

Measuring hearing aid outcomes—Not as easy as it seems

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Abstract—Outcomes measurement in audiology has received much attention because of the need to demonstrate efficacy of treatment, provide evidence for third-party payment, carry out cost-benefit analyses, and justify resource allocation. Outcomes measurement shows the benefits obtained from a hearing aid and determines the costs of obtaining those benefits. In this article, we discuss why the seemingly simple issue of outcomes measurement is highly complex and the use of generic and disease-specific tools and the relationship between them; we also provide information regarding the International Classification of Functioning (ICF) system for selecting outcome measures. We then discuss factors complicating outcomes measurement, including discrepancies between clinically derived outcomes and functional outcomes, the ways clinicians can affect outcomes, and factors intrinsic to the patient that influence outcomes. We conclude that if the vision of moving quickly and efficiently from bench to chairside is to be realized, then clinicians must routinely measure hearing aid outcomes and researchers investigate their validity and usefulness.

Key words: audiology, hearing aid, hearing loss, International Classification of Functioning Disability and Health, measurement, outcome assessment (healthcare), outcomes, quality of life, treatment outcome, World Health Organization.

INTRODUCTION: WHY MEASURE OUTCOMES?

The measurement of outcomes in audiology has received much attention in recent years [1–3] because of the need to demonstrate efficacy of treatment for consumers, provide evidence for third-party payment, carry

out cost-benefit analyses, and justify allocation of resources [4–5]. While outcomes measurement is critical for all audiological services, much of the recent attention

Abbreviations: APHAB = Abbreviated Profile of Hearing Aid Benefit, CD = compact disc, COSI = Client Oriented Scale of Improvement, CUA = cost-utility analysis, DTG = delayed treatment group, HHIE/A = Hearing Handicap Inventory for the Elderly or for Adults, HINT = Hearing in Noise Test, ICD = International Classification of Disease, ICF = International Classification of Functioning Disability and Health, ITG = immediate treatment group, PIADS = Psychosocial Impact of Assistive Devices Scale, PPDIS = Performance-Perceptual Discrepancy, PPT = Performance-Perceptual Test, QALY = quality-adjusted life year, SADL = Satisfaction with Amplification in Daily Life, SD = standard deviation, SNR = signal-to-noise ratio, SRTN = Speech Reception Threshold in Noise, VA = Department of Veterans Affairs, WHO = World Health Organization, WHODAS II = World Health Organization Disability Assessment Schedule.

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focuses on outcomes of hearing aid intervention in the adult population [1,3]. Outcomes measurement allows audiologists to show the benefits that are obtained from a hearing aid, as well as to determine the costs of obtaining those benefits. In a large healthcare system such as the Department of Veterans Affairs (VA), which dispensed 315,224 hearing aids in fiscal year 2004 at a cost exceeding \$119 million, it is especially important for clinicians, researchers, and administrators to understand current trends and issues associated with the measurement of hearing aid outcomes and to justify such expenditures.

HOW SHOULD WE DEFINE HEARING AID OUTCOME?

Outcomes are often defined simply as measurable differences resulting from treatment [6]. Although the definition may be simple, the practice is more complex for several reasons. The first relates to a need to determine what “differences” we should be measuring. That is, are we interested in examining subjective (reported) hearing aid satisfaction, objective (measured) benefit, and/or hours of hearing aid use? Another reason for the complexity is that once we have decided what to measure, we need to select from a plethora of currently available tools and, as discussed below, each has its pros and cons [1–2,7]. In addition, no single metric appears adequate for understanding the full array of possible hearing aid outcomes. Humes, for instance, showed that hearing aid outcome is a multidimensional construct requiring evaluation of multiple factors, including aided speech recognition, speech-recognition benefit, subjective sound quality, subjective benefit and satisfaction, and hearing aid use [5]. However, he found that even when as many as 13 variables were measured, only 60 to 70 percent of the total variance in outcome was explained for various groups of hearing aid users [5].

WHAT TOOLS ARE AVAILABLE?

