Original Article

Artigo Original

Bruna da Silva Rocha[1]
Renata Coelho Scharlach[2]

The use of the Frequency Modulation System by hearing-impaired children: benefits from the family's perspective

O uso de Sistema de Frequência Modulada por crianças com perda auditiva: benefício segundo a perspectiva do familiar

Keywords

Hearing Loss
Family
Hearing Aids
Wireless Technology
Patient Satisfaction

ABSTRACT

Purpose: To evaluate the family's perspective of benefits of the frequency modulation (FM) system adapted to children with sensorineural hearing loss. **Methods:** This is a descriptive, analytical, cross-sectional study with the participation of family members of hearing-impaired children aged 6 to 15 years, users of hearing aids and/or cochlear implants, benefited with the FM system by a hearing health service of the Unified Health System (SUS), Brazil. The FM Listening Evaluation For Children questionnaire with 14 questions was used to evaluate the benefits of using the FM system, the characteristics of the hearing aids and/or cochlear implants, and the brand/model of the FM system the children used. **Results:** Statistically significant differences were found between the questionnaire responses of FM users and non-users in all situational analyses (quiet, noise, auditory only, distance), with better learning performance and improvements and attention among FM users, from the families' point of view. No method was used to formally evaluate such performances. **Conclusion:** It was observed that, according to the parents' and guardians' perceptions, the use of FM systems improves the performance of hearing-impaired children in various acoustic situations, with special emphasis on speech recognition in noisy environments and at increased distances from the sound source. Although used in different contexts and situations, the FM system has brought greater benefits for the children in the school environment, according to the respondents.

Descritores

Perda Auditiva
Família
Auxiliares de Audição
Tecnologia Sem Fio
Satisfação do Paciente

RESUMO

Objetivo: Avaliar o benefício do uso do sistema de frequência modulada (FM) adaptado em crianças com perda auditiva neurossensorial, segundo a perspectiva do familiar. **Métodos:** Trata-se de um estudo do tipo descritivo, analítico de delineamento transversal. Participaram da pesquisa familiares e cuidadores de crianças de seis a 15 anos com deficiência auditiva neurossensorial, usuárias de aparelho de amplificação sonora individual (AASI) e/ou implante coclear (IC), que foram beneficiadas pelo Sistema Único de Saúde (SUS) com o sistema FM em um serviço de saúde auditiva paranaense. Aplicou-se o questionário Avaliação do Sistema FM composto por 14 perguntas sobre o benefício do uso do FM, bem como sobre as características do AASI e/ou IC e do tipo de sistema FM utilizado pelas crianças. **Resultados:** Houve diferença estatisticamente significante comparando as respostas do questionário com e sem o uso do FM, para todas as situações (silêncio, ruído, apenas via auditiva, distância), observando-se melhor desempenho e mudanças no comportamento em relação à atenção e ao aprendizado com o uso do sistema FM, segundo a percepção dos familiares. Não sendo utilizado nenhum método para avaliar formalmente tais desempenhos. **Conclusão:** Verificou-se que, segundo a óptica dos pais, o uso do sistema FM melhora o desempenho do deficiente auditivo em várias situações acústicas, sendo mais evidente em ambientes de fala no ruído e quando há o aumento da distância da fonte sonora. Apesar de o sistema FM ser utilizado em diferentes situações, trouxe maiores benefícios à criança no ambiente escolar, segundo relato dos pais.

Correspondence address:
Bruna da Silva Rocha
Rua Orlando Silva, 220,
Consolata, Cascavel (PR), Brazil,
CEP: 85815-190.
E-mail: bruzandona@gmail.com

Received: November 28, 2016

Accepted: May 06, 2017

Study carried out at Centro de Excelência em educação e comunicação LTDA – ME, Instituto de Estudos Avançados da Audição – IEAA, São Paulo (SP), Brazil.

[1] Instituto de Estudos Avançados da Audição – IEAA - São Paulo (SP), Brazil.

[2] Universidade Federal de Santa Catarina – UFSC - Florianópolis (SC), Brazil.

Financial support: nothing to declare.

Conflict of interests: nothing to declare.

INTRODUCTION

Hearing is one of the five human senses and of great importance for the development of human communication[1].

