

Assistive Technology (AT) for Children who are Deaf or Hard of Hearing

Assistive Technology (AT) is all about access. That is, the overall goal of AT is to provide access to information that people with typical hearing would get.

This article provides an overview of AT for children who are Deaf or Hard of Hearing. The information will provide a general understanding of AT. Technology is constantly changing, so a complete and current list is less helpful than a general overview.

The first step in determining if your child might benefit from AT, and if so which type, is to assess your child's needs and environment. The next is to brainstorm and identify AT options in relation to those needs. Finally, you will be ready to make a choice!

Step 1: Assessment of your Child's Needs and Environments

Every child has different needs. Every child lives, learns, and plays in a range of environments. The goal is to access the same information as typically hearing children in these environments. Careful analysis of need and selection of AT is important. In a school setting, your child's team evaluates:

1. How much your child uses her residual hearing?
2. What environments she typically encounters?

"Your child's team" in a school setting may consist of you, your child's teacher, an educational audiologist, a teacher for the Deaf and Hard of Hearing, and/or a speech-language pathologist. This article, however, will focus on AT for your child's life *outside of school*. Often, "the team" for life outside of school will be considerably smaller. For most families, you (the parent) will be the Team

Leader, and your community audiologist may also be involved. You may seek other team members as they are required.

As noted above, it is important to evaluate your child's needs outside of school in two areas:

1. How Much Does Your Child use her Residual Hearing?

The answer to this question can be explored through your answers to the following questions:

- What types of technology is your child using?
- Does she use sign language and/or an interpreter?
- How does she communicate with family, peers, and members of the public?
- In situations where an adult leader is more than six feet away (such as a soccer coach, dance instructor, etc.) can she understand what the leader says? What about if the leader walks around, or if his back is turned?
- Can she access what her peers say during group activities? How does she access information in large or small group activities in programs or events?
- Does she hear the smoke detector from her room (with her hearing aid/cochlear implant(s) turned off)? Can she hear fire alarms?
- Can she understand important announcements while in a train, subway, airport, or plane?
- Can she hear you in the car?
- Does she have a way to contact you in an emergency?
- Does she have access to movies and videos?
- Do you (and she) know how to access TV captioning?
- Is she a full partner in family conversations in a restaurant?
- Can she communicate with others in public places, such as a clerk in a noisy food store or a drive-thru window at a fast food restaurant?

- Can she understand worship services at church?

2. What Environments Does She Typically Encounter?

What are the characteristics of the environments in which she lives, learns, and plays? There are three factors to consider in **room acoustics: noise, reverberation, and distance.**



Noise. What is the level of background noise?

Noise can come from her peers (such as in group activities), traffic, television, background music, equipment, heating and cooling systems, etc. A common way to describe the amount of noise is to compare the level of the noise to the level of the adult leader's voice, such as the soccer coach. This comparison is called the *signal-to-noise ratio, or SNR*. If the coach is speaking at 60 dB and the noise is 50 dB, this would be a +10 dB SNR, as the speech is 10 dB louder than the noise. If the coach's voice is at 65 dB and the noise is at 65 dB too, then the SNR would be 0 dB. If the coach's voice was at 60 dB and the noise is at 65 dB, then the SNR would be -5 dB.

Signal-to-noise ratio (SNR) compares the level of the desired signal to the level of the background noise.

If the noise level is roughly similar to the noise levels at school, then the SNR is going to be 0 or less (when your child is more than six feet away). In that situation (0 dB SNR), the average child with hearing devices will hear about 40% of what is said.

Imran Mulla, PhD, an audiologist, [demonstrated](#) (2013) that infants and children routinely encounter situations where the SNR is -5 dB or worse. At a -5 dB SNR, the ability to recognize words for children wearing hearing aids will be around 20%. Another [study from the University of Western Ontario](#) indicated that children must try to listen to speech in the presence of noise for at least 70% of their day.

A good example of this is communicating in the car. Travel time in the car is an excellent opportunity to talk about what you are both seeing around you, as



you have **shared visual attention** (see article on *Early Communication and Visual Attention* in the toolkit). Unfortunately, background noise levels are high.