Clearly, in a clinical setting, the use of multiple outcome measures is impractical in terms of the time and costs involved, and although many outcome measures have been developed, few are routinely used in the clinic. In audiology, outcome measures generally fall into two categories: performance-based measures, such as tests of speech in noise that are used to compare aided and unaided performance or performance with two different hearing aids (e.g., Central Institute for the Deaf Auditory Test W-2 and W-22 [8]; Hearing In Noise Test (HINT)

[9], and Connected Sentence Test [10]), and self-report measures that are used to rate auditory disability (activity limitation) with and without hearing aids (e.g., Abbreviated Profile of Hearing Aid Benefit [APHAB] [11]), to rate auditory handicap (participation restriction) with and without hearing aids (e.g., the Hearing Handicap Inventory for the Elderly or for Adults [HHIE/A] [12–13]), or to rate patient satisfaction with hearing aids (e.g., Satisfaction with Amplification in Daily Life [SADL] [14]). Yet other questionnaires are available, such as the Client Oriented Scale of Improvement (COSI) [15] and the Glasgow Hearing Aid Benefit Profile (GHABP) [16], that measure multiple aspects of subjective outcome and permit definition and evaluation of patient-specific treatment goals.

While these disease-specific measures are useful outcomes measures for audiologists, a need also exists for measurement of the effects of hearing aid intervention with the use of generic health status instruments. Generic instruments allow for comparisons of treatment effects and costs across interventions for different diseases and disorders. Generic outcome measures offer several advantages over disease-specific measures, including (1) encouraging audiologists to think of hearing aid intervention in the broad context of overall mental/physical status; (2) allowing for comparative cost-benefit analyses across disciplines, thus enabling better planning for resource allocations; (3) providing for a better understanding of generic issues underlying rehabilitation; and (4) permitting direct comparisons between the impact hearing aids and other assistive devices have on quality of life, especially when the individuals being assessed use more than one category of device. Unfortunately, as Bess pointed out [17], commonly used generic instruments, such as the Sickness Impact Profile [18] and the Medical Outcomes Survey Short Form-36 [19], lack sensitivity to the effects of hearing aid intervention, despite a good reason to believe that amplification does improve well-being and quality of life [20]. Beck suggests that the lack of sensitivity of commonly used generic instruments is likely due to their failing to reflect the activity limitations and participation restrictions imposed by a hearing loss [4]. Two recently evaluated generic measures, however, have been shown to be sensitive to hearing aid outcome; these are discussed next.

The first generic measure is the World Health Organization (WHO) Disability Assessment Schedule (WHO-DAS II) [21–22], developed by the WHO and the National Institutes of Health. It assesses multiple

domains associated with quality of life, including understanding and communicating, getting around, self-care, getting along with others, household and work activities, and participation in society. Of particular relevance to audiology are two items in the understanding and communicating domain—one which assesses a person's ability to understand what people say and the other which assesses a person's ability to start and maintain a conversation. In a recent VA Rehabilitation Research and Development Service study, Abrams and Doyle used the WHODAS II to examine hearing aid outcomes in veterans [23]. All participants were fitted binaurally with hearing aids for the first time. Half the veterans were randomly assigned to an "immediate treatment" group (ITG), and half were assigned to a "delayed treatment" group (DTG). ITG participants were fitted with hearing aids 2 weeks after recruitment into the study, while the DTG participants were fitted after 10 weeks of no treatment. The WHODAS II was completed at recruitment, immediately before hearing aid fitting (i.e., pretest), and 8 weeks after the hearing aid fitting for both groups (i.e., posttest). The mean total WHODAS II scores (± 1 standard error) obtained at recruitment, pretest, and posttest for each treatment group are illustrated in **Figure 1**, with higher WHODAS II scores indicating greater difficulty. **Figure 1** reveals that mean WHODAS II scores increased for both groups from recruitment to pretest prior to hearing aid fitting and then decreased after hear-

ing aid intervention. To further examine these data, we conducted a repeated measures analysis of variance with one within factor (i.e., test occasion) with three levels (i.e., recruitment, pre-, and posttest) and one between factor (i.e., immediate vs. delayed treatment). The most important finding from this analysis was a significant interaction between group and test occasion ($F_{2,696} = 3.18, p = 0.042$). Post hoc *t*-tests using Bonferroni corrections for multiple comparisons indicated that the change in scores from pre- to posttest for both groups was statistically significant. Further, while no significant difference was found between the groups at recruitment, the difference between the ITG posttest score and the DTG pretest score, which were both obtained 10 weeks after recruitment into the study, was statistically significantly different. Based on this preliminary analysis of the data, the WHODAS II appears to meet the needs of audiologists for a sensitive generic health status instrument.

