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Implementation of the hybrid teleaudiology model: acceptance, feasibility and satisfaction in a cochlear implant program

Implementação do modelo híbrido da teleaudiologia: aceitação, viabilidade e satisfação em um programa de implante coclear

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ABSTRACT

Purpose: This article aims to describe the incorporation of teleaudiology in the routine of a highly regarded, government funded, cochlear implantation program and evaluate the satisfaction of users and their families with hybrid assistance. **Methods:** Actions were developed that provided the connection between users and specialists, through the hybrid model of teleaudiology, combining remote practices (synchronous/asynchronous) with face-to-face care. To check patient satisfaction with teleaudiology, the Customer Satisfaction Questionnaire (CSQ) was applied. **Results:** 218 remote appointments and 23 other presential attendances were coordinated, between teleconsultations, guidance and counseling; parent coaching and hearing rehabilitation validation, therapy; troubleshooting, cochlear implant first activations and mappings, intra-operative measures, teleconsultations with specialists and delivery of repaired electronic devices. Of the participants, 36 patients responded to the questionnaire and reported being very satisfied with the services provided in general or in large part (88.9%) and with the amount of care they received (72.2%).This study suggested that, at some point during the pandemic, most patients had their needs met using teleaudiology long term care. **Conclusion:** The hybrid approach to audiology care was feasible, accepted and achieved user satisfaction.

Keywords: Cochlear implant; Patient-centered care; Telehealth; Audiology; Blended care

RESUMO

Objetivo: descrever a incorporação da teleaudiologia na rotina de um programa público referência em implante coclear e avaliar a satisfação dos usuários e de seus familiares com a assistência híbrida. **Métodos:** foram desenvolvidas ações que proporcionaram a conexão entre usuários e especialistas, por meio do modelo híbrido da teleaudiologia, combinando práticas remotas (síncronas/ assíncronas) e/ou atendimentos presenciais. Para verificar a satisfação dos pacientes com a teleaudiologia, foi aplicado o Questionário de Satisfação do Cliente. **Resultados:** foram realizados 218 atendimentos remotos e 23 atendimentos presenciais coordenados, entre teleconsultas para orientação e aconselhamento, *coaching* de pais, terapia para reabilitação auditiva, validação dos resultados, resolução de problemas, ativação e mapeamentos, procedimentos intraoperatórios, teleconsultas com especialistas e entregas de peças de manutenção da tecnologia auditiva. Dos participantes, 36 responderam ao questionário, relataram estar muito satisfeitos com os serviços prestados de maneira geral, ou em grande parte (88,9%) e com a quantidade de atendimentos que receberam (72,2%). Este estudo sugeriu que, em algum momento durante a pandemia, a maioria dos pacientes teve suas necessidades atendidas usando teleaudiologia para cuidados continuados. **Conclusão:** a abordagem de atendimento híbrida em audiologia foi viável, aceita e alcançou satisfação dos usuários.

Palavras-chave: Implante coclear; Cuidado centrado no paciente; Telessaúde; Audiologia; Atendimento híbrido

Study carried out at Universidade Federal do Espírito Santo – UFES – Vitória (ES), Brasil.

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INTRODUCTION

The Covid-19 pandemic, caused by the SARS-CoV-2 virus, was declared a Public Health Emergency of International Concern in January 2020 and in March 2020 it was characterized as a pandemic by the World Health Organization (WHO). Due to the lack of knowledge about this illness, organizations and institutions around the world have developed instructions regarding precautionary measures to reduce the spread of the disease, such as hand hygiene, wearing masks, social distancing and isolation of people with symptoms[1].

In Brazil, around mid-March 2020, elective medical appointments for cochlear implant (CI) procedures were postponed, just like in most countries, all non-essential hearing-related procedures were canceled and/or rescheduled. Despite the suspension of face-to-face activities, it was essential to plan the follow-up of patients with cochlear implants and osseointegrated auditory devices, in compliance with the Government Directive No. 2.776, of December 1st, 2014[2] which was supported by studies that outlined models for the provision of ongoing otologic and audiologic care, aiming to reduce the effects on the speech and language development of patients[3,4].

Thus, by prioritizing the continuity of hearing health services, keeping patients in touch with the professionals and the programs, it was possible to make a positive impact on the lives of patients who have treatment-related expectations, such as the activation of cochlear implants, in order to be able to hear for the first time, or follow-up appointments for adjustments/ speech mappings, or to repair issues associated with speech processors and further demands related to monitoring the aural rehabilitation[4-6].

