Goals and outcomes of FM use by adults

By Theresa Hnath Chisolm, Rachel McArdle, Harvey Abrams, and Colleen M. Noe

INTRODUCTION

An almost universal complaint of adults with hearing loss is difficulty understanding speech in the presence of background noise.[1,2] Assistive listening devices provide useful, but often overlooked, solutions to the problems adults experience when listening in noisy environments. Use of an FM system, for example, can result in dramatic improvements in speech recognition in noise.[3–6]

Recent advances in FM technology, including miniature receivers that can be coupled directly to a behind-the-ear (BTE) hearing aid or built into a BTE hearing aid, along with easy-to-use handheld transmitters, make FM systems increasingly user-friendly for adults. In addition, several researchers have documented both objective and subjective benefits of FM technology in adults[5,7,8] Yet, despite positive research findings, few or none of the adults in studies by Jerger et al.[7] and Boothroyd[5] indicated they would use FM systems after study completion. Although Sanford and Kierkhaefer reported a higher uptake rate, with 22 of 28 participants electing to purchase FM systems,[8] our clinical experience indicates a disappointingly low use rate of FM systems in the adult population. This is supported by a report from Phonak's managing director of wireless products stating that approximately three times as many FM systems are purchased for children as for adults.[9]

> *"... we believed that our systematic approach to counseling, coaching, and instruction in FM device use was also critical to our success ..."*

Recently we undertook a study at two VA audiology clinics (VAMC, Bay Pines, FL, and VAMC, Mountain Home, TN) to address two reasons postulated for minimal use of FM systems by adults: (1) lack of clear criteria for determining device candidacy[9] and (2) lack of "considerable counseling, instruction, and coaching" regarding FM use (Boothroyd, p. 32[5]).

We previously reported our approach for addressing the lack of candidacy criteria.[10] A panel of five clinicians experienced in fitting FM devices to adult patients developed the following criteria for participants in an extended trial period of FM use: (1) at least a moderate-to-severe bilateral hearing loss; (2) experience using BTE hearing aids or expressed willingness to use them; (3) no known psychiatric or physical problems that would preclude FM use; and, (4) perhaps, most importantly, an indication on initial interview of lack of satisfaction with hearing aid use in at least one situation where an FM device could be helpful.

Based on these criteria, we recruited 36 veterans (18 from each clinic) who completed a systematic 7-week trial period of FM use. When we compared the reported satisfaction of our participating veterans with various aspects of their current hearing aids against the data in the latest MarkeTrak survey,[11] we found significantly lower levels of satisfaction for the veterans in several areas, including: listening in small groups, during worship, while watching TV, listening to music, and listening in restaurants, cars, and on the telephone.[10]

Chisolm and colleagues reported preliminary results for the outcomes of FM use by our veteran sample.[12] Positive outcomes were obtained for self-perception of communication performance as measured through select items from the Communication Profile for the Hearing Impaired;[13] satisfaction with device use in specific listening situations as measured through select items from the MarkeTrak survey;[14] and, achievement of individualized goals, as measured through the Client Oriented Scale of Improvement (COSI).[15] The "gold standard" outcome was the decision to keep and use the FM systems after the trial period.

At the time of preliminary data analysis, all 31 individuals who had completed the trial period elected to keep their FM systems. Although the veterans did not need to pay for the FM devices, we asked how much they would be willing to pay (WTP) given the benefits received. Participants were provided with an anchor, as they were told the hearing aids they had cost about $4000 a pair. The mean WTP response was $2323.10, which was lower than the manufacturer's suggested retail price of approximately $3250 for two receivers and the transmitters used in the study. However, more than 25% of the participants gave WTP values equal to or higher than the suggested retail price.

Although we could not rule out the contribution of there being no personal expense for our subjects on their high rate of uptake, we believed that our systematic approach to counseling, coaching, and instruction in FM device use was also critical to our success. This systematic approach depended on obtaining individualized communication goals for FM use.

Using COSI, each participant identified one to three goals during an initial session. Over the 6-week trial period, goals were addressed in individual sessions with written,

oral, and pictorial instructions on how the goal could be achieved. Progress toward goals was monitored and instruction reinforced throughout the trial period.

From a clinical perspective, we found that the use of COSI for setting goals and measuring outcomes was the most important component of the project, although the two clinics took different approaches in using COSI as an outcomes measure. At Mountain Home, we measured outcomes in terms of the *Degree of Improvement* the FM system provided over hearing aids alone. At Bay Pines, we measured outcomes both in terms of perceived *Final Ability* with amplification pre- and post-FM system use, as well as *Degree of Improvement*. Since both *Final Ability* and *Degree of Improvement* outcomes could be useful for clinicians, we will report detailed COSI data from the 18 patients seen at Bay Pines. Additional data on the preliminary analysis of final ability of all 36 participants can be found elsewhere.[12]

"... the results of this study clearly demonstrate that when specific goals are established and individuals are provided with systematic instruction and counseling regarding FM use over several sessions, a great amount of success can be achieved ..."

