A GUIDE TO REMOTE WORKING IN AUDIOLOGY SERVICES DURING COVID-19 AND BEYOND

Evidence based practice: what works and why?

Contents

Introduction.

Telehealth, often referred to interchangeably as telepractice, telemedicine, and ehealth, can be broadly defined as “the use of communications technologies to provide and support health care at a distance” (National Institutes of Health, 2016). Telehealth is not a separate medical specialty, it is simply an adaptation of how healthcare is delivered (Krupinski, 2015). While health outcomes from care provided via telehealth should meet or exceed those achieved with face-to-face care, telehealth has the potential to yield better outcomes on other metrics such as patient and provider satisfaction, patient access, clinical efficiency, travel and clinical costs, and wait times. To what extent, do data support positive outcomes for teleaudiology?

There are four models of telemedicine, each of which has been in audiology for providing services: (a) synchronous/real-time data collection in which the patient and provider connect in real time via for example, a video teleconference, (b) store and forward telehealth in which data are collected at one location by a technician and are then sent later to a specialist for interpretation and diagnosis, (c) remote monitoring in which data are collected through a device worn by the patient and monitored remotely by a provider, and (d) mobile health in which smartphone applications (apps) or other software are used by the patient to self-manage their condition independently of a provider (Jacobs and Saunders, 2014).

The literature reviewed below addresses only that pertinent to procedures that can be carried out either by the patient alone (e.g. online testing, apps, etc.) or via synchronous care with a clinician in one location and the patient in another because we are focusing on evidence for practice that can be applied now, during the COVID-19 crisis. For this reason, procedures that require an intermediary to run a test or take a measurement (e.g. remote otoscopy or use of certain threshold measurement apps), have been excluded.

The literature about eight forms of teleaudiology is discussed: (i) Audiometric evaluation, (ii) Hearing aid programming and fine tuning, (iii) cochlear implant programming, (iv) paediatric care, (v) tinnitus management, (vi) attitudes towards teleaudiology, (vii) remote risk assessment, and (viii) mobile health interventions.

1.1. Audiometric evaluation for adults

Remote assessment of pure tone hearing thresholds has been limited by the need for calibrated headphones and a sound attenuated environment. Currently there is no validated method for assessing pure tone thresholds remotely without provision of special equipment. It should be noted however, that a systematic review conducted by Mahomed et al. (2013) showed that methodologically the differences in pure tone hearing thresholds obtained for conventional manual and automated air conduction audiometry were small (mean: 0.4dB, SD: 6.1 dB) when calibrated equipment was used and they did not differ from typical test–retest differences obtained with conventional manual audiometry (mean: 1.3 dB, SD: 6.1). Thus, methodologically the accuracy of remote audiometry is sound, although a method for overcoming the need for calibrated signals and transducers remains. Audiometric assessment has therefore been limited to suprathreshold testing or in-situ audiometry using signals delivered via a hearing instrument.

Suprathreshold testing has been widely used for screening using digits presented in background noise (Digits in noise test; DIN). Rather than measuring a hearing threshold, DIN tests measure a signal-to-noise ratio for a fixed level of performance from which hearing thresholds can be estimated. DIN data are available for versions used in the Netherlands (Smits et al, 2004), Belgium (Jansen et al., 2013), US (Folmer et al., 2017), South Africa (Potgieter et al., 2016), and Australia (Dillon et al., 2016). It has been used for testing conducted via the telephone (Smits et al., 2004), a computer (Folmer et al., 2017) and a smart phone (Potieger et al., 2018). Studies have shown that the sensitivity and specificity of the DIN for identifying hearing loss is high, being >0.85 for both in most studies (Folmer et al., 2017; Potgieter et al., 2018, Jansen et al., 2013, Dillon et al., 2016). The test, however, is not entirely independent of familiarity with the language in which the testing is being conducted (Potgieter et al., 2018). Further, scores on the DIN have been shown to correlate significantly with pure tone thresholds measured using conventional audiometry (Koole et al., 2016; Dillon et al., 2016). The DIN is thus a well-validated measure than can be used for self-assessment of hearing loss. The DIN has recently been used for home-based assessment among adult cochlear implant users (de Graaff et al., 2018). The results demonstrated no difference in performance between home-based and clinic-based performance; thus, it is feasible for experienced CI users to perform self-administered speech recognition tests at home.

