Novel Hearing Aid Fitting Approach for Developing Countries

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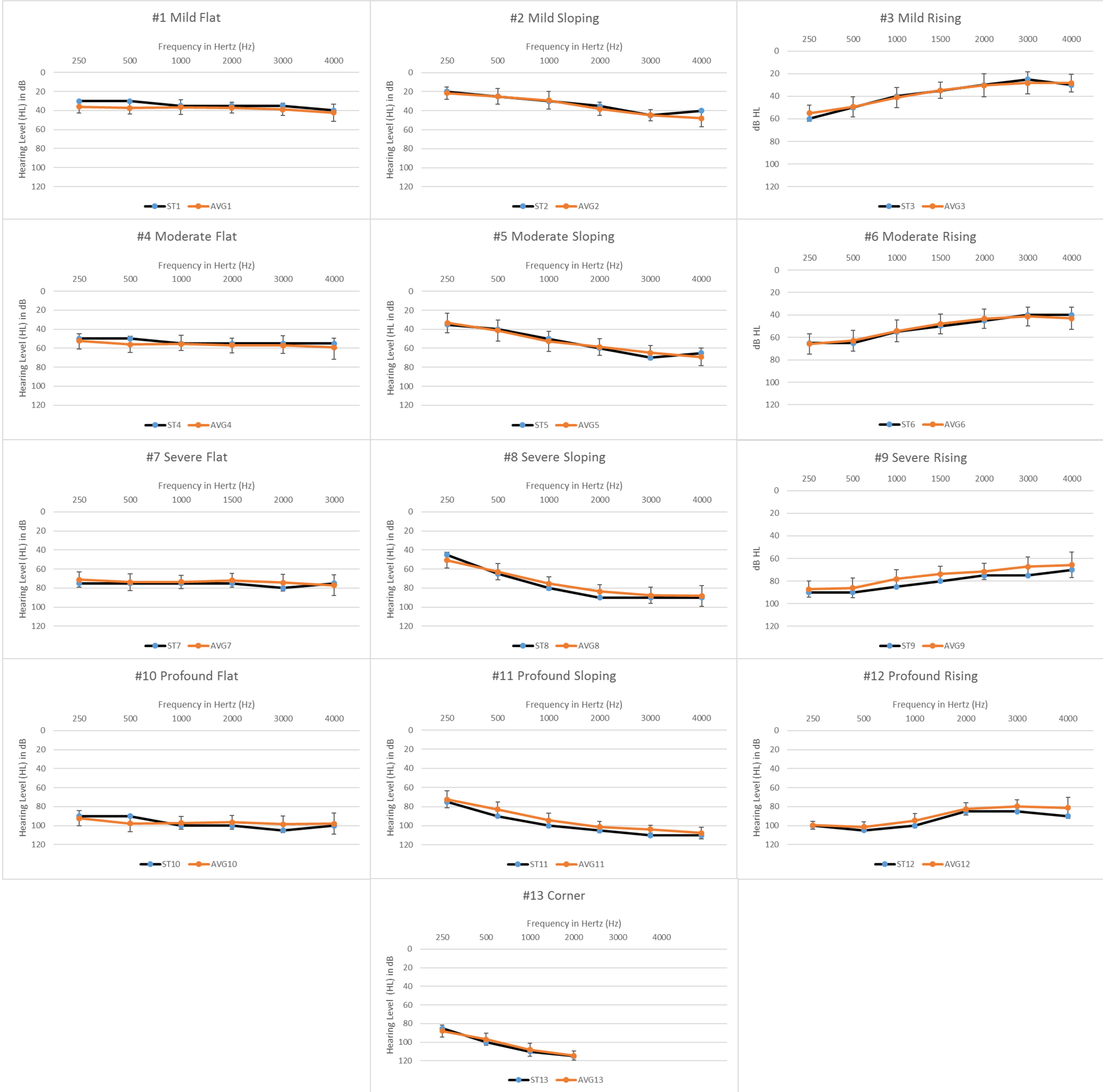
Introduction

ASU Hearing for Humanity, a non-profit organization committed to providing sustainable humanitarian audiologic services in Malawi, Africa, stresses the importance of following best practices and ethical standards in the identification and treatment of hearing loss. A clinically based approach using objective verification resulted in better outcomes (Tomblin et al, 2014, Abrams et al, 2012) and ensured fitting precision, but is time-intensive and therefore forgoes scalability. The lack of equipment and consistent electricity also prohibits its use.

