Original Article

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Challenges of usability and access to a digital tool in a telerehabilitation program for COVID-19 survivors in a developing country

Desafios da usabilidade e do acesso a ferramenta digital em programa de telerreabilitação para sobreviventes da COVID-19 em um país em desenvolvimento

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ABSTRACT

Objective: The outbreak of COVID-19 brought many challenges for health system, including for rehabilitation facilities. To supply the high amount of patients with disabilities and functional impairments, telerehabilitation might be a feasible strategy. The aim of this prospective clinical trial is to present a practical experience of a 3-month physical telerehabilitation program, for post COVID-19 patients from a public health system, after hospital discharge. **Method:** The sample was recruited from a list of 407 patients, to be enrolled up to eight weeks after discharge. Primary outcome measures: Two-minute step test (2MST), Time to Five repetition in the Sit-To-Stand Test, EuroQol (EQ5D). This virtual-wise program consisted of customized videos for respiratory and functional exercises, on a 3-times a week basis. **Results:** Out of 407 patients, only 19 were enrolled, and 14 completed the program. Main sample losses were due to lack of phone contact, internet and technological constraints and in-person return to work needs. Participants mean age was 56 ± 16.8, 57.9% men; 12 (63.2%) lost weight during hospitalization. Patients increased the 2MST (p= 0.004), a reduction in the five repetitions in the sit and stand test (p= 0.002) and health status score (p= 0.007). **Conclusion:** Telerehabilitation is a promising option for the treatment of post-discharge COVID-19, physically disabled patients. However, socioeconomical barriers must be taken into account during the development of remote programs for rehabilitation, in order to ensure population access, especially to unequal countries.

Keywords: Coronavirus Infections, Telerehabilitation, Exercise Therapy, Quality of Life, Developing Countries

RESUMO

Objetivo: O surto de COVID-19 trouxe muitos desafios na saúde, incluindo o setor de reabilitação. Para atender o grande número de pacientes com deficiências funcionais, a telerreabilitação pode ser uma estratégia viável. Este ensaio clínico prospectivo tem como objetivo apresentar uma experiência prática de um programa de telerreabilitação física de 3 meses, para pacientes pós-COVID-19 de um sistema público de saúde. **Método:** A amostra foi recrutada a partir de uma lista de 407 pacientes, selecionados até oito semanas após a alta hospitalar. Desfecho primário: teste de marcha estacionária de dois minutos (TME2min), tempo para cinco repetições no teste sentar-levantar, EuroQol (EQ5D). Este programa virtual consistia em vídeos customizados de exercícios respiratórios e funcionais, realizados 3 vezes por semana. **Resultados:** Dos 407 pacientes, apenas 19 foram recrutados e 14 completaram o programa. As principais perdas amostrais ocorreram por falta de contato telefônico, restrições tecnológicas e de internet e necessidades de retorno presencial ao trabalho. A média de idade dos participantes foi de 56 ± 16,8, sendo 57,9% homens; 12 (63,2%) perderam peso durante a internação. Os pacientes aumentaram o TME2min (p= 0,004), redução nas cinco repetições no teste de sentar-levantar (p= 0,002) e no escore do estado de saúde (p= 0,007). **Conclusões:** A telerreabilitação é uma opção promissora para o tratamento de pacientes com deficiência funcional pós-alta COVID-19. No entanto, as barreiras socioeconômicas devem ser levadas em consideração durante o desenvolvimento de programas remotos de reabilitação, a fim de garantir o acesso da população, especialmente nos países desiguais.

Palavras-chaves: Infecções por Coronavírus, Telerreabilitação, Terapia por Exercício, Qualidade de Vida, Países em Desenvolvimento

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Conflict of Interests
Nothing to declare

