

REM Target Match: Effortless Fitting, Improved



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Introduction

Audiology best practice guidelines recommend using Real Ear Measurements (REM) as part of the hearing aid fitting verification procedure¹. Research has shown that real-ear verification measures are consistent with better overall patient satisfaction with their hearing professional, with their hearing aids and an improved client experience². Unfortunately, numerous studies have shown more than half of hearing professionals do not routinely complete real-ear measurements.^{3,4,5} One reason often cited for not completing real-ear measurements is the amount of time it takes to complete the process. When manually matching to targets, the hearing professional must switch between adjustments in the hearing aid fitting software and measurements in the verification system, often over multiple iterations until the gain of the hearing aid approximates the prescriptive targets (referred to as “traditional real-ear measurements”). This can take considerable time, which is sometimes not feasible in busy hearing aid offices. Also, increased time spent during the hearing aid fitting process results in less time available to counsel and educate the hearing aid user.

Starkey’s REM Target Match is an automatic REM tool that allows the hearing professional to quickly and automatically fit hearing aids to prescriptive targets. REM Target Match works with commercially available REM systems to measure the unique acoustics of a patient’s ear, creating a personalized fitting, based on real ear measurements, with the push of a button in the Inspire X fitting software. REM Target Match is an incredibly versatile tool,

with compatibility to Otometrics Aurical Free Fit, the MedRx Avant, the MedRx Avant REM+, Inventis Trumpet, and now Verifit 1 and Verifit 2 systems. This makes REM Target Match available to more providers and offers more flexibility than ever before. REM Target Match can be used with any fitting formula supported by Inspire X, including NAL-NL2 and Starkey’s proprietary e-STAT targets.

A study was completed to validate this newest iteration of the REM Target Match tool and ensure optimal fitting performance based on two important criteria: The first was that the REM Target Match System matched the hearing aid response to targets quickly, as defined by completion of the automatic target-matching procedure in under 10 minutes. The second criterion was that the REM Target Match tool provides comparable levels of audibility to traditional, manual real-ear measurements. Both time and resultant audibility are essential in providing an effortless fitting experience. Less time spent in the hearing aid software matching to prescriptive targets is more time the provider is able to spend with the patient.

Validation Study Methods

Twenty-nine hearing-impaired participants recruited from Starkey’s participant database (8 females, 21 males) were fit binaurally with Evolv AI 2400 2.4 GHz hearing aids. Participant age ranged from 40–85 years ($M= 69$, $SD =9.7$). Fifteen participants had severe to profound hearing loss and were fitted with Power Plus Behind-The-Ear (BTE) hearing aids with slim tube (four participants), or standard tubing and earmold (11 participants).

The remaining 14 participants in the study had moderate to moderately severe hearing losses and were fitted with Completely-In-Canal (CIC) hearing aids. See Figure 1, below, for average audiograms.

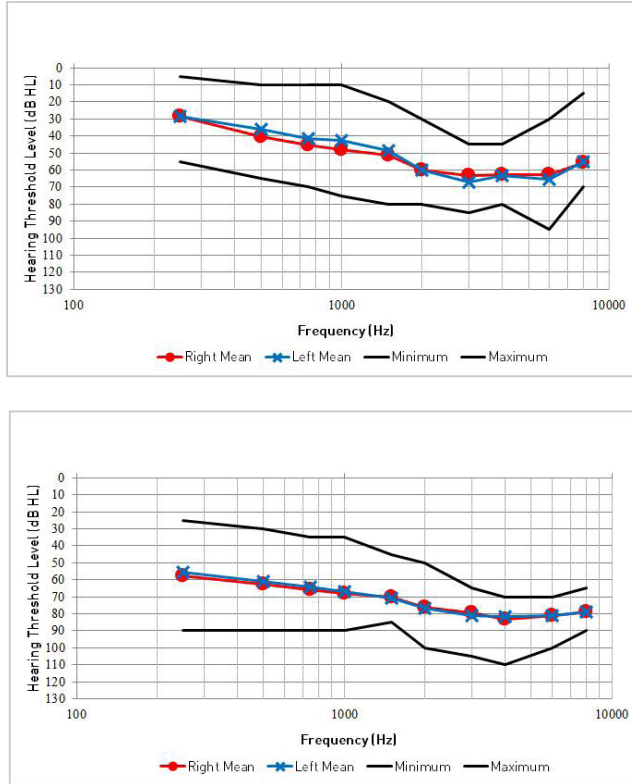


Figure 1: Average audiograms for CIC participants (top) and Power Plus BTE 13 participants (bottom).

