Automated Audiometry: A Viewpoint

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Jerger's 1963 *Modern Developments in Audiology* devoted an entire chapter to the topic of automated pure tone audiometry, a logical development in an era in which sophisticated technology was beginning find its way into clinical test environments. Because audiometry is governed by a set of rules that can be expressed as algorithms, and because a large proportion of our patients are capable of following instructions required to obtain accurate test results, automation of our most basic test potentially can increase the accuracy and decrease the cost of a procedure that is performed millions of times each year in the U.S. alone.

Except for the use of Bekesy audiometry as a "special" diagnostic test and as a method for monitoring in hearing conservation programs, automated pure tone audiometry has not been widely used. As audiology transitions to a doctoral profession, highly skilled professionals continue to manually administer a procedure we refer to as the "Hughson-Westlake method" after the 1944 article on assessment and rehabilitation of military veterans returning from World War II.

In a meeting I had a few years ago with a hospital medical director about why our clinic was losing money, she suggested we could improve efficiency by automating some of our tests. Several well-educated patients commented to me after hearing evaluations that some tests I had just performed manually could be automated. When knowledgeable "outsiders" view what we do, we do not always appear to take full advantage of the benefits of technology. I became convinced that, used properly, automated testing could positively influence the practice of audiology. In 1999 I began a research and development program to develop and evaluate automated hearing tests. The program has been funded by the National Institutes of Health Small Business Technology Transfer program since 2001. A fundamental principle of the methods developed under that program is that computer technology is capable of doing more than turn stimuli on and off and control frequency and levels. The computer is capable of tracking patient behaviors that can be exploited as quantitative, validated quality indicators, at least in part replacing the expert knowledge of the experienced audiologist. In 2002, the United States Patent Office awarded patent no. 6,496,585 for the method of obtaining a pure tone audiogram with a number of quantitative quality indicators. The system is currently in a multi-center clinical trial.

In 2003, Tympany Inc. introduced *The Otogram*™**,** an automated pure-tone and speech audiometer. Pure-tone audiometry is performed by an automated Hughson-Westlake procedure. Masking noise is automatically presented to the non-test ear when needed. Speech-recognition tests are performed by a closed-set, picture-pointing task.

The Otogram™ and the Hearing Health Network (HHN) formed by Sonic Innovations, Inc. after they acquired Tympany Inc. in 2004, have raised many concerns among audiologists. In my view, many of these concerns result from a marketing strategy that has not been viewed as friendly to audiologists. Consequently, the discussion of the emerging technology of automated diagnostic hearing testing is occurring at a time when some audiologists feel threatened. If Tympany's goals had been presented as efforts to help audiologists, rather than replace them, the discussion may be more centered on the clinical value of automated tests and their most appropriate place in various clinical settings.

Much of the concern related to automated hearing tests relates to the propriety of diagnostic hearing testing in non-audiologist offices. Of particular concern is the HHN plan to provide automated hearing test equipment to primary care offices (on a sale or lease basis) and establish a referral network of "hearing health professionals" to whom patients would be referred. The "hearing health professionals" are audiologists, hearing instrument dispensers, and otolaryngologists. Although there is no requirement that these professionals dispense Sonic Innovations products, it is only natural that the company wishes to increase sales of SI hearing aids.

The rationale for placing hearing test equipment in primary care offices is that there is a large number of hearing-impaired people, most of whom have not sought the services of audiologists. Twenty-four million is the number that is cited by the AAA website and many other sources. That number has been widely used by professional organizations and industry to argue for a wide range of programs to reach millions of unserved hearing-impaired (although one AAA past-president has recently argued that the number is inflated). Let's assume that, whatever the true number, there are many Americans with hearing loss that could benefit from the services of audiologists. Then it follows that building relationships between audiologists ("hearing health professionals") and primary care physicians would benefit those patients and would bring more patients to audiology offices.

It is my opinion that even though some form of hearing testing in primary care offices would benefit patients and audiologists, it is very unlikely that there will be a significant takeup rate of plans like the HHN. My opinion is based on two factors. First, I consulted with an industry leader who has a solid understanding of the markets for audiometric equipment and he felt that there is strong resistance in the primary care market to level of commitment required to implement hearing testing, even automated testing in their offices. Hearing testing with *The Otogram*™ requires capital outlay, space, a significant time commitment, personnel, record keeping, and other forms of overhead that makes it unattractive in that setting. (My family physician told me that also.) Second, we can take a lesson from tympanometry. Tympanometry was invented by an otolaryngologist, can be justified for most patients that are seen in primary care offices, requires no space, takes 10 seconds, is reimbursable, requires little record-keeping, and has little associated overhead. And yet despite the efforts of manufacturers who cater to that market, only 5% of Medicare billings for tympanometry are by primary

care physicians (Freeman, 2005, unpublished communication). My family physician who sees many children for otitis media does not use tympanometry, although there is an instrument in the office. If primary care physicians are not interested in incorporating tympanometry into their practices, I think it is unlikely that automated diagnostic audiometry will find its way into that arena in any significant numbers.

That's my opinion but it's not a fact. It behooves us to establish some principles that govern our policies and recommendations regarding automated diagnostic hearing tests. So here are some principles that I think are appropriate for our profession to promote in our communication with payers and other professions on this issue.

1. Automated audiometry potentially is a tool that can increase accuracy and decrease costs associated with routine hearing testing. Accuracy of automated testing systems should be studied thoroughly in laboratory and clinical settings.

2. When sufficient information exists to understand the accuracy of automated test systems and their impact on audiology services, audiologists should have the prerogative to decide if and how they should be used in their practices.

3. The use of automated testing technology by professionals who are not trained in hearing assessment is a concern to audiologists.

4. Some form of hearing assessment should be a component of physical examinations performed by primary care physicians.

5. Diagnostic hearing evaluations should not be performed in physician offices unless they are performed by licensed audiologists.

6. Hearing testing that is performed in physician offices should be designed to accurately determine the need for diagnostic testing by a licensed audiologist. Tests that are diagnostic in nature such as bone conduction tests, speech audiometry, otoacoustic emissions, acoustic reflexes, and auditory evoked potentials should not be performed in physician offices unless they are performed by licensed audiologists or unless they are specifically designed as screening tests.

The American Academy of Audiology is actively pursuing a program to develop better relations between Audiology and primary care medicine. We should encourage physicians to include hearing in their review of systems when examining patients. At the same time we should continue our efforts to educate physicians about the value of audiologists in performing comprehensive hearing assessments and treatment of communication disorders.

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