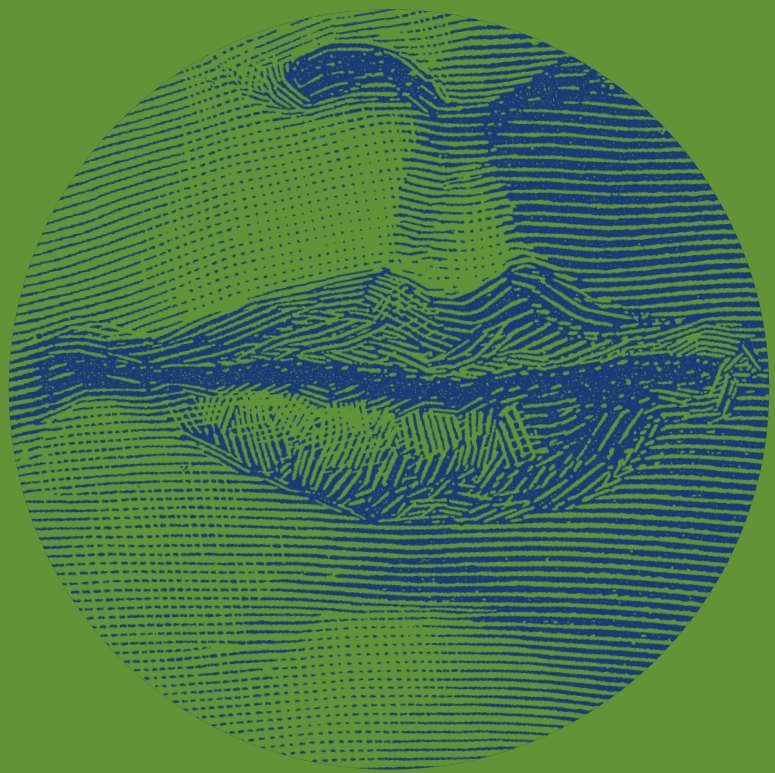


COLLEGE OF
AUDIOLOGISTS AND
SPEECH-LANGUAGE
PATHOLOGISTS OF
ONTARIO



PREFERRED PRACTICE
GUIDELINE FOR THE
PRESCRIPTION OF
HEARING AIDS
TO ADULTS

APPROVED DECEMBER 2000

Preferred Practice Guideline for the Prescription of Hearing Aids to Adults

Table of Contents

Preamble	2
A Definition of Hearing Aid Prescription	3
B Client or Procedure Description/Definition	3
C Resource Requirements	3
D Service Locations	3
E Client Process/Procedures	4
E.(i) The Prescription Process	4
1. Non-electroacoustic Considerations	4
2. Electroacoustic Considerations	4
3. Prescribing the Hearing Aid(s)	4
4. A Copy of the Prescription	5
E.(ii) Measurable Outcomes: Verification and Validation	5
1. Verification	5
a) Electroacoustic analysis	5
b) Real ear measurements	5
c) Aided soundfield testing	5
2. Validation	5
F Documentation	6
G Competencies	6
Appendix A: Processes for Hearing Assessment for the Purpose of Hearing Aid(s) Prescription	7
Appendix B: Procedures for Predicting Real Ear Performance of a Hearing Aid Using Real Ear to Coupler Difference	8
Appendix C: Glossary	9
Appendix D: Service Locations for the Prescription of Hearing Aids for Adults	12
References	13
Research Notes	14
Membership Contributions to Development	16

Preamble

Preferred Practice Guidelines (PPGs) are necessary to ensure quality care to the people of Ontario who need hearing aids. Hearing aid prescription is a controlled act under the *Regulated Health Professions Act, 1991*, in Ontario, and as such, requires a high level of training and knowledge. Proper prescription of a hearing aid requires knowledge, education and experience in a variety of specialized and related topics. They include human anatomy and physiology; audiologic assessment; the audiologic (re)habilitation process; hearing aids and other specialized devices available; manufacturers' information and how it applies to each individual case; and the customized verification processes available to insure that the device is appropriate.

This document is based on the philosophy that hearing aid prescription is an inseparable part of the entire continuum of hearing aid provision, which includes assessment, prescription, dispensing and fitting of hearing aids. This philosophy assumes that registered audiologists have the necessary knowledge and skills to provide all components of this continuum in the delivery of hearing health care services. In circumstances where the audiologist dispenses hearing aids, dispensing is considered to be part of the hearing prescription process. This document provides **recommendations for best practices** for hearing aid prescription.