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INTRODUCTION

Recently, the outbreak of COVID-19, an acute respiratory disease caused by SARS-CoV-2, became a public health emergency worldwide and brought many challenges for health system. The pandemic's scenario imposed worldwide governments to carried out several measures and control strategies, such as social distancing (lockdown and mandatory quarantine) and self-isolation, to reduce the transmission of the virus and to prevent the collapse of national health care systems. However, these actions also culminated in deleterious consequences, with restriction and impairment of mobility in people's daily lives, including the interruption of treatments of both chronic and acute diseases, and the delay in seeking health care.[1,2] This was not different in rehabilitation facilities, in which closed doors lead to thousands of outpatients suddenly to interrupt their programs for disabilities secondary to musculoskeletal, cardiovascular or neurological conditions.[3] At the same time, empirical observations and a growing number of published data have been showing a great volume of patients recovering from prolonged post COVID-19 hospitalizations being discharged with persistent fatigue, and loss in weight, muscle, and global capacity,[4,5] pointing to a clear demand for rehabilitation engagement aiming their functional recovery.

Indeed, several guidelines and formal recommendations[6] highlight that convalescent COVID-19 patients need rehabilitation programs to fulfill specific demands shortly after hospital discharge. However, this new population adds up to the patients' quota that was already deprived from rehabilitation, leading to an extra pressure in the scarce provision of services. Since then, the main concern of health professionals of this area has been to find strategies to maintain patients' rehabilitation care. Many approaches are outlined to meet this requirement, but among them, the expansion of telemedicine, without a doubt, is the one that stands out the most.[7]

Telemedicine is defined as the practice of medicine that use medical information by technology to deliver care at distance and improve patient's health. It is considered an important strategy to supply the needs of patients that do not have easy access to health system or who must be isolated during convalescence in various diseases.[8] In the last years, although the effective use of telemedicine had been demonstrated in many areas of rehabilitation[9-12] as cost reduction and time-saving possibility, its use, still remains restricted.[13,14] In some countries, this modality of rehabilitation provision was not accepted by professional class (boards). In Brazil, a federal permission to telemedicine use took place in March 2020 and "in exceptional character and for as long as the battle to combat COVID-19".[15] Nonetheless, nowadays it is not reasonable to believe that this modality will no longer be accepted.

Many technologies are being used to facilitate telerehabilitation, including smartphone apps, text and audio messages, email address, multimodal systems like videoconferencing, web-based platforms, and virtual reality.[16] These solutions are attractive, have a safe profile, and seem a viable alternative for rehabilitation during COVID-19 pandemic.

OBJECTIVE

The aim of this study is to present a practical experience of a remote physical rehabilitation program proposed, through a digital platform, for post COVID-19 patients from a public health system, after hospital discharge.

METHOD

This was a prospective observational, approved by the Research Ethics Committee at the Hospital (CAAE: CAAE: 34170820.0.1001.0071) and performed in accordance with the Declaration of Helsinki. All participants provided the informed consent prior to participation in the study. This trial was registered at www.ClinicalTrials.gov (NCT04695301), and involved two public hospitals, managed by a private general hospital, through a private-public partnership. These general public hospitals were transformed into referral hospitals for the treatment of COVID-19.

Men and women affected by COVID-19, over 18 years of age, who had been hospitalized in ward, step down units or in intensive care units (ICU) for more than 10 days were selected. The period for selecting patients and applying treatment was during the second half of 2020 and the first half of 2021. Patients were contacted up to eight weeks after discharge. The exclusion criteria were the presence of any physical or cognitive condition that made it impossible or contraindicated the performance of the functional tests and the proposed exercises. Pregnant women, patients with a more severe clinical and functional profile, who were discharged in need of care from a caregiver or who needed to be referred to another health service, such as a nursing home, were also excluded.

Social and clinical background

Information regarding age, ethnicity, gender, education level, work status, physical activity habits was collected by phone interview.

Measures

All evaluations were carried out remotely, applied by video call. The entire research team responsible for applying the assessment tests already worked with the tests applied and were trained for their standardized application through telerehabilitation, considering the standards necessary for each test. The chosen instruments could be easily applied remotely, are extensively used in rehabilitation studies, have good reliability, and are validated to local application. The measured activities were executed by the patient alone, under instructions given by the research team.