In-situ audiometry allows testing of pure tone thresholds using signals generated by a hearing instrument. It has the advantage that the signals are presented through the same coupling and transducer as will be used for amplification (Convery et al., 2015). There are few studies on the validation of in-situ audiometry. Boyman and Dreschler (2017) reported that hearing thresholds obtained via in-situ audiometry and conventional audiometry with one particular hearing aid was comparable, while Kiessling et al. (2015) showed more variation in findings. They measured thresholds for 30 individuals with hearing loss via conventional audiometry and in-situ audiometry using hearing aids from four major manufactures (Resound, Phonak, Starkey, and Oticon). They found that the in-situ thresholds overestimated severity of hearing loss at low frequencies and underestimated it at higher frequencies. There were also large variations across each manufacturer's hearing aid, and there was an interaction between the error and degree of hearing loss. The hearing aids evaluated in this study were manufactured over five years ago. It will be interesting to find out whether in-situ audiometry with newer models of hearing aid yields more comparable findings.

Data collected by Convery et al. (2015) raise the importance of individual differences in cognition and education level for self-administered audiometry. Although they examined individual factors that impacted the ability of participants to independently conduct in-situ audiometry, their findings that cognitive function and education level significantly impacted outcome presumably apply to some degree or other to all self-administered testing.

1.2 Hearing aid programming and fine tuning

A recent systematic review of teleaudiology services for rehabilitation of adults with hearing aids concluded that of the 14 available studies, none demonstrated strong methodological quality or high quality of evidence (Tao et al., 2018). Individual studies however, report that outcomes following remote hearing aid programming are equivalent to those obtained via face-to-face encounters (e.g. Campos & Ferrari, 2012; Pentaedo et al., 2014; Pross et al., 2016), although in these studies hearing aid adjustments were made by a technician at the same site as the patient with instruction from a remotely located audiologist. A more recent study, however, has shown good outcomes for hearing aid remote programming conducted via a manufacturer-specific app (Convery et al., 2019). Indeed, most major hearing-aid manufacturers now have apps available that allow the audiologist to program hearing aids remotely, some of which are now available from the NHS. Despite the absence of high-quality evaluations of these apps, there is no reason to believe outcomes will differ from programming conducted in the clinic. In fact, because the patient is in their home environment when evaluating the settings, there is the possibility that outcomes will be better than for clinic-based programming.

1.3 Cochlear implant programming

The data regarding remote programming of cochlear implants is relatively comprehensive, with numerous studies showing that both performance outcomes and subjective outcomes are the same for face-to-face programming as for remote programming, with or without a facilitator present at the remote site (Slager et al., 2018; Schepers et al., 2019; Luryi et al., 2020). Further, remote testing does not compromise safety (Schepers et al., 2019) and patient satisfaction is high (Kuzovkov, et al., 2014). In the above studies, programming adjustments were made by an audiologist, however, two studies show good outcomes for patient-made adjustments also (Cullington et al., 2018; Vroegop et al., 2017).

1.4 Paediatric care

Several studies have compared results of pure tone hearing screening using a tablet or computer with results obtained using in-person screening audiometry for children aged three and older (Kam et al. 2014; McPherson et al. 2010; Botasso et a., 2015; Khoza-Shangase and Kassner, 2013). In general, the results of screenings conducted using a tablet or computer yielded acceptable sensitivity and specificity relative to those conducted in-person, although unsurprisingly, age effects are evident, especially among very young children (see Kam et al, 2014). In a slightly different vein, McCarthy et al. (2019) report the findings of a scoping review of telepractice, i.e. care provided using telemedicine, delivery of family-centred early intervention for children who are deaf or hard of hearing. They concluded that while challenges arose, the literature indicates that telepractice can be an effective model for delivering family centred early intervention for children who are deaf or hard of hearing. The DIN test has also been used to successfully assess the hearing of children (Koopmans et al., 2018), although adult norms would have to be adjusted for a paediatric population.