Because audiologists widely use both the Verifit 1 and Verifit 2 systems, it was important to validate the REM Target Match system on both. The Verifit 1 system was used to fit all participants using the Evolv AI CIC hearing aid, and the Verifit 2 system was used to fit all participants using the Evolv AI Power Plus BTE 13 hearing aids. With both the Verifit 1 and Verifit 2 system, the researchers compared the traditional method of matching to prescriptive targets and REM Target Match in regards to time and resultant audibility. These conditions were counterbalanced across participants.

It should be noted that REM Target Match only matches to target at the 65 dB SPL input level. Because of this, traditional REMs were, also, only done with the 65 dB SPL input signal. Due to the nature of hearing aid channel relationships and compression, changes at the 65 dB level affect gain values at softer and louder inputs. Therefore, results (time and audibility, below) were analyzed with match-to-targets at soft, medium, and loud input levels for Verifit 1 and Verifit 2, instead of just the 65 dB level.

Hearing Aid Programming

Each participant's audiogram was entered into Inspire X software, and the hearing aids were initially programmed to the NAL-NL2 fitting prescription. Each participant's audiogram was also entered into the Verifit 1 or 2, and NAL-NL2 targets were selected in the Verifit. All noise management features were disabled, and the hearing aid microphones were set to omnidirectional mode. This was done manually for traditional REM and happens automatically when completing REM with REM Target Match.

Traditional REM

Real-ear aided responses (REAR) were measured for both ears for each participant. When completing the traditional REM, REAR was measured using International Speech Test Signal (ISTS) passage played at 65 dB SPL. After the initial delivery of the ISTS signal, gain was adjusted in Inspire X software by the research audiologist to match 65 dB SPL targets between 250 and 8000 Hz. The traditional real-ear measurements were considered complete when the gain was within +/- 3 dB of NAL-NL2 targets from 250 – 8000 Hz, or at maximum output of the hearing aid if this tolerance could not be achieved. With the Verifit 1 (Evolv AI CIC users), each ear was programmed and matched to targets, individually. The Verifit 2 allowed for binaural measurements, expediting the traditional measurement process for BTE users.

REM Target Match

Hearing aids and probe tubes were removed from the participants' ears and hearing aids were reset to NAL-NL2 first-fit (Best Fit) in the hearing aid software. The procedure was completed again using the REM Target Match tool in Inspire X software. The REM Target Match system automatically matches the hearing aid output to prescriptive targets. Once REM Target Match was complete, gain adjustments are saved to hearing aids.

Results were analyzed for both validation criteria: time and accuracy. For traditional real-ear measurements, time began when the ISTS signal at 65 dB SPL was initially played, and time stopped when the audiologist was within +/- 3 dB of NAL-NL2 targets from 250 – 8000 Hz, or reached maximum output of the hearing aid, binaurally. For the REM Target Match system, time started when the ISTS signal was initially played, and time stopped when the tool had completed its workflow.

Accuracy and audibility were evaluated with the speech intelligibility index (SII) values provided by the Verifit software. SII approximates the percentage of speech sounds that are audible, and ranges from 0% to 100%. The goal of the current validation was to ensure equivalent SII values between traditional real-ear measurements, typically considered the gold standard in hearing aid fitting, and the REM Target Match fitting. Equivalency is defined as no significant statistical difference between SII values captured with the traditional REMs versus those captured with REM Target Match. In this way, it could be demonstrated that the expediated nature of the REM Target Match fitting does not come at any expense to audibility, as compared to what would be provided with traditional REMs.

As mentioned above in the Methods section, even though REM Target Match and Traditional REMs were only completed at the 65 dB SPL input level, soft, medium, and loud input levels were considered when analyzing the results for both time and audibility.

Time Results CIC – Verifit 1

The average amount of time needed for traditional REM and REM Target Match are displayed in Figure 2, below. REM Target Match took less than five minutes to complete, on average (M= 4 minutes 35 seconds, SD = 7 seconds), and traditional REM took, on average, around 10 minutes to complete (M = 10 minutes 1 second, SD = 2 minutes 30 seconds). The results of a paired t-test revealed a significantly shorter amount of time to complete REM Target Match than traditional REMs ($p < 0.001$).

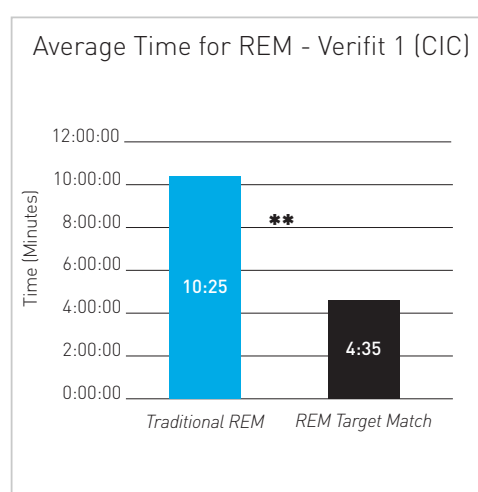


Figure 2: Average time to complete real-ear measurements for CIC users (Verifit 1). ** = $p < 0.001$