In early childhood, the senses have a central role in the apprehension of the exterior world and gain of experiences that will promote the child's psychosocial development. Normal oral language acquisition depends on the anatomical and physiological integrity of the auditory system and hearing sensitivity, so alterations and impairments causing any type of hearing loss may affect the child's learning process, cognitive development and social inclusion[2]. Therefore, the hearing impairment diagnosis should be performed as early as possible, preferably before the sixth month of age[3].

Currently, programs for the early detection and intervention of hearing impairment have made it possible and urgent to access the auditory environment via hearing aids. The primary aim of an early intervention program on hearing impairment is to support and encourage family members in structuring the child's communication process[4,5]. Among the guidelines given to the family is the need for the use of hearing aids, including the frequency modulation (FM) system[6].

The FM system functions as an invisible cable (through radio waves) connecting a microphone attached to the interlocutor/teacher with the hearing aid of the hearing-impaired individual. According to some authors, the FM system is the most important and essential educational tool ever developed for hearing-impaired children, because regardless its type (personal, self-contained, free-field) it is the most effective means to improve speech signal acquisition and eliminate the effects of distance, noise and reverberation, especially in an educational environment[7].

Until the middle of 2013, this technology was affordable only to individual buyers, reaching just a small part of the population for its high cost[8]. With Ordinance No. 1274[9] of June 25, 2013, the Personal Modulation Frequency System (FM) was incorporated into the Brazilian Unified Health System (SUS), giving hearing-impaired children and adolescents access to this technology.

Family has a fundamental role in the language development of the hearing-impaired child. In this sense, speech therapists and audiologists should advise the patient, parents and guardians about important aspects of the hearing loss condition and the use of hearing aids (HA). They should also offer emotional support, follow the patient's progress, assure the successful use of the amplification system under possible operating conditions, and organize the therapy and special training. In addition, it is important to provide guidance on the use of hearing-aid devices, such as the FM system, not only to HA and/or cochlear implant (CI) users and their families but also to educators, promoting active participation of the hearing-impaired person in the community[10].

The more involved and adapted the family, the better prognosis the child will have. This way, the family will play a key role in the process, as it is with the family that children spend most of their time, in a constant exchange and moments of interaction with their parents[11].

Moreover, it is known that children spend a considerable amount of time at school and, in 45% of that time, they are involved in activities in which the speech of teachers and classmates predominates. Thus, one can easily conclude that a clear reception of the message and the ability to listen to it is essential for the child's learning process[12].

The FM Listening Evaluation For Children[13] questionnaire, that was translate to Brazilian Portuguese[14], is a subjective evaluation tool that provides a situational analysis of the use and benefit of HAs and the FM system. This evaluation can be completed by parents, teachers, audiologists or speech therapists, and it is used to evaluate a child's performance in different auditory situations with HAs only or with HAs and FM combined.

The national and international literature provides evidence that the use of FM is beneficial in the school environment[15]. Evaluating such benefits is essential to determine its effectiveness prior to recommending or prescribing hearing-aid devices with this technology. However, in Brazil, to date there is only one study that reports the benefits of the FM system from the family's point of view[16]. Internationally, there are also few studies describing the benefits of FM systems based on the family's opinion[13,17]. It is important to know the parents' or guardians' opinion about this system, and how much they perceive the advantages of using this technology in terms of the improvements in speech perception and recognition in different acoustic situations that it delivers. Considering that the family spends most of their time with the child and may have a close contact with the school and teachers, this can be an important communication channel to assist the audiologist and speech therapist in guiding teachers about the use and benefits of the FM system in the school environment.

Based on these considerations, the present study aimed to evaluate the benefit of using the frequency modulation system adapted to children with sensorineural hearing loss, taking into account the family's view of this technology.

METHODS

This is a descriptive, analytical, cross-sectional study. It was approved by the Research Ethics Committee, filed under number 813.109, and was carried out in a clinic located in the State of Paraná, Brazil, accredited by the SUS to provide services in the Hearing Health Program of the Federal Government. The clinic delivers medium and high complexity services, covering in its entirety six regional health units. Upon authorization from the hearing health program and approval by the research ethics committee, the data collection was initiated.

The study used convenience sampling. Twenty-six parents or guardians of children using HAs and/or CI agreed to participate in this study. The inclusion criteria encompassed children with bilateral sensorineural hearing loss using the FM system dispensed by the SUS, for at least three months. They were children attending elementary and middle school assisted by the hearing health service. The families who agreed to participate in the study signed an informed consent form.