1.5 Tinnitus management

Audiologist-guided internet-based tinnitus management has been shown to be effective in at least two randomized controlled trials (RCTs). Beukes et al. (2018) found that after participating in an internet based cognitive behavioural therapy (CBT) program, individuals randomized to the intervention group had a significantly greater reduction in tinnitus distress, insomnia, depression, hyperacusis, cognitive failures, and a greater improvement in quality of life compared to those in the control group. The group differences were maintained at 2-months post-completion of the intervention. Likewise, Henry et al. (2019) showed similar for an RCT that used the telephone to provide progressive tinnitus management (PTM) which consisted of a combination of CBT and therapeutic sound intervention. Individuals in the PTM group had significantly better outcomes than the waitlist control group in terms of reduced distress from their tinnitus, anxiety and depression and increased self-efficacy for managing their tinnitus. Finally, a review by Guitton (2013) concluded that telemedicine can be beneficial to supporting tinnitus management at the point of screening and diagnosis, providing therapies and for long-term monitoring and support.

1.6 Attitudes towards teleaudiology

In 2014, Singh et al. reported the findings of a survey of 202 hearing providers in Canada regarding their attitudes towards teleaudiology. At that time, although more than 80% of respondents were willing to use teleaudiology for answering patients' questions about hearing loss and hearing aids, and more than 50% were willing to use it for counselling and auditory rehabilitation (AR) classes, fewer than 10% were willing to use it for hearing assessments, cochlear implant mapping, or fitting a hearing aid for a first time user. Moreover, 40% considered teleaudiology would have negative impacts on relationships with a new patient, the ability to discuss private topics, and the quality of their interactions with patient. On a positive note, however, over 50% believed teleaudiology would positively impact wait time, access, patient travel, and the how the profession of audiology is viewed. There were differences with whom audiologists were willing to use teleaudiology, such that about 50% were moderately willing to use it with adults aged between 18 and 65 yr., less than 20% were willing to use it with children younger than 12 yr. and adults over age 80 yr.

A more recent survey of 258 hearing practitioners (Kimball et al., 2018) focused on the willingness of practitioners to allow their patients to use a smartphone to make hearing aid adjustments, send messages, etc. Just 20% of practitioners were very or extremely willing to allow patients to use a smartphone to make permanent hearing aid adjustments to their main hearing aid program, and ~50% were very or extremely willing to allow the patient to add additional programs and use the phone to send messages to the practitioner. On the other hand, ~80% or more were very or extremely willing to allow the patient to use a smartphone for videoconferencing, making volume adjustments, and scheduling appointments. Their willingness was associated with years in practice, with newer practitioners being willing to give patients less autonomy than more experienced practitioners.

A qualitative study by Ng et al. (2017) examined the opinions clinicians and patients about smartphone connected hearing aids, all of whom had experience with their use. They learned that while clinicians take prior experience with technology into consideration, they do not use this to rule out such technology for those with little or no experience. The clinicians reported that in the process of fitting connected hearing aids, they got to know their patients better because they asked more in-depth questions about lifestyle and preferences when selecting and fitting the aids and they were hopeful that by associating hearing aids with a smartphone, hearing aids might become more socially acceptable and less stigmatizing. Patient interviews reflected similar opinions.

Two other studies have examined patient attitudes to teleaudiology. In one, (Eikelboom and Atlas, 2005) 116 individuals were surveyed about their willingness to use telemedicine for hearing-related appointments. At the time the data were collected, only 75% of respondents were aware of the possibility of teleaudiology. Just 30% said they would be willing to try teleaudiology for a hearing aid related appointment, although an additional 10% said it could be appropriate for other hearing-related services, citing the desire for face-to-face interaction and a sense that appointment quality would be diminished as reason for their lack of enthusiasm. A more recent study (Ratanjee-Vanmali et al., 2020) reported patient satisfaction with a hybrid model of audiological care that combined an online hearing screening test, face-to-face audiological assessment and hearing aid fittings and web-based audiological rehabilitation. Of the individuals who completed an online satisfaction survey, over 90% agreed or strongly agreed that the test was simple, quick and informative, and said that the test had prompted them to seek care. Of those who went on to receive online rehabilitation, 89% said it was helpful. A hybrid model of service provision would thus appear to be feasible and acceptable. Indeed, there are now companies providing hearing health care in this manner.

