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Telemonitoring as a Telehealth strategy to contain the COVID-19 pandemic in a Brazilian capital

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Abstract

Objective: This study aimed to describe and analyze the process of creating and implementing telemonitoring services for COVID-19 cases, focusing on strengths and weaknesses.

Methods: A single case study incorporating qualitative and quantitative data using descriptive and exploratory approach was performed from 24 March 2020 to 24 March 2021 in a Brazilian capital city. Data collection took place through interviews, document analysis, and direct observation. Thematic content analysis was performed, and the results were presented in categories.

Results: The project included 512 health professionals, and 102,000 patients were monitored. The service was designed to break the chain of transmission, reinforce biosecurity measures, and provide comprehensive care to patients. Initially, two levels of monitoring were created. The first was a multidisciplinary health team that made calls to patients in the database. If the patients showed warning signs or aggravation, they were referred to the physician's monitoring referral service. Subsequently, a third level was created and staffed by psychologists. The main challenges were the number of patients notified, needing to update the contact forms as COVID-19 knowledge increased, and inconsistent telephone numbers recorded in the notifications.

Conclusions: Telemonitoring allowed signs of worsening COVID-19 to be identified, monitored thousands of people, and stopped infected patients from circulating. Adapting the existing telehealth structure was a viable, agile, and powerful strategy to reach a large number of people.

Keywords

Telemedicine, COVID-19, telemonitoring, telehealth

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Introduction

The COVID-19 pandemic caused by the novel SARS-COV-2 coronavirus put the adaptability and responsiveness of health services to the test.[1] The uncertainties of facing a new disease, its rapid spread, and the consequent overload led to a collapse of health services around the world. Indeed, the challenge of expanding access to health care, the need to maintain social distancing, and the urgency to

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stop the spread led to new coping strategies, with information and communication technologies being one of the main tools used in health care.[2]

One of the leading strategy and technology used in this scenario was telemedicine, a remote virtual care model.[2] This estrategyl helps to reduce the unnecessary circulation of patients and the spread of the virus and the burden on health services by allowing patients to consult health services from home. Understanding this, the Brazilian Ministry of Health published Ordinance No. 467 in March 2020, and Law No. 13,989 was enacted in April 2020, authorizing the wide use of telemedicine during the public health emergency caused by the COVID-19 pandemic.[3,4] Tools such as teleconsultation, telemonitoring (TM), telediagnosis, tele-triage, and telediagnosis became central to serving the population during the pandemic, whether due to COVID-19 or other health conditions.[5]

Telemonitoring (TM), a service that involves health professionals making calls to the population to collect information or pass on information, makes it possible to monitor the evolution of patients with COVID-19 in their homes, identify signs of severity, classify the symptom-related risk, refer the patient to health services when necessary, and give guidance on home isolation.[6]

In this context, in the city of Goiânia, the capital of Goiás, a state in the central-west region of Brazil, health professionals and managers of the Municipal Health Department of Goiânia (*SMS*/Goiânia) and the Telemedicine and Telehealth Center (*NUTTs*) of the Medicine School of the Federal University of Goiás (*FM/UFG*) joined forces in April 2022, through a series of meetings, to establish means and actions to face the pandemic in the municipality, with the offer of follow-up via TM for suspected and confirmed patients with COVID-19.[7]

Telehealth-Goiás (*TS*-GO) was an already existing regional reference center performing matrix support and telediagnostic actions for Primary Health Care (PHC) professionals in about 182 municipalities in the state since 2007, with 12,686 teleconsultations completed from 2015 to 2020. The existing structure, which had communications equipment, computers, and human resources, was quickly mobilized for the service being built to combat the pandemic.

Considering the significant impact of the pandemic, the search for quick and effective actions to confront it, and the small amount of published research on COVID-19 TM globally, it is especially relevant to disseminate experiences, descriptions, and analyses of these activities around the world. Therefore, this article aims to describe and analyze the creation and implementation of the COVID-19 TM service in a Brazilian capital, focusing on the strengths and weaknesses.