When background noise levels are high, hearing devices such as hearing aids and cochlear implants alone will not be enough - some additional assistive technology will be required (such as a remote microphone).

Reverberation. Reverberation is a sound that echoes. In your home, do you have high ceilings and hardwood floors? Does your child take part in activities that are held in gyms, community centres, and cafeteria-style environments? These types of environments - that is, without carpets, curtains, or other materials to absorb sound – have reverberation.

Less reverberation is better. Try adding carpeting and curtains. For activities that take place outside the home in rooms that are highly reverberant, hearing aids and cochlear implants may not be enough; some form of assistive technology might be required, such as a remote microphone.

Distance. How far away is the adult leader from your child? How far away are you, in the house, when you talk to her from another room? How far away are her peers in group activities and discussions?

Hearing aids and cochlear implants have a circle of sound of approximately six feet. When more than six feet away, hearing devices can't give access to the soft, high pitch sounds like /s/, /f/, /th/, etc. This means parts of words are literally missing and will affect the ability to hear plurals, verb tenses, and make meaning of what is said.

Fortunately, a remote microphone will help overcome (but not “fix”) the problems associated with background noise and distance.



Beyond acoustics, the **visual environment** can also be modified to help your child.

Visual access. How well can she see everything that is happening? Are there visual alarms? Can desks, tables, or chairs be moved into a U-shape, or a circle, to provide visual access? Is there visual access to fire alarms, smoke detectors, and/or announcements, if needed?

Lighting. What type of lighting is available? Fluorescent lights often emit additional background noise. Inadequate lighting or large banks of windows can make it challenging to see people's faces. If your child uses an interpreter, it is important that the interpreter is not located in any shadowed areas.

The next step in determining AT needs to brainstorm and gather information about the possible AT solutions that most appropriately address the needs you've just identified.

Step 2: Brainstorming and Information-Gathering

Now that you have a list of potential needs, the next step is to find solutions to these needs. If you have an overwhelming list, you can pick the most important ones to start. Access and safety are two important elements to keep in mind. Keep in mind that a variety of solutions will exist and there may not be a

permanent and definite best approach. Keep an eye on things and adjust as needed. Involve your child in this monitoring as well, if possible.

Assistive technology for children who are Deaf or Hard of Hearing can be grouped into three general categories: **hearing technology**, **alerting devices** and **communication supports**. Within each category, there are numerous manufacturers and models that change frequently. Since technology does change so quickly, a general explanation of the technology will be given - refer to *Appendix B: Resources* in this article for manufacturer websites and organizations that have multiple products.

1. Hearing Technology

The hearing technology described here are **Assistive Listening Devices (ALDs)** - that is, above and beyond hearing devices such as hearing aids and cochlear implants.

Rather than describe every type of ALD, such as induction loops, infrared technology, and other technologies that have been around for many years, this article will look at some of the newer technologies offered by hearing aid and cochlear implant manufacturers.

Here are the more common ALDs for children:



Remote microphones. All ALDs use a transmitter that sends (transmits) a person's voice. Another name for a transmitter is a microphone. Remote microphones are so-

In high levels of noise, or over extended distances, a more advanced (and more expensive) type of RM-HAT should be used: FM systems, or the newer DM (Digital-Modulation) systems such as Roger.

called because the microphone can be located far away from the child's hearing devices. The "official" name for this technology is a mouthful: **Remote Microphone Hearing Assistance Technology (RM-HAT)**. The goal of RM-HAT is to overcome the obstacles of noise, reverberation, and distance. Two common types of RM-HAT are FM (frequency modulation) and DM (digital modulation)

systems. Both work to improve your child's ability to hear the desired signal over and above unwanted noise.

Most of the major hearing aid and cochlear implant manufacturers have small remote microphones that either work with a streamer, or have the ability to connect directly to the hearing devices. These lower-cost microphones can be used in the car, restaurants, and in small group conversations. Due to limited SNR improvement, these microphones are not recommended for school use, or in any situation with high levels of noise or transmission over extended distances. In high levels of noise, or over extended distances, another, more advanced (and more expensive) type of RM-HAT should be used: FM systems, or the newer DM (Digital-Modulation) systems such as Roger.