The data was collected when the patients and their family attended the annual follow-up visit or during the speech therapy.

Data collection was performed by means of the FM Listening Evaluation For Children[13] questionnaire (Appendix A) in its Brazilian Portuguese published translation[14].

This inventory is a subjective evaluation allowing a situational analysis of the use and benefit of HAs/CIs and the FM system, which was filled out with information provided by parents or guardians. The questionnaire sought for information on the children's performance in different auditory situations using only HAs and/or CIs, and using HAs and/or CIs with FM. It contains five auditory situations, with seven listening conditions, scoring from 1 (seldom) to 5 (usually) or NA (not applicable) the child's behavior or performance on typical days with and without the FM system.

The questions were read out to the respondents and the answers were written down by the researcher. The answers obtained, as per the questionnaire authors' instructions, were submitted to a situational analysis considering the following aspects: (quiet, noise, auditory only, distance), then the total score was calculated.

Subsequently, the data were tabulated in a spreadsheet and submitted to a descriptive and inferential statistical analysis. Wilcoxon non-parametric tests and the two-proportion z-test were used for the analysis. The level of significance was set at 5% ($p < 0.05$).

RESULTS

The children who participated in this study were 6 to 15 years old, a mean age of 10.3 years, being 9 females (34.6%) and 17 (65.4%) males.

In terms of audiological characteristics, 21 children (81%) had symmetrical hearing loss, being 20% mild, 5% moderate, 20% moderately severe, 20% severe and 35% profound. The remaining five children had asymmetric hearing loss, of which three (60%) had moderate loss in the best ear; one had mild loss; and the other had severe loss. Regarding the type of hearing aid device, 18 children (69.2%) used HAs; seven children used CIs; and only one child used HA and CI combined.

As for the FM system itself, the most common model was Inspiro (Phonak), used by 96.2% of the children. Regarding the period of adaptation to the FM system, it was observed that 50% of the children had been using it for less than 12 months and 50% between 12 and 24 months. Considering the daily use of FM, 80.8% of the children use it daily, and 71.4% use it 4 to 8 hours/day. Only 19.2% of the children use the system occasionally, of which 80% use it for 3 to 4 hours/day. This was the information given by the respondents (parents and guardians) as to questionnaire's specific questions.

The following tables present the data analysis carried out with the information obtained from the questionnaire. Table 1 refers to questions 1 through 3, and Table 2 refers to questions 4 and 5, as can be observed.

The Wilcoxon statistical test showed a statistically significant difference for all questions and all acoustic situations. The questionnaire score was higher among the FM users than among non-users.

The Wilcoxon test was also used to compare the results, as shown in Table 3, of the Situational Analysis. A statistically significant difference was observed between the situations with and without FM in all scores, being the highest average scores for situations with FM. The total score presented averages of 198.7 and 118.2, respectively.

Finally, Table 4 displays the data obtained about the use of FM and its benefits as reported by the family.

Table 1. Descriptive measures and comparative results of the FM Listening Evaluation questionnaire, according to variable 'FM use', for questions 1, 2 and 3 in each acoustic situation

	FM Use	Question 1				Question 2				Question 3			
		Mean	SD	Median	P value	Mean	SD	Median	P value	Mean	SD	Median	P value
A	With	4.96	0.20	5.0	0.005*	4.88	0.33	5.0	0.002*	4.62	0.75	5.0	<0.001*
	Without	4.19	1.17	5.0		3.92	1.26	4.5		3.15	1.32	3.0	
B	With	4.88	0.33	5.0	<0.001*	4.77	0.51	5.0	<0.001*	4.38	0.85	5.0	<0.001*
	Without	3.31	1.23	3.0		2.96	1.28	3.0		2.54	1.21	2.5	
C	With	4.69	0.62	5.0	<0.001*	4.50	0.51	4.5	<0.001*	4.27	0.96	5.0	<0.001*
	Without	3.38	1.24	4.0		2.88	1.07	3.0		2.62	1.24	2.5	
D	With	4.62	0.64	5.0	<0.001*	4.42	0.64	4.5	<0.001*	4.04	1.18	4.0	<0.001*
	Without	2.58	1.42	2.0		2.23	0.95	2.0		2.15	1.16	2.0	
E	With	4.73	0.53	5.0	<0.001*	4.46	0.65	5.0	<0.001*	4.15	1.16	4.5	<0.001*
	Without	2.96	1.34	3.0		2.23	1.11	2.5		2.12	1.14	2.0	
F	With	4.62	0.64	5.0	<0.001*	4.27	0.83	4.5	<0.001*	3.92	1.29	4.0	<0.001*
	Without	2.62	1.30	3.0		1.58	0.76	1.0		1.73	0.78	2.0	
G	With	4.50	0.76	5.0	<0.001*	4.12	0.91	4.0	<0.001*	3.81	1.39	4.0	<0.001*
	Without	2.81	1.33	3.0		1.77	0.82	2.0		1.73	0.78	2.0	

