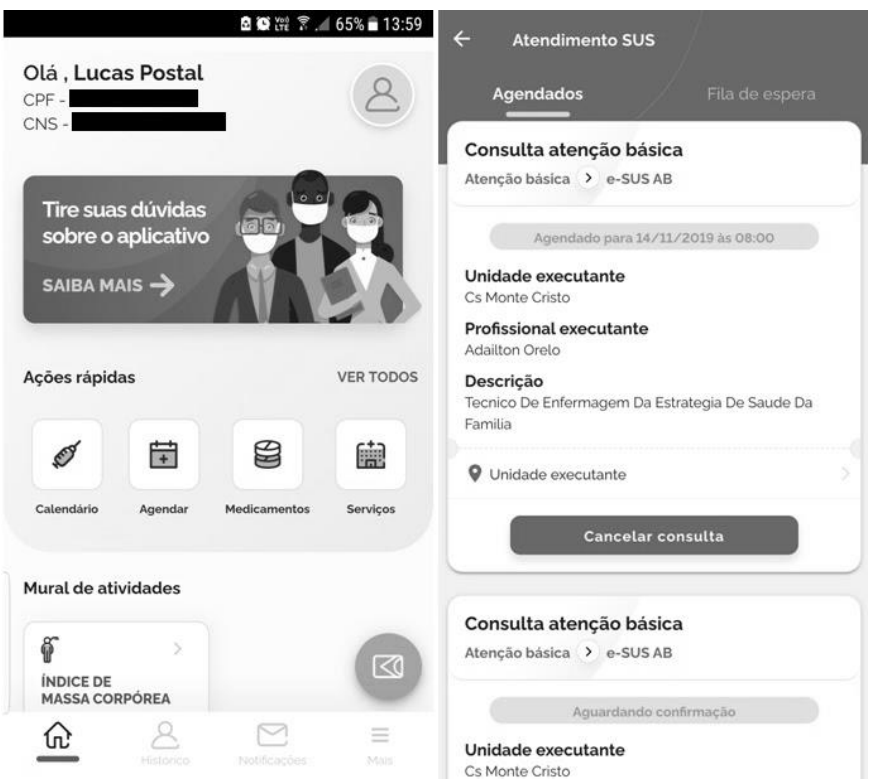

Figure 4. Conecte SUS Cidadão's home and appointment screens.

Source: Conecte SUS Cidadão version 60.0.33[2].

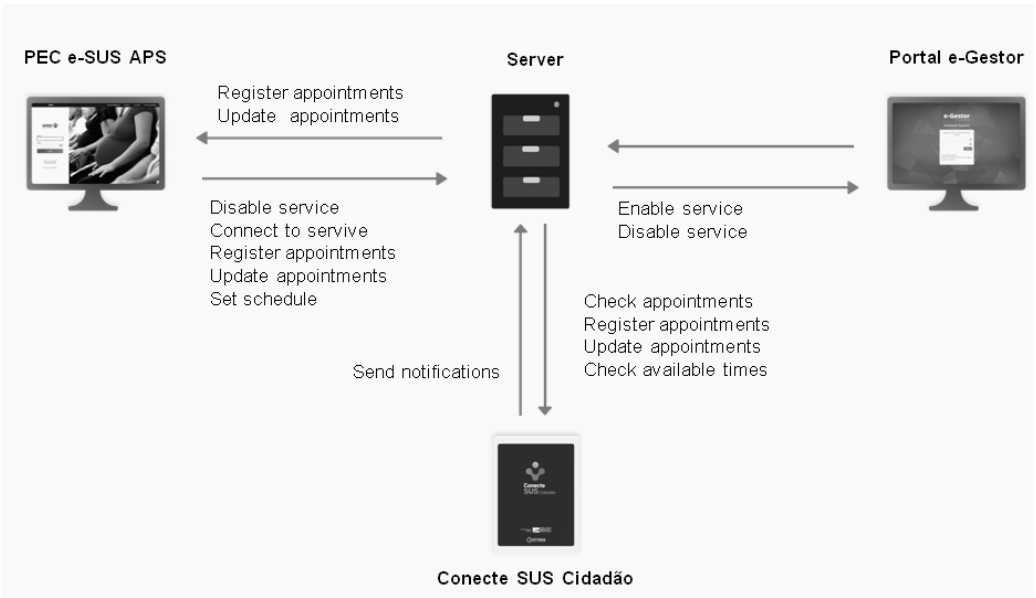

Figure 5. Architecture of the online scheduling system.

Source: Authors' elaboration (2020).

that there are no inconsistencies in the request. After the booking is confirmed, the server sends a booking confirmation notification via the *Conecte SUS Cidadão* app.