Inappropriate assessment of hearing problems or prescription and fitting of inappropriate hearing aids can cause physical and/or mental harm including, but not limited to

- delaying appropriate treatment for a medically treatable condition.
- impairing hearing further due to inappropriate and/or excessive amplification.
- producing painfully loud sounds.
- providing no measurable improvement in hearing.
- negatively impacting on educational, vocational emotional and psychological aspects of life.

A hearing aid prescription should state the type of aid, appropriate settings and applications that will result in an amplification system that will improve the quality of life for the individual who is hearing impaired. The audiologist, the client and the family/caregivers will review the extent of the hearing loss and determine realistic goals for amplification, as each individual case requires.

While these guidelines are recommended as the best practice standards for the majority of cases, the College recognizes that there will arise from time to time exceptional circumstances and/or conditions when guideline procedures cannot be followed and the professional may be required to modify recommended procedures. **Audiologists should exercise professional judgment according to the clinical environment and individual adult clients and must document all modifications.**

A Definition of Hearing Aid Prescription

Hearing aid prescription is defined as the process of selecting the device, including the verification and validation of the selection. Hearing aid provision, including prescription and dispensing of hearing aids, is an ongoing process requiring the joint participation of the audiologist, client, family/caregivers and significant others.

Appendix C provides a glossary of terms used in this document.

B Client or Procedure Description/Definition

These guidelines are designed to provide audiologists with best practice recommendations for prescribing hearing aids as part of a comprehensive audiologic rehabilitation plan for adults. For the purposes of this Practice Guideline, the definition of "adult" has been kept consistent with the definition used by the Ontario Ministry of Health for the purposes of hearing aid provision, that is, 18 years of age or older. In some instances, a younger client may demonstrate the ability to perform the required tasks. In such cases, the procedures described in these guidelines may be appropriate. A hearing aid may be prescribed to any client whose hearing is not normal and who complains of difficulty hearing. The need for the use of an amplification device is determined by joint participation of the audiologist and client. Participation in this process by family members, caregivers, significant others and managing professionals (e.g., speech-language pathologist, physician, home care nurse, etc.) is strongly encouraged to provide ongoing support for the rehabilitative process.

For the purposes of this PPG, "hearing aid" is defined as any electronic device fitted to the ear and designed to **amplify** and deliver sound to the ear.¹ These devices include hearing aids described as but not limited to body worn, behind-the ear, in-the-ear, canal, completely in the canal, BICROS, CROS, and eyeglass style hearing aids. Programmable and digital hearing aids must also be

prescribed using the PPG. Any modifications in the prescription process must be documented in the client's record. Prescription of a hearing aid requires consideration of electroacoustical and non-electroacoustical characteristics using an appropriate prescriptive formula, as well as verification and validation of the fitting. The general principles of the PPG are also intended to guide the fitting of nonconventional amplification devices such as implantable devices and vibrotactile devices. This PPG is not intended to guide the fitting of assistive listening devices such as FM and infrared systems, where the intent in fitting the device is signal enhancement rather than primary amplification.

C Resource Requirements

Audiometric testing and the prescription of hearing aids requires an otoscope, audiometer, sound-treated room, immittance system, an electroacoustic analyzing box with real ear measurement capability and equipment necessary to adjust and modify the prescribed device (e.g., computer) as a **minimal standard**. The equipment should be calibrated at least annually and meet current ANSI standards.^{2,3,4,5,6,7}

Audiometric testing should be routinely conducted in a sound-treated room. Under exceptional circumstances, where client needs dictate, assessment and prescription may be conducted in a quiet room. Use of a sound level meter to ensure that ambient noise levels are low enough to meet ANSI recommendations is strongly recommended.⁸ Such circumstances must be documented in the client's record.

D Service Locations

Appendix D outlines a variety of service locations where hearing testing and prescription of hearing aids may be completed. Audiologists will exercise professional judgment in modifying the guidelines, where appropriate, to the clinical environment and individual case. Exceptions to standard clinical practice must be documented in the client's record.

¹ Stach, B.A. (1997). *Comprehensive Dictionary of Audiology Illustrated*. Baltimore, Md.: Williams & Wilkins.

² American National Standards Institute (1981). Reference equivalent threshold force levels for audiometric bone vibrators. New York: Author.

³ American National Standards Institute (1986). Artificial headphone for the calibration of audiometer bone vibrators. New York: Author.

⁴ American National Standards Institute (1987). Specifications for instruments to measure aural acoustic impedance and admittance (ANSI S3.39-1987). New York: Author.

⁵ American National Standards Institute (1991). Maximum permissible ambient noise levels for audiometric test rooms (ANSI S3.1-1991). New York: Author.