Considering the need to adapt to the new reality of social distancing and the circumstances prior to the pandemic, which required the provision of assistance in a safe, consistent and innovative way, teleaudiology was used as a strategy to mitigate infection. The purpose of this article was to describe the implementation of a hybrid hearing health care that covers cochlear implant programs, as well as to evaluate the satisfaction of users and their families/guardians with the services provided.

METHODS

The present study was approved by the Research Ethics Committee of the Federal University of Espírito Santo, under No. 41219620.1.0000.5071. All individuals involved or their respective guardians signed the Informed Consent Form (ICF) for teleaudiology. This is a cross-sectional epidemiological study. Seventy patients who underwent follow-ups in the cochlear implant program during the months of March 2020 to January 2021 were included. The activities were conceived through the selection of materials and according to the best clinical practices for patients with hearing loss, users of CI at all ages[5,6]. The activities were developed in customized stages, to better take advantage of the use of alternating modalities, which combined face-to-face, synchronous and diverse asynchronous situations[7].

Telephonoaudiology describes six main activities, but is not limited to them and, among these, the following activities were chosen for the program continuity: 1) interpretation services: they are services at geographical and/or temporal distance, with the transmission of graphs, images, sounds and data, for the issuance of a report or opinion by a speech-language pathologist with expertise in the area related to the procedure; 2) teleconsultation: it is the appointment/speech therapy, mediated by Information and Communication Technologies (ICTs), with the speech-language pathologist/ audiologist and the client based in different geographical spaces; 3) telemonitoring: consists of monitoring health and/or disease parameters (within the scope of the speech-language pathologist's/ audiologist competence) through ICTs and devices that can be aggregated or implantable in clients.

Accordingly, heeding the main activities established in Brazil[7], both information and communication technologies were used by the speech-language therapy team and other specialized areas that make up the program's staff, including social assistance, psychology and nursing, for the subsequent models of distance service provision:

1) Synchronous: real time interaction, for multiple specialties appointments. Used for guidance, counseling, parent coaching, therapy, validation of results, activation and speech mapping of cochlear implants, performed by an audiologist;

2) Asynchronous: data collected, stored and sent in real time. Interpretation services of intraoperative objective measures for cochlear implant surgeries, performed by a non-specialist professional; sharing of educational materials for guidance as well as counseling to parents and family members, surveys, tutorials to troubleshoot hearing aid issues; telemonitoring of the hearing devices' daily use records;

3) Automatic: use of self-directed software/applications for auditory skills training, monitored by audiologists;

4) Hybrid: offer of a combination of face-to-face/real-time activity, with asynchronous activities for patient rehabilitation or patient/family education/guidance, problem solving/maintenance.

Figure 1 shows a didactic example of the referred service delivery modalities that can be implemented in the care of patients with hearing loss contemplated by the cochlear implant program.

All factors that could influence the advantage of teleaudiology were taken into consideration: physical technological infrastructure and connectivity, which are critical components, as well as the use of trained human resources[8]. The team was prepared with the necessary skills to choose the materials required for each patient/care profile, in order to comply with the technical standards of data storage, handling and transmission, ensuring confidentiality, privacy and professional secrecy, in accordance with the General Personal Data Protection Law (LGPD, Portuguese acronym for "Lei Geral de Proteção de Dados Pessoais") and the use of an institutional platform[6,7,9,10].

In this context, the selection of the patients profile[11] was carried out by an analysis of the patient clinical records as to consider their minimum capacity for attending a remote activity, taking into account the physical, sensory and cognitive conditions, the demand/possibility of the presence of a facilitator[6] as well as the acceptance of the remote modality of the ICT-based services[8-10].