This project examined a novel hearing aid fitting approach using standardized audiograms. Data were collected on the efficiency, accuracy, and appropriateness of this approach for use during humanitarian outreach.

Methods

Fig. 1: 13 standardized audiograms were developed based on actual audiometric data collected between 2012 to 2015.



Methods Continued

Audiograms obtained in Malawi in 2016 were reviewed. After excluding audiograms with an air-bone gap, 511 audiograms were used for the study. Each test audiogram was compared to the standardized audiograms and the template with the best fit was selected. Except for profound rising, each degree/configuration category had at least 30 test audiograms. Phonak Naida V90 SP and UP hearing aids were preset to DSL-child amplification targets within $\pm$ 2 dB of the target as verified by the AudioScan Verifit. Each test audiogram was evaluated using 2 fitting methods. The **Clinical Method** followed the traditional approach whereby the hearing aid was programmed to meet the amplification targets for each test audiogram using SREM. The **Standardized Method** involved fitting a hearing aid preset to a standardized audiogram and measuring SREM data without making fitting adjustments.

STANDARDIZED-BASED METHOD	CLINICAL-BASED METHOD
Novel approach	Traditional approach
◦ Enter audiogram into Verifit	◦ Enter audiogram into NOAH and Verifit
◦ Connect aid with preset amplification settings for the selected standardized audiogram	◦ Connect and fit aid
◦ Measure output using Verifit; no changes made	◦ Make programming adjustments to achieve amplification targets using Verifit (SREM)
◦ Record time required to fit aid	◦ Record time required to fit aid

The time to complete each approach was measured as well as the output for 55, 65, and 75 dB SPL inputs and MPO. As needed, age appropriate RECD was used if the patient was $\leq$10 years of age. Hearing aid output data for each method was analyzed using strict versus lax criteria (Table1 below).

	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	SLOPE
STRICT	$\pm$ 5 dB	$\pm$ 5 dB	$\pm$ 5dB	$\pm$ 5dB	$\pm$ 8 dB	$\pm$ 8 dB	$\pm$ 5dB
LAX	$\pm$ 10 dB	$\pm$ 10 dB	$\pm$ 10 dB	$\pm$ 10 dB	$\pm$ 13 dB	$\pm$ 13 dB	$\pm$ 10 dB

Study Questions

1. How efficient is the standardized method versus the clinical method?
2. How accurate is the standardized approach compared to the clinical approach using strict versus lax criteria?
3. Is the standardized approach a viable option for fitting hearing aids when a clinical method is impractical?

Results

The Standardized Method took significantly less time on average to complete compared to the Clinical Method. The time need to fit 1 or 2 aids was reduced by **more than 50%.**

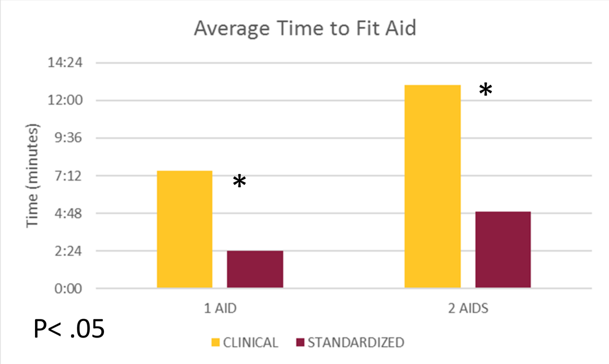


Fig. 2: Average time to fit 1 or 2 aids using each method.