*Statistically significant values ($p < 0.05$) - Wilcoxon test

Legend: item A (In a quiet room, within 3 feet); item B (In a quiet room, at 10 feet); item C (In a noisy room, within 3 feet); item D (In a noisy room, at 10 feet); item E (Without visual cues); item F (From another room) e item G (Outside/in the community). Question 1: Child responds to his/her name when spoken to; Question 2: Child attends to person speaking; Question 3: Child distinguishes between words that sound alike. SD = Standard Deviation; FM = Frequency Modulation System

Table 2. Descriptive measures and comparative results of the FM Listening Evaluation questionnaire, according to variable 'FM use', for questions 4 and 5 in each acoustic situation

	FM Use	Question 4				Question 5			
		Mean	SD	Median	P value	Mean	SD	Median	P value
A	With	4.77	0.65	5.0	0.001	4.62	0.90	5.0	0.002*
	Without	3.73	1.22	4.0		3.77	1.37	4.0	
B	With	4.50	0.76	5.0	<0.001	4.62	0.70	5.0	<0.001*
	Without	3.00	1.10	3.0		3.19	1.20	3.0	
C	With	4.42	0.70	5.0	<0.001	4.54	0.65	5.0	<0.001*
	Without	2.96	1.18	3.0		2.77	1.27	3.0	
D	With	4.27	0.78	4.0	<0.001	4.23	0.86	4.5	<0.001*
	Without	2.38	1.06	2.0		2.23	1.03	2.0	
E	With	4.19	0.80	4.0	<0.001	4.27	0.87	5.0	<0.001*
	Without	2.35	0.94	2.0		2.23	0.95	2.0	
F	With	3.96	0.72	4.0	<0.001	4.12	0.91	4.0	<0.001*
	Without	1.92	0.74	2.0		1.92	0.89	2.0	
G	With	3.92	0.89	4.0	<0.001	3.92	1.16	4.0	<0.001*
	Without	1.77	0.76	2.0		1.92	0.89	2.0	

*Statistically significant values (p <0.05) - Wilcoxon test
Legend: item A (In a quiet room, within 3 feet); item B (In a quiet room, at 10 feet); item C (In a noisy room, within 3 feet); item D (In a noisy room, at 10 feet); item E (Without visual cues); item F (From another room) e item G (Outside/in the community). Question 4: Child responds accurately to spoken directions and/or questions; Question 5: Child comprehends oral instruction & concepts. SD = Standard Deviation; FM = Frequency Modulation System

Table 3. Results (%) of the comparison with and without FM in the Situational Analysis

Situational Analysis		Mean (%)	Median (%)	Standard Deviation	Q1	Q3	N	CI	P value
Quiet	With FM	47.0	48.5	3.9	45.5	50.0	26	1.5	<0.001*
	Without FM	33.8	32	8.9	26.25	39.8	26	3.4	
Noise	With FM	64.3	67	9.0	57	71.0	26	3.5	<0.001*
	Without FM	36.2	35	9.7	30.25	41.8	26	3.7	
Auditory only	With FM	21.8	23	3.1	20	24.0	26	1.2	<0.001*
	Without FM	11.9	12	3.8	10	13.8	26	1.5	
Distance	With FM	65.6	67.5	7.5	61.25	72.5	26	2.9	<0.001*
	Without FM	36.3	35	9.9	30.25	41.0	26	3.8	
Total score	With FM	198.7	204.5	21.7	185	217.3	26	8.3	<0.001*
	Without FM	118.2	111.5	29.4	101.5	131.8	26	11.3	