⁶ American National Standards Institute (1996). Specifications for audiometers (ANSI S3-1996). New York: Author.

⁷ American National Standards Institute (1996). American National Standard Specification of Hearing Aid Characteristics (ANSI S3.22-1996). New York: Author.

⁸ American National Standards Institute (1991). Maximum permissible ambient noise levels for audiometric test rooms (ANSI S3.1-1991). New York: Author.

E Client Processes/Procedures

Proper hearing aid prescription involves a number of stages to ensure that the most appropriate hearing aid(s) are prescribed and subsequently fit to the individual. These stages have been identified as

1. Hearing assessment for prescription of hearing aids. (see Appendix A)
2. The prescription process.
3. Measurable outcomes: verification and validation. (stages 2 & 3 are described below)

E.(i) The Prescription Process

1. Non-electroacoustic considerations.

Following the hearing assessment, where a hearing aid is recommended, the member informs the client/family/caregiver(s) about the hearing loss and discusses options available including information about hearing aids. Decisions about the non-electroacoustic characteristics of the hearing aid to be prescribed should be based on the management plan/needs assessment and the ongoing interaction with the client. Factors to be considered should include but are not limited to the following:

- binaural versus monaural hearing aid fitting.
- hearing aid style (e.g., BTE, ITE, ITC, CIC) and colour.
- number and size of user controls.
- ability to operate (e.g., size, volume preferences, remote control).
- other features (e.g., programmable, multichannel, directional).
- telecoil.
- cost issues.
- environmental considerations.

2. Electroacoustic considerations

The actual selection of the hearing aid(s) appropriate to any individual requires knowledge and experience with the amplification devices. The audiologist should be familiar with the amplification characteristics of hearing aids and know how to utilize specification standards as a tool to help make prescriptive decisions.

The audiologist will select an appropriate verifiable

prescriptive procedure. Selection of an appropriate fitting method requires consideration of the following factors by the clinician:

- a) The prescriptive procedure must be based on a defensible rationale such as amplifying all frequency bands to subjective equal loudness, restoring the average speech spectrum to the subject's MCL, or providing operating gain most likely to result in maximum recognition of speech for an individual hearing loss.
- b) The prescriptive procedure should provide a complete electroacoustical specification for target hearing aid performance, including gain or output by frequency, reserve gain (where applicable) and maximum output.
- c) When the prescribed characteristics are obtained to a reasonable degree, it should provide acceptable sound quality, clarity of speech and a loudness level that is judged to be comfortable by the user.
- d) The prescriptive procedure chosen must be appropriate for the type of circuit being considered (e.g., linear versus non-linear).
- e) The prescriptive approach should be supported by research.

3. Prescribing the hearing aid(s)

Information about the prescribed hearing aid(s) should include, but not be limited to

- a) ear(s) to be fit.
- b) the type of hearing aid(s) or device.
- c) the manufacturer's name/model number.
- d) special applications, including, but not limited to, a bone conduction hearing aid, a CROS hearing aid, direct audio input and T coil, where applicable.
- e) special potentiometers including, but not limited to, gain control, output control, and tone control.
- f) target gain and output expressed as 2 c.c. coupler values. It may be necessary to include correction factors for binaural fittings and/or conductive or mixed hearing losses.⁹
- g) initial settings of potentiometers, recognizing these settings may change once the client leaves the "ideal" test environment.
- h) the initial volume control setting, where applicable.
- i) the earmold style and material and specifications for

⁹ American Speech-Language-Hearing Association (1998). Guidelines for hearing aid fitting for adults. *ASHA*, 40 (Suppl. 18): 126.

modifications, including venting and tubing, where applicable.

- j) any special applications for earhooks including, but not limited to, pediatric earhooks.
- k) recommendations for follow-up and audiologic (re)habilitation.

4. A copy of the prescription

Upon completion of the prescription, the audiologist reviews the process with the client/family/caregiver(s) to ensure that client needs have been met. The audiologist will supply the client with a written prescription. A copy of the prescription must be retained in the client file. When the audiologist prescribes and dispenses the hearing aid(s), the above information is to be recorded in the client file.

E.(ii) Measurable Outcomes: Verification and Validation

Proper prescription of hearing aids results in amplification systems that are

1. verifiable by delivering appropriate gain, frequency response and output values which can be measured in an acoustic analyzer, and
2. validated by the client's satisfaction measured through the use of formal or informal scales, questionnaires, interview forms, etc., available to the audiologist.

