



Cochlear Implants and Personal FM Systems

Rationale

Students who use cochlear implants are just as likely to experience difficulty in complex listening environments as students who use hearing aids. Therefore, they should be considered candidates for personal FM systems. Personal FM systems improve access to the speaker/signal in distant and noisy situations and can provide greater access to soft speech. While classroom audio distribution systems are designed essentially for the same purpose, and often improve the auditory learning environment, they have not been found to provide a significant speech-in-noise advantage for cochlear implant users, and therefore will not be discussed here.

FM Candidacy Considerations

Every student using a cochlear implant is a potential candidate for personal FM, however there are many factors which need to be considered prior to implementation. The American Academy of Audiology has developed practice guidelines for using hearing assistance technology (HAT) with children, and that document offers a thorough discussion of these considerations as well as recommendations for verification and monitoring. ([Download HAT Guidelines](#)) Several cautions for FM implementation are listed in the troubleshooting section below, and audiologists fitting FM systems on cochlear implant users are referred to the AAA document as well as manufacturer recommendations for further guidance.

FM Options

There are two types of personal FM systems. The first is electrically coupled to the cochlear implant through a cable or an adapter directly plugged into the processor, or via an electromagnetic signal through an induction loop. The second option delivers the remote microphone signal through a small speaker which sits on a desktop or near the student. Both options have been proven to improve speech-recognition in noise for children with cochlear implants, but electrically connected systems have been shown to provide a more favorable FM advantage and should take first consideration when fitting FM for students with cochlear implants. Many students are bilateral cochlear implant users or use a CI in one ear and a hearing aid in the other. When possible, both ears should be given access to the FM signal.

Collaboration of Team Members

As is true with all technology, cochlear implants and FM systems continue to rapidly evolve and change. Specific expertise and training in CI and FM technology is necessary to keep up with these changes. Audiologists in the school setting are most familiar with FM technology, while those who work in implant centers are most knowledgeable and equipped to manage the needs of the child’s cochlear implant. Therefore, it is imperative that there be good communication between these two professionals, as well as with parents, in order to coordinate the complex technology needs.

Establish a System of Communication!		
<i>The implant audiologist should know:</i>	<i>The educational audiologist should know:</i>	<i>The parent should know:</i>
<ul style="list-style-type: none"> ✓ Name; contact info of educational audiologist ✓ If FM is being used at school and what type 	<ul style="list-style-type: none"> ✓ Name; contact info of implant audiologist ✓ Processor settings and how they should be used 	<ul style="list-style-type: none"> ✓ If FM is being used at school and what type ✓ Processor settings

Technology Considerations

The interfacing of FM systems with personal CI processors can be complex due to the characteristics of both the implant processors and the optional FM settings.

Choice of FM receiver configuration: The choice of whether to use direct audio input (DAI) receivers versus a teleloop receiver is a decision that many audiologists will face when choosing FM for students. Some of the pros and cons of each are listed below:

Direct Audio Input	Teleloop
• More consistent FM signal	• Most cost effective for bilateral fittings
• Smaller; less conspicuous & cumbersome	• Easiest option for bilateral and bimodal fitting
• Greater wear and tear on processor	• More flexible/universal for future use
• Extra adapter or cable often needed	• Larger; more cumbersome esp. for babies
• Can be easy to lose	• Signal strength can be intermittent
• FM interference with CI transmitting coil possible	• Electromagnetic interference possible

Choice of (CI) microphone mixing ratio: Due to the potential of reducing access to incidental sounds in the student’s learning environment, a mixing ratio of 1:1 or 50:50 is recommended as best practice. This ratio is usually programmed or set by the implant audiologist during the CI mapping process, however, newer devices may enable the user to set the mixing ratio.

Choice of designated FM program within the CI: Often the mixing ratio, the speech processing strategy, the microphone sensitivity and/or the telecoil function must all have specific settings depending upon which type of FM system is used. Typically, it is recommended that the implant audiologist assign a designated program to be used when the student is using FM. This will be especially important when major changes to the user’s daily map are necessary to optimize the FM fitting.

Fitting Recommendations

Cautions for fitting: If two or more of the following conditions are present, FM fitting may be contraindicated or should be carefully monitored at all times by trained, attentive adults in the child’s learning environment.

- Child’s listening or language age is too immature to identify or report problems with the quality of the signal; or the child is too young to manipulate the processor programs
- The child’s map is unstable (due to newness or excess age of map)
- The FM signal quality cannot be confirmed or has intermittent interference of unknown origin
- The child’s full audibility of self and peers cannot be confirmed
- The implant audiologist and the educational audiologist have not communicated about FM use

Potential for FM/CI noise: There are times when noise is reported by the user for reasons that are unknown. Suggestions for dealing with this situation are: change the FM channel; increase distance between FM receiver and CI transmitting coil; swap out equipment and explore potential sources for interference; use of desktop FM system; or discontinue use of FM. For certain devices there are specific FM channels that are recommended for use. Please check with manufacturers of these devices for more information.

Troubleshooting & Monitoring

Specific tools and techniques for troubleshooting equipment are available from the device manufacturers (see table below for major manufacturers and contact information). School personnel are encouraged to visit the websites for detailed manuals and to call technical support, which is free of charge for schools, whenever a problem cannot be solved. It is imperative that both equipment function as well as auditory function be verified to ensure that the child is hearing adequately. Teachers, parents and the student (when possible) need to have a clear plan to use, monitor and troubleshoot the FM system. For detailed information about monitoring plans, performance verification and validation of FM use with cochlear implants, see the AAA HAT Guidelines referenced above.

Company	Customer Service	Website	Devices (not full list)
Advanced Bionics	877.829.0026	www.bionicear.com	Auria, Harmony CI Processors
Cochlear Americas	800.523.5798	www.cochlearamericas.com	Freedom, N5 CI Processors
Med-El	888.633.3524	www.medel.com	Opus, Tempo CI Processors
Oticon	888.684.7331	www.amigofm.com	Amigo R1/R2 ear-level receiver, Amigo ARC loop receiver
Phonak	800.777.7333	www.phonak.com	MicroLink Freedom (for Cochlear), MLxS/MLxi ear-level receiver, MyLink loop