METHODS

Participants

The 18 veterans recruited from the VAMC-Bay Pines ranged in age from 66 to 85 years (mean = 77.26). The mean four-frequency, pure-tone averages (500, 1000, 2000, and 4000 Hz) for the right and left ears were 77.78 (SD = 9.89) and 75.46 (SD = 11.48), respectively. As noted above, all participants were experienced hearing aid users with no psychiatric or physical conditions precluding FM use and all expressed lack of satisfaction with their current hearing aid(s) in at least one area where an FM device could be useful.

COSI

Dillon, James, and Ginis provide a detailed description of COSI.[15] Briefly, in the COSI procedure, patients can nominate up to five listening situations they would like to improve with amplification. The resultant goals can be classified into one of 16 categories for comparison across groups of patients. These categories are: conversation with one or two persons in quiet; conversation with one or two persons in noise; conversation with group in quiet; conversation with group in noise; television/radio at normal volume; familiar speaker on the phone; unfamiliar speaker on the phone; hearing phone ring from another room; hear front door bell or knock; hear traffic; increased social contact; feeling embarrassed or stupid; feeling left out; feeling upset or angry; church or meeting; and other.

For the present study, participants were asked to nominate from one to three situations in which their current hearing aids were not effective in improving communication. After 6 weeks of FM system use, patients were asked to note their *Degree of Change* from use of hearing aids alone as either "worse," "no change," "slightly better," "better," or "much better." They were also asked to rate their *Final Ability* (i.e., how much they could hear in the situations they nominated as treatment goals), choosing from five options: "hardly ever" (10%), "occasionally" (25%), "half of the time" (50%), "most of the time" (75%), "and almost always" (95%). Ratings of *Final Ability* were obtained for hearing aid use alone before the subjects were fitted with FM systems and then for FM system use at the end of the trial period.

Hearing aids and FM systems

Ten of the participants used analog and eight used digital BTE hearing aids binaurally. All digital hearing aids incorporated directional-microphone technology.

We coupled the hearing aids to either Phonak MLx or ML8 receivers. We used several transmitters, including the Phonak TX2 (lapel with lavaliere microphone), the Phonak TX3 (handheld microphone), and the Phonak TX4 (telephone- and television-linked microphone). To fit the FM devices, we first compared the hearing aid response with the NAL-R insertion gain target.[16] Because the participants were experienced hearing aid users, some variations in the fitting target were required to match patient preference.

Next we placed the FM transmitter 15 cm from the real-ear system speaker and set the hearing aid and FM receivers to the FM-only mode. We presented a 65-dB-SPL composite signal and compared the real-ear insertion gain (REIG) as processed through the FM system with the REIG of the hearing aid. The verification was intended to ensure that the FM system was providing a smooth and appropriate frequency response when coupled to the hearing aid, as well as ensuring that equal gain was obtained in the FM-only and hearing aid-only modes by observation of a higher SPL for the FM-only REIG (due to the microphone being 15 cm from the speaker) than the hearing aid REIG (microphone at 1 meter from the speaker).

Protocol

We saw participants in five individual sessions over a 7-week period. During Session 1, adequate functioning of hearing aids was determined, baseline outcomes measured, and individualized goals for FM were obtained through the use of COSI. In Session 2 a week later, FM devices were fitted, instructions on use given, and a COSI goal was introduced. For each participant, we provided individualized instructions orally, in writing, and with picture support describing how the FM system should be used to achieve the first goal.

Each participant returned 2 weeks later for the third session to discuss progress and receive instruction on meeting the

Category	Goal Priority First	Second	Third	TOTAL
1 Conversation with 1 or 2 in quiet	4	1	1	6
2 Conversation with 1 or 2 in noise	3	2	4	9
3 Conversation with a group in quiet	1	1	0	2
4 Conversation with a group in noise	4	4	2	10
5 TV/radio at a normal volume	0	3	4	7
6 Familiar speaker on the telephone	1	4	3	8
15 Church or meeting	5	2	1	8

