Real-Ear Service Provision

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Today, hearing aid practitioners are confronted with competing in a tilted landscape that includes alternate distribution channels, such as Big Box, internet, and retail-based healthcare clinics, and the probability of over-the-counter (OTC) amplification devices available via direct-to-consumer means. While these nontraditional distribution channels have the potential to increase the number of users of amplification, they also have the potential to increase the stigma associated with using amplification.

For practitioners to be fiscally and professionally successful, service provision is the key differentiator. One form of service provision is verification, which ensures appropriate aided acoustic information is being delivered to the tympanic membrane. To meet this objective, the use of a probe microphone or real-ear measurements (REM) is the only way to verify the appropriateness of the device’s gain and output at the tympanic membrane for a given ear. Sadly, the provision of REM is one aspect of service delivery that has not been embraced as a part of the profession’s standard of care, despite the procedure having been available for nearly three decades. Recent professional surveys indicate that for every 100 practitioners who dispense hearing aids, only 57 own a REM system (Kirkwood, 2006; Mueller & Picou, 2010). Of the 57 practitioners who own a REM system, only 19 perform this service routinely. In other words, odds are that 81 hearing aid fittings, out of a possible 100, likely do not provide optimal aided audibility and sound quality to the end user. Such data, unfortunately, supports one reason for the low stagnant aid rates in the market, which was a catalyst for the recent recommendations by the U.S. President’s Council of Advisors on Science and Technology (PCAST, 2015) and, more recently, the National Academy of Sciences, Engineering, and Medicine (NASEM, 2016; formerly the Institute of Medicine) to establish a new category of OTC wearable devices.

The primary catalyst for not utilizing REM is the practitioner’s reliance on the manufacturer’s default target predictions to provide aided gain and output. The literature indicates that the hearing aid manufacturer’s fitting software may not always predict the appropriate aided gain in the ear canal. Aazh and colleagues (2012), for instance, reported on 51 hearing aid fittings programmed to the manufacturer’s default (i.e., first-fit/Quick-Fit) prescription formula, which was based on the NAL-NL1 prescriptive target (Byrne et al., 2001). Of these fittings, 36, or 71 percent, resulted in gain deviating from the manufacturer’s default target — both below and above — by > 10 dB. Sanders and colleagues (2015) compared aided gain across multiple manufacturers’ default versions of NAL-NL2 to the original NAL-NL2 prescriptive target (Keidser et al., 2011). These authors found that, in general, the manufacturers’ default predictions offered less aided gain, which inherently reduced audibility compared to the original NAL-NL2 targets provided by the REM verification equipment.

Research further suggests manufacturers’ default prescriptive algorithms can yield less audibility compared to the original prescriptive approach [e.g., NAL-NL1, NAL-NL2]. This reduction in audibility has been shown to reduce the hearing aid
wearer’s ability to understand speech in the presence of competing noise. Leavitt and Flexer (2012) fit individuals with six premier pairs of hearing aids, one from each of the six largest manufacturers, which were programmed to the manufacturer’s default prescriptive target, with advanced features enabled (e.g., directional microphones, noise reduction, feedback suppression, ear-to-ear communication). In addition, the authors included a 10-year-old, analog, single-channel, omnidirectional device that was fit to the original NAL-R target (Byrne & Dillon, 1986). Aided performance was measured using the QuickSIN (Killion et al., 2004), with each of the seven hearing aids worn in random order by five long-time users of hearing aids. QuickSIN results revealed that mean speech understanding in noise was statistically (p<.05) poorer with five of the six premier devices programmed to the manufacturers’ default gain target compared to the analog device fit to the original prescriptive target. Likewise, Abrams and colleagues (2013) fit listeners with new hearing aids programmed with the original NAL-NL1 target and the manufacturer’s default prescriptive target. Listeners wore their devices with a given target for a trial period of 4 to 6 weeks. After each trial period, the listeners reported their self-perceived hearing aid benefit, as measured by the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox & Alexander, 1995). Results revealed improvement in all four APHAB subscales for the original NAL-NL1 target when compared to the manufacturer’s default prescriptive target.

In 2016, Amlani and colleagues assessed the extent to which real-ear procedures influenced patient satisfaction and practitioner loyalty. The authors collected data on three groups of 20 adult listeners (n = 60) with mild-to-moderately severe sensorineural hearing loss. Group 1 consisted of experienced users of amplification (>1 year of use, 8 hours of daily use), Group 2 consisted of users of amplification who owned but did not use their devices on a frequent basis (i.e., hearing aids are in the proverbial “drawer”), and Group 3 consisted of non-adopters of amplification who experienced hearing difficulties and were interested in a trial period with amplification. Ten listeners in each group were fit with an experimental hearing aid programmed to the hearing aid manufacturer’s default NAL-NL2 prescriptive target, while the remaining 10 listeners in each group were fit to the original NAL-NL2 targets, which were individualized using a REM clinical protocol that included obtaining ear-specific real-ear unaided responses and real-ear-to-coupler differences (RECD). The rationale for obtaining ear-specific REUR and RECD data on each subject was to reduce variability in gain between manufacturers’ default values and measured values obtained on the wearer’s ears. During the fitting process with each group, listeners had an opportunity to influence the final settings by rating the comfort and clarity of the experimental devices until a rating of 8 on a 10-point scale (i.e., 1 = lowest and 10 = highest) was achieved while listening to a passage of continuous discourse presented in quiet from a loudspeaker positioned 1 meter in front of the listener at a level of 68 dB SPL. During and after the fitting process, each subject was counseled on the procedures being performed by the same experienced investigator.