When compared to an FM system, DM (Digital Modulation) systems are able to provide a higher level of analysis and control over the signal that is captured. These systems typically use a carrier frequency that "hops" from frequency to frequency many hundred times per second, a characteristic that makes DM systems less susceptible to interference.

Funding is outside the scope of this article; however, note that FM and DM systems may be eligible for funding from provincial government programs. See the *Alberta Aids to Daily Living (AADL)* article in this toolkit for more information.

Please refer to *Appendix A: Important Considerations in Using RM-HAT* in this article for some important information about using remote microphones with children.

Streamers. Sound is 'streamed' when the video or music file is saved outside of the playing device, such as a television or DVD player. The file is played from its source - such as Netflix (we don't 'download' movies, we 'stream' them). With hearing devices, streamers can be used to connect to a cell phone, music, television or computer. Using streamers with cell phones can be particularly exciting for children who have two hearing devices and have some difficulty hearing on the phone. One research study found that hearing on the phone

with both ears can improve understanding by up to 35% over hearing with one ear. Note that some of the RM-HATs can act like streamers - such as FM or DM systems.

Phones. Some hearing aid manufacturers have cordless phones that automatically connect to hearing aids (but only that specific manufacturer's hearing aids). These types of phones also have the potential for hearing on the phone with both ears.

Amplified phones have a built-in amplifier, or may be connected to an external amplifier. This feature is available to some extent in regular phones and cell phones, but there are also specialized phones or external attachments that are specifically designed for the Deaf and Hard of Hearing that provide even greater volume.

A few hearing aid manufacturers have apps that can directly connect Smartphones to hearing aids - which eliminates the need for an intermediary streaming device. These hearing aids, however, may not be your first choice for RM-HAT compatibility (such as FM or DM systems). Remember to keep your list of priorities in mind when evaluating this option; is Smartphone use without a streamer the most important priority?

In the U.S., the FCC (Federal Communications Commission) has passed regulations for cell phones to be compatible with hearing aids. This has also had a positive effect on phones that are available in Canada. Only phones that meet Hearing Aid Compatibility (HAC) guidelines can be labelled as such. If you see a "M3," "M4," "T3," or "T4" on the box, then the phone is HAC compliant. A larger number is better in this case. For more information, see <http://www.betterhearing.org/hearingpedia/hearing-aid-compatible-cell-phones>

2. Alerting Devices

Alerting devices provide an amplified and/or visual signal or vibration to get the attention of your child. They can be used for public emergency alerts like fire alarms, or for everyday situations such as the smoke detector, alarm clock,

phone ringing, or the doorbell. For children, probably the most important alerting device is the smoke detector. If your child can't hear the smoke detector in her room with her hearing device(s) turned off, an alerting device is strongly recommended. Service dogs, or more specifically, Hearing Assist dogs, have also been used for this purpose. See the *Hearing Assist Dogs* article in this toolkit for more information.

See *Appendix B: Resources* in this article for information on alerting devices.

3. Communication Supports

As with hearing technology, rather than list every type of communication support, such as TDD/TTY and other technologies that have been around for many years, this article will look at some of the newer technologies.

Communication supports are changing and improving rapidly - popular present-day examples are provided in some cases, but this information will become outdated over time. A good strategy is to ask for advice from adults who are Deaf or Hard of Hearing. If you don't have access to adults who are Deaf or Hard of Hearing, try the Alberta Hands & Voices Facebook page.

- **Captioning for phones.** Captioning for phones allows your child to read the display on the phone itself, or on a computer screen, a tablet, or a cell phone.
- **Captioning for movies.** In movie theatres, *Captionview* is a system that shows captions on a regular display held in place by a flexible wire attached to a base that fits in the cup holder. Movies that you watch in your home via Internet video programming (such as Netflix) are usually captioned. For more information about captioning on the Internet, go to <http://www.fcc.gov/guides/captioning-internet-video-programming>.
- **Video Relay Services (VRS).** VRS is a service that enables people who communicate with sign language to communicate with voice telephone users. As with other telephone relay services, an operator is involved. The operator voice-interprets the signed message and vice versa.