*Statistically significant values (p <0.05) - Wilcoxon test
Legend: FM = Frequency Modulation System, 1st quartile (Q1), 3rd quartile (Q3), Confidence Interval (CI),% = Percentage

Table 4. Characterization of the use and benefit of the FM system

Activities that were most beneficial	N	%	P value
Story-time/reading /School	21	80.8	Ref.
Listening/speech therapy	2	7.7	<0.001*
At home	3	11.5	<0.001*
Types of activities the FM is used for	**N**	**%**	**P-value**
Story-time/reading	6	23.1	0.023*
Listening/speech therapy	2	7.7	<0.001*
At home	4	15.4	0.004*
All of the above	14	53.8	Ref.
Greatest benefit(s) of the FM system	**N**	**%**	**P-value**
Learning	7	26.9	0.087
Attention	6	23.1	0.044*
Speech comprehension	13	50.0	Ref.
Greatest change(s) in the child after FM use	**N**	**%**	**P-value**
Child became more focused	19	73.1	Ref.
Better speech skills	2	7.7	<0.001*
More communicative	3	11.5	<0.001*
Better social performance/peer interaction	2	7.7	<0.001*

*Statistically significant values (p <0.05) - Two-proportion z-test
Legend: FM = Frequency Modulation; N = Number of individuals; Ref = value statistically different from the others

The two-proportion z-test showed that the activity in which the FM system most helped the children was school activities (80.8%), as 53.8% of them use FM in several situations (school, therapy and home). The greatest benefit observed by parents and guardians was with regard to speech comprehension, and the major change in the child's behavior was about their attention span – 73.1% of the respondents stated that their children became more attentive when they were using the FM system associated with a HA and/or CI.

DISCUSSION

The research analysis allowed observing, by comparing the auditory situations with and without FM in Tables 1 and 2, a statistically significant difference between the two situations. The use of FM proved best performance in all abilities evaluated, regardless of distance and acoustic environment. It was possible to verify that using only a HA and/or CI the children still have great difficulties in understanding speech in noisy environments – a fact that does not happen when using

the FM system. In another study[16] developed with school children, the questionnaire answered by parents also showed a clear difference, with better scores for the use of FM.

It is worth noting that all children in the present study are attending school, and it is known that (competitive) environmental noise interferes with oral communication. This can cause physical, emotional and educational damage, such as changes in auditory thresholds; perception of tinnitus; fatigue resulting from the greater effort to listen and concentrate. All that can cause learning loss, since the student may partially understand the lesson or even receive the message distortedly[12]. Using the FM coupled with their hearing devices, such unfavorable listening situations in the school environment would occur less often and would also stimulate the child's participation in school activities[15,18-20].

A significant difference was also observed in performance, as can be seen in the situational analysis in Table 3. Although all analyses were statistically significant ($p < 0.001$), evidencing a better performance with the use of FM, it can be verified that for situations in which noise was present and/or there was an increase in the distance from the sound source, the improvement was greater than in situations of silence. In the situational analysis of quiet, the benefit percentage observed was 13.2%, whereas in the situational analyses of noise and distance it was 28.1% and 29.3%, respectively. These results meet the real objective of the FM system, namely, the improvement of speech signal acquisition, eliminating the limiting factors to speech comprehension, which are three: noise, distance and reverberation. In view of that, FM can be an alternative among the differentiated materials and support resources used by students with special educational needs, aiming at educational integration[21].

A normal-hearing child's ability to recognize speech, in comparison to an adult's ability, is mostly affected by adverse conditions such as noise and reverberation[22]. Hearing impaired individuals, even using HAs or CIs, experience difficulty in speech recognition in noisy surroundings[23]. Therefore, it should be emphasized that the FM system is the most important and indispensable educational tool ever developed for hearing impaired children[7].

It is widely known that the use of FM contributes greatly to the development of the hearing-impaired individuals as a noteworthy accessibility tool. In this way, it is important to raise resources in order to develop the necessary conditions for the inclusion of students with special needs as a premise to make them individuals of creation and production of the goods produced by society[24].