Power Plus BTE – Verifit 2

The average amount of time needed for traditional REM and REM Target Match are displayed in Figure 3 on the next page. REM Target Match took less than five minutes to complete, on average (M= 4 minutes 17 seconds, SD = 3 minutes 2 seconds), and traditional REM took, on average, around 7 minutes to complete (M = 7 minutes 10 seconds, SD = 3 minutes 58 seconds). The results of a paired t-test revealed a significantly shorter amount of time to complete REM Target Match than traditional REMs ($p < 0.05$). The greater degree of difference between the two measurement methods for CIC users than BTE users is most likely due to the fact that the Verifit 2 system allows for binaural measurements.

Audibility Results

Audibility was analyzed with average SII values for 50, 65, and 75 dB SPL input levels and targets for Verifit 1, and 50, 65, and 80 dB SPL input levels and targets for Verifit 2. Paired t-tests resulted in no significant differences between SII values resulting from traditional REMs versus REM Target Match for either the Verifit 1 or Verifit 2 systems at soft, medium, and loud input levels.

Conclusion

The REM Target Match Validation Study was designed to investigate two important elements of this tool: The amount of time the REM Target Match system takes to match targets and the degree of audibility achieved. Results of the current validation showed that REM Target Match can achieve comparable audibility to the gold standard: traditional real-ear measurements with manual matching in the hearing aid software. Moreover, the REM Target Match fitting can be completed in under five minutes, regardless of whether the Verifit 1 or Verifit 2 is being used. For busy practices these findings have important implications on the way time is allocated during a hearing aid fitting appointment. Time that would be spent making clicks in the software can now be spent counseling and providing audiological expertise to the hearing aid user. REM Target Match, now with Verifit 1 and Verifit 2 compatibility, is the next evolution towards a truly effortless fitting.

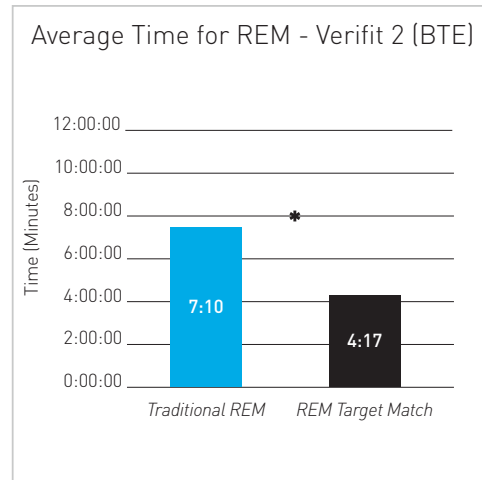


Figure 3: Average time to complete real-ear measurements for BTE-users (Verifit 2). * = $p < 0.05$

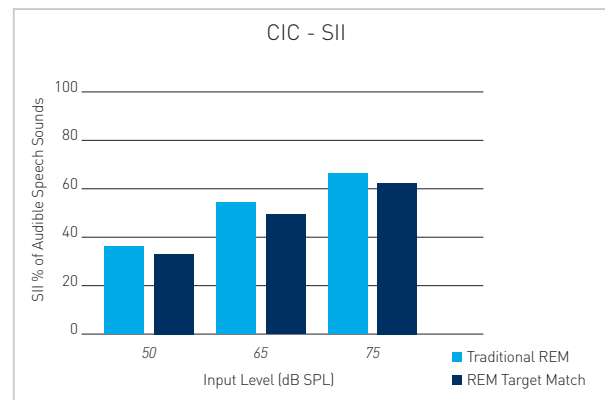


Figure 4: Average SII values for 50, 65, and 75 dB SPL input levels for CIC users, using the Verifit 1 system.

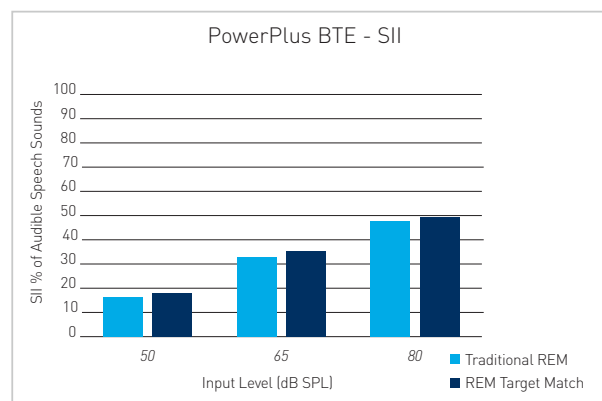


Figure 5: Average SII values for 50, 65, and 80 dB SPL input levels for BTE users, using the Verifit 2 system. No significant differences between Traditional REM and REM Target Match for either group of participants.

References

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