






Evaluation of advances in Telemedicine provided by Covid-19 pandemic

Avaliação dos avanços em Telemedicina proporcionados pela pandemia por Covid-19

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Abstract

Objectives: evaluate telemedicine exercise before and during the COVID-19 pandemic. **Method:** This is a systematic review, in which articles published from January 2004 to June 2020 were selected. The databases used to survey the studies were PubMed and LILACS. **Results:** 81 articles were found. After the exclusion criteria, 15 articles were included in the qualitative synthesis, of which eight explain the Telemedicine approach before the COVID-19 pandemic and seven during the pandemic. Based on the articles, it was observed that, before the pandemic period, visits by Telemedicine were less used and more restricted; during the pandemic, it was observed that the practice of Telemedicine was more used and necessary in several specialties, in addition to postoperative consultations and patients with COVID-19. Furthermore, the evidence indicated that the pandemic enabled, through Telemedicine, greater ease of access to consultations, which could assist in the rapid detection and early implementation of conduct. **Conclusions:** In the general context, Telemedicine proved to be effective in increasing personal assistance. However, more studies are still needed to analyze the applicability of Telemedicine, its benefits and its harms, to define the situations in which it can be used with greater security.

Keywords: Coronavirus; Information Technology; Telemedicine; Health Policies; Telemonitoring.

Resumo

Objetivos: avaliar o exercício da telemedicina antes e durante a pandemia de COVID-19. **Método:** trata-se de uma revisão sistemática, na qual foram selecionados artigos publicados no período de janeiro de 2004 a junho de 2020. As bases de dados utilizadas para levantamento dos estudos foram PubMed e LILACS. **Resultados:** foram encontrados 81 artigos. Após os critérios de exclusão, 15 artigos foram incluídos na síntese qualitativa, dos quais 8 abordam a Telemedicina antes da pandemia de COVID-19 e 7 durante a pandemia. Com base nos artigos, observou-se que, antes do período pandêmico, a Telemedicina era menos utilizada e mais restrita; durante a pandemia, observou-se que a prática da telemedicina foi mais necessária em diversas especialidades, além das consultas pós-operatórias em pacientes com COVID-19, e as evidências indicaram que a pandemia possibilitou, por meio da Telemedicina, maior facilidade de acesso às consultas, o que poderia auxiliar na detecção rápida e implementação precoce de condutas. **Conclusão:** no contexto geral, a Telemedicina mostrou-se eficaz em incrementar o atendimento pessoal. Porém, mais estudos ainda são necessários para analisar a aplicabilidade da Telemedicina, seus benefícios e malefícios, a fim de definir as situações em que ela pode ser utilizada com maior segurança.

Palavras-chave: Coronavírus; Tecnologia da Informação; Telemedicina; Políticas de Saúde; Telemonitoramento.

INTRODUCTION

Telemedicine is medicine at a distance; it aids the health care process by facilitating a more efficient exchange of information, which enables numerous activities related to care, such as education, administration and treatment^{1,2}. Furthermore, the main barriers to wider adoption are limited reimbursement, lack of comfort with telemedicine technologies by patients and providers, and few compelling cases for replacing personal care³.

Among the benefits of telemedicine, we can mention easy accessibility and better convenience for both the professional and the patient⁴. However, the known barriers for the use of telehealth are centered in the lack of information technology (adequate) and the security of communication links about personal data (including health), besides the inclusion of the

need to rethink the business models and overcome the financial barriers, including incentives, charging and initial and long term financing⁵.

In current days, telemedicine gained greater prominence during the pandemic period, as COVID-19 ("Corona Virus Disease 2019"), within a few weeks, significantly changed the patient's medical care capabilities and is a growing challenge affecting various aspects of clinical care^{6,7,8}.

It is in this context that telehealth presents itself as a powerful tool, since it favors frequent care and adequate support through multidisciplinary teams, with nutritionists, social workers, pharmacists, among others⁹.