As described, the first step in the audiologic intervention process is the use of sound amplification for the hearing impaired[24], and the FM system should be considered as a key part of rehabilitation, especially for children. However, it is worth emphasizing that it is within the school environment that the greatest benefits of the FM system are observed, since it guarantees the best access to the information and the knowledge being conveyed directly to the auditory system. The adoption of FM by the hearing impaired is supplementary to the use of other HA devices.

According to the results of the present study, the greatest benefit reported by the families was the improvement of the child's speech comprehension. As can be seen in Table 4, parents and guardians stated that, with FM, the child can understand speech better, either at home, school or therapy, consequently the speaker needs to repeat less often and the child understands the message. The primary benefit of using a wireless communication system, such as FM, is the improvement in the understanding of the teacher's speech in a noisy environment such as the classroom, thus creating conditions favorable to learning acquisition and consolidation for children and/or young people with hearing loss[15,18-20].

Another relevant factor of the FM system, as observed in the data analysis in terms of behavior, was that children's level of attention increased. It is known that only attention is not enough for the development of the teaching/learning process; other factors also contribute to the process, such as teaching strategies, the teacher's expertise and the student's self-commitment[21]. However, it is also known that auditory attention is a prerequisite for perfect learning.

Results similar to the findings of this paper were published by a Brazilian study in 2015. According to the authors, the greatest benefit of FM, as described by parents and/or guardians, was the improvement of speech recognition in all environments, especially in the school context, where children showed better learning performance[16]. Other benefits reported by parents include the fact that FM systems improve attention in noise, keep the child focused on the speaker, and give extra boost to hearing aids[13].

In the present study, of the 26 children under analysis, four did not use the FM system in school because the educational institution did not allow them to. Even knowing about the benefit of using oral communication that the device brings to their children - who met the criteria required by the SUS and were benefited with the FM system - families end up complying with the school's decision. In a previous study, the non-use of the device in the school environment was also verified. The reasons were the teachers' fear of handling or damaging the device and lack of training to operate it, even though it was offered[16].

Although the benefits of using FM systems for the inclusion of hearing-impaired children in regular classrooms have been known for decades, there are scarce national scientific publications that can assist this process in the Brazilian reality. This reality has changed since the issue of Ordinance 1274 of June 25, 2013, which made it possible for children throughout the Brazilian territory, through the SUS, to benefit from the FM system. As a result, new studies have been published showing the effectiveness of this accessibility equipment.

It is worth mentioning that, from the family's perspective, all the children in the present study had better benefits with the use of FM rather than its non-use, and the difference in results was significant.

This study sought to verify if the family, responsible for the hearing-impaired children using FM, did perceive improvements in the hearing quality of these children in all the environments in which the system was used. The results showed that parents/guardians are increasingly willing to seek solutions from professionals to

heal or minimize the hearing difficulties of their children and indeed perceived improvements in their children's behavior and performance when using FM. However, it is necessary to provide teachers with specific qualification to receive the students who are FM users, in addition to greater dissemination and guidance to parents and/or professionals in other areas who do not know this technology. Furthermore, the opinion of parents, teachers and therapists was key to understand whether or not the use of HA devices was beneficial to the children.

The study revealed that patients do not regularly attend the follow-up visits with the speech therapist to verify the functioning and benefits of the HAs and FM, which made it difficult to have a greater number of participants in this study. Moreover, it is necessary to develop more research in the area in order to measure improvements observed and reported by family regarding understanding, attention and, consequently, progress in the teaching/learning process.

CONCLUSION

This study verified that, from parents' and guardians' points of view, the FM system improves hearing-impaired individuals' performance in several acoustic situations, especially in speech environments in noise and at distance from the source sound. Still according to family, although the FM system can be used in different situations, it is in the school environment that it brings greater benefits to the children, since the improvement of the signal-to-noise ratio helps them pay more attention, improve speech comprehension, thus facilitating the teaching/learning process.

ACKNOWLEDGEMENTS

To the Cascavel Hearing Clinic for consenting and supporting the development of this study.

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Authors contributions

BSR collected and analyzed the data, and wrote the manuscript; RCS supervised the development of the study, analyzed data and wrote the manuscript.