Methods

A single case study incorporating qualitative and quantitative data was conducted using a descriptive exploratory approach. We followed the consolidated criteria for reporting qualitative research (COREQ) recommendations (Supplementary file 1).[8] A single case study was chosen

Table 1. Number of professionals by area who performed telemonitoring of patients with COVID-19 by Telehealth-Goiás from 24 March 2020 to 24 March 2021.

Category	Number of participants
Medicine	274
Nursing	140
Psychology	43
Dentistry	18
Nutrition	11
Physiotherapy	11
Social assistance	05
Physical education	04
Biomedicine	03
Speech therapy	03
Total	512

Source: Telehealth-Goiás database.

Table 2. Data related to the telemonitoring of patients with COVID-19 carried out by Telehealth-Goiás from 24 March 2020 to 24 March 2021.

Type	Number of participants
Patients input into the database in the study period	236,692
Monitored patients	102,615
Referred to physician telemonitoring	2454
Referred to psychologist telemonitoring	8959
Monitored health professionals	27,805
Monitored security professionals	4869

Source: Telehealth-Goiás database.

because this methodology describes processes in the socially complex contexts into which they are inserted.[9]

This study sought to analyze actions against the COVID-19 pandemic in the TM service of the *TS*-GO telehealth service of the Medicine School of *UFG* in partnership with the *SMS*/Goiânia. The study period is 24 March 2020 to 24 March 2021, the first year of the pandemic, and this is the only project involving TM COVID-19 cases. The project served the residents of Goiânia, a city with an estimated population of 1,536,097 inhabitants in 2020.[10]

The quantitative data were automatically generated, extracted from the Goiás/*UFG* Telehealth System, and entered into Excel spreadsheets in August 2021. Quantitative data were analyzed using descriptive statistics in Excel and presented in Tables 1 and 2. Table 1 shows the number of professionals who performed TM and their professional areas. Table 2 illustrates the number of people monitored in general and by sector, in addition to the number of health and safety professionals who were monitored.

The qualitative data collection took place in the first half of 2021 through interviews, document analysis, and direct observation of TM. The interviews were conducted by the first author of this paper with key personnel in the project's planning, implementation, and development. The interviewer had previous experience in conducting focus groups and interviews for carrying out qualitative research. Every subject invited to the interview was key personnel involved in the TM implementation. Inclusion criteria were as follows: personnel involved in the initial TM team meetings for planning, implementation, and service improvement. Were excluded subjects who did not sign the informed consent were not comfortable in answering the questionnaire or did not provide a schedule for the interviews.

The questionnaire was designed by the researchers, aiming to answer the study objectives. A validation phase was conducted as a first step. A pilot questionnaire was applied to three subjects who worked at the COVID TM service. The first author did the clarification of the questions that showed some degree of miscomprehension before conducting the study interviews. Three people were interviewed after signing the informed consent and agreeing to the proposed interview schedule: (a) a professional who worked in the TM service, (b) a *TS*-GO manager, and (c) a technical consultant on the *SMS*/Goiânia surveillance service. After the third interview, it was noticed that there was data saturation, hence leading to the end of this step. The interviews were conducted by video call with a semi-structured script with questions about the service implementation (Supplementary file 2).

Documentary analysis[11] was completed on the COVID-19 TM protocols prepared by the technical reference service of *SMS* Goiânia and *TS*-GO management, technical standards, and guidance of the Ministry of Health and *SMS*/Goiânia, and TM records. The direct observation[8] took place over 4 days, in different shifts, with items and situations visualized from a semi-structured script (Chart 1).

The recorded interviews were transcribed, and Bardin's thematic content analysis, effective for qualitative investigations in health, was used.[11] Three steps were performed: pre-analysis, exploration of the subject, and treatment of the obtained results and interpretation. Thus, the questions answered by the participants were systematized, facilitating their interpretation. The interviewed participants were identified as P1, P2, and P3. After analyzing the collected data, the information was organized into three categories.

This study was submitted and approved by the Research Ethics Committee of the *UFG*, opinion 38089120.5.0000.5083, in 2020, following National Health Council Resolution No. 510 of 2016.[12]

Telemonitoring rooms
Telemonitoring equipment
Room lighting and air conditioning
Work performed by professionals and managers.
Internal workflows
Operating routine
Follow-up of telemonitoring

Chart 1. Direct observation script of the telemonitoring service for patients with COVID-19 in the years 2020 and 2021 (Goiânia, Goiás, Brazil).

Results

During data analysis, the results were classified into three categories. The first deals with creating and establishing partnerships and initial steps in implementing the TM service. The second, entitled "functional flows," described the dynamics of TM and the workflows that patients followed. The third category, "transformations, challenges, and improvements," listed the lessons learned with the process, helping and hindering service delivery.

Creation, partnerships and implementation

The TM of patients with COVID-19, carried out by *TS*-GO, started on 24 March 2020, 12 days after the first confirmed case in Goiânia. With the initial objectives of breaking the chain of transmission, reinforcing biosecurity measures, and providing comprehensive care to patients with suspected or confirmed COVID-19 and isolated at home, the service structure was set up at the Medicine School at

UFG. The agility demonstrated in the creation and structural adaptation is highlighted, as explained by one of the technicians at *SMS*/Goiânia.

> In a week, we structured everything […]. We set up the physical structure with the necessary equipment, and then we already had the system developed by the I.T. (Information Technology) team, and there was a lack of H.R. (human resources). Then the Secretary of Health managed to arrange the H.R. from the elective health services suspended because of the pandemic. Elective consultations were suspended […], and many elderly health professionals or those with comorbidities were involved. There were almost 60 professionals. (P1)

The physical resources of the Medicine School at *UFG* were used, and 18 rooms were adapted to become suitable to TM services, such as monitoring booths with computers, telephones, and headphones. The pre-installed structure of *TS*-GO, financed with resources from the Department of Digital Health at the Ministry of Health, located in this same building, was also used, as their information technology (IT) professionals. *SMS* provided some health professionals who belonged to COVID-19 risk groups and were isolated from patient care or were involved in suspended elective services to perform the TM. About 60 professionals from nursing, medicine, nutrition, physical education, physiotherapy, social work, and dentistry started the activity. Since then, the TM service has operated daily from 7 AM to 7 PM, including weekends and holidays.

The monitored patient data were imported from the public health electronic notification (*E-SUS Notifica*) system to the *TS*-GO database 24 h after notification, proceeding accordingly to ordinances 356/G.M. and 1792/G.M. of the Ministry of Health.[13,14] Patients with suspected or confirmed COVID-19 infection treated at public and private health units in Goiânia, as well as those who were tested positive in laboratories or pharmacies in the city, should be immediately referred to the *E-SUS Notifica* online public health notification system.

The first monitoring protocol was prepared by *SMS*/Goiânia in cooperation with *TS*-GO management, in-line with Ministry of Health publications on the topic and the priorities of the city health department. Then, the TM professionals were onboarded with agreed-upon strategies for how to approach patients, workflows, questions to be asked, clinical conduct, and training in handling the system. In the first year of the service, about 30 training sessions were conducted.

> We (the technical team of *TS*-GO and *SMS*/Goiânia) made the first protocol […]. I was responsible for training. Within this process, the approach to the patient, all the filling out of the questionnaire, the questions. Some professionals even had much difficulty because there were many older people, some with computer literacy difficulties, […]. and we were able to implement it and monitor patients. (P1)

By July 2020, TM had become a relevant strategy, and efforts were made to expand and improve the service. To this end, a formal agreement was established between *SMS*/Goiânia and *TS*-GO. Next, there was a financial transfer to hire health professionals. Finally, new professionals were hired to take their places due to the professionals initially assigned by *SMS* returning to their previous regular activities.

> The great challenge for the teams was that they were people who had not worked in telemedicine before, professionals who were on the front lines and then came to telemedicine […]. We also managed to do a good job with this team, albeit temporarily. This team had to return to the front after restrictions were lifted. We had to hire other people to be able to do the telemonitoring work. So, another challenge was to retrain the whole team so that this could happen. (P2)

During the study period, 512 professionals from different health areas worked in the service (Table 1). In addition, specific TM supplies were acquired, such as computers, tablets, microphones, headphones, and oximeters.

Workflows and operation. During the first year of TM, 24 March 2020 to 24 March 2021, 506,560 suspected cases of COVID-19 were reported in Goiânia, 151,911 cases were confirmed, and 4574 deaths occurred.[15] Of the total number of patients notified and residing in Goiânia, approximately 102,000 patients were monitored at different levels of follow-up by the *TS*-GO (Table 2). The number of patients in the database is lower than the number of notifications due to filters being implemented over time, such as excluding people who did not live in Goiânia, duplicate notifications of the same patient, and patients who had private insurance coverage.

The number of reported cases exceeded the service's TM capacity; therefore, the service prioritized monitoring confirmed COVID-19 cases, risk groups that were more likely to evolve with complications, hospitalizations, and death, such as the elderly, pregnant patients, and those with chronic diseases, in addition to health and public law enforcement security workers, who continued to work face to face during the pandemic and were more exposed to contamination.[16]

Initially, two levels of monitoring were created. The first, called general TM, had a multi-professional health team that made calls to patients in the database. If the patients showed warning signs or aggravation, they were referred to the physician's monitoring service (Figure 1).

The general TM professionals called the individuals on the list in the order they were input into the database, and

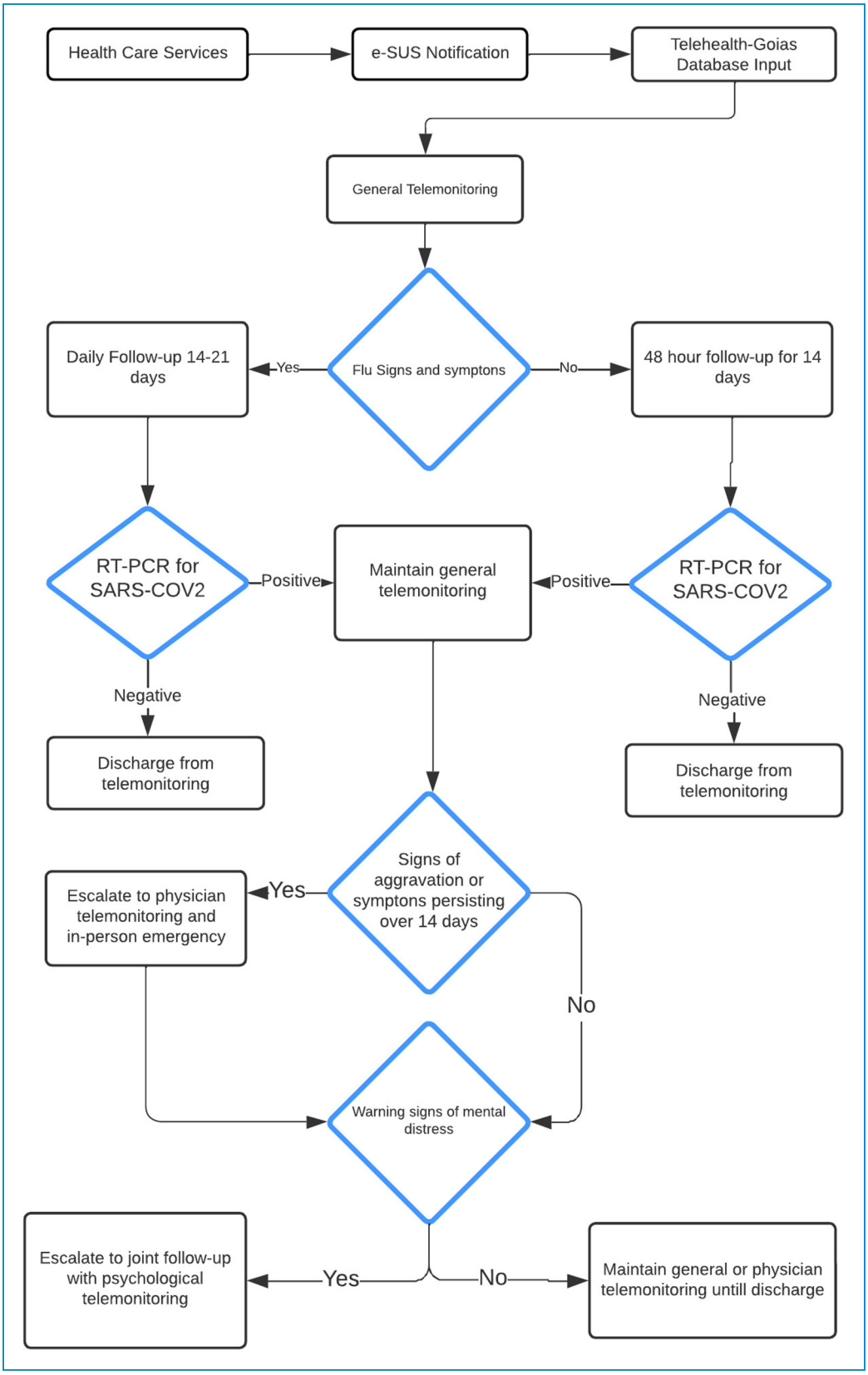

Figure 1. Flowchart of the operation of the telemonitoring service for patients notified by COVID-19 by Telehealth-Goiás, Goiânia, Goiás. RT/PCR: reverse transcription polymerase chain reaction.

cases with positive serological results were prioritized. Later, along with health and public safety professionals, elderly patients and those with comorbidities were prioritized in the queue. If the patient did not answer, the next person on the list would be contacted. Ultimately, the TM professionals completed an electronic questionnaire with clinical and epidemiological information. The extracted data were identification, clinical and epidemiological aspects, and a field for conduct.

The follow-up protocol stated that an asymptomatic patient confirmed for COVID-19 would receive calls every 48 h until the 14th day of the reverse transcription polymerase chain reaction (RT/PCR) or antigen exam. Confirmed symptomatic cases of COVID-19 would receive contact daily until the 14th, extending to 21 days depending on the clinical evolution. These patients would be discharged from TM and come out of home isolation after a minimum of 14 days if they had no respiratory symptoms, no fever, and no need for antipyretic medication for 24 h. Patients suspected of COVID-19 undergoing TM whose RT/PCR test result in the recommended time came back negative were terminated from TM and discharged.[17]

Cases that showed any sign of being severe, warning signs, or remained symptomatic from the 14th day onwards were medically referred for monitoring. The monitored warning signs were persistent fever, worsening cough, respiratory distress, asthenia, chest pain, fainting sensation, and lack of appetite. The signs of aggravation, which suggested referral to emergency services, are described in Table 3.

Physicians made daily calls to assess the condition and provide guidance. After the evaluation, the doctors could keep the patient in the physician's monitoring queue, return them to general TM, or refer them to other services.

In hospitalized patients, they were referred for psychological TM, and professionals provided psychosocial support to their families. The need to offer psychosocial support to most of the monitored patients was quickly realized, and monitoring performed exclusively by psychologists was instituted.

> We (professionals and managers of the telemonitoring service) began to feel the need […] to incorporate mental health monitoring with psychosocial support in the context of the pandemic into telemonitoring. We prepared a technical note. (P1)

Patients or family members identified by TM as needing mental health services and who accepted the help were directed to this service. The frequency of contact was defined based on the patient's psychological condition and could be done daily, every 2 days, or every 3 days. The guiding signs and symptoms to support the referral to psychological support are contained in Chart 2.