The second generic measure shown to be sensitive to hearing aid intervention is the Psychosocial Impact of Assistive Devices Scale (PIADS) developed by Day and Jutai [24]. This instrument assesses the way in which assistive devices affect subjective perceptions of psychological well-being and quality of life. Saunders and Jutai [25] compared hearing aid outcome measured with the PIADS to that measured with three disease-specific measures (APHAB, SADL, and Expected Consequences of Hearing Aid Ownership [26]) to determine their relative sensitivity to hearing aid use and to examine the relationship between pre-hearing aid use expectations and post-use outcomes. Between-questionnaire comparisons showed the generic measure to be as sensitive as the hearing aid-specific measures and that each questionnaire has one or more subscales with a monotonic relationship to reported daily hearing aid use. All three PIADS subscales showed stronger relationships with daily use than either the SADL or the APHAB. In light of studies that have shown the use of amplification to improve various psychosocial aspects of life [27–29], these stronger relationships with daily use are not surprising. Saunders and Jutai conclude that each of the measures has a different clinical application and the measure chosen for use should be determined by the desired information [25]. The APHAB would be the best tool for trouble-shooting a particular hearing aid fitting, the SADL would be most revealing when trying to understand specific issues an individual may have with the concept of amplification and hearing

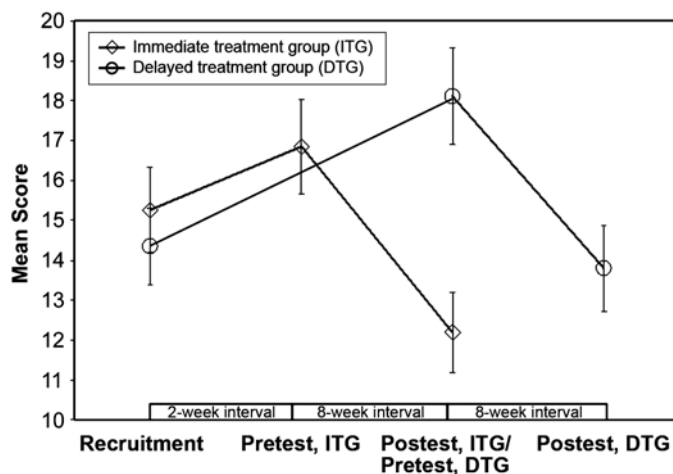


Figure 1.

Mean total World Health Organization Disability Assessment Schedule scores obtained at recruitment, pretest, and 8 weeks after hearing aid fitting for each treatment group.

aids, and the PIADS would be the measure most sensitive for documenting overall psychosocial outcome.

Saunders and Jutai's study [25], as well as the study by Abrams and Doyle [23], illustrates that if designed appropriately, generic measures assessing quality-of-life issues can be sensitive to hearing aid outcomes.

HOW SHOULD ONE GO ABOUT CHOOSING AN OUTCOME MEASURE?

In choosing an outcome measure, one needs to be clear as to the purpose for which outcomes are being measured. For example, in the clinic the primary purpose of measuring hearing aid outcome is likely to be the need to assess the success of the intervention from the perspective of the patient. One logical approach, therefore, is to determine (1) a specific treatment goal or goals for the patient, (2) which outcome domain(s) are most appropriately matched to those goals, and (3) which specific measures are most appropriate for addressing the domains of interest.

International Classification of Functioning Disability and Health: A Conceptual Model

The WHO's International Classification of Functioning Disability and Health (ICF) [30] is a useful conceptual framework for delineating the goals of hearing aid intervention and then for selecting instruments with which to measure outcomes related to those goals. The ICF is a biopsychosocial model of health that describes the consequences of a health condition (i.e., diseases and disorders) and the dimensions of disablement and functioning at three levels: the body (i.e., impairment of body structures and functions), the person (i.e., activity—what a person can or cannot do in a controlled situation), and society (i.e., participation—what a person does or does not do in the real world). The model accounts for the fact that these three main levels of health interact with each other and are influenced by both environmental (e.g., products, social norms, culture, etc.) and personal (e.g., gender, age, coping style, etc.) factors. In addition, the ICF provides a coding mechanism, similar to the diagnostic codes provided by the WHO International Classification of Disease (ICD), which would allow the clinician to code and quantify the impairments, activity limitations, and participation restrictions resulting from a health condition, as well as to code the contextual factors that may be barriers or facilitators to activity and participation. Unlike the ICD, however, the ICF coding architecture is a

dynamic one, allowing for modifications to the code when the effect of the impairment on activity and participation is impacted by clinical intervention or changes to the patient's physical, social, or political environment.