Two-minute step test (2MST)

The test measures the number of patient's knee elevations. The patient was instructed to remain in orthostatic position with or without support of the upper limbs, and for 2 minutes to raise the largest possible number of repetitions of the lower limbs alternately. At the signal, the participant always starts flexing the hips / knees with the right leg, simulating the movement of a step without moving, and them, the evaluator counts the number of times the right knee was elevated.[17]

Time to Five repetition in the Sit-To-Stand Test

The test was performed in a chair on a stable surface and the patient sat in the middle of the seat, with the spine erect, feet flat on the floor and arms crossed against the chest. At the signal, the patient should get up, standing fully upright and then return to a

fully seated position. Patients were encouraged to sit and stand up completely five times and the time spent was registered. The result was determined by counting the time spent by the participant correctly performs the movements of sitting and getting up from the chair.[18]

Quality of life assessment

The health-related quality of life of the study participants was measured by the EQ-5D questionnaire, an instrument created by the EuroQol group, which consists of 2 parts: a descriptive system (which assesses health in 5 dimensions: mobility, personal care, usual activities, pain / malaise and anxiety / depression) and a visual analog scale, ranging from zero (worst health condition imaginable) to 100 (best health condition imaginable).[19]

Rehabilitation program

The main mean rehabilitation delivery and monitoring program for research participants was provided by MyWellness (TechnoGym Inc), a well-known digital applicative that had been previously acquired by the hospital for use in patients on rehabilitation as a digital exercise guidance tool via video. As advantages, its content is Portuguese translated, and had good outpatients' acceptance. The digital applicative allows remote monitoring with adequate data security technology. Also, it permits training prescription and follow-up, and monitor the patient's adherence from a distance. The patient downloaded the application on her cell phone or computer, cost-free.

We set the program for 3-month length with customized demonstration videos, recorded by the research team especially made for the patients in our study, with prescription of breathing exercises (4 lung expansion exercises) and physical exercises of large muscle groups of upper limbs (pectoralis, deltoids, triceps, back and biceps), lower limbs (quadriceps, hamstring and calf) and abdominals, focused on improving functionality, with a number of 1 to 3 sets, varying with a progressive increase in intensity, according to the functionality observed in the evaluation carried out, totaling a session of 45 minutes to a maximum of 1 hour. They were designed to be performed by the participant 3 times week, in addition to the encouragement to maintain scheduled daily activities.

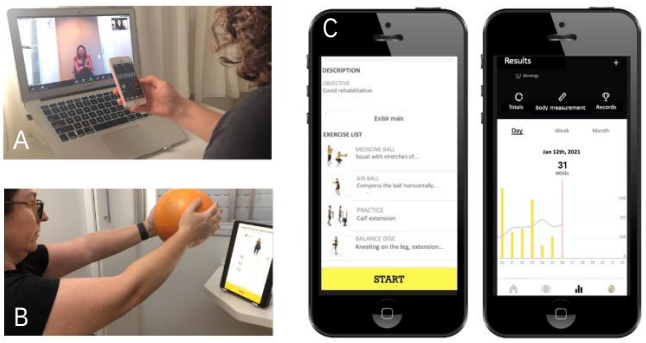

Figure 1. Remote rehabilitation program – A) Direct contact with the patient; B) Production of video exercises; C) Patient's screen

They were also instructed that, each time they accessed the platform to perform the exercises, a notification would be generated that they had performed the exercises. Additionally, on a weekly basis, the researchers contacted patients through the in-app chat or by WhatsApp, text message (a popular cellphone application in Brazil), thus ensuring access to the entire population, including the most economically vulnerable. Subsequently, patients were reassessed at the end of the 3-month, remote rehabilitation program. We set effective adherence if compliance more than 80% of the sessions were attained, verified directly by the researcher's contact via WhatsApp and the digital platform log.

Patients were monitored regarding their physical performance and effort tolerance. They were advised to report any symptom of clinical instability or adverse effect presumably caused by the exercise intervention.

Statistical analysis

Categorical data were described by means of absolute and relative frequencies, and numerical data by means, standard deviation, medians and quartiles. Baseline and final evaluations results were compared using non-parametric Wilcoxon tests for numerical or ordinal variables, and McNemar tests for categorical variables. Analyzes were performed using the SPSS program, considering a 5% significance level. Study data were collected and managed using REDCap electronic data capture tools hosted at HIAE.[20,21] REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies.

RESULTS

We started the screening with a list of 407 patients hospitalized during 2020 and 2021, who had been discharged within a maximum of 8 weeks. Of these patients, 288 were eligible for the study and were first phone contacted. We were able to reach by call only 152 patients, in which 51 refused, 17 had no indication of do the telerehabilitation program remotely, as they were already engaged in traditional physical activities and 19 said they would confirm later but ended up refusing to participate or the call no longer answered. Sixty-five patients agreed to participate after the first telephone contact, but when recontacted to gather the informed consent and perform the assessments, 18 patients no longer answered and 28 refused to participate. A total of 19 patients started the telerehabilitation program remotely for a 3-month period; however, only 14 patients completed the protocol, including the final evaluations (Figure 2).

Baseline measurements

We included 19 patients, with age between 26 and 79 years old (56 ± 16.8), 11 (57.9%) men and 8 (42.1%) women, with body mass index between 16.5 and 40.4 (27.4 ± 6.1 kg / m²). 12 (63.2%) pa-tients lost weight during hospitalization and for 11 (57.9%) the loss was greater than 10% of the weight at hospital admission, 1 (5.3%) patient was smoker and 1 (5.3%) alcoholic and 14 (73.7%) were sedentary at the hospital admission.

Seven subjects were (36.8%) caucasians, 7 (36.8%) blacks, 3 (15.8%) mixed and 2 (10.5%) without information. For the education level, 11 (57.9%) had completed elementary school, 5 (26.3%) with up to high school and 3 (15.8%) with higher education. Six subjects (31. 6%) were retired, 8 (42.1%) were on leave, 4 (21.1%) were active and 1 (5.3%) did not report.

Physical assessment of functionality and quality of life after 3 months of telerehabilitation

From the 19 included patients, 14 completed the rehabilitation program with adherence higher than 80% and were evaluated after 3 months of telerehabilitation.

We observed an increase in the number of knee elevations in the 2MST (p= 0.004) and a reduction in the time to perform five repetitions in the sit and stand test (p= 0.002) (Table 2). Also, an increase in the patients' health status score (p= 0.007) was observed, but no significant variation in the score of the EQ-5D (p= 0.483).

Table 1. Clinical and sociodemographic characteristics of selected patients (n= 19)

Age (years)	
Mean ± SD	56 (16.8)
Minimum - Maximum	26.7; 79.4
Gender	
Male	11 (57.9%)
Female	8 (42.1%)
BMI (kg/m2)	
Mean ± SD	27.4 (6.1)
Minimum - Maximum	16.5; 40.4
Lost weight on admission	
No	5 (26.3%)
Yes	12 (63.2%)
No information	2 (10.5%)
Lost more than 10% of weight	
No	6 (31.6%)
Yes	11 (57.9%)
No information	2 (10.5%)
Smoker	1 (5.3%)
Alcoholic	1 (5.3%)
Previous physical activity	
Sedentary	14 (73.7%)
Active (more than 3x week)	3 (15.8%)
No information	2 (10.5%)
Ethnicity/ Race	
White	7 (36.8%)
Black	7 (36.8%)
Mixed	3 (15.8%)
No information	2 (10.5%)
Education Level	
Incomplete elementary school	10 (52.6%)
Complete elementary school	1 (5.3%)
Incomplete high school	3 (15.8%)
Complete high school	2 (10.5%)
Graduated	3 (15.8%)
Professional situation	
Retiree	6 (31.6%)
Away	8 (42.1%)
Active	4 (21.1%)
No information	1 (5.3%)

SD: Standard deviation

Table 2. Physical and Quality of life evaluation at the beginning and after 3 months of telerehabilitation (n= 14)

	Measures		P value
	Baseline	After 3 months	
Physical evaluation			
2MST: number of			
Median (Q1; Q3)	50.0 (31.0; 58.0)	56.0 (38.0; 64.0)	0.004
Minimum: maximum	21.0; 68.0	27.0; 110.0	
Time 5 repetition Sit-To-Stand Test: in seconds			
Median (Q1; Q3)	19.0 (16.0; 21.0)	15.0 (12.0; 19.0)	0.002
Minimum: maximum	10.0; 32.0	5.0; 25.0	
Quality of life – EQ-			
How is your health?			
Median (Q1; Q3)	65.0 (50.0; 80.0)	75.0 (70.0; 90.0)	0.007
Minimum: maximum	10.0; 95.0	30.0; 100.0	
EQ-5D Score			
Median (Q1; Q3)	0.822 (0.691; 1.000)	0.890 (0.725; 1.000)	0.483
Minimum: maximum	-0.016; 1.000	0.414; 1.000	