As for the synchronous activities, protocols similar to face-to-face interaction were created, which provided comfort and confidence to patients, who were able to test the new setting

Figure 1: Asynchronous mode

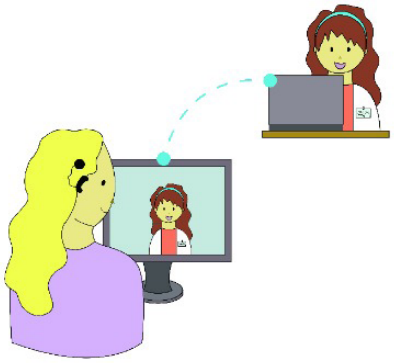

Figure 2: Synchronous mode

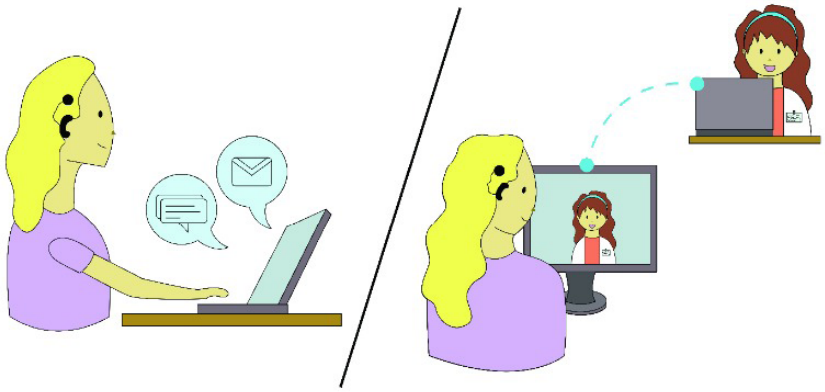

Figure 3: Hybrid mode

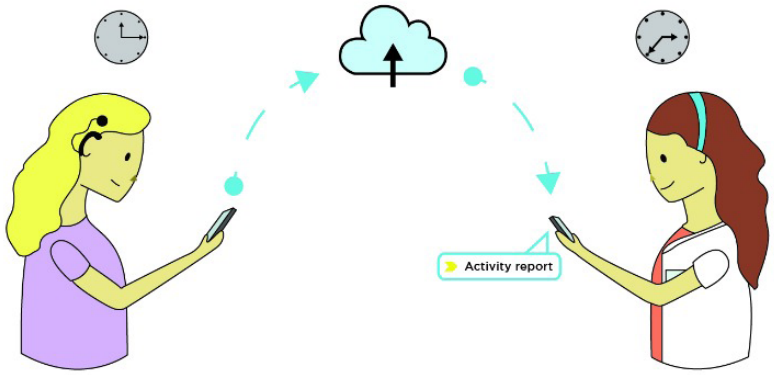

Figure 4: Automatic mode

Figure 1. Modalities of teleaudiology. Person with cochlear implant on the left and professional speech-language pathologists on the right

before the first appointment. This and other arrangements were previously presented to users who were candidates for remote care, in a checklist format to be completed, so that the conditions were appropriated to the remote modality and the assistance effectively equivalent to the face-to-face services[6,8].

The information provided to the patients was presented in a language appropriate to their profile as service users, easy to read and to understand, along with other accessible information. Activities such as message exchanges, gamification, sending of tasks/surveys, sharing of offline materials[5] and use of applications for hearing training on mobile devices allowed for the implanted patients continuous process of rehabilitation and encouraged the use of these modalities to all patients who accepted non-presential care at some point of the social distancing scenario. Therefore, activities were implemented using teleaudiology to comply with the traditional routine of a cochlear implant program at various stages of the patient's journey. After the appointments, aiming to record the satisfaction of teleaudiology patients during the pandemic, the Customer Satisfaction Survey (CSS)[12] was sent online, through an institutional messaging

app, without identifying the patient, that is, anonymously, minding only the "patient of the service" "family caregiver of the patient contemplated by the service" fields.

RESULTS

Sociodemographic and clinical characteristics

Seventy patients and family caregivers linked to the cochlear implant program were assisted, aged between 1 year and 76 years (mean age=23.27 SD± 23.39), 27 adults and 43 children, accompanied by their legal guardians; 30 participants considered themselves as female and 40 as male.

Of the 70 patients treated, 12 were in pre-surgical evaluation, 66 were already users of CI (55 with bimodal hearing and 4 users of bilateral CI). All patients reported to have access to the internet and met the eligibility criteria[11], including the presence of a mediator/facilitator[6]. All subjects accepted the ICT-based remote care[9-11] and participated in the proposed activities.

Hybrid appointment systems

A total of 218 remote appointments and 23 coordinated face-to-face visits were conducted. The same patient, in some cases, participated in more than one session for the same activity, bearing in mind that parent coaching, guidance/counseling and therapy are types of continuous care and sometimes presented an unexpected demand. In addition to the alternation of face-to-face and remote activities, interchange between the remote modalities was offered. Chart 1 shows the services provided during the period and the modalities related to them.