Audiologic Application of ICF

Application of the ICF framework to the health condition of adult-onset sensorineural hearing loss allows for the goals of hearing aid intervention to be easily specified and the selection of appropriate outcome measures to be simplified. For example, ICF code b230 applies to hearing functions, which are described as "sensory functions relating to sensing the presence of sounds and discriminating the location, pitch, loudness and quality of sounds" (ICF, p. 65) and are assessed on a 5-point scale, with 0 indicating no impairment and 4 indicating complete impairment. At the level of impairment, the most common goal of hearing aid intervention is related to b230—specifically, the minimization of the impairment of sensing the presence of sounds. Thus, any method that allows for assessing increased audibility, whether it is functional gain, real-ear gain, or even improvements in articulation indices with the use of amplification, could be selected as an outcome measure at the level of impairment. At the levels of activity and participation, the primary goal of hearing aid intervention relates to ICF code d310, communicating with—receiving—spoken messages (ICF, p. 133). Activity and participation are assessed on a 5-point scale, with 0 indicating no difficulty and 4 indicating complete difficulty. Speech-recognition performance assessed in the clinical setting provides outcomes measures at the level of activity, while self-report measures of speech understanding such as the APHAB can serve as an outcomes measure at the level of participation. Many other codes for activity and participation might be affected by adult-onset sensorineural hearing loss and thus alleviated through hearing aid intervention, including, for example, d750, informal personal relationships; d620, acquisition of goods and services (through shopping); d920, recreation and leisure; and others. While audiologists do not formally assess a person's ability to engage in these activities in a clinical setting, they could use measures such as the COSI to identify goals related to these codes and then to quantify changes in participation as a result of hearing aid intervention.

Some Examples of ICF Use

While the ICF coding system has not yet been institutionalized in the United States, the framework and concepts

that drive the ICF have significance and relevance for establishing hearing aid treatment goals using existing audiologic outcome measures and ensuring that the treatment goals are directly related to the patients' primary complaints. For example, consider that the treatment goal of a patient who complains of not being able to hear normal conversational speech would be to enable him or her to hear family members better. Such a goal would be related to the ICF domain of participation. The outcome of treatment, as it relates to the specific treatment goal, can be measured through the COSI (if "hear family members" is established as one of the treatment goals) or through a specific question on a standardized scale such as item 4 on the APHAB ("I have difficulty hearing a conversation when I am with a family member at home."). The danger of not matching the outcome measure to the treatment goal is demonstrating benefit on a measure that is not particularly meaningful to the patient. Indeed, the challenges associated with the clinical measurement of outcomes for hearing aid intervention are often related to a mismatch between outcomes that are important to the patient and those that are important to the provider. Demonstrating and documenting an improvement in speech recognition may intuitively appear to be a logical positive outcome to many clinicians, but our patients' evaluation of our treatment is driven more by their perception of functional changes—particularly in those specific situations that cause them the most difficulty—than by clinical performance measures.

Standardized measures such as the APHAB or the HHIE/A attempt to address the issue of mismatched goals by presenting a list of situations that presumably cause the most difficulty for most of our hearing-impaired patients. The scoring system associated with these measures allows the clinician or program manager to compare each patient's results with their pretreatment score, an individual patient with a similar cohort of patients, or clinicians with one another. A shortcoming of this approach, however, is that the items on the questionnaires are assumed to be of equal importance or relevance to the patient. For example, the ability to hear the cashier at the grocery store (item 1 on the APHAB) is considered equally as important as understanding one person among several at the dinner table (item 7) in terms of the scoring algorithm.

Measures such as the COSI address the issue of item relevance by having the patient identify and prioritize those communication situations that create the greatest

problems. The implied assumption is that focusing on and measuring the treatment effect of problems that are most relevant to the patient will lead to an outcome measure that most accurately reflects the true functional impact of intervention as perceived by the patient. The disadvantage is that such a system does not lend itself to comparisons across clinicians or clinics, because each COSI is individualized for the patient and thus likely to be less useful at the institutional level.