Table 1. *Distribution of COSI goals across categories and priorities.*

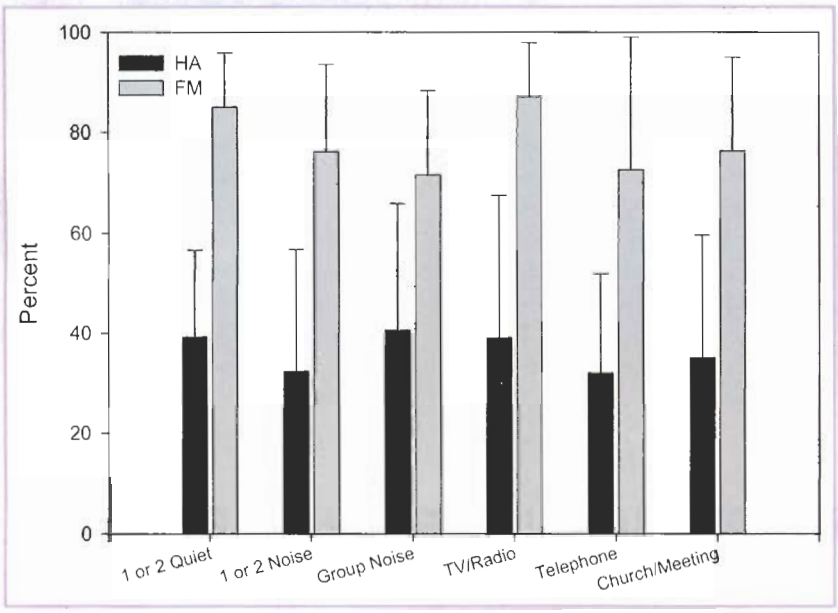

Figure 1. *With regard to Final Ability, means and standard deviations of the percent hearing ability when listening with hearing aids alone and with hearing aids coupled to FM systems are shown for listening situations assigned to COSI categories.*

next goal. If there was no second goal, the first goal was reinforced. During the fourth session, held 2 weeks later, the final goal was introduced if needed and previous goal(s) were reinforced. After 2 additional weeks of FM use, the participant returned for the final session at which COSI outcomes, as well as the outcomes reported in Chisolm et al.,[12] were obtained.

RESULTS

To summarize across participants, we assigned the individual goals to one of the 16 general COSI categories. The seven categories shown in Table 1 encompassed all the goals. This table shows the number of goals in each of the categories, as well as whether the goals were assigned first, second, or third priority. Fifteen of the 18 participants had three goals for FM use, two had two goals, and the other had only one goal. The most common goals involved "conversation with groups in noise," followed closely by goals involving "conversations with one or two in noise." The third most common goals involved either "talking with a familiar speaker on the telephone" or hearing at "church or meetings."

Figure 1 shows the mean of the percent values assigned to each of the *Final Ability* descriptors for self-report of performance with hearing aids alone and with hearing aids coupled with FM systems for goals in all of the COSI general categories except "conversation with a group in quiet." Only two participants had goals in this category. One indicated that he "hardly ever" heard well during "conversations in quiet" with his hearing aids; and, with the FM system he heard well "most of the time."

The other participant with a goal in this category reported he heard well "most of the time" with his hearing aids and that the FM system did not change performance. As can be seen in Figure 1, for goals in all other categories, mean perception of the ability to hear with hearing aids was lower than with FM systems. For each category, a *t*-test for related measures indicated that the differences in self-perception of listening ability were statistically significant ($p < .05$).

Table 2 shows the number of participants providing each of the responses for *Degree of Change* in listening abilities for each of the categories. The modal response for each category indicated that the majority of participants believed their listening abilities were "much better" with FM systems than with hearing aids alone, except for the "conversations with a group in quiet" category. Recall that there were only two participants with goals in this category. While the one who indicated a change in *Final Ability* reported the *Degree of Change* as "much better," the one who perceived little difference in *Final Ability* reported the *Degree of Change* to be only "slightly better."

DISCUSSION

One of the considerations for participation in this study was an indication of a lack of satisfaction with hearing aids in a communication situation where clinicians believed an FM device could be helpful. It was not surprising that the majority of the established goals for FM use involved better hearing in noise. Given that the average hearing loss of participants was in the severe range, the finding that many of their goals were associated with improving telephone communication and hearing at a distance (i.e., church and meetings) was also not surprising. The results of this study clearly demonstrate that when specific goals are established and individuals are provided with systematic instruction and counseling regarding FM use over several sessions, a great amount of success can be achieved.

In view of the success achieved by the study participants, VAMC-Bay Pines has made several modifications to its routine

Category	Degree of Change: No Difference	Slightly Better	Better	Much Better
1 Conversation with 1 or 2 in quiet			2	4
2 Conversation with 1 or 2 in noise			1	8
3 Conversation with a group in quiet		1		1
4 Conversation with a group in noise		2	1	7
5 TV/radio at a normal volume	1		1	5
6 Familiar speaker on the telephone	1		1	6
15 Church or meeting			4	4

Table 2. *Distribution of responses to Degree of Change when listening with the FM system vs. hearing aids alone.*

clinical protocol for fitting patients with FM devices. Currently, clinicians are encouraged to use COSI on a regular basis to set goals and measure outcomes for hearing aid use. Also as a result of this study, patients whose *Final Ability* with hearing aids is only "half the time" (50%) or less for goals involving listening in noise, on the telephone, to television/movies, or at church/meetings are now routinely considered for a trial period of FM use.