Changes, challenges, and improvements

As the pandemic gained strength in the country and knowledge about the disease increased, new challenges and needs arose. Therefore, the technical team that managed the telemedicine service added new information and variables to be collected in the questionnaire. As a result, the changes described in Chart 3 were made to improve patient monitoring, surveillance, and control of the pandemic.

> The great challenge was making the system and keeping the system working and updated with the new demands. […] The change in knowledge regarding the disease, COVID-19, implied the need to constantly update the questionnaire being made for patients. (P2)

The significant increase in suspected and confirmed cases exceeded the TM capacity of professionals, and it was impossible to monitor them all. Another difficulty encountered was related to inconsistent telephone numbers. About a quarter of these were found to be incorrect.

The inconsistency of identification data in medical records and records with health services, such as telephone numbers, e-mails, and addresses, and the difficulty of many patients accessing ITs are challenges for adopting remote monitoring technologies.[18]

Another appropriate improvement to the system took place in the second half of 2020. The TM team started to make appointments for the close contacts of monitored patients to test and break the chain of transmission.

Table 3. Signs of aggravation evaluated by the professionals of the telemonitoring service for patients with COVID-19 in the years 2020 and 2021. Goiânia, Goiás, Brazil.

Age profile of patients	Signs and symptoms
Adults and seniors	Blue discoloration in the extremities of the fingers and mouth, worsening malaise, palpitations, disorientation, worsening existing diseases, syncope, mental confusion, excessive sleepiness, irritability, and inappetence.
Children	Rapid breathing, shortness of breath/dyspnea, refusal to breastfeed, seizures, worsening of existing diseases, drowsiness, and bluish coloration of the fingertips and mouth.

- Diagnosed Psychic Disorder
- Risk of suicide or previous attempts
- Recurrent negative thoughts;
- Considerable increase in feelings of anxiety, fear, or sadness;
- Domestic or family violence.
- Hospitalized Family members;
- Recent death, grief process;
- Indications of substance use (alcohol or other drugs).

Chart 2. Guiding signs and symptoms to subsidize referral to psychological support in 2020 and 2021 (Goiânia, Goiás, Brazil).

1. Inclusion of questions that assessed loss of smell (anosmia) and loss of ability to taste (ageusia)
2. Question to find out if the person left home during the quarantine period and the reason.
3. Question to find out if the person used public transport and the reason
4. Question to find out if the person was tested for COVID-19, which method, when, and the result
5. Introduction of a tab referring to psychological and mental health monitoring
6. Question to find out if the person worked as a health or public safety professional.
7. Information on intra-family contacts (how many, age, clinical picture):
8. Oxygen saturation (if oximeter available)
9. Ask if the patient was pregnant

Chart 3. Questions and variables entered in the form during the pandemic in 2020 and 2021 (Goiânia, Goiás, Brazil).

Some offshoots of the original project emerged. In June 2020, intending to conduct expanded testing at a time when there were not many tests available, to reduce transmission and follow-up, the Nursing School of *UFG* (*FEN/UFG*) started testing symptomatic health and public safety professionals in response to a public notice from the Ministry of Education to create a COVID-19 project. After testing, nursing students performed the TM of these patients through the *TS*-GO platform. These actions took place for 3 months and ended due to resuming academic activities. Several studies are being developed with the material obtained. As of March 2021, a partnership with the multiprofessional residency at Clinics Hospital at *UFG* was established to expand psychological TM.