1.7 Remote risk assessment

A major concern about remote-only audiology practice, such as in the case of direct-to-consumer hearing aids, is that in the absence of a medical evaluation, including otoscopy, ear diseases will go unnoticed resulting in serious adverse health consequences. In general, the prevalence of medical conditions that require medical intervention is low in the general population. For example, the prevalence of chronic otitis media is 4.5%, cholesteotoma 0.01%, and vestibular schwannoma or other retrocochlear 0.002% (see Zapala et al., 2010 for prevalence of other conditions also). Using data from medicare beneficiaries in the US, Zapala et al. estimate that fewer than 11% of patients complaining of hearing loss would be expected to have active otologic disease/medically treatable conditions affecting their hearing. Nonetheless, if remote-only audiology is to be safe, there is a need to distinguish symptoms that are red flags for serious conditions from those that are not. To that end, Kleindienst et al. (2016) conducted a literature review to identify conditions likely to occur in adults complaining of hearing loss and their consequences. They identified 104 conditions, including malignant external otitis, cholesteatoma and facial neuroma that would be important to detection prior to adult hearing aid fitting. The key symptoms associated with these conditions were documented, and a questionnaire was developed that consisted of questions aiming to identify these symptoms. Because many of the presenting symptoms for these conditions are similar, for example asymmetric hearing loss and sudden onset hearing loss, the resulting questionnaire, known as the Consumer Ear Disease Risk Assessment (CEDRA), consists of just 15 items. The items require a combination of yes/no responses and multiple-choice responses. The CEDRA has been validated in several ways. First, it has a reading grade level of 5.7 (equivalent to UK year 6-7), which falls within the recommended reading difficulty level for health materials and is better than most other hearing and health questionnaires (Klyn et al., 2019). Studies have shown the sensitivity of the CEDRA to vary from 76% to 91% and the specificity from 72% to 80%, depending on the test sample and computations used (Kleindienst et al., 2017; Klyn et al., 2018). To our knowledge its validity has not been assessed with at-risk populations; however, further research is ongoing to test and refine the tool.

1.8 Mobile health and other interventions.

Instruction and education. Providing instruction and education via telehealth is relatively well established through the use of multimedia online materials developed by researchers (Ferguson et al., 2016) and provided by hearing aid manufacturers on their websites. The materials of Ferguson and colleagues have shown benefits regarding patient knowledge of hearing aid handling skills, hearing aid use among suboptimal users, and self-efficacy for self-management (Ferguson et al., 2016; Gomez and Ferguson, 2020). Presumably, but not yet evaluated, the online videos provided by most hearing aid manufacturers are valued by their clients. However, caution should be applied when using materials that were not developed with principles of health literacy in mind.

Online rehabilitation programs. Online auditory rehabilitation programs, such as that of Thorén et al (2014), have the possibility to provide remote support to new hearing aid users. Thorén et al. reported decreased hearing handicap and increased hearing aid use in individuals who attended a 5-week online rehabilitation program that consisted of self-study, training and professional coaching in hearing physiology, hearing aids, and communication strategies, and online contact with peers, relative to those in a control group.

Photo sharing. Photo sharing is the use of patients' personal photos to facilitate communication, understand needs, and enhance audiological counselling. It is a novel way to provide remote support to patients who are struggling with aspects of their hearing aids. Saunders et al. (2019) showed photo sharing facilitated highly tailored counselling and provision of evidence-based recommendations for hearing assistive technology, enhanced interaction between communication partners, provided insight into participants' lifestyle and communication needs, and seemed to generate rapport and trust. Recently, it has been suggested photo-sharing could be used to troubleshoot hearing aid insertion, fit and feedback problems by having a patient compare a photo taken of their (possibly mis-inserted) hearing aid in their ear with one taken by the audiologist of the correctly inserted hearing aid.

Auditory training (AT). The evidence for the efficacy and effectiveness of computer-based AT for hearing aid users is poor (Henshaw & Ferguson, 2013; Saunders et al., 2016). Computer-based AT outcomes for cochlear implant users is better, with effects in the region of 10% points or less or ~2 dB SNR for trained materials (Stacey et al., 2010; Schumann et al., 2015; Green et al., 2019). It is also possible that AT may increase communication efficacy or decrease listening effort rather than improve speech scores, and many individuals enjoy the training. There are many computer-based At programs available and since there is nothing to suggest that the costs of using AT outweigh the perceived benefits, if a patient wants to engage in AT, there is probably no need to discourage it (Saunders & Chisolm, 2015).

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