Therapy for individual aural rehabilitation

For adults who underwent CI activation during this period, 8 remote appointments were proposed, after activation, for synchronous auditory training combined with automatic/asynchronous auditory training.

Parents coaching

For children up to 2 years of age, the choice of parent coaching was the central methodology and required the active participation of parents during the session. The parents then learned to become the main facilitators of the communication of their child.

Cochlear implants troubleshooting

The resolution of technology issues was performed both by the parents of children with CI and by adult patients, who identified the problems and sought help from the program to check the processors and accessories.

Activation and speech mappings

Reaching a higher level of complexity among the services provided, remote mappings of cochlear implants were carried out. These procedures are part of the protocol for monitoring patients with CI that, especially after surgery, require periodic follow-ups for activation, new psychoacoustic measurements, telemetry and monitoring of progress.

Adjustments were made to include the definition of hearing threshold levels (level T) and maximum comfort level (level M or C), through a behavioral evaluation, as well as the objective tests, remotely performed[13], with a rigorous protocol as to control the situation, monitored by a two-way communication device using audio/video, remote access to the *software*/interface and support from the trained facilitator[14,15].

Intraoperative procedures

The intraoperative procedures[16,17] were performed with the presence of an audiologist as a facilitator in the operating

Chart 1. Summary of the performed activities

Service	Remote appointments	Face-to-face appointments	Activity modality
Audiological Guidance and Counseling (pre and post-surgical)	35	-	synchronous
Auditory training as well as evaluation of the results of adolescents and adults*	36	-	synchronous/asynchronous/ automatic
Parent Coaching	86	-	synchronous
Troubleshooting hearing aids	25	-	Synchronous and asynchronous
CI Activation and Speech Mapping**	6	1***	synchronous
CI Intraoperative procedures****	3	-	synchronous/asynchronous/
Specialist's teleconsultations*****	87	-	synchronous
Delivery of auditory aid maintenance parts	-	22	face-to-face
Total	218	23	

*six patients performed an eight-session program; **delivery of interface materials to allow accessibility; ***mapping; ****two synchronous and one asynchronous; *****other non-phonoaudiological areas

Caption: CI = cochlear implant

room, with a notebook and specific interfaces to each hearing aid brand. A professional specialized in audiology coordinated the procedure remotely on another computer, with access as well as remote control of the notebook used at the operating room, relying on a video call for interacting with the site and monitoring of the test conditions. The facilitator placed the antenna inside a sterile plastic container, approached the stimulator receptor to the patient's head with the help of the surgery team, and waited for the intraoperative procedures led by the audiologist in charge, being mindful of the information obtained by the facial nerve monitoring and by observing the patient.

The appointments were held according to the elective follow-up planning, but also meeting the patients personal urgent demands, including the assistance from various specialties of the multidisciplinary team, namely speech therapy (n=49), nursing (n=28), psychology and social work (n=10). The required face-to-face sessions took place at a pre-scheduled time, using every safety protocol recommended by the WHO[1].

Activities with audio and video input can present a challenge for people with hearing loss, due to the possible existence of degration and delay, which in turn requires a greater listening effort. Consequently, several strategies and tools were implemented to optimize teleconsultation. Examples include the use of instant subtitles and lessons on the use of technologies such as remote microphones along with other connectivity systems to improve the signal-to-noise ratio. These actions demanded a greater commitment from the professionals, regarding the explanation of the technology use, in order to provide a full understanding of the program to the patients.

Patients and family members satisfaction with the services

Of the 70 patients treated during this period, 36 answered the satisfaction survey[18] which was sent through an online form. The patients reported being very satisfied with the services provided as well as with the number of appointments they had, which was observed in the amount of responses rating "in general" and "in large part" (88.9%). The majority stated that they would resort to the program again if they needed help, and would recommend it to other patients with hearing loss (72.2%). The patients also stated that the services received helped them to deal effectively with the problems they experienced at the time which could not be solved with face-to-face assistance (83.3%). Chart 2 presents the results obtained with the patients (n=36) who answered the survey.