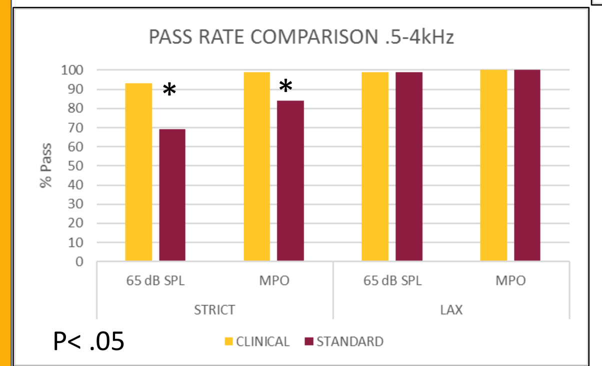


Fig. 3: Average pass rate for each fitting method using strict vs. lax criteria for 65 dB SPL and MPO. Fail = deviation from target criteria at >2 frequencies for output and/or slope.

The pass rate was significantly higher for the Clinical Method vs. the Standardized Method using strict criteria (Fig. 3). There was no significant difference using lax criteria. Even the Clinical Method did not reach 100% using a strict criteria due to output limitations at 3 and 4kHz.

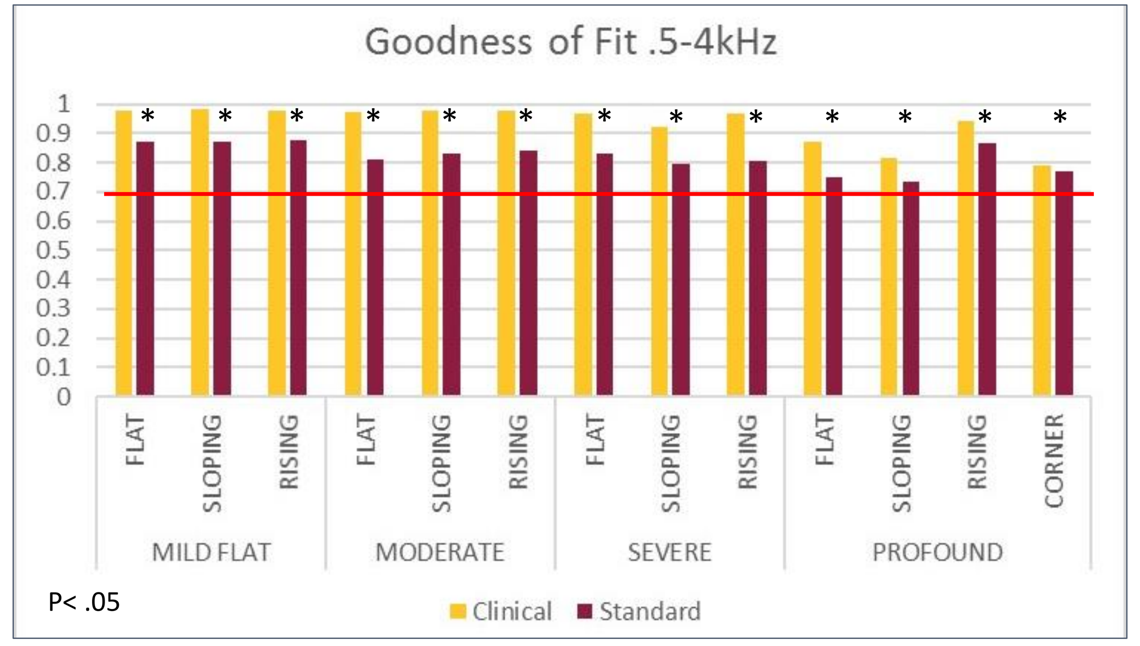


Fig. 4: The fittings were evaluated against the Goodness of Fit (GoF) calculator Mark IV (GoF-IV, Hostler, 2004) which evaluates the overall goodness of fit based on gain for 65 dB SPL input. The GoF has been shown to be highly correlated with both the Aided Audibility Index and clinician ratings of goodness of fit (Hostler, 2004). The GoF-IV values range from 0 to 100%, with higher values indicating better fittings. Mean GoF values shown for each audiogram. Red line is the mean data from Munro et al (2016) for 1st-fit algorithms.