While FM trial periods for clinic patients involve fewer sessions than in the experimental protocol, individualized goals are developed and patients are seen at least twice after being fitted with the devices. The follow-up sessions are necessary to ensure that patients are using the devices appropriately to achieve their goals. Finally, a specialty clinic was developed for patients with significant hearing losses. The clinician assigned to the facility maintains a high level of knowledge regarding coupling of FM systems to various BTE models, develops training and educational materials, and considers ALDs in addition to FM systems, if needed.

Although it is important to document the outcomes of FM use by adults through standardized approaches such as COSI, our decision to make FM trial periods a routine part of clinical practice was also prompted by the comments of patients. When a patient tells us that the FM system "has already in 6 weeks improved the quality of my life significantly,"[17] we know that the systematic counseling, instruction, and coaching we provided was time well spent. HJ

Acknowledgments

This work was supported by Phonak, Inc. We thank the veterans from the Bay Pines, FL, VAMC who participated in this study for their time and insights. We thank Amanda Hemard, Kelly Koder, and Lauren Rost for their assistance in data collection.

Theresa Hnath Chisolm, PhD, is an audiologist at the University of South Florida. **Rachel McArdle**, MS, and **Harvey Abrams**, PhD, are audiologists at the VA Medical Center in Bay Pines, FL. **Colleen M. Noe**, PhD, is an audiologist at the James H. Quillen VA Medical Center in Mountain Home, TN. Correspondence to Dr. Chisolm at Department of Communication Sciences and Disorders, PCD 1017, University of South Florida, Tampa, FL 33620; chisolm@chuma1.cas.usf.edu.

REFERENCES

1. Carhart R, Tillman TW: Interaction of competing speech signals with hearing loss. *Arch Otolaryngol* 1970;91:273–279.
2. Killion MC: New thinking on hearing in noise: A generalized articulation index. *Sem Hear* 2002;23:57–75.
3. Hawkins D: Comparisons of speech recognition in noise by mildly-to-profoundly hearing-impaired children using hearing aids and FM systems. *J Sp Hear Dis* 1984;49:409–418.
4. Fabry D: Noise reduction with FM systems in FM/EM mode. *Ear Hear* 1994;13:82–86.
5. Boothroyd A: Hearing aid accessories for adults: The remote FM microphone. *Ear Hear* 2004;25(1):22–33.
6. Valente M, Crandall CC, Lewis S, Enrietto J: Improving speech recognition in noise: Directional microphone and FM systems. In Fabry D, Johnson CD, eds., *ACCESS: Achieving Clear Communication Employing Sound Solutions. Proceeding for the First International FM Conference.* Great Britain: Cambrian Printers, 2004: 31–38.
7. Jerger J, Chmiel R, Florin E, et al.: Comparison of conventional amplification and an assistive listening device in elderly persons. *Ear Hear* 1996;17:490–504.
8. Sanford MJ, Kierkhaefer B: Adults use of FM systems: Subjective benefit by adult users. *Hear Rev* 2002;9(3): 24–33.
9. Ermann H: Personal communication. Phonak Corporation, 2003.
10. Noe CM, McArdle R, Chisolm TH, et al.: FM technology use in adults with significant hearing loss I: Candidacy. In Fabry D, Johnson CD, eds., *ACCESS: Achieving Clear Communication Employing Sound Solutions. Proceeding for the First International FM Conference.* Great Britain: Cambrian Printers, 2004: 113–119.
11. Kochkin S: MarkeTrak VI: 10-year customer satisfaction trends in the US hearing instrument market. *Hear Rev* 2002;9(10):14–25,46.
12. Chisolm TH, Noe CM, McArdle R, et al.: FM technology use in adults with significant hearing loss, Part II: Outcomes. In Fabry D, Johnson CD, eds., *ACCESS: Achieving Clear Communication Employing Sound Solutions. Proceeding for the First International FM Conference.* Great Britain: Cambrian Printers, 2004: 141–146.
13. Demorest M, Erdman S: Development of the Communication Profile for the Hearing Impaired. *J Sp Hearing Dis* 1987;52:129–143.
14. Kochkin S: Introducing MarkeTrak: A consumer tracking survey of the hearing instrument market. *Hear J* 1990;43(3):17–27.
15. Dillon H, James A, Ginis J: Client Oriented Scale of Improvement (COSI) and its relationship to several other measures of benefit and satisfaction provided by hearing aids. *JAAA* 1997;8:27–43.
16. Byrne D, Cotton S: Evaluation of the National Acoustic Laboratories' new hearing aid selection procedure. *J Sp Hear Res* 1988;31:178–186.
17. McArdle R: Use of FM technology to improve telephone communication. *Sem Hear* (in press).