Institutional Versus Individual Outcomes

The purpose of measuring outcomes on an institutional level typically differs from that of measuring outcomes in the clinic. At the level of the institution, the goal might be to evaluate a particular service model or to compare the functioning of one clinic against another. For such purposes, a brief, highly standardized tool would likely be necessary. One example of such a tool is the International Outcome Inventory for Hearing Aids [31], which consists of just seven items and assesses multiple aspects of hearing aid outcome. The data obtained might be used to conduct a cost-effectiveness analysis, a health economics measure that compares the costs of intervention alternatives against a specific outcome resulting from the intervention [1]. If the institutional purpose of measuring outcomes is to compare interventions for different diseases or disorders, then generic health status instruments, such as the WHODAS II or the PIADS, would need to be used. As discussed by Abrams, Chisolm, and McArdle, data from generic health status instruments can be used to calculate of the costs of intervention per quality-adjusted life year (QALY) gained [32]. This approach is used to place the cost of an intervention in relationship to a universal standard, thus allowing for comparisons among divergent procedures and interventions, while accounting for the variations in quality of life that can result from treatment for different disorders and diseases.

Another way to measure outcomes when the goal is to calculate costs per QALY gained is to measure utilities. Utility is another term for health state preference and is measured on a universal scale from 0 (least desirable health state) to 1 (most desirable health state). Three techniques are typically used to obtain utility values: time trade-off, standard gamble, and visual analog rating scale [1]. When utilities are used in the calculation of QALYs gained, the economic approach is called a cost-utility analysis (CUA). While utility measurement for hearing aid

outcomes is relatively new, several studies have explored the potential use based on the importance placed on CUA by health economists [33–34]. Further, Abrams and colleagues have recently developed a new software program called Utility Measurement for Audiology Applications, which allows for measuring utilities in patients with hearing loss, tinnitus, and dizziness [35].

Clearly, many possible reasons exist for measuring hearing aid outcomes, and many tools are available. A detailed review of available measures is beyond our scope here. In addition to the comprehensive reviews of, for example, Abrams and Hnath-Chisolm [1] and Johnson and Danhauer [2], Cox provides an up-to-date and informative discussion of the selection of self-report measures [36].

ARE WE MEASURING WHAT WE THINK WE ARE?

As just discussed, measuring outcomes is a complex process. A contributing factor to this complexity is an apparent disconnect between clinically derived outcomes (e.g., speech-recognition performance) and the functional outcomes (e.g., self-report of speech understanding) of hearing aid intervention. This disassociation is often seen in the clinic with individuals who report dissatisfaction with their hearing aids but whose measured scores on speech-recognition tests show considerable benefit. The same phenomenon is also seen in research studies. For instance, investigations have found subjects' speech intelligibility scores that do not differ among different hearing aids or hearing aid settings, although subjective evaluations show a strong listener preference for one model or response over another [37–40]. Some studies have found little or no relationship between reported benefit and measured benefit [41–42]. Yet other investigations find subjects reporting strong preferences for one of two pairs of hearing aids worn during a study, even though both pairs of hearing aids were identical [43–44]. In instances in which there is a disconnect between clinically derived outcomes and functional outcomes, clinicians are faced with a situation in which data from one test must be given more weight during interpretation than the data from another.

In another article, Saunders and colleagues addressed this problem by developing an outcome measure that permits a direct comparison of clinically derived outcomes with self-reported outcomes, using the same test materials,

the same testing format, and the same unit of measurement (signal-to-noise ratio [SNR]) to assess both. The test is known as the Performance-Perceptual Test (PPT) [45–46]. The HINT sentence lists, masking noise and adaptive algorithm [9], are used to measure a Performance Speech Reception Threshold in Noise (SRTN) and a Perceptual SRTN. For the Performance SRTN, subjects repeat to the experimenter what they heard (as for the HINT). For the Perceptual SRTN, the experimenter alters the SNR based on whether subjects feel that they can “just understand everything that was said.” The Perceptual SRTN is thus the SNR at which listeners perceive that they can “just understand all of the speech material.” A third result is available from this test: the difference between the Performance SRTN and the Perceptual SRTN. It is known as the Performance-Perceptual Discrepancy (PPDIS) and is a measure of the extent to which the listener “misjudges” his or her hearing ability. If the Perceptual SNR is more adverse (a lower SNR) than the Performance SNR, it suggests that listeners overestimate their hearing ability. If the Perceptual SNR is less adverse (a higher SNR) than the Performance SNR, it suggests that listeners underestimate their hearing ability. The test thus permits a direct comparison between perceived ability to hear speech in noise and actual ability to hear speech in noise. In that article, Saunders and colleagues do not attempt to explain why some individuals underestimate their hearing ability. While others overestimate their hearing ability, they are interested only in using the metric to better understand hearing aid outcome.