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Given the increasing use of telemedicine and telehealth in the current scenario of the COVID-19 pandemic, our objective was to evaluate telemedicine exercise before and during the COVID-19 pandemic, outlining specific variables that will be exposed throughout the article.

METHODS

Search methods for identification of studies

This is a systematic review study based on the methodological recommendations of Preferred Reporting Items for Systematic Reviews and Meta-Analyses - PRISMA. The process of identification and selection of articles was carried out independently from June 2020. Articles published from January 2004 to June 2020 were selected. The databases used for the survey were PubMed, Scielo and LILACS. The following search descriptors were used: "Telemedicine" AND "COVID-19"; "telehealth" AND "COVID-19"; "telehealth" AND "Coronavirus disease 2019"; "telemedicine" AND "COVID-19"; "telemedicine" AND "coronavirus disease 2019"; "telemedicine" AND "evolution"; "telehealth" AND "evolution".

Study selection

Regarding duplicate articles, i.e., containing in both databases, we aimed to remove only one of the searched repeated articles, and the studies were examined based on the selection criteria. The abstracts of the studies were examined for eligibility for the systematic review, and the full text of the articles was searched when the abstracts did not provide enough information to make a decision. The search was conducted independently by two researchers (RGPA and FEASJ) to reduce selection bias, both of whom authored the paper.

Criteria for election

The inclusion criteria consisted of original and full articles. Eligible studies were human clinical trials and case reports, in any language, that met the study objective. The exclusion criteria were: studies that did not have a clear methodology, studies that were conducted with animals, articles that did not address telemedicine according to the objective of this study, incomplete or inaccessible articles.

Variables studied

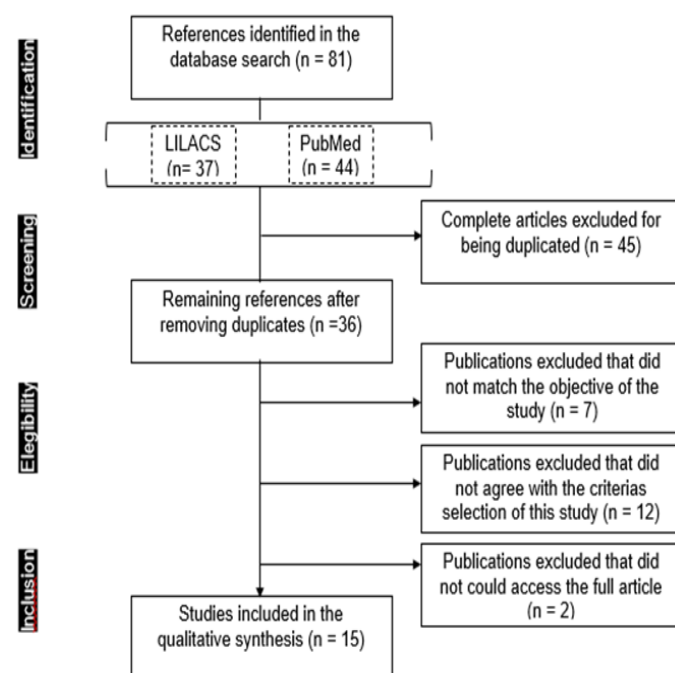
In the present article, the exercise of telemedicine before and during the pandemic period of COVID-19 will be evaluated, using specific variables as a method of comparative study, being the quality of the virtual connection of the method provided, user satisfaction regarding the online consultation, the number of consultations performed by professionals in telehealth exercise, level of specialty of the service, the time between diagnosis and treatment, duration of consultation, type of disease and conclusions of the articles about the implementation of telemedicine to care services.

RESULTS

Article Selection

A total of 81 articles were found, of which 44 were from the PubMed platform, 37 from the LILACS platform. Of the 81 articles, 36 were selected and 45 duplicate articles were excluded after independent research by the researchers. Of the 36 selected articles, 21 were excluded, of which seven did not match the study objective, 12 did not agree with the study selection and two because it was not possible to access the full article. Thus, 15 articles were included in the qualitative synthesis (figure 1).