DISCUSSION

The Covid-19 pandemic gave rise to an unprecedented moment for updating and innovating cochlear implant programs practices through remote appointments. Considering the organization of cochlear implant medical centers with elective and urgent face-to-face health care, the proposed alternative allowed to attend to the vast majority of patients and their families, welcoming demands in a personalized way, for activation, speech mapping, checking devices, guidance/counseling and therapy for auditory training and language development[18,19].

Intervention

People who undergo cochlear implant (CI) surgery should spend some time learning to use the new sounds they hear. This rehabilitation includes device programming, formal evaluations and counseling, requiring many follow-ups, especially in the first year after surgery.

The use of good quality internet resources and the interaction by audio, video as well as exchange of messages between patient,

Chart 2. Customer satisfaction survey

Questions	Answers in % (n=36)			
1. How would you rate the quality of the service you received?	Excellent	Good	Regular	Weak
	61.1	33.3	5.6	NA
2. Did you receive the type of service you wanted?	Most definitely, yes	Mostly, I think	Not exactly	Definitely not
	50.0	41.7	8.3	NA
3. To what extent has our program met your needs?	Almost all	The majority	Just a few	None
	41.7	47.2	8.3	2.8
4. If any other patients needed help, would you recommend our program to them?	Most definitely, yes	Yes, I think so.	No, I don't think so	Definitely not
	72.2	22.2	2.8	2.8
5. How satisfied are you with the amount of help you have received?	Very satisfied	Satisfied for the most part	Indifferent or slightly satisfied	Fairly dissatisfied
	66.7	22.2	5.6	5.6
6. Did the services you received help you deal more effectively with your problems?	They helped a lot	They helped a little	They did not help	Looks like they made things worse.
	83.3	13.9	2.8	NA
7. Overall, how satisfied are you with the service you have received?	Most definitely, yes	Satisfied for the most part	Indifferent or slightly satisfied	Fairly dissatisfied
	63.9	25.0	8.3	2.8
8. If you needed help again, would you turn to our program?	Most definitely, yes	Yes, I think so.	No, I don't think so	Definitely not
	75.0	22.2	2.8	NA

Caption: % = percentage; n = number of participants; NA= no answer

family and professionals allowed for an alternative method of providing health care, mainly for rehabilitation through parent coaching[20-22] along with the rehabilitation of adult CI users[20,23], in addition to enabling a patient/family centered planning. The contemplation of care with a family-centered approach respects preferences as well as values, engages family/friends, reinforces shared decision-making, proposes the establishment of goals and prioritizes the free exchange of information[6], making the patient more involved in their own process, as a whole.

Many hearing training programs are available for download via computer, web-based applications, and even through smartphones apps[14]. Hearing training that use the internet or applications, that can be executed by the patient at home, can significantly improve speech recognition, also enabling high customization of the proposed work as a complementary tool[24,25].

Mobile Health (mHealth) has been growing rapidly due to the use of personal mobile devices, such as smartphones or tablets, furthermore, the popularity of apps concerning hearing health care has gained much visibility and endorsement[20].

Parent coaching

By means of the remote activity, it was possible for families to passively observe while the professional interacted with the child. Some studies[22] report that families involved in distance activities have significant improvement regarding the scores of involvement between parents and children, when compared to the face-to-face groups[26].

Cochlear implant troubleshooting

Parents of children with CI tend to report concerns related to the development of speech and language, due to a possible non-detection of a device failure and maintenance issues on the part of the child. Adults are able to identify these problems and look for assistance to check the speech processors and other accessories[23]. These procedures are part of the face-to-face routine and were replaced by synchronous remote demonstrations of device use and handling, presented by video tutorials that described the components, guided the operation test of specific parts and made it possible to identify the need for specialized technical analysis along with the replacement of parts. In these cases, the patients were asked to schedule the delivery and removal of the physical processor within the program services, through the drive-thru system[6,11]. The demand for services regarding the replacement of parts, repair and revision of speech processors had a substantial increase in the pandemic period, given the quick awareness of the family about possible issues of new user habits at home.

Activation and speech mappings

These procedures are part of the protocol for monitoring patients with CI that, especially after surgery, require periodic returns for activation, new psychoacoustic measurements, telemetry and monitoring of progress.

As a consequence of the interface limitation and portable equipment available from cochlear implant companies, along with the distance from the patient place of residence to the headquarters of the CI program, it was not possible to meet the entire demand, that is, the limitation of the users regarding the technology and the distance prevented the incorporation of this routine, causing delay in some follow-ups[14].