Once the client is wearing the hearing aid(s), the audiologist and the client/family/caregiver(s) shall make reasonable efforts to have a follow-up appointment within the initial 30-day period to review client satisfaction and for verification/validation of the hearing aid(s).

1. Verification

Whenever possible, the audiologist shall determine empirically that the instrument provides the prescribed performance characteristics to the client by means of an appropriate verification procedure. Real ear measurements are the preferred method for verifying and optimizing the electroacoustic characteristics of the hearing aid fitting.

Many hearing aid manufacturers have their own guidelines for the fitting of digital hearing aids. The PPG must still be followed for verification.

It is important that the audiologist verify that the hearing

aid(s) fit and comfort and ease of operation are acceptable to both audiologist and client.

a) Electroacoustic analysis

Once the hearing aid(s) has/have been obtained, the audiologist should verify the exactness of the hearing aid(s) being prescribed by comparing the electroacoustic characteristics of the client's hearing aid(s) with the manufacturer's specifications. It is also important to perform a subjective listening check to ensure that the sound quality and performance of the hearing aid are satisfactory.

Established ANSI protocols should be used by the member in obtaining information about gain characteristics, output characteristics, frequency response characteristics, distortion level, input noise and attack and release times.¹⁰

b) Real ear measurements

The prescribed hearing aid(s) has/have been obtained and fit on the client according to the prescription. The audiologist will perform testing to verify the original prescription decision. *One* of three options may be used and are listed in order of preference:

- **in-situ real ear measurements**, at a minimum of two input levels including speech level input and maximum output level, *or*
- **measurements using real ear to coupler difference (RECD) values**, at a minimum of two input levels including speech level input and maximum output level (see Appendix B for suggested protocol), *or*
- **measurements using average ear values**, at a minimum of two input levels including speech level input and maximum output level.

Any deviations from the PPG must be documented in the client's records.

c) Aided sound field testing

Where appropriate, consideration should be given to functional gain assessment such as threshold sound field aided testing and/or speech (including speech in noise) sound field aided testing as part of the verification process. Sound field aided testing requires appropriate test conditions, stimuli and calibration.¹¹

2. Validation

The audiologist and client/family/caregiver(s) shall meet to discuss client satisfaction. Many assistive tools such as

¹⁰ ANSI S3.22-1996. American National Standard Specification of Hearing Aid Characteristics.

¹¹ Cornelisse, L.E. & Moroso, M.J. (1990). Test conditions, stimuli and calibration values for sound-field testing. *Journal of Speech-Language Pathology and Audiology*, 14(1): p. 21+.

inventories, diaries and scales are available to assist the audiologist to determine the client's satisfaction and capability with the prescribed hearing aid(s). The audiologist may also devise his/her own, providing that client feedback is documented in the records.

Any audiologist prescribing hearing aids must be a registered, practicing audiology member of CASLPO. Members engaged in the prescription of hearing aids should also ensure that their commitment to the mandated Continued Education and Professional Activities Program include continuing education in the area of hearing aid technology, prescription and fitting.

As hearing aid prescription poses some risk of harm to the client, delegation of this procedure must be in accordance with any regulations governing the professional delegating the procedure and with any regulations governing the professional to whom the procedure is delegated. Audiology members should not delegate the hearing aid prescription process.

In accordance with the *RHPA*, no person shall dispense a hearing aid for a person who is hearing impaired except under a prescription by a member authorized by a Health Professions Act, such as the *Audiology and Speech-Language Pathology Act, 1991*, to prescribe a hearing aid for a person who is hearing impaired, c. 18, S. 31.

F Documentation

Documentation is mandatory for the protection of all parties involved in the prescription process. The details of procedures including results, summary and recommendations should be documented in the client's records in full at the time of each client contact. Audiologists are directed to the Proposed Records Regulation drafted by the College of Audiologists and Speech-Language Pathologists of Ontario to obtain guidance for record keeping.¹²