2MST: two-minute step test; Q1: first quartile; Q3: third quartile; P value by Wilcoxon test; Health (0-100); EQ-5D score (0-1)

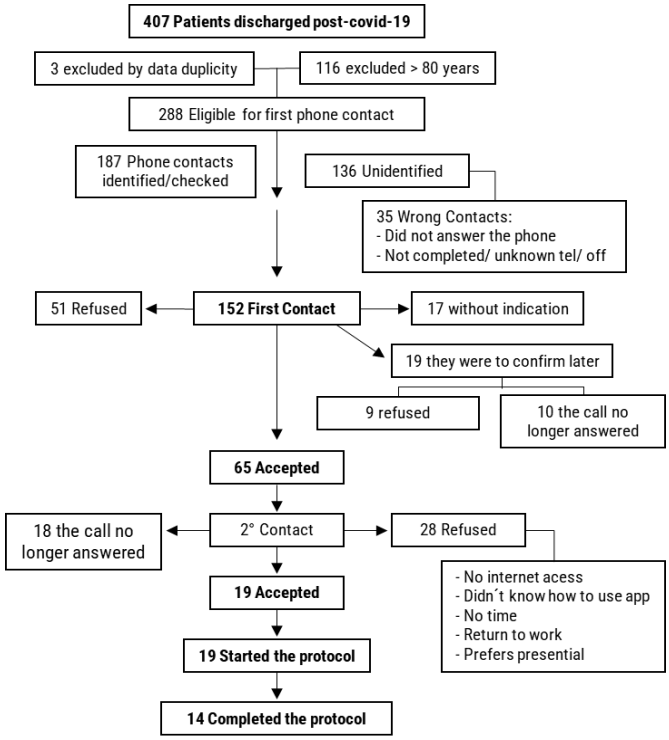

Figure 2. Flowchart of the study

DISCUSSION

This short Brazilian telerehabilitation experience revealed a young population affected by COVID-19, of both sexes and with the majority with incomplete elementary education. Significant weight loss and functionality were observed after COVID-19. Despite the small sample size, improvements of functional mobility and quality of life measures after 3 months of the program were noted. The post-discharge patient care with a remote, brief physical telerehabilitation program through a digital platform seems auspicious as a rehabilitation delivery method.

Our baseline results are in line with previous studies with survivors of the 2002 epidemic of severe acute respiratory syndrome (SARS) showing those patients had cardiopulmonary functional assessment and musculoskeletal function to daily activities reduced at 3- and 6-month follow-up,[22] and significant impairment in health quality of life of these patients at 6 months follow-up.[23] The results pointed the need for rehabilitation, which was provided remotely within constraints that were observed to be less related to clinical issues, and more to contextual, social aspects.

Recently, a study showed an association between different socioeconomic determinants, such as poverty level, education, and income, with COVID-19 outcomes in the United States.[24] They observed that United States counties with higher education and income level are at a higher risk of COVID-19 infection, but counties with higher disability rates and higher poverty levels have a higher rate of mortality.[24] Unsurprisingly, data from recent studies depicted the link between disease severity, psychosocial variables and long term COVID-19 manifestations, such as fatigue, chronic pain, cognitive dysfunctions – which demand, again, rehabilitation programs.[25,26]

