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Title
Rethinking the Standard Approach to Audiometric Testing

Permalink
https://escholarship.org/uc/item/7x7682dp

Journal
The Hearing Journal, 74(1)

ISSN
0745-7472

Authors
Kozin, Elliott D
Feng, Anne Y
Franck, Kevin

Publication Date
2020-12-01

DOI
10.1097/01.hj.0000725060.32427.92

Peer reviewed

Telemedicine for Hearing Loss

By Fan-Gang Zeng, PhD

The original goal of telemedicine was to enable those who live in remote or underserved areas to access adequate medical care and service. The COVID-19 pandemic has greatly expanded the targeted audience of telemedicine. For example, many elderly individuals who need hearing care the most during this pandemic are not willing or able to go to traditional clinics out of fear of infection or hiatus of non-essential care (*Hearing Journal*. 2020;73[6]:6-8). The movement toward telemedicine has also been accelerated due to its heightened attention, acceptance by the health care providers, expanded reimbursement by insurance companies, and relaxed policies on wearable and over-the-counter medical devices by regulatory agencies.

Now, the key question is: Are technologies good enough to support safe, effective, and satisfactory telemedicine in hearing health care? Here, I argue that the answer is yes for most essential hearing care and service.

Let us first examine the audiogram, which measures hearing thresholds as a function of sound frequency from 120 to 8,000 Hz. A good audiogram requires a calibrated audiometer, a quiet test environment such as a sound-treated booth, and an audiologist who knows how to operate the audiometer. Out of nearly 100 online hearing tests or apps, at least three use high-quality and relatively cheap consumer electronics such as iPad and Sennheiser headphones to achieve sufficiently accurate audiograms without any professional intervention at home (e.g., HearX, P.A.R.T., and SHOEBOX). As audiological evaluation moves away from the audiogram to functional speech in noise recognition tests, the need is further diminished for calibrated equipment, a quiet environment, and trained professionals.

Otoscopy and tympanometry are critical to diagnosing a middle ear infection, the most common cause for children to visit hospitals. A smartphone-based test system has produced comparable and slightly better performance in diagnosing middle ear infection than the traditional in-office professional care model (*Sci Transl Med*. 2019; 11 [492] eaav1102). Note that this level of performance was achieved by parents at home with video instructions and machine learning algorithms. Other objective measures such as evoked auditory potentials can likely be reliably obtained using easy-to-use dry electrodes and apps in a home environment soon.

Remote-fitting hearing aids or cochlear implants (CIs) have been researched in the last twenty years but did not gain much traction until COVID-19. A low-hanging fruit is for patients to get their devices initially fitted by a professional in the clinic and then receive subsequent care remotely using wired or wireless connection to the devices with teleconferencing consultation from the professional. Most hearing aid and CI manufacturers have built sophisticated *in-situ* microphones, telemetry circuits, and data-logging capabilities to allow remote device monitoring and adjustment, if necessary, for optimal performance.

In the near future, artificial intelligence will automatically fit the hearing aids and CIs for most patients, potentially eliminating even the need for a first-time face-to-face appointment. In fact, auto-fitting a CI may have results similar to that obtained by an average clinician (*Cochlear Implants Int*. 2020 Sep;21[5]:260-268). Successful, widespread application of auto-fitting will liberate clinicians and allow them to focus on complicated and difficult cases while broadening the scope of the traditional hearing care to include patients with autism and dementia.

If there is a silver lining from COVID-19, then it is telemedicine. I believe that telemedicine for hearing loss is not only here to stay, but also its advanced version, or automated care, is coming to provide safe, effective, and satisfactory performance and services for many people with hearing loss across the globe. ■

Dr. Zeng is the chairman of *The Hearing Journal* Editorial Advisory Board, as well as the director of the Center for Hearing Research and a professor of anatomy and neurobiology, biomedical engineering, cognitive sciences, and otolaryngology at the University of California, Irvine.