Prior to the experiment, listeners in Groups 1 and 2 provided survey responses of their previous experiences using (1) willingness-to-pay (WTP), price anchored at $250, for professional services, and (2) a modified version of the Perceived Value Measurement - Service Scale (SERVAL) that was designed to assess a respondent’s attitude and behavior toward professional services (Petrick, 2002) as assessed in five dimensions: perceived quality, perceived value, behavioral intent, emotion and price. Each listener was randomly assigned to a verification protocol (i.e., manufacturer’s default, REM clinical protocol). After receiving services for a given protocol, each listener’s perception toward the service received was quantified using the same surveys. Group responses allowed for a comparison between groups. In addition, listeners in each of the three groups who initially received the manufacturer’s default protocol were then provided the REM clinical protocol, and their
perception of the services provided for the REM clinical protocol was quantified using the same three surveys. The provision of this test protocol allowed for a comparison within each group. All surveys were administered by a secondary investigator to reduce respondent bias.

Outcomes from the two surveys showed significantly \( p < .05 \) improved perceptions in all three groups toward the services provided for the REM clinical protocol compared to the services provided for the manufacturer’s default fitting. Specifically, WTP results yielded significant \( p < .05 \) differences in mean responses between service protocols pooled across groups, suggesting that listeners both experienced and inexperienced with amplification technology are observant of the value of the services provided by the practitioner (Figure 1). Findings from the SERVAL revealed that the REM clinical protocol improved patient satisfaction while reducing anxiety (i.e., emotional distress) for all three groups tested in this study (Figure 2). In addition, the REM clinical protocol resulted in significant improvements \( p < .05 \) on the WTP and SERVAL surveys for those listeners within each group who first experienced the manufacturer’s default fitting protocol followed by the REM clinical protocol. These authors concluded that services provided for the REM clinical protocol, and not the manufacturer’s default fitting protocol, should be implemented as a standard procedure in clinical practice.

More recently, Amlani and Pumford [2017] reported on how differences between the manufacturer’s default fitting protocol and REM approaches influenced (1) speech-perception-in-noise performance, using the CST, and (2) audibility, as quantified by the Speech Intelligibility Index (SII; Acoustical Society of America, R2012). The methodology for this undertaking was obtained using the same groups with the same experimental hearing aid as reported in their 2016 article.

During the speech-in-noise task, listeners were seated in the center of a sound-treated room having a reverberation time of 208 msec. Four CST passages were presented at a fixed signal-to-noise ratio of +4 dB (i.e., speech presented at 75 dB SPL from a loudspeaker positioned at 0 degrees azimuth at a distance of 1 meter from the listener; noise presented from loudspeakers positioned at 90, 180, and 270 degrees azimuth at a distance of 1 meter from the listener and at combined level of 71 dB SPL), based on a literature review that was deemed representative of real-world conditions. Results revealed a statistically significant \( p < .05 \) improvement in performance for devices that were fit and verified using the REM clinical procedure compared to devices fit using the manufacturer’s default target protocol for all three subject groups (Figure 3).
The audibility impact of the assigned fitting procedure was further evaluated by analyzing the SII differences between the REM and manufacturer’s default target protocols, as calculated by the Verifit2 hearing instrument verification system for average speech (i.e., 65 dB SPL). The real-ear condition data reflects the settings required to match the original NAL-NL2 prescribed REAR targets as generated by the Verifit2, with slight adjustments to account for any comfort/clarity concerns based on the aforementioned quality and comfort rating scales. As shown in Figure 4 for average speech (i.e., 65 dB SPL), the manufacturer’s default target protocol provided significantly less audibility than the REM protocol as assessed by the SII for all three listening groups.

In summary, the service provision of a REM approach is an evidence-based protocol that should be a part of every practitioner’s standard of care when fitting a hearing aid or any alternative amplification product that will be entering the market. While REMs are generally considered to offer the practitioner only a tool to ensure that aided gain and output meets a prescriptive target based on the acoustics of the patients’ ears, they represent much more. With respect to patient attitudes, REM clinical protocol can enhance the patient’s self-perceived benefit of their amplification devices, satisfaction with the practitioner and can help facilitate patient loyalty. In addition, REM clinical protocol positively impacts the user’s confidence with and perception of their hearing aid. With respect to aided speech understanding, REM clinical protocol provides increased audibility over the manufacturer’s default target approach, which yields increased speech performance in the presence of competing noise. This increase in speech understanding performance under real-world conditions, in principle, results in fewer follow-up visits (Kochkin et al., 2010), increasing satisfaction for the patient. With fewer patient return visits, the practitioner will have an increase in appointment slots with the potential to assist more listeners in need of audiological services.
References