GoF data (Fig. 4), revealed significantly higher GoF ratings for the Clinical Method vs. the Standardized Method for all audiograms. The GoF value for the Standardized Method was .8 or higher for all audiograms except for audiograms #8 (severe sloping), #10 (profound flat), and #11 (profound sloping). Compared to 1st-fit GoF data (Munro et al, 2016), the Standardized Method was as good or better. The Clinical Method was also lower for these audiograms due to the output limits of the hearing aids. The GoF for the Clinical Method was >.9 for all other audiograms.

Results

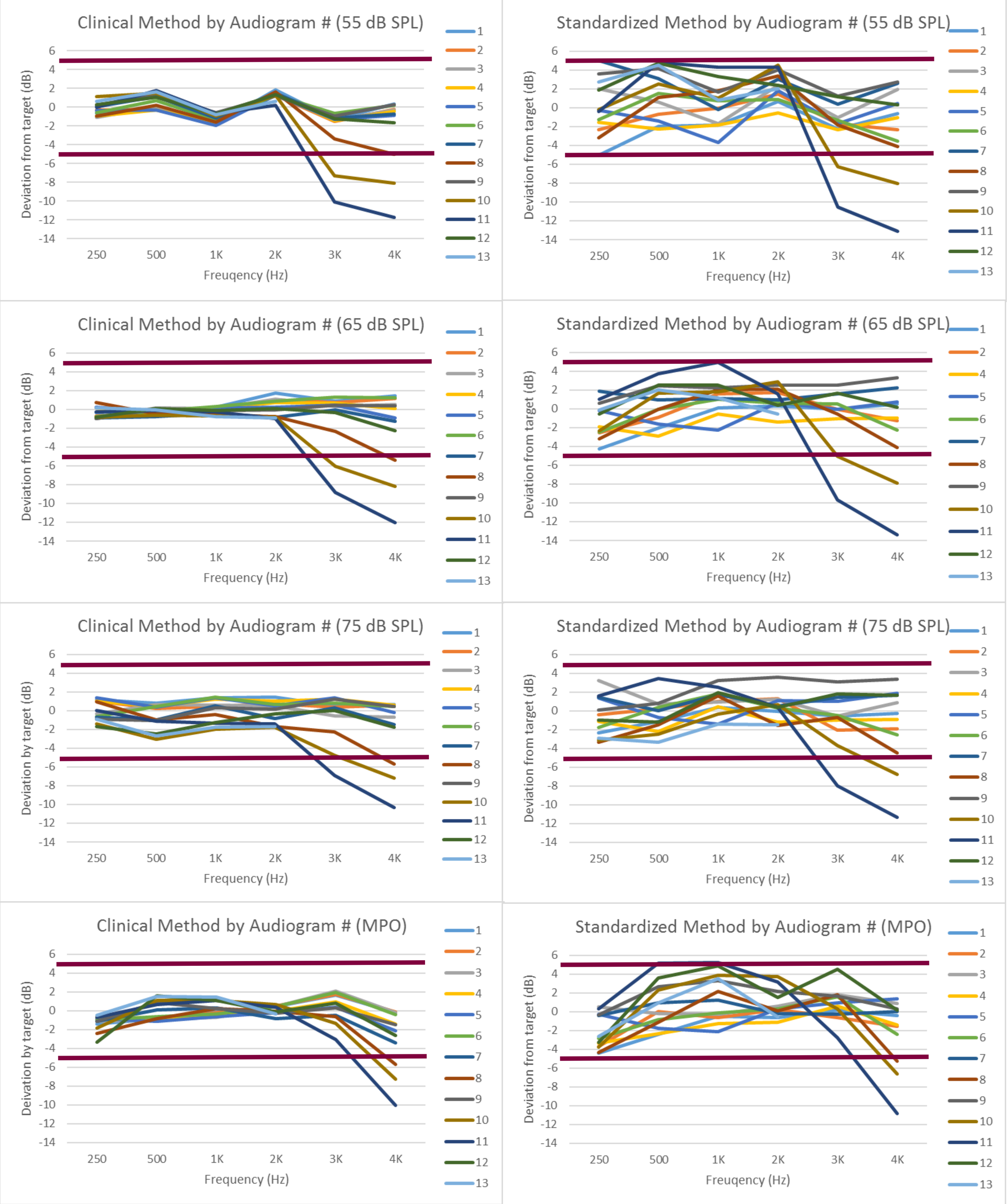


Fig. 5: Average deviation from DSL target as a function of frequency for audiograms 1-13. Bold red lines show the $\pm$5dB range.

Fig. 5 further illustrates how the targets could not be achieved at 3-4kHz using either method for audiograms #8 (severe sloping), #10 (profound flat), and #11 (profound sloping). Although the fitting was less precise, the pass rates for .5-4kHz using the Standardized Method and strict criteria were 69% with a 65 dB SPL input and 84% for MPO compared to 93% and 99%, respectively for the Clinical Method (Fig. 3). Fig. 6 shows the pass rates across the 13 audiograms using strict vs. lax criteria. Using strict criteria, audiograms #8, #10, and #11 had the lowest pass rate for both methods.