Figure 1. Flowchart of the selection of the study on telemedicine before and during the pandemic.



Telemedicine before the pandemic of COVID-19

With the bibliography used, it was observed that 8 of the 15 articles evaluated^{15,16,17,18,19,20,21,22} explain the telemedicine approach before the pandemic by COVID-19 (table 1).

User satisfaction

In Salvador and collaborators, the study assessed aspects correlated to the application of telemedicine monitoring in the context of cardiovascular diseases, such as hypertension, malignant arrhythmias, heart failure, and post-infarction rehabilitation, with results based on the Likert scale. Specifically, on the topic of user satisfaction before and after the application of telemedicine care techniques, it was observed that most patients (80%) agreed, from the beginning, that the technology would be beneficial. At the end of the project, after knowing how telehealth care and telemedicine techniques work, 91% of

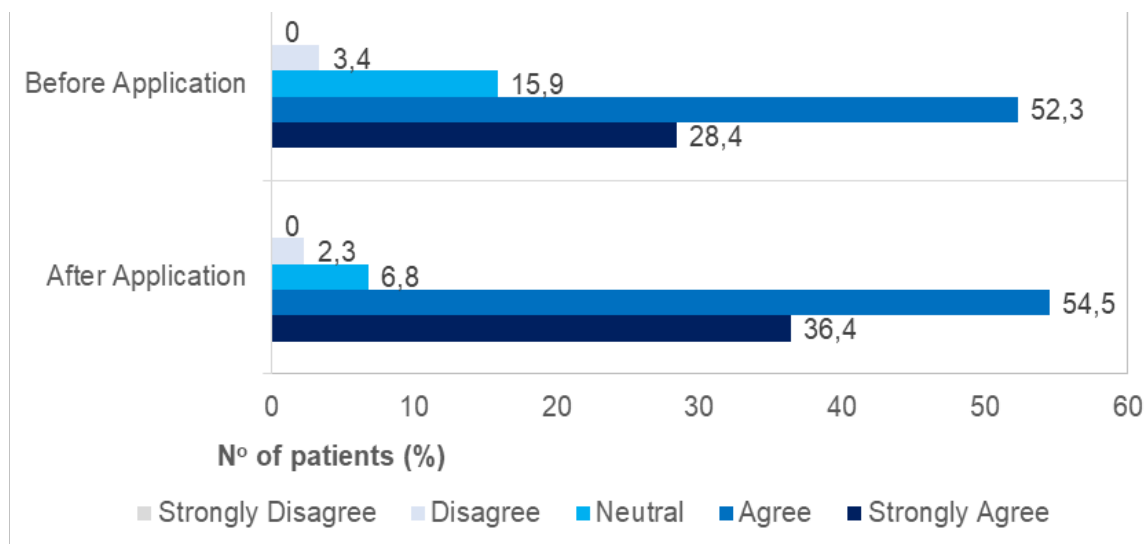
3 Advances in Telemedicine provided by Covid-19 pandemic

the interviewees considered that the technological application to medicine would bring beneficial effects, an increase coming from patients who had no initial opinion, as shown in figure 2²¹.

Table 1. Analysis of telemedicine, before the COVID-19 period.

Disease	Length of consultation	Time between diagnosis and treatment	Level of specialty of the service	Number of inquiries	User satisfaction	Quality of connection	Year	Authors
-	-	-	-	-	-	-	2019	Valenzuela and Sibrian ¹⁵
-	-	-	-	-	-	-	2018	Fuertes-Guiró and Velasco ¹⁶
Oncological patients	-	-	-	-	-	-	2016	Viñoles et al. ¹⁷
Obstructive sleep apnea	-	-	Patients were already in specialized service	-	-	-	2014	Mendelson et al. ¹⁸
-	-	-	-	-	-	-	2012	Hendy et al. ¹⁹
Pressure ulcers	-	-	Patients were already in specialized service	1	Most satisfied in early stages of ulcers	-	2007	Pato et al. ²⁰
Cardiopathies	Parameter evaluation: 3 min 11 s ECG: 2 min and 30 s	Diagnosis already made. It was monitoring	Patients were already in specialized service	-	There was a good adaptation of the patients (Likert Scale)	< 0.1% failure rate. 30-60 s delay	2005	Salvador et al. ²¹
Chronic renal failure	-	-	-	-	-	-	2004	Jeanpierre and Charpillat ²²