APPENDIX A. FM LISTENING EVALUATION FOR CHILDREN

C. DeConde Johnson, Revised June 2003

Name:_____Date of Birth: _____

Completed by:_____Date:_____

( ) parent ( ) audiologist ( ) teacher ( ) other - specify _____

Length of hearing aid usage:_____

HA brand/model:_____

Length of FM usage:_____

FM brand/model:_____

( ) FM used daily ( ) Number of hours per day used_____

( ) FM used occasionally ( ) Number of hours per week used

Please rate the following skills based on the child's behavior or performance on typical days.
Indicate if performance was obtained () with FM or () without FM (baseline).
To score, subtract any NA (not applicable) items from the total, then determine percent for total performance and for each situation.

	Seldom Sometimes Usually
1. Child responds to his/her name when spoken to:	
a. In a quiet room, within 3 feet	1 2 3 4 5 NA
b. In a quiet room, at 10 feet	1 2 3 4 5 NA
c. In a noisy room, within 3 feet	1 2 3 4 5 NA
d. In a noisy room, at 10 feet	1 2 3 4 5 NA
e. Without visual cues	1 2 3 4 5 NA
f. From another room	1 2 3 4 5 NA
g. Outside/in the community	1 2 3 4 5 NA
2. Child attends to person speaking:	
a. In a quiet room, within 3 feet	1 2 3 4 5 NA
b. In a quiet room, at 10 feet	1 2 3 4 5 NA
c. In a noisy room, within 3 feet	1 2 3 4 5 NA
d. In a noisy room, at 10 feet	1 2 3 4 5 NA
e. Without visual cues	1 2 3 4 5 NA
f. From another room	1 2 3 4 5 NA
g. Outside/in the community	1 2 3 4 5 NA
3. Child distinguishes between words that sound alike (e.g., bay for day, sink for think, or sun for fun):	
a. In a quiet room, within 3 feet	1 2 3 4 5 NA
b. In a quiet room, at 10 feet	1 2 3 4 5 NA
c. In a noisy room, within 3 feet	1 2 3 4 5 NA
d. In a noisy room, at 10 feet	1 2 3 4 5 NA
e. Without visual cues	1 2 3 4 5 NA
f. From another room	1 2 3 4 5 NA
g. Outside/in the community	1 2 3 4 5 NA
4. Child responds accurately to spoken directions and/or questions:	
a. In a quiet room, within 3 feet	1 2 3 4 5 NA
b. In a quiet room, at 10 feet	1 2 3 4 5 NA
c. In a noisy room, within 3 feet	1 2 3 4 5 NA
d. In a noisy room, at 10 feet	1 2 3 4 5 NA
e. Without visual cues	1 2 3 4 5 NA
f. From another room	1 2 3 4 5 NA
g. Outside/in the community	1 2 3 4 5 NA

APPENDIX A. Continued...

5. Child comprehends oral instruction & concepts:

a. In a quiet room, within 3 feet	1 2 3 4 5 NA
b. In a quiet room, at 10 feet	1 2 3 4 5 NA
c. In a noisy room, within 3 feet	1 2 3 4 5 NA
d. In a noisy room, at 10 feet	1 2 3 4 5 NA
e. Without visual cues	1 2 3 4 5 NA
f. From another room	1 2 3 4 5 NA
g. Outside/in the community	1 2 3 4 5 NA

TOTAL SCORE: _____/(175) = ____% __with FM __without FM

Situational Analysis: Quiet (a,b) ____/(50) = ____% Noise (c,d,g) ____/(75) = ____%

Auditory only (e) ____/(25) = ____% Distance (b,d,f) ____/(75) = ____%

Information on FM Use

	Seldom Sometimes Usually
1. HA/FM system is easy to operate:	1 2 3 4 5 NA
2. HA/FM system has remained in good working order:	1 2 3 4 5 NA
3. HA/FM system is comfortable for child to use:	1 2 3 4 5 NA
4. Child tries to turn HA/FM system off:	1 2 3 4 5 NA
5. Feedback (whistling noise) is present with HA/FM:	1 2 3 4 5 NA

6. Indicate types of activities the FM is used for:

____ snacks ____ play ____ story-time/reading ____ playground ____ walks

____ listening/language/speech therapy ____ shopping ____ car

Other (describe) _____

7. For which of the above activities do you think the FM was most beneficial?

_____

8. What do you think is the greatest benefit(s) of the FM system?

_____

9. What do you think is the greatest challenge(s) with the FM system?

_____