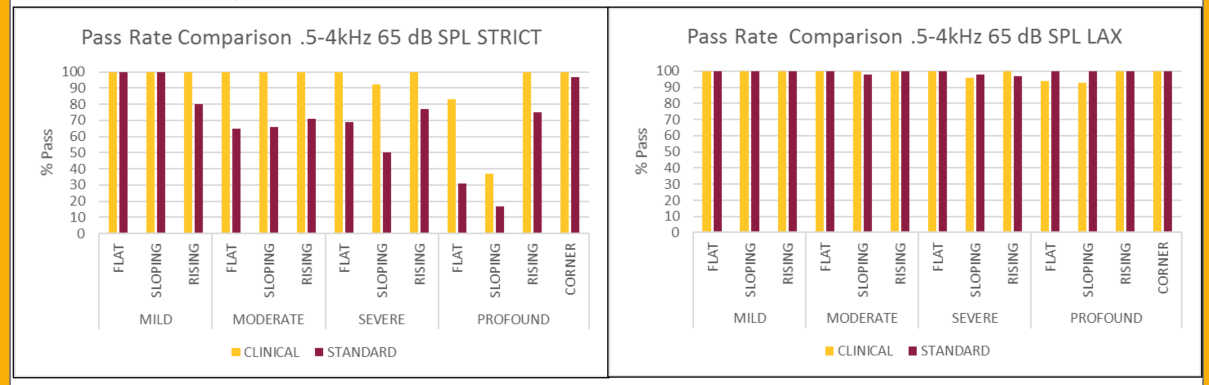


Fig. 6: Pass rate as a function of Audiogram for strict vs. lax criteria; input 65 dB SPL

Conclusions

1. The Standardized Method was twice as efficient as the Clinical method.

2. The Standardized Method was less precise compared to the Clinical Method using strict criteria. Using lax criteria, the two methods were not significantly different. Aazh & Moore, 2007, reported a pass rate of 36% for 1st-fit algorithms using a lax criterion of $\pm$10 dB at 1 or more frequencies for .25-4kHz. Using the same analysis, the Standardized method used in this study had a pass rate of 72%, so it was better than a 1st-fit approach.

3. Based on the data, the Standardized Method is a viable method to use when a Clinical Method is not feasible. The potential for error was greatest with the most severe hearing losses and sloping configurations. The approach may not be appropriate for unusual configurations.

Limitations

This study examined sensorineural hearing losses only. More research is needed with conductive and mixed hearing losses. This study was also a retrospective analysis. The actual implementation of the standard method in the field has not yet been completed.

References

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Acknowledgements & Contact

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