Saunders and colleagues have found that the PPDIS is significantly correlated with reported hours of hearing aid use, reported benefit for hearing in background noise, reported benefit for overall ease of communication, and reported positive emotional benefits of the hearing aid. On the other hand, neither the Performance SRTN nor aided benefit as measured by the difference between aided and unaided Performance SRTNs is correlated significantly with any of these variables [47]. In other words, several aspects of self-assessed hearing aid outcome are more strongly associated with perceived ability to hear than measured ability to hear or measured hearing aid benefit. Additional data illustrating these relationships are shown in **Figure 2**, where the HHIE/A scores of 95 hearing aid users were classified into three groups according to the mean expected HHIE/A score for their audiometric thresholds as specified in Newman et al. [12] and Ventry and Weinstein [13]. The mean Performance SRTN score and the mean PPDIS score of subjects in each group were

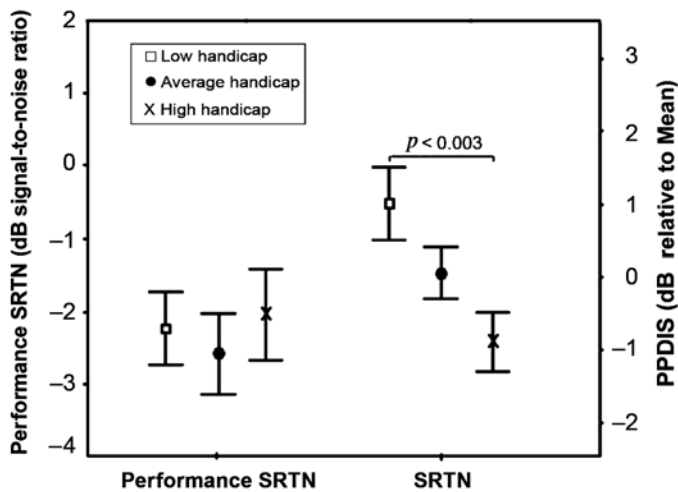


Figure 2.

Group mean Speech Reception Threshold in Noise (SRTN) and Performance-Perceptual Discrepancy (PPDIS) scores of subjects with low, average, and high handicap scores on Hearing Handicap Inventory for the Elderly or for Adults. Bars represent ± 1 standard error.

then plotted along with ± 1 standard error bars. Subjects depicted by an open square (low handicap group) have an HHIE/A score >0.5 standard deviation (SD) below the expected HHIE/A score for their pure-tone average. Subjects depicted by the filled circle (average handicap group) have an HHIE/A score that is within ± 0.5 SD of the mean expected score for their pure-tone average, and subjects depicted by the X (high handicap group) have an HHIE/A score >0.5 SD above the mean HHIE/A score for their pure-tone average. In other words, subjects in the low group report less handicap than expected, subjects in the average group report the expected degree of handicap, and subjects in the high group report more handicap than expected. Little relationship is seen between reported hearing handicap and the Performance SRTN. On the other hand, there is a relationship between reported handicap and the PPDIS such that individuals with low handicap have a higher PPDIS than individuals with high handicap. A positive PPDIS indicates overestimation of hearing ability, while a negative PPDIS indicates underestimation of hearing ability. Thus, individuals reporting higher handicap than expected underestimate their hearing ability, while subjects reporting lower handicap than expected overestimate their hearing ability. Other work with the PPT showed that the Performance SRTN explained between 8 and 10 percent of the variance in hearing aid satisfaction, and aided self-assessed auditory

disability and handicap [45]. The PPDIS, on the other hand, explained 23 percent of the variance in hearing aid satisfaction and between 6 and 17 percent of the variance in auditory disability and handicap. That is to say, these studies show that self-reported hearing aid outcome is as strongly influenced by individuals' beliefs about their hearing as it is by the actual benefit provided by hearing aids. This finding should alert clinicians to the possibility that the explanation for the often seen divergence in performance-based outcome and self-reported outcome is a function of the user's perception of the situation and his or her measured ability to hear.

CAN THE CLINICIAN INFLUENCE OUTCOME?

We would like to think that our intervention, if professionally and skillfully provided, determines the outcome of treatment. Some evidence, however, does suggest that the combination of what we tell our patients, even before the initiation of treatment, and the patients' beliefs or desires can significantly influence their perception of the outcome, regardless of what we do. Bentler et al., for example, examined whether the "label" we place on hearing aids would bias outcomes toward newer technological designs [43]. In this single-blinded crossover design, half of the participants were initially fit with digitally "labeled" instruments and given manufacturer-specific marketing information about the benefits of digital technology, while the other half were initially fit with conventionally "labeled" instruments and given very general information about use and care. The participants switched to the other technology after several weeks of use. In fact, the "digital" and "conventional" instruments were the same instrument. When pre- versus postoutcome measures were analyzed, a significant effect of labeling was found on subjective measures such as the APHAB, Glasgow Benefit Inventory, and COSI, with better outcomes for the digitally labeled instrument. Furthermore, 33 of the 40 participants preferred the hearing instrument labeled "digital." The results of this study illustrate the impact of the clinician's bias on the outcome of care, as well as the critical importance of double-blinding (the participant and the experimenter) as part of clinical trial research that compares different treatment methods and the power of patient beliefs to influence perception.

Often, the clinician (and the treatment protocol) can influence outcomes in subtle but very significant ways. In many practices, administering pretreatment measures before the patient is evaluated is customary (in the waiting room or mailed to the patient prior to the visit). We logically assume that pretreatment measures are not likely to change until we readminister our measure following treatment. In fact, the very act of informing the patient of the examination results may change the patient's perception of their health status. As just discussed, **Figure 1** illustrates the effect of time on the WHODAS II scores. As can be seen, the mean scores of the WHODAS II increase for both the ITG and DTG groups, suggesting that perception of general health worsens while awaiting treatment. Recall that the time difference between recruitment and retest of baseline was 2 weeks for the ITG group and 10 weeks for the DTG group. The greater change in scores for the DTG group than the ITG group between recruitment and retest of baseline suggests that perception of general health continues to deteriorate as the time between recruitment and retest of baseline increases. As a matter of fact, if we were to compare the posttreatment WHODAS II scores with the baseline scores rather than with the posttest scores for the delayed treatment group, we would conclude that there was very little change as a result of our treatment on self-perception of generic health status.

WHAT PATIENT FACTORS INFLUENCE OUTCOME?

A number of other factors intrinsic to the individual at the time he or she arrives at the clinic have been shown to affect hearing aid outcome: personality, patient attitudes toward hearing aids, patient expectations of hearing aids, and visual acuity/manual dexterity. Next, we briefly summarize what research has shown regarding each of these.

Personality

Personality describes the way in which an individual thinks, behaves, and feels. The potential influences of personality on hearing aid outcome are many. First, personality can affect the types of activities in which an individual participates. Someone who participates in activities requiring communication and audition is more likely to be detrimentally affected by a hearing loss than an individual whose activities are largely solitary. Sec-

ond, personality affects the way in which an individual reacts to a particular situation. An individual who is anxious is more likely to find communication situations stressful than an individual who is less anxious. Third, personality traits can affect the way an individual perceives the behavior of others in a particular situation. For instance, Saunders and Cienkowski showed that individuals with high anxiety ratings reported their families to be less supportive regarding hearing-related matters than did individuals with lower anxiety ratings [48]. It is unlikely that the families of anxious individuals were less supportive than the families of less anxious individuals. More probably, the anxious individuals were more sensitive to the reactions of those around them and thus perceived less support. Each of these influences of course has implications for the outcome of intervention with a hearing aid.

Just three studies published in peer-reviewed journals appear to have directly addressed the impact of personality on hearing aid outcome. Gatehouse reported that the personality traits of depression, hysteria, obsession, and anxiety each played a significant role in explaining variance in hearing aid use, reported help, and/or hearing aid satisfaction [49]. Remarkably, the traits of depression and anxiety also explained significant percentages of the variance in objective performance benefit. Similarly, Cox et al. reported that multiple regression analysis showed that the personality traits of outward orientation (extroversion), anxiety, and locus of control explained significant variance in reported hearing aid benefit scores as measured by the APHAB [50]. Garstecki and Erler found that women who used hearing aids had greater ego strength and higher internal locus of control than female nonusers; this pattern of results was not seen, however, among their male subjects [51]. The paucity of studies examining the influence of personality on hearing aid outcomes has arisen probably because clinicians cannot directly intervene in modifying specific personality traits. However, an awareness of the potential influence of personality could perhaps alter the way in which clinicians counsel patients and even influence the technology they prescribe. For example, the clinician might not want to prescribe a multimemory directional hearing aid for an introverted individual who does not attend social gatherings.