- **Video Phones.** A small camera and TV display is needed to use a video phone, as well as a high-speed Internet device. This allows a direct connection (i.e., an operator is not involved) between video phone users.
- **UbiDuo Face-to-Face Communicator.** This portable device is battery operated and has two keyboards with displays. The keyboards are wirelessly connected.
- **Handwriting recognition devices.** These devices convert handwriting into computer-generated text. Digital Pen is one such device.
- **Voice to Text/Sign.** Voice recognition software can convert voice to printed text or computer-generated sign language. Voice-to-text programs include Dragon Naturally Speaking or Dragon Dictation. A voice-to-sign device is the iCommunicator.
- **CART (Communication Access Real Time Captioning).** CART provides a word-for-word transcription, similar to a court reporter. Two articles about the use of CART in schools are featured in this toolkit in the *Advocacy* section.

Step 3: Choosing and Implementing Assistive Technology

After considering your child's needs, brainstorming about the possible solutions and gathering information, it is time to make a decision. This article has pointed out some of the more common solutions - however, we have not provided an exhaustive list, simply because the information will become outdated quite quickly.

It is important to consider also what technology is used at school, and to ensure that there is communication between the audiologist in the school (educational audiologist) and your community audiologist. An effective partnership between you, your child, the clinic, and the school is key.

Once you have found some devices that interest you, you can use a feature match process to make your final decision. That is, match the features of the

device to your child's communication needs. Select the devices that best match her needs and her environments. Limit your selections to a reasonable number and prioritize them according to those that you would like to acquire immediately followed by those that should be considered in the future.

When possible, involve your child in the process of selecting and evaluating AT. Technology is and will be a big part of your child's life. These are exciting times for children who are Deaf or Hard of Hearing - and by all indications, the technology will continue to get better.

Appendix A

Important Considerations in Using Remote-Microphone HAT (RM-HAT)

There are some important considerations in using RM-HAT in infants, very young children and teenagers.

Infants and Young Children

Much of the research on RM-HAT has been conducted in schools, with children that are old enough to provide feedback about what they like and don't like about the technology. Infants and very young children, however, can't tell us when the technology is helpful and when it is not. Some general guidelines may be helpful:

- *Target specific listening situations.* When is background noise or distance going to affect your child's access? Focus on using RM-HAT in those environments - such as car rides, or noisy public places such as the zoo or museums.
- *Remember the importance of overhearing.* Although RM-HAT systems provide benefits to listening in particular situations, there are also situations where RM-HAT may not be as helpful. Because most RM-HAT systems have only one microphone, these systems are not ideal for situations with more than one talker.

Depending on the noise level and type of technology used, the person wearing the microphone will be the only talker that your child will hear clearly. While this set-up has considerable advantages for improving access to that specific talker, there may be situations where your child needs more access.

An example of when your child might need access to other talkers or environmental sounds is a family visit to the zoo. If you are having a conversation with your spouse about an animal's behaviour, your child will only hear one side of the conversation. The sound of a waterfall, birds chirping, or

leaves rustling in the wind may be important environmental sounds that are part of your conversation, but these environmental sounds will be de-emphasized when RM-HAT is used.

You may be unintentionally limiting access to other talkers and environmental sounds if you turn on the RM-HAT microphone and leave it powered on for the entire duration of your visit to the zoo. Instead, it may be more beneficial to 'mute' (or turn off) the microphone when you are not speaking, so that your child has access to other talkers and the sounds around her.

If the noise levels are high during some conversations, you can leave the RM-HAT microphone powered on, but either point the microphone at your spouse (if he is very close), or hand the microphone to your spouse for his part of the conversation. Siblings are also important language models and should get their time at the podium!

Some RM-HAT transmitters don't have a 'mute' button, or have a lengthy 'power on/off' process. This makes it slightly more inconvenient to mute or turn on/off - and is a factor to consider when choosing a specific RM-HAT device.

- *Learning about RM-HAT is a process.* Most parents report being given their child's RM-HAT system with only a brief orientation and troubleshooting at the same appointment. Much like the process of learning to understand your child's hearing aids, you may need more and continued training to get comfortable with the RM-HAT system.