Figure 2. Evaluation of the opinion of patients with cardiovascular diseases on the degree of consideration of the benefit of telemedicine care. The answers refer to a questionnaire applied before and after the implementation of the method (Adapted from: SALVADOR et al, 2005).



Access to specialized service

In Hendy and collaborators, it was seen that telemedicine, besides adding efficiency and reducing costs, can enhance the attention of specialized care¹⁹. This is reflected in the –access to health services in remote regions, presenting the potential to expand the actions of health –professionals, integrating them to –services located in hospitals and reference centers, regarding prevention, –diagnosis and treatment. Thus, advantages of feasibility, organizational flexibility and interactive learning are observed as one of the many tools to expand access in specialized health systems¹⁹. In this sense, in Guiró and collaborators, it is noted that the primordial aspect of telemedicine is its potential to democratize access to health services. It is a natural evolution of health care, in which, every day, the capacity that telemedicine has to improve quality, equity and accessibility to health care becomes more unquestionable¹⁶.

Degree of resolutivity

In Salvador and collaborators, the study assessed aspects correlated to the application of telemedicine follow-up in the context of cardiovascular diseases (hypertension, malignant arrhythmias, heart failure and post-infarction rehabilitation), with results guided by the Likert scale. Specifically in the topic that evaluated the degree of users' resoluteness before and after the application of telemedicine care techniques, it was observed that most patients (84%) had a positive attitude towards the project from the beginning, and at the end, this number increased to 89.8%, because 5 (5.7%) of the 12 patients (13.6%) who expressed no opinion at the beginning, adopted a positive attitude when the project ended²¹.

Telemedicine during the pandemic of COVID-19

With the bibliography used, it was observed that 7 of the

15 articles evaluated^{7,9,10,11,12,13,14}; explain the approach of telemedicine amid the pandemic by COVID-19 (table 2).

Access to specialized service

In Peters and collaborators, it was observed that, indeed, COVID-19 forced the implementation of dramatic changes in health services, some of which enable access and expected positive patient outcomes.

Thus, according to Garg and colleagues, many providers and patients are discovering the benefits of home telemedicine as they are exposed to this method of care¹³. Patients can interact with their providers from the comfort of their homes. Virtual visits are also more cost-effective, faster, and avoid travel and parking, helping to minimize time away from work and/or school.

Connection quality

According to Garg et al. the advance of remote monitoring devices connected continuously allows easy flow of data from the patient to the attending physician. However, due to technical inability or even lack of adequate equipment, technological management remains a barrier for many patients. This is particularly relevant for the geriatric population, a group that could widely benefit from this technological apparatus and that presents very common day-to-day challenges, such as access difficulties (transportation, problems with walkers, wheelchairs, etc.) to face-to-face visits, infection risks from Coronavirus exposure and associated high morbidity and mortality, already correlated with this age group¹³.

Table 2. Analysis of telemedicine, during the COVID-19 period.

Disease	Length of consultation	Time between diagnosis and treatment	Level of specialty of the service	Number of inquiries	User satisfaction	Quality connection	Year	Authors
COVID-19	-	Along with the diagnosis	Patients were already in specialized service	-	-	-	2020	Huang et al. ¹⁰
COVID-19	-	-	-	-	-	-	2020	Caetano et al. ¹¹
COVID-19 ocular initially	-	Same day, apparently	Patient had consultation with Ophthalmologist	2 (11-day interval)	-	-	2020	Daruich et al. ¹²
Post-surgery for neck cancer	-	1 month	He was a specialist. Because he accompanied the postoperative	The article only commented on 2 (may have been more)	-	-	2020	Qualliotine and Orosco ⁷
Type I Diabetes Mellitus (DM I)	-	Same day, apparently	Patients were in consultation with a specialist (endocrinologist)	1st patient had 1 appointment. 2nd patient had 12 appointments	-	-	2020	Peters and Garg ⁹
DM I	-	They were already being treated	They were already being consulted with experts	1st patient was consulted 7 times in person and 14 times virtually. 2nd patient was monitored 14 times virtually.	-	-	2020	Garg et al. ¹³
Coloproctology and pelvic floor physiotherapy service.	-	-	-	-	Although no satisfaction surveys have been prepared, patients especially value and appreciate the fact that their doctor calls, listens and takes care of them, trying to solve their health situation as far as possible. In addition, not having to expose themselves in hospitals increases patient and physician satisfaction.	-	2020	Márquez ¹⁴

Telemedicine before vs during the pandemic of COVID-19

Table 3 presents the findings of the 15 articles about the implementation of telemedicine to care services.

Table 3. Conclusive exposition of the articles evaluated.

Authors	Year	Conclusions on telemedicine
Huang et al. ¹⁰	2020	Through a form via telemedicine, the multidisciplinary team was able to assess the patient's conditions promptly, monitor dynamic changes in their conditions, and provide medical guidance.
Caetano et al. ¹¹	2020	Telehealth provides capabilities for remote screening, care, treatment and assists in monitoring, surveillance, detection and prevention of conditions.
Daruich et al. ¹²		This case illustrates the utility and relevance of teleophthalmology procedures during the current epidemic, which, in addition to preventing coronavirus transmission, could help detect patients potentially with COVID-19.
Quallitione and Orosco ⁷	2020	The article relies on telehealth strategies for surgical drain management, in which small practical adaptations can facilitate healthcare solutions, reducing unnecessary exposure for patients and healthcare teams.
Peters and Garg ⁹	2020	The pandemic has allowed the addition of new ways (with the help of new technologies) to manage high-risk patients with DM I and diabetic ketoacidosis through telehealth assistance.
Garg et al. ¹³	2020	Regarding follow-up and cost-effectiveness, telemedicine can be safe and effective for DM I in children and adults. Moreover, the pandemic of COVID-19 stimulated the expansion of the medium in digital medicine
Márquez ¹⁴	2020	To ensure uninterrupted medical assistance and access to patients in the area of colorectal surgery and pelvic floor biofeedback, a teleconsultation program was established, receiving high satisfaction ratings from users.
Valenzuela and Sibrian ¹⁵	2019	Based on the study of a teleneurology program, this article analyzes the three logics for telemedicine: civic efficiency, safety and quality of care. It is proposed that the recognition of such logic assists in the valorization of health care practices, favoring understanding, anticipation and resolution of the tensions that emerge with the implementation of digital health technologies.
Fuertes-Guiró and Velasco ¹⁶	2018	Teleguided medicine improves information sharing with the surgeon at different locations and patient care; however, it should not be anticipated, for ethical reasons.
Viñoles et al. ¹⁷	2016	The study proposes the development of a national epidemiological registry on oncological data, using the tools of telemedicine. This allows data integration between institutions, optimizing operational, technical and financial processes.
Mendelson et al. ¹⁸	2014	Positive air pressure treatment supported by telemedicine alone did not improve blood pressure in patients with obstructive sleep apnea at high cardiovascular risk.
Hendy et al. ¹⁹	2012	Remote care, to be implemented, needs to evolve organically, being responsive and adaptable to the local health and social care system; furthermore, it must be driven by the support of frontline staff and managers.
Rocar Pato et al. ²⁰	2007	The patients were evaluated by two psychiatrists in person and separately, from whom clinical data were obtained and photographs of the ulcers were taken. All data were forwarded for evaluation by psychiatrists at a distance. After a comparative evaluation between physicians, it was concluded that the protocol is effective to evaluate pressure ulcers in the early stages (I and II).
Salvador et al. ²¹	2005	The study assessed aspects correlated to telemedicine follow-up of cardiovascular diseases, with results based on a Likert scale. We observed a positive evolution in the acceptance of telemedicine over time.
Jeanpierre & Charpillat ²²	2004	The main focus was to monitor patients with chronic renal failure and detect hydration problems. An automated system could detect changes and send instant data to alert doctors, being a beneficial system for patients' health.