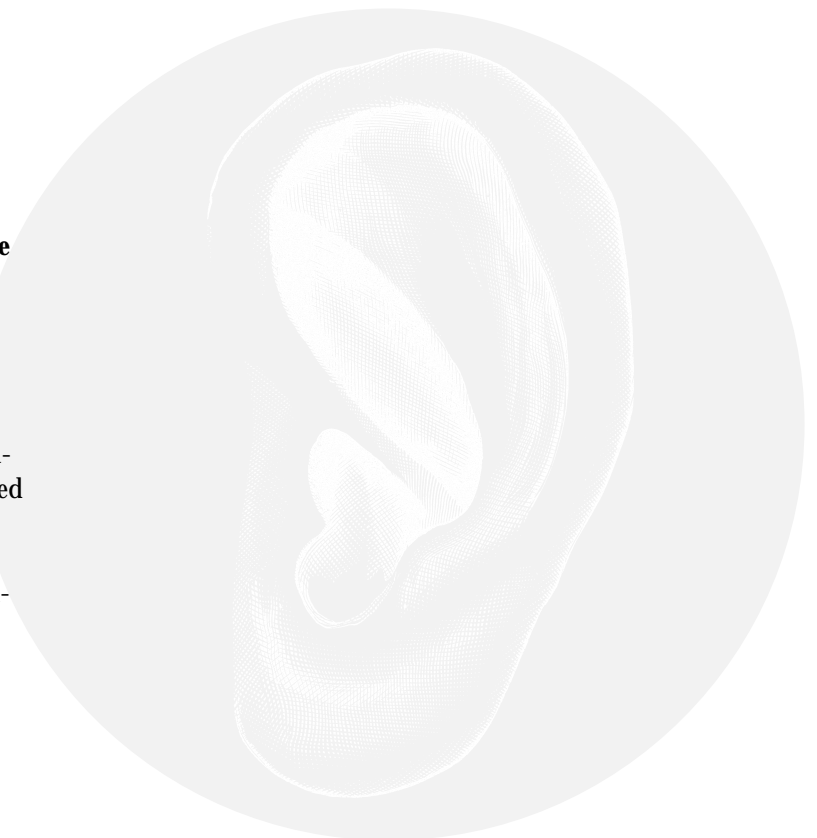
Throughout the prescription process, the audiologist shall document all pertinent information in client files. Proper documentation is essential in the prescription process to ensure continuity of hearing health care.

As well, in the event of exceptional circumstances and/or conditions when guideline procedures cannot be followed, the audiologist is required to document such exceptions and explain any modified procedure that might be used.

G Competencies

As previously stated in the Preamble, **Preferred Practice Guidelines are necessary to ensure quality care to the people of Ontario who need hearing aids.** Hearing aid prescription is a controlled act under the *Regulated Health Professions Act, 1991*, in Ontario, and as such, requires a high level of training and knowledge. Proper prescription of a hearing aid requires knowledge, education and experience in a variety of specialized and related topics. They include human anatomy and physiology; audiologic assessment; the audiologic (re)habilitation process; hearing aids and other specialized devices available; manufacturers' information and how it applies to each individual case; and, the customized verification processes available to insure that the device is appropriate.

Prescription of a hearing aid is a controlled act which audiologists are authorized to perform under the *Audiology and Speech-Language Pathology Act, 1991*.



¹² Proposed Regulation for Records (April, 1996). College of Audiologists and Speech-Language Pathologists of Ontario.

Appendix A

Procedures for Hearing Assessment for the Purposes of Hearing Aid(s) Prescription

1. Case History

The case history should include identifying information, purpose of referral, communication history, audiologic history, otologic history and pertinent medical history.

For potential hearing aid candidates the history should consider the person's candidacy by recognizing lifestyle considerations, physical and cognitive capabilities and expectations of hearing aid use. Use of communication inventories (formal or informal) may be helpful to assist the audiologist choose and prescribe appropriate amplification.

2. Otosopic examination and cerumen management, where required

Cerumen management falls into the audiologists' scope of practice in Ontario. It may be completed by an audiologist who has had theoretical and practical training and is competent with the techniques.¹³

3. Standard pure tone bone and air conduction testing completed on both ears, with masking where appropriate, as per current standards and guidelines.^{14,15}

4. Speech tests which may include Speech Recognition Threshold (SRT) and Speech Recognition Scores (SRS) completed on both ears, with masking where appropriate.

Speech Recognition Threshold or Speech Reception Threshold (SRT) is considered optional as part of a battery of tests for the purposes of hearing aid prescription. Where performed, however, it is recommended that the test be performed according to the ASHA (1988) guidelines, including familiarization, to ensure reliable and valid test results.¹⁶

When speech tests are performed, the use of recorded materials is preferable to the use of monitored live voice to ensure reliable and valid test results.^{17,18}

5. Suprathreshold measures, which may include Uncomfortable Listening Levels (UCL). Research in the area of hearing aid prescription is clear that threshold information (speech or pure tone) is not a reliable predictor of suprathreshold loudness perception characteristics, and does not provide enough information on its own to predict hearing aid response characteristics.¹⁹

It is important that suprathreshold measures be obtained or predicted using a standardized method that is applied consistently to ensure reliable and valid test results.

6. Immittance testing including static compliance, impedance and acoