

# Telemedicine in the Management of Primary Headaches: A Critical Review

## Telemedicina no manejo das cefaleias primárias: uma revisão crítica

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### ABSTRACT

Telemedicine is a modality of health care services delivery with the use of communication technologies. Its use has grown in several medicine areas. Several studies evaluated the feasibility, acceptance, efficacy, cost-effectiveness, and safety of telemedicine in the diagnosis and management of primary headache disorders. Videoconsultations were shown to be effective, convenient, and safe for primary headache disorders and migraine follow up. Some mobile health devices were shown to improve adherence favoring better outcomes. Handling health data is a major concern so that international compliance standards must be adopted in all telemedicine procedures. The impact in the health system and increased access to appropriate primary headache treatments with the use of these technologies has yet to be elucidated.

**Keywords:** Telemedicine, Primary Headache; Migraine; Videoconsultation; Mobile Health

### RESUMO

A telemedicina é uma modalidade de disponibilização de serviços médicos com o uso da tecnologia da informação. Seu uso tem crescido enormemente em várias áreas da medicina. Vários estudos avaliaram a viabilidade, aceitação, eficácia, custo-efetividade e segurança da telemedicina no diagnóstico e tratamento das cefaleias primárias. A vídeoconsulta mostrou-se uma forma eficaz, conveniente e segura no seguimento terapêutico das cefaleias primárias e da enxaqueca. Alguns aplicativos para dispositivos móveis mostraram aumento da aderência, favorecendo melhores resultados. A segurança de dados de saúde é uma preocupação, sendo imprescindível seguir rigorosamente os protocolos internacionais de conformidade. O impacto no sistema de saúde e o aumento do acesso a tratamentos adequados proporcionados por estas tecnologias ainda precisa ser melhor elucidado.

**Descritores:** Telemedicina; Cefaleias Primárias; Enxaqueca; Vídeoconsultas; Aplicativos de Saúde.

### INTRODUCTION

The definition of telemedicine according to the World Health Organization is "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities".<sup>(1,2)</sup> The history of telemedicine begins in the early 20th

century with the transmission of electrocardiographic using telephone wires.<sup>(3)</sup> Other technologies, such as closed circuit television, began to be used in the 1950s and 1960s.<sup>(4,5)</sup> In 1967, the Massachusetts General Hospital starts to provide remote health healthcare services to Boston Logan Airport, being the first structured telemedicine service.<sup>(6)</sup> With the introduction of World Wide Web (www) in 1990, the possibility of health information exchange is greatly expanded, by replacing analogue processes with digital ones, increasing enormously the capacity to store and transmit data.<sup>(7)</sup>

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The delivery of telemedicine services can be made by four different ways: 1) synchronous - with live video between patient and provider or non-specialist with specialist, 2) store and forward - by acquiring medical data and further transmitting it to a provider or a specialist, 3) remote monitoring - with the use of wearables and biosensors, and 4) mobile health (mHealth) - which is the health practice supported by mobile devices.<sup>(8-10)</sup> The use of telemedicine in Neurology is growing due to the fact that neurological care is still poor around the world. Telestroke accounts for 65% stroke treatments “in the USA” - A determiner is probably missing here and Canada. Several studies have showed potential benefits of telemedicine in the management of Parkinson’s Disease, Epilepsy, Multiple Sclerosis, Brain and Spinal injury, and Amyotrophic Lateral Sclerosis.<sup>(11,12)</sup>

Primary headaches are associated with a significant impact.<sup>(13-15)</sup> However, the availability of headache medical services is poor worldwide and even higher in developing countries such as Brazil.<sup>(16-21)</sup> Considering the need to expand access to headache treatment and the high prevalence of these disorders, telemedicine seems to be an attractive alternative to provide care for these patients. In the present review we will critically discuss the current evidence about this topic.

## TELEMEDICINE AND HEADACHE IN THE LITERATURE

By searching with the words “Telemedicine” and “Headache” in the PubMed database 53 articles are found, including several article types, such as clinical trials, case reports, reviews, and opinion articles. Among them, twenty are clinical studies or case presentations evaluating specific telemedicine procedures in the treatment of headache or specific headache disorders. The first scientific paper about the use of communication technologies in headache care was published in 2004. Several studies about behavioral interventions on adherence and outcomes in headache treatment with the use of mHealth were published between 2004 and 2016, when the first well designed, prospective telemedicine and headache clinical trial article was published.<sup>(22-24)</sup> In this critical review we took into consideration the most important articles evaluating synchronous telemedicine and mobile health (mHealth).

### Synchronous telemedicine (videoconsultations)

Müller et al. evaluated synchronous telemedicine and showed high levels of acceptability, feasibility, as well as cost effectiveness with videoconsultations when compared to conventional consultations. The study was carried out in Northern Norway and included adult patients referred to a neurologist for non-acute headache treatment by primary care physician. The patients were randomized for telemedicine consultations or conventional face-to-face appointments. Videoconsultations were performed using appropriate equipment in a telemedicine hospital room, with audio and video communication between the neurologist

and the patient in the videoconference room. The same physician carried out the consultations of the telemedicine group and the conventional consultation group. Nearly 400 hundred subjects were randomized for telemedicine or conventional consultations and were followed for one year and telemedicine was shown to be feasible.<sup>(25)</sup> In another publication originated from the same clinical trial the authors compared efficacy of telemedicine and conventional treatment with visual analogue scale (VAS) and headache impact test (HIT-6), showing non-inferiority of telemedicine approach.<sup>(26)</sup> The satisfaction of patients with telemedicine was also evaluated by the same study group. Telemedicine patients did not express less satisfaction than those with traditional consultation.<sup>(27)</sup> The safety of using telemedicine was also assessed. The ability to identify secondary headaches over one year of follow up was not significantly different between telemedicine and conventional consultations. The percentage of neuroimaging exams indication, neuroimaging abnormalities, as well as the proportions of hospitalized patients during the follow up period was not significantly different between the two groups. It was estimated that over 20,000 telemedicine consultations are necessary to miss one secondary headache.<sup>(28)</sup>

The feasibility of telemedicine consultations was also evaluated in children with headache. Vierhile and cols. conducted a small open study in which children were evaluated in a spoke site with the presence of a nurse practitioner. The connection was established with a hub center with a specialist. Overall, the headache outcomes were comparable to outcomes with conventional in office consultations. Most of the parents liked not having to drive to the medical center and not having to cancel the activities of the children due to medical consultation.<sup>(29)</sup> Qubty et al. carried out a prospective pediatric headache telemedicine study and showed that telemedicine was convenient, cost-effective, and patient-centered for routine pediatric headache follow-up visits. Overall patients and family were satisfied with telemedicine.<sup>(30)</sup>

The efficacy of telemedicine has also been tested for the management of specific headache types. Bekkelung and Müller compared video consultations and traditional consultations in patients with Medication Overuse Headache (MOH). The group treated with telemedicine had non-inferior outcomes, including reduction in the number of headache days and reduction of analgesic consumption.<sup>(31)</sup> Friedman et al. conducted a prospective, randomized trial of telemedicine for migraine management. Patients were evaluated in an initial in-office visit and then randomized for follow-up with telemedicine consultations or in-office visits. Telemedicine consultations were conducted with specific software installed on a patient choice computer and were carried out by the same physician of the traditional consultations group. The follow-up time was one year. All the measured outcomes, including efficacy of treatment, headache impact, and safety, were similar between the two groups. Physician productivity was higher with

telemedicine group. The perception of convenience by the patients was higher in the telemedicine group. <sup>(32)</sup>

## Mobile health (mHealth)

The use of mHealth has potential advantages as an auxiliary tool in the management of headaches, particularly in patient education and life style modification that are important in the effective treatment of people with headache disorders. The mHealth devices may be a good way to record headache-related symptoms and information such as possible triggers.

Despite the availability of a growing number of smartphone apps, in particular electronic headache diaries, there is still little evidence about its efficacy and safety in handling patient data. Mosadeghi-Nik and cols. carried out a systematic review with smartphone headache diaries, which are presumably easier and more practical to use than paper-based diaries. One reported advantage is that electronic diaries can be filled in real time. Another advantage is that assistant physician can have access patient data through a web portal, also facilitating the database generation. However, the authors point that the evidence of effectiveness and safety of these mobile apps for headache disorders treatment is still limited. <sup>(33)</sup> In a recent narrative review, Stubberud and Linde sought for clinical evidence on mHealth based classical behavioral therapies, such as cognitive behavioral therapy, biofeedback, and relaxation in patients with migraine; however, evidence is still missing in this field. <sup>(34)</sup> In a systematic review, Hundert et al. also evaluated clinical evidence with the use of some available headache diary apps. The authors found 38 headache diary apps but only 18% were developed with headache expertise. Little evidence regarding its effectiveness was found. <sup>(35)</sup> Concern about privacy with headache diary smartphone apps was also reported by Minem et al. that examined 29 apps (14 diary apps and 15 relaxation apps). Only 11/14 headache diaries disclosed privacy policy and 6 stated that user data were used for targeted advertisements. Only 11/15 relaxation apps had disclosed privacy policies. <sup>(36)</sup>

One large and controlled study evaluated the efficacy of a mHealth device in headache management. The value of electronic monitoring and alerting system was assessed in the management of MOH in a controlled multicenter study. In this study, Tassorelli et cols. evaluated the Comoestas tool which is a diary with an alerting system that allows remote monitoring of key clinical data. The system has a headache diary allowing data collection to a web platform, generating high and low priority alerts. The system also facilitates electronic communication with smartphone, e-diary, and E-mail text messages as well as smartphone calls. A significantly higher percentage of patients were overuse-free, there was a lower rate of subjects lost to follow-up, and higher level of patients satisfaction were registered in the group treated with the aid of Comoestas. <sup>(37)</sup>

One study compared the use of paper-based diaries and electronic diaries. Bandarian-Babooch et al. compared two paper diaries (short and long) and four types of electronic diaries. The authors found more missing date

and more errors in data filling in the long paper use than with short paper diary and electronic diaries. Long paper diaries were found more burdensome and significantly less easy to use than electronic diaries and short paper diaries. The authors concluded that electronic diary is a potentially useful tool in clinical trials as well as in the behavioral treatment of headaches. <sup>(38)</sup>

## DISCUSSION

The available evidence shows that telemedicine is effective, convenient, and cost-effective in the treatment of primary headaches. Concern about safety still exists but available published data shows that using appropriate screening tools or a first face-to-face consultation, the safety level is in identifying secondary headaches is similar between telemedicine and conventional consultations. Therefore, there is scientific evidence that telemedicine is viable for primary headache disorders follow-up, allowing higher physician productivity, and it is associated with high level of satisfaction by the patients or caregivers. There is also some evidence that the use of mHealth devices may contribute in monitoring headache, potentially contributing to better outcomes and easier interaction between patient and assistant physician.

The health system impact of using telemedicine in headache care still needs to be measured. Considering that telemedicine is a potentially useful tool in primary care, it can be used in this setting in the management of patients with primary headache disorders. <sup>(39)</sup> Potential advantages would be an earlier introduction of preventive treatments, better orientation for patients in the management of headache attacks, lifestyle change orientation, and analgesics overuse prevention. This would also facilitate the identification of patients requiring treatment at a specialized tertiary center. Despite these potential advantages, there is still need for studies evaluating the clinical and economic impact in health system and how it can facilitate the access of patients to adequate treatments.

The use of telemedicine brings concerns about data security and compliance with local legislations. Most of the available synchronous telemedicine studies cited in this review employed validated and safe telemedicine platforms that allow the storage and inviolability of data, as well as making it available to the patient or guardian upon request. There is still concern about some mHealth devices, particularly electronic diaries, since many of them do not disclose data security policy. Creating and maintaining large headache databases has potential enormous benefits, for example, in generating local and national headache registries that can help to guide public health policies. <sup>(40)</sup> Handling these databanks should be done according to all compliance rules to avoid targeted advertisements. Health Insurance Portability and Accountability Act (HIPAA) established security standards for protecting health information in its electronic form. <sup>(41,42)</sup> The procedures established by HIPAA must be adopted by every app or system dedicated to telemedicine. Regulatory and legal issues regarding telemedicine have specificities around world. <sup>(43)</sup> In Brazil, some general

rules were published in 2002; however, they do not address technological developments and telemedicine advances over the last 17 years. There is a new and more detailed regulation under discussion and it is expected that this regulation with more specific rules, detailing of technological requirements, and better specification procedures will be available until 2020.

In conclusion, the existing evidence favors telemedicine as an alternative in the treatment of primary headache disorders. This modality of delivering medical care may be an option for patients with difficulty in accessing in-office consultations. It is possible that, as in other areas of medicine, telemedicine may increase the access to available headache treatments. The current available treatments are not yet widely available because, among other factors, there are no headache experts in many regions. The use of telemedicine within ethical and compliance parameters by qualified professionals may be incorporated into the treatment of primary headache disorders. Not as a new treatment, but as an agile and scalable way to deliver currently available headache treatments.

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