Some families report frustration or limited understanding of how the RM-HAT system works - and as a result, they don't use it. Ask for support and training specifically related to RM-HAT during your visits to the audiology clinic.

- *Incorporate listening checks.* It is important to do listening checks with both the RM-HAT system and the hearing aids. Infants and young children may not be able to report whether the system is functioning adequately.

Ask for an opportunity to practice listening checks during your visits to the audiology clinic if you need further support.

- *Timing is important.* It is least expensive to purchase the RM-HAT during the same year as the purchase of the hearing aids, if you receive funding for the RM-HAT from the Alberta provincial government with the current funding structure. While such funding is a positive development, you may need some time to establish routines around hearing aid use before being given the additional responsibility for care and maintenance of the RM-HAT system. The timing should be based on the listening needs of your child, and your readiness to take on additional assistive technology, rather than simply the availability of funding.

Also, it is important to keep in mind that infants and young children are often held really close to their parents as they talk. This close distance between your mouth and her hearing devices helps to minimize the negative effects of background noise and reverberation. As children begin to grow and explore the environment, the distance from their parents increases. The age where a child starts to move around, between 9-12 months for most typically developing children, is an ideal time to start using RM-HAT systems at home.

Teenagers

Don't be surprised if your child eventually says she does not want to use the RM-HAT system, especially at school. Usually around the time they reach junior high school, children become increasingly determined to blend in with everyone else.

Factors that have been found to impact on the use of RM-HAT in teens include:

- Acceptance of hearing status and personal self-esteem.
- Degree of motivation to perform well in school and actively participate in classroom discussions.
- Age at which RM-HAT started to be used (earlier is better!).

- Any “hassle-factors” in using the system.
- Self-knowledge about hearing loss, the technology, its purpose and intended benefits, what the technology can and cannot do, and the recommended ways to use it.
- Parental support and encouragement regarding its use.

A research study that surveyed teens, parents, and professionals found that there are a variety of reasons why teens reject RM-HAT. On average, 53% of responses indicated that the primary reason was social. Also interesting are the reasons that make up the other 47%. Lack of benefit was the next highest reason reported by 44% of students. Mechanical and convenience problems were each reported by 22% of students, followed by support issues (11%). The social reasons can be managed on a societal level over a longer term. But nearly half the reasons teens may choose not to use RM-HAT can actually be addressed quite easily.

Teens need to understand the purpose of RM-HAT, what it can do and not do. They should work with parents and professionals to identify situations where RM-HAT will provide benefit, and together develop a usage plan. It is also important to make sure that the devices are comfortable to wear and convenient to use. Ask your audiologist for support.

Appendix B

Resources

Deaf and Hard of Hearing Apps

- Alberta Hands & Voices
<http://www.handsandvoices.org/resources/apps.htm>

Equipment Sales

- Deaf and Hear Alberta
Since DHA is a non-profit organization, prices for AT are very reasonable. They have an online store, and you can also arrange for an appointment to try out equipment in person (offices in Calgary and Edmonton).

<http://deafandhearalberta.ca/>

- ALDS
A father and son operation in Vancouver. Comprehensive online store.

<http://alds.com/>

- Harris Communications
Extensive online store, with U.S. pricing. Flat fee for ground shipping to Canada.

<https://www.harriscomm.com/>

Captioning

- Alberta Shorthand Reporters Association

<http://www.asraonline.com/>

- Independent Reporters

<http://indreporters.com/>

- C-Print Rochester Institute of Technology

www.ntid.rit.edu/CPrint

Specific Products (mentioned in article)

- Caption Mic
www.captionmic.com
- Captionview
www.doremilabs.com/products/cinema-products/captiview/
- Digital Pen
www.logitech.com
- Dragon Naturally Speaking
www.nuance.com/naturallyspeaking
- iCommunicator
<http://www.icommunicator.com/>
- UbiDuo Face to Face Communicator
www.scommonline.com

Printed Material

- NCHAM E-book: A Resource Guide for Early Hearing Detection and Intervention: Chapter 39: Making the World Accessible for Deaf and Hard-of-Hearing Children Through Technology
http://www.infanthearing.org/ehdi-ebook/2015_ebook/39-Chapter39MakingWorldAccessible2015.pdf