> We (professors and students at *FEN/UFG*) did the entire scheduling, testing, delivery of results, and telemonitoring workflow. Then we took the telemonitoring that was working there (*TS*-GO) up to today, in the same way, in the same workflows, the same models, and we set up telemonitoring to monitor these patients. (P3)

> We are developing research with this database. How did these professionals get contaminated while using PPE? We asked this question. We also evaluate signs and symptoms, focusing on pain. We evaluate the use of medication in COVID-19 and evaluate home isolation. (P3)

In 2021, oximeters, tablets, and cell phones were purchased with funds from the agreement between *SMS*/Goiânia and *TS*-GO and distributed to PHC teams. The PHC teams themselves would monitor patients residing in PHC-covered areas. Oximeters were sent to patients through PHC or the *TS*-GO team according to clinical recommendations or priorities concerning monitoring oxygen saturation (elderly, pregnant, obese, and patients with other chronic comorbidities). Motorcycle couriers were hired to take the oximeters to the patients who performed the oxygen saturation assessment four times a day and reported the data to the TM professionals.

In order to monitor the patients who needed it most within the installed capacity, the list of people who would receive TM was filtered in 2021. As a result, patients with health plans or PHC monitored areas were excluded from the general TM list. In addition, pregnant patients were prioritized in the TM queue.

Discussion

In Brazil, several distance support methods were used to fight COVID-19. Measures such as telescreening flu symptoms in patients in a city in the Bahian interior,[18] teleorientation and TM in a city in interior Minas Gerais,[19] teleorientation and screening in the gaucho interior (meaning the state of Rio Grande do Sul),[20] and teleconsulting activities for PHC physicians in the care of flu patients[21] were some of the actions performed and published. In addition, telehealth in several states also offered educational materials related to COVID-19 for the population and health professionals through web classes, videos, web pages, and protocols.[22]

Evidence on the impact of TM in patients with COVID-19 is still under construction, but preliminary results from studies around the world[6] and studies that evaluated TM in other diseases[23] suggest that this can be an essential tool in pandemics. Indeed, identifying the signs and symptoms of aggravation early, reducing demand for face-to-face care, and decreasing the circulation of infected people characterize this strategy.[6]

The quick response from *TS*-GO and *SMS*/Goiânia made it possible to follow up on suspected cases when little was known about the disease. It should be noted that this process was as agile as it was because there was an existing telehealth center already in place, financed by the Ministry of Health, active and operating together with primary care in the state of Goiás.

Flattening the infection curve at that moment and following the evolution of the infected in an agile and close way were the main objectives until therapeutic and prevention alternatives were developed, the same as in other areas of the world. On the other hand, this quick start triggered the need for a series of fixes and updates in the process. It is also important to highlight that most professionals had

no experience with telemedicine services and training was essential for the project's success.

Mental disorders may start during health emergencies and get worse, such as in the SARS epidemic in 2002 and H1N1 in 2009.[24] Uncertainties during the pandemic, restrictions on people moving through the streets, economic problems, fear of getting the virus, and mourning work against the mental health of the population.[25] In addition, anger, anxiety, irritability, fear, and sadness are often present in face-to-face or distance meetings between patients, family members, and health professionals, generating the need for greater attention and psychological support by patient care services.[25,26]

The initial focus on breaking the chain of transmission and monitoring the clinical aspects proved insufficient to comprehensively support the patient as the pandemic progressed. Therefore, a psychosocial support arm was essential to optimize the care provided.

In TM, three issues stood out: the ability to adapt to the challenges that emerged, the rapid response to the emergence of the pandemic, and the large number of monitored cases. However, there is currently no report of a Brazilian TM service for patients notified by COVID-19 that has followed an equivalent number of patients.

Conclusion

Telemonitoring proved to be a viable strategy that could potentially reach a large group of patients and could be replicated in other municipalities. A pre-installed telehealth structure also allowed these actions to be conducted with decisive speed. The service provided an opportunity for early identification of signs of aggravation, monitored thousands of people, avoided the circulation of infected patients, and generated a large amount of data for research and greater knowledge about the disease.

These results have limitations as they data was collected from an observational study. However, new ways of providing care need to develop quickly, and these data and the strengths and weaknesses of these experiences need to be shared so others can benefit from them. These reports also support public policies for health surveillance and health care using remote care strategies, such as telehealth and telemedicine.

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