Specialties evaluated

In eight of the 15 articles, it was observed the care of patients with specialists: two addressed patients already diagnosed with diabetes being assisted by endocrinologists (9) (13); one reported cardiopathic patients, such as systemic arterial

hypertension, congestive heart failure, post-infarction and malignant arrhythmias, being assisted by cardiologists²¹; one article approached a postoperative consultation of a patient submitted to a head and neck surgery with the surgeon who operated on her⁷; one article approached patients already diagnosed with obstructive sleep apnea being seen by sleep specialists¹⁸; one article addressed the analysis of pressure ulcers by physiatrists²⁰; one article addressed the care and diagnosis of COVID-19 with a multidisciplinary team¹⁰; one article addressed a patient complaining of red-eye and foreign body sensation in the eye, being seen by an ophthalmologist and, apparently, on the same day, receiving a diagnosis of COVID-19, and one article addressed teleconsultations of coloproctology and pelvic floor physiotherapy^{12,14}.

Waiting time for service

In general, according to Garg and collaborators, it is evident that the fruitful application of telemedicine will allow a reduction in the waiting time for inter-consultations; in addition, it is considered that effective care results in less need for referrals for face-to-face consultation, shortening the waiting time for specific treatments and reducing social costs arising from patient displacement. Another advantage is to promote services such as scheduling appointments and prescribing previously prescribed medications, avoiding patients' commuting to medical centers for reasons that have an easy and quick resolution. This is particularly even more relevant for the geriatric population, a group that could benefit due to the high potential for morbidity and mortality, challenges with access, such as transportation, problems with walkers, wheelchair use, among others, and often with comorbidities and associated immunosuppression status¹³.

Time between diagnosis, treatment and implementation of conducts

According to Peters et al., it was observed easier access to consultations and, consequently, a faster implementation of conducts, further extending health care and shortening the beginning of treatment of possible acute complications⁹.

In Garg and collaborators, the use of remote monitoring services makes it possible to notify physicians and other health professionals about the continuous health status of their patients, thus, in situations whose clinical condition could be signaling deterioration, the aid of detection monitoring and preventive guidance could assist in the rapid detection and early implementation of conducts, aiming to contribute widely to the quality of life of the patient¹³.

DISCUSSION

The present work brings, for the first time, characterization of published articles that report on telemedicine care before and during the pandemic. Since this care strategy is increasingly used during COVID-19, this work is highly relevant.

Before COVID-19, research on telemedicine had promising results and good patient satisfaction, even if the amount of such research was not very large²¹. We have important characteristics in the pre-pandemic period: it was more of a priority to create protocols or systems that could be performed by the Internet than to perform teleconsultations (20)(22); there was possible insecurity about the use of telemedicine in the teleconsultation area. Thus, before the pandemic by COVID-19, few studies on telemedicine were conducted, making it difficult to evaluate this technology.

During COVID-19, there was greater use of telemedicine and more research addressing the topic, in such a way that the use of telemedicine was observed in areas that were not used, as is the case of Ophthalmology¹². In addition, an increasing number of telecare cases were observed^{7,9,12,13}, and many COVID-19 diagnoses were performed through telemedicine^{10,11,12}.

Currently, we have varying degrees of knowledge about the impact of innovative technologies in different aspects of the health system and social assistance¹⁹. In the last years, telecommunication technology has strongly aggregated to medicine, helping in the amplification of the access to health, in the facilitation of the access to specialized services, in the rationalization of costs, in the support to epidemiological surveillance, among other factors, reaching a potential of comprehensiveness in almost all specialties and subspecialties. Thus, when carefully applied in the appropriate clinical context, telemedicine can be a facilitator of health care⁷.