If these health disparities are observed with the COVID-19 outcomes in usual care, we can anticipate that the challenges scale up when it comes to telerehabilitation. General sense claims that technologies do not work for all patients, especially for those with limited access to the internet or support at home. Moreover, they

require a device compatible to the digital platform or software delivering the health care, and a minimal personal digital proficiency is mandatory. The adoption, acceptance, and adherence for telerehabilitation are lower among individuals with lower educational/ income level.[27] It is noteworthy the paradox in which, although the socioeconomically vulnerable population is the most affected by chronic, poorly controlled diseases, including COVID-19 consequences, and yet is the one unable to take advantage from technological, accessible solutions. These hardships seem frequent in several low/ middle income countries; in the Philippines, the adoption in large scale of private and public telerehabilitation programs is prevented by telecommunication costs, professionals/ therapies fees, lack of population awareness and technology acceptance, limited technical resources, and persistent concerns about data privacy and patient safety.[28]

Indeed, telerehabilitation is influenced by many different social features and specificities of health care systems, which vary country-wise.[29] As a middle-income country, Brazil brings a combination of adversities related to the public health system as well to the patient experience in public hospitals. Firstly, the lack of a robust public registry system leads to a precarious database of the patient's information, hampering personal contact and proper clinical information gathering. Secondly, the lack of wi-fi network in certain remote areas is relevant, considering the continental country size of 8.5 million of km^2, and regional inequalities in terms of structural development and technological supply.

Thirdly, several barriers within the patient's reality: low cultural level making both comprehension troublesome to this "new" possibility of rehabilitation and prejudice towards such 'unusual' health delivery method; insufficient income to guarantee wi-fi and internet access for remote rehabilitation program; fear of criminal or fake phone calls, leading to hostility and contact avoidance. In addition, many patients did not accept our contact or the program enrollment as they had already returned to face-to-face work,[30] once most of the Brazilian population is contingent to off-line labor their main survival means; at the same time, is the most exposed to SARSCov2 reinfections.[26,29] Besides that, the requirement of the remote care continuity at home or how to use the rehabilitation digital platform were unclear to many patients and their caregivers, possibly because our information provision was done virtually as well. There was an apriori interest in many patients, but it was lost whilst they were instructed about the need of a mobile phone with internet, the application download, and the indispensable commitment to engage to rehabilitation exercises on a 3-times a week basis.

The country has also major barriers for the rapid and wide implementation to virtual communication tools for patient care, such as the lack of telemedicine federal regulation, proper protocols, and insufficient professional formation for good performance; unclear payments policy; issues about confidentiality and security. These challenges apply both from the perspective of the public and the private health system.[15]

Some actions might be helpful to overcome the mentioned difficulties, when setting a distance rehabilitation program, such as: sending printed booklets by mail with the exercises and guidelines for their performance, implementation of functional rehabilitation hybrid programs with home visits by health professionals, use of social networks of encouragement by professionals and patients. Importantly, knowing the local reality is crucial to create robust projects and effective protocols for telerehabilitation and its extended use, including its value as a public policy. This is not a rhetoric discussion, as the technology implementation in health worldwide has been one of the main interests of several institutions, such as World Health Organization[31] which develops guidelines for tools to be used extensively, seeking the maximum reach of underserved individuals and in remote areas.

Despite the difficulties for the participants contact, adherence, and the telerehabilitation implementation as a direct influence of the country social context, we observed functional improvements of the enrolled patients. They increased performance and general quality of life levels, after three months of a digital rehabilitation platform use. We believe our preliminary results are promising, but they should be better explored by further research protocols with long-term outcomes and other protocols, including hybrids (virtual and face-to-face modalities) and tailored programs that consider different local healthcare funding.

The results of our study were hampered by several limitations, such as a small sample size, variation in length of hospital stay among patients, the lack of standardized outcome measures to track functional progress over time remotely and variance of the sample population. Due to the lack of comparative analysis or control group, it is not possible to exclude results as consequence of return to the mean, natural history of the disease, incidental effects, and sample variance. Other factors include lack of patient perception of their rehabilitation needs directly impacting recruitment and adherence; lag time between discharge and our first phone contact.

CONCLUSION

After 3 months of telerehabilitation program, post COVID-19 survivors showed improvements of functional mobility and quality of life. Our preliminary data from a practical experience suggest that telerehabilitation is a promising option for providing the continuum care of post-discharge COVID-19 patients. However, socioeconomical barriers influenced the trial execution. Our exploratory data reinforce the need for public agents and health care providers to be aware of these issues and strive to implement tailored telerehabilitation programs.

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