The PEC e-SUS APS possesses a set of features that are essential to the functioning of the online scheduling system, including a functionality for generating passwords to enable the system, set the health professional's schedule and book appointments.

The functionalities of the online scheduling system (such as how to notify appointments scheduled in person at the PCC and checking future patient appointments using the *Conecte SUS Cidadão* app) can only be used if the online scheduling server connection is enabled by the installer of the PEC e-SUS APS. In addition, for a patient to register an appointment using the *Conecte SUS Cidadão* app, the following conditions must be met:

The patient needs to be registered in a health facility and affiliated with a health team.

The health team needs to have enabled the available time slots for the patient to be able to book an appointment online.

Appointments cannot be booked for the next two days or more than 30 days in advance after these days.

Online scheduling utilization statistics

Two studies were undertaken to assess the utilization of the PEC e-SUS APS online scheduling system. The first used data from the database of the online scheduling server obtained via the electronic citizen information system (e-SIC, acronym in Portuguese)[34]. The second was a survey of health professionals' perceptions of the *PEC e-SUS APS* online scheduling system.

The first study used data from 2018 to June 2020. Eleven separate items of information were requested from the e-SIC, as shown in Chart 1. The items are organized into three categories: 1) appointment scheduling; 2) installs that enabled the service; and 3) professionals with registered online schedules.

The findings show that a very small number of patients used the online scheduling system. Only 789 appointments were registered using the app, 250 of which were cancelled. These appointments were booked in 42 PEC e-SUS APS system installs. The majority of appointments (3,294,471) were booked in person at a PCC.

A total of 4,038 passwords were identified (3,243 disabled and 795 enabled). Of the 795 enabled passwords, 39% were linked to a PEC e-SUS APS system install and 61% were not linked to an

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install, meaning that the online scheduling system enabling process had not been finalized for these passwords.

A total of 430 professionals were registered in the online scheduling system; however, only 209 had enabled their schedules and only 205 had set up their schedules to receive appointment bookings via the *Conecte SUS Cidadão* app. A total of 7,648 weekly time slots were available for online appointment scheduling.

The survey was conducted using an online questionnaire sent to 36 health professionals in management positions in different municipalities that use the PEC e-SUS APS. Twelve professionals completed the questionnaire. Half of the respondents said that they were unaware of the online scheduling system. Of those who were aware of the system, only two had enabled their schedules for online scheduling. None of the municipalities had set up the professionals' online agenda to allow patients to book appointments using the *Conecte SUS Cidadão* app.

With regard to the questionnaire item asking whether the online scheduling system could help reduce the number of no-shows, only 16.67% of the professionals said that they believed it could help reduce non-attendance, 33.33% said it did not help and 50% did not answer the question.

Discussion

Long queues for medical appointments are unfortunately rule of thumb in Brazil`s PHC services. This situation is aggravated by the difficulties faced by some patients in getting to the health facility and shortage of available appointment time slots. The availability of scheduled appointments is also adversely affected by high no-show rates, which average 27% in South America[5]. The consequences of this problem include wasted staff time, repeated appointment scheduling and longer queues for unscheduled care. This situation is not exclusive to Brazil.

Researchers have presented proposals to improve patient access to health services, most of which involving initiatives to reduce scheduled appointment no-show rates[5]. The most common initiatives are open access scheduling and the use of reminders.

Open access scheduling consists of leaving most of health professionals' daily schedules open to permit same-day appointments. Various studies have shown that this approach, also known as advanced access, results in a significant reduction in no-show rates[10,11,35,36].

The use of reminders is widely discussed in the literature as a way of reducing no-shows due to forgetfulness, which is one of the most common reasons for missing an appointment[13]. Reminders are notifications sent in advance to re-

Chart 1. Information on the utilization of the online scheduling tool.

Category	Information	Number
1	Number of appointments booked using the Conecte SUS Cidadão app	539
1	Number of appointments cancelled using the Conecte SUS Cidadão app	250
1	Number of appointments booked using the PEC e-SUS APS system	3,294,471
1	Number of PEC e-SUS APS system installs that received appointments scheduled using the Conecte SUS Cidadão app	42
2	Number of passwords enabled in the online scheduling server	795
2	Number of passwords disabled in the online scheduling server	3,243
2	Number of passwords enabled and linked to a PEC e-SUS APS system install	310
3	Number of health professionals with enabled online schedules	209
3	Number of health professionals with disabled online schedules	221
3	Number of health professionals with enabled online schedules set up to receive appointment bookings from the Conecte SUS Cidadão app	205
3	Number of weekly appointment time slots available via the Conecte SUS Cidadão app	7,648

Source: Authors' elaboration (2020).

mind patients about the appointment date and time. They can be delivered using various types of media, including telephones, SMS text messaging and mobile apps.

Studies show that that the use of reminders can help reduce no-show rates[37-40]. Comparisons of SMS text messaging and phone reminders have shown that the latter have a greater impact[41,42]. However, other studies show that text messaging has a better cost-benefit ratio[38,43,44]. In addition, the use of reminders also leads to an increase in appointment cancelling and rescheduling rates[37].

The PEC e-SUS APS online scheduling system integrated into the *Conecte SUS Cidadão* app can provide important benefits. Zhao et al.[19] report that reductions in no-shows may be associated with improved access to scheduling, which allows patients to book, check and cancel appointments without having to go to the care facility, and the fact that patients feel more responsible for their appointments when they make them themselves[19].

Despite the benefits described in the literature, a very small number of health professionals use the PEC e-SUS APS online scheduling system. Out of a total of 48,000 health workers providing individual appointments via the PEC e-SUS APS system, only 205 (a mere 0.42%) have time slots available for online scheduling. Moreover, at least 33.87% of the 310 PEC e-SUS APS installs that had enabled on line scheduling had not set up time slots.

The main reason for this low level of adherence is difficulty changing pre-established health facility work protocols[19]. In additions, screening difficulties with online scheduling can lead to the provision of inappropriate services, with patients who need urgent care scheduling primary care appointments for example. Another factor is that health managers fear losing control of the schedule system because of misguided use and patient abuse of the system.

These factors were also mentioned by the PHC professionals who participated in the abovementioned survey, with respondents mentioning the need to update work protocols. Other obstacles to adherence mentioned by the respondents included the risk of reducing access to vulnerable service users, lack of knowledge about the system and lack of guidance on how to use the system and the risks involved. Some professionals also highlighted the need to update patient registries and improve care center facilities.

The reduction of no-show rates leads to an increase in appointment availability, thus reducing waiting times and improving service quality, ultimately increasing the level of user satisfaction[5,7,14,15].

Although numerous authors have highlighted the advantages of online scheduling, including the reduction of scheduled appointment no-shows, 33.33% of the respondents said that online scheduling systems do not lead to a reduction in non-attendance. The reasons given include lack of patient commitment, long waiting times and uncertainty regarding appointment confirmation. This illustrates that the system has been poorly disseminated and a lack of knowledge on the part of the health professionals, given that the system provides a notification service precisely so that patients can be certain that the time slot is confirmed and do not forget the appointment.

To address some of these factors and ensure the proper use of the scheduling system, a number of rules have been established to prevent *inappropriate appointment booking*. For example, only patients registered with a PCC and affiliated to a health team are able to book appointments using the *Conecte SUS Cidadão* app.

In 2020, the Ministry of Health redesigned the PHC funding policy, making patient affiliation to a health team mandatory, thus expanding the number of people able to use the online scheduling system. To prevent patients from overloading health professional work schedules with multiple appointments, the system prevents patients from booking appointments more than 30 days in advance. In addition, patients can only book appointments with professionals from the team they are affiliated to. Finally, to ensure that health professionals are able to maintain control over their schedules, the *Conecte SUS Cidadão* app only shows time slots made available by the care provider.

However, a number of actions are needed to promote the adoption and effective use of the online scheduling system, including wider dissemination to raise awareness about the tool among local health managers, health professionals and service users. In addition, appropriate guidance should be provided to these groups on how to use the functionalities and how they can be adapted to the local context.

Final considerations

This article describes the open source online scheduling system developed by the Ministry of

Health and integrated into the PEC e-SUS APS and *Conecte SUS Cidadão* systems. Despite the benefits of online scheduling systems both for patients and health professionals, their potential has been poorly exploited in Brazil. The main reasons for this include lack of information and training of health professionals on how to use the system and its potential benefits for PHC services.

The literature on online scheduling systems shows that the use of the system presented in this study could facilitate access to PHC services in Brazil. To this end, wider dissemination is needed to raise awareness about the system and appropriate guidance should be provided to health professionals and service users for its proper use.

Collaborations

L Postal contributed to study conception and design, data analysis and interpretation, drafting the article and revising it critically for important intellectual content, and approving the final version to be published; this author is also accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. IC Celuppi contributed to data analysis and interpretation, drafting the article and revising it critically for important intellectual content, and approving the final version to be published. GS Lima contributed to drafting the article and approving the final version to be published. M Felisberto contributed to data analysis and interpretation and drafting the article. TC Lacerda contributed to study conception and design, data analysis and interpretation, and drafting the article and revising it critically for important intellectual content. This author is also accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. RS Wazlawick contributed to revising the article and is accountable for all aspects related to the quality of the manuscript and ensuring it complies with the journal's guidelines. As general coordinator of the e-SUS PHC project, this author is also accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. EM Dalmarco contributed to article content, drafting the article and revising it critically for important intellectual content, and approving the final version to be published.

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