In this perspective, the evidence perceived in Peters and Garg indicated that the pandemic motivated the greater use of telemedicine, which facilitated the access to consultations, in addition to enabling the aid of detection monitoring and preventive guidance, which could contribute to the rapid detection and early implementation of conducts^{9,13}. These data are positive for the growth of telemedicine in daily life, but it is valid to consider the bias of being studies carried out in developed countries, not being possible to determine if this result presented applies to countries of medium and low income, because, as Fuertes-Guiró states, these countries suffer from low investment in health and, therefore, prioritize the most essential technologies and treatments, being the telecare left in the second plan¹⁶.

Regarding the costs of telecare, the analysis of the articles selected from the literature does not allow us to quantify, with precision, the financial costs related to the request of the service for the patient. Thus, from the economic point of view, there is no unanimity regarding the cost-effectiveness of this new technology, partly due to the few studies that analyze them. However, because the telemedicine structure provides remote care, it helps to reduce costs related to displacements that would be necessary for face-to-face care, besides reducing costs with employees at the site of care. Nevertheless, because it is equipment that needs recurrent maintenance and association with services that ensure data protection,

security and confidentiality, such factors may be conditions that eventually can raise the price of the requested service²⁵.

In the case of costs for the hospital system, large-scale studies in this specific field are also limited, making a useful analysis more difficult to be performed. However, it is already known that, especially in centers where such technology is not widely established, the implementation of reliable and quality systems becomes quite challenging, as it demands large costs and planning time from institutions to restructure the entire health service. Therefore, the institutions' management teams must promote organizational flexibility and interactive learning of users and providers¹⁹. However, in the long term, it is assumed that telemedicine can help reduce costs, due to the potential of systematization of care, restructuring of health services and organization of care provided, such as those from hasty and unnecessary referrals²⁵.

However, variables such as quality of connection, duration of consultation and number of consultations could not be assessed because they were not present in most of the articles analyzed in this review. This information could contribute to a better comparison of telemedicine before and during the pandemic, which can help optimize telemedicine care as a whole, besides contributing to a more detailed characterization of this type of health care (charts 1 and 2).

This study was limited by the fact that it was written in the first year of the Coronavirus pandemic, and few studies on telemedicine and COVID-19 had been published by the end of this review. Possibly, as time goes by, more questions may be answered, since the number of publications on this subject has grown intensely in recent months.

Finally, as telemedicine has been growing with the improvement of technologies and the need for social isolation, provided by the

pandemic caused by the Coronavirus, it is of utmost importance that more studies address this issue.

Thus, it is possible to outline future perspectives, such as clarifications about a possible obligation of a digital signature for physicians (to make this practice more secure), the possibility of offering an academic module in the area of telemedicine, as well as a medical residency on the subject in question. Such topics are highly relevant for legislations, universities, medical careers and patients in general.

CONCLUSION

Thus, in the general context, telemedicine proved to be effective in increasing face-to-face care and, amid the COVID-19 pandemic, the implementation of technological innovations could be seen as an excellent opportunity to avoid problems related to face-to-face health care, especially due to the high risk of contamination.

Furthermore, it is worth noting that it is convenient that the medical field increasingly uses technological attributes to assist in whatever is possible in medical practices. This is important to enable access to health care, allowing care to users in remote areas and clinical monitoring of patients in situations where the physical presence of the health professional is not necessary, promoting quality care and patient well-being.

Finally, the pandemic was able to expand the possibilities for, in a few years, the guidelines to be more defined on the use of telemedicine, and it is important to emphasize that further studies are still needed on the applicability of telemedicine, its benefits and harms, to define the situations in which it can be used more safely. Thus, it will be possible to consider new forms of clinical management of the patient and implement new techniques of health promotion, providing the ideal care to the user, either in person or virtually.

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9 Advances in Telemedicine provided by Covid-19 pandemic

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