Studies determine that the parameters found in the surveys for remote programming of the speech processor and further objective tests (electrode impedance and electrically evoked compound action potential) are equivalent to those obtained in face-to-face conditions. On the other hand, the evaluation using speech perception test is more challenging as to the control of the test environment[13,15].

Intraoperative measures

Intraoperative monitoring during surgery has been routinely performed in the cochlear implant program. In this study, in order to analyze the integrity of the device, determine whether there are measurable neural responses, collect information for prognosis and evaluate changes in auditory nerve response over time, intraoperative impedances were measured on all electrodes, as well as The Neural Response Imaging (NRI)/Electrically evoked compound action potentials (ECAP), measurements were recorded at the time of surgery[16]. The evaluation demonstrated that the remote test of the cochlear implant device along with the patient response to electrical stimulation are technically feasible, and the test can also be performed by the general practitioner speech-language pathologist to be analyzed by the specialist speech-language pathologist. The procedure may be useful for cochlear implant programs with limited audiological support, or for programs that seek to expedite intraoperative device testing protocols[16].

Satisfaction of the support with teleaudiology

Given the efforts and services provided, it was necessary to evaluate patient satisfaction with the quality of services and other related variables. Although not all patients gave their assessments on the survey, the analysis was performed based on 51.4% of the treated patients. This fact may indicate a limitation in the generalization of the findings, which indicates the need for further studies with more details, according to the offer of services/activities. Previous investigations found, in their results, that satisfaction with the experience of using telehealth techniques for CI care was considered extremely positive for patients and audiologists[14,17].

A similar study, conducted in Japan, evaluated the satisfaction of 20 patients who had been using cochlear implants for at least one year, with teleaudiology. Among those evaluated, 80% reported being satisfied with the provision of services and 85% agreed to perform it again. In this study, which involved patients with experience using such technology ranging from one month to seven years, we found relatively higher values of satisfaction (88.9%), and almost all individuals would use it again (97%). However, it cannot be said that teleaudiology is for all, or that every patient or user prefers the remote modality than face-to-face appointments[27].

The lowest values found in this research refer to the quality of care, although all protocols have been considered to verify the conditions of assistance via the internet, to ensure effectiveness. It is believed that some human factors, such as the permeability to change from the face-to-face circumstances to online, the lack of previous experience with remote appointments and other technical issues, such as, for example, the vulnerability of the user's internet network at the moment, may have impacted the results found[28].

Although digital proficiency was not measured in this study, this factor may favor or limit to a greater or lesser extent patient satisfaction with remote care. Digital literacy is not a predictor for adherence to audiological services in the hybrid modality of care for the hearing impaired. A recent study[29] found that more than digital skills, age was an indicator of acceptance of patients from hybrid hearing care services. The older the patient is, the more likely they are to continue with their hearing health care and accept intervention offered at a distance for a longer period of time.

By strategically considering the inclusion of providing hybrid services to patients in need of long-term care, such as cochlear implant users, audiologists can increase patient access to services and support with their self-care management for their daily hearing needs, increasing patient confidence, engagement and satisfaction. The potential benefits[30] are evident, such as more stable hearing (problems identified and resolved more quickly), better hearing (fine-tuning ability when outside the clinic), convenience of not needing to travel or maintain social distance, when mandatory, avoiding sick leave from work/school, or changes in the family routine. Among other factors, the use of teleaudiology in this study reduced transportation and time costs for patients and professionals, which translates into convenience for both ends, in addition to filling the local gap of specialists in hearing rehabilitation.

Despite this convergence of evidence in support of teleaudiology appointments, they may not be suitable for all patients. It is important to distinguish each individual and determine the model that best fits the moment, in order to obtain the greatest benefit in the long term, in relation to clinical results, safety and personal privacy. The combined approach to follow-ups can provide an effective and high-quality service, regardless of the type or modality of assistance delivery.

CONCLUSION

The use of the hybrid modality of teleaudiology was feasible, considering that the activities and services were restructured and maintained, ensuring continuous assistance during the pandemic. Qualitatively, the following benefits were identified: better and faster user access, significant improvement of cost-benefit, personalized care and diversification of offer of hearing rehabilitation services. Regarding satisfaction, most patients reported being "very satisfied" and "mostly satisfied", totaling 88.9%, and almost all patients would use the offered services again (97%).

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