Patient Expectations

Prior to receiving a hearing aid, most individuals will have a preconceived notion about what hearing aids will do for them. Research has shown that these expectations

can affect individuals' willingness to acquire a hearing aid [51], their satisfaction with the aids [52,26], and the frequency with which they wear the hearing aids [53]. A mismatch between preuse expectations and actual outcome that results in disappointment will likely lead to decreased use of hearing aids. However, the relationship between expectations and outcome has been shown by some studies to change over time, as follows. Saunders and Jutai found that the longer individuals wear hearing aids, the more positive their reported outcome and that the prefitting expectations of non-hearing aid users are higher than the satisfaction scores of hearing aid users with 6 weeks to 1 year of experience, but are similar to those obtained from individuals who have worn hearing aids for longer than 1 year [25]. These findings have important clinical implications regarding counseling of newly fitted hearing aids and the 30-day hearing aid trial period. Although presumably audiologists explain to their clients that "it takes time to get used to wearing hearing aids," explaining that improvements in perceived benefit continue throughout the first year of use is important.

Attitudes

Studies have shown that attitudes toward hearing loss and hearing aids affect hearing aid outcome. For example, hearing aid use is lower among individuals reporting general negativity toward amplification [54–55], those who perceive that their hearing impairment has little affect on them [56–57], and those who consider hearing aids to be stigmatizing [57–58]. On the positive side, studies have also shown that counseling individuals regarding these attitudinal issues at the time of hearing aid fitting can increase hearing aid use and/or decrease the perceived handicap [59–63].

Manual Dexterity

In addition to hearing loss, reduced visual acuity and poorer manual dexterity are also associated with aging. Unfortunately, relatively good vision and manual dexterity are required for hearing aid insertion, manipulation (changing of programs, altering of volume control), and upkeep (changing the battery, checking for cerumen). This can result in difficulties for elderly hearing aid users. Indeed, research has shown poor manual dexterity to be associated with poorer hearing aid outcome, less use, and lower satisfaction [55,64–65]. Furthermore, manual dexterity was the only factor that differentiated older and younger individuals in their reasons for dissat-

isfaction with hearing aids [66], and another study concluded that ease of use of a hearing aid was a major factor in hearing aid preference among a group of elderly first-time users [67]. Clinicians can consider this when selecting a hearing aid for, counseling, and educating older patients. For instance, behind-the-ear hearing aids are often difficult to insert, while completely-in-the-canal aids are difficult to remove and have extremely tiny batteries. Provision of a magnetic tool can make battery changing easier, and coloring battery doors can help patients distinguish the left from right hearing aid. In addition, when possible, family members can be educated in hearing aid use and upkeep so they can assist the hearing aid user as necessary.

CONCLUSIONS—WHAT ARE THE CLINICAL AND RESEARCH IMPLICATIONS?

Given the complexities and multiple considerations associated with outcome measures, is it reasonable to expect the audiologist working in today's busy clinical environment to develop and maintain the appropriate knowledge and skills to choose and administer the "right" outcome tool? Currently, most audiologists are trained in the test "battery" approach for the diagnosis and management of hearing and vestibular disorders and are faced with a complex array of clinical measurement choices daily. The VA's Tonal and Speech Materials for Auditory Perceptual Assessment compact disc (CD) (Disc 2.0), for example, contains no fewer than eight separate tests for assessing central auditory processing [68]. The VA's Speech Recognition and Identification CD (Disc 1.1) contains six speech recognition tests [68]. The vestibular test battery consists of at least seven measures of ocular-motor and vestibular functioning. In view of the emerging importance of outcome measures as an integral and critical element of the patient care experience, it is reasonable to expect the clinician to develop the same level of competence associated with appropriately selecting and administering outcome measures as would be expected with any other type of clinical assessment. Just as a clinician is expected to select the most suitable diagnostic test based on the patient's history, signs, and symptoms, so should the audiologist be expected to select the most appropriate outcome measure based on the patient's communication needs and established treatment goals (and, if necessary, the needs and goals of the institution).

In the world of outcome measures, the role of the researcher is to investigate the validity and usefulness of our existing measures, to develop new ones that are sensitive and specific to the effects of audiologic intervention and are acceptable to the clinician and the patient in terms of ease of administration and meaningfulness of the information, and to further the importance of the role of audiologic treatment in the larger healthcare arena. Research investigations directed toward and clinical implementation associated with audiologic outcome measures represent an outstanding opportunity to realize the vision of quickly and effectively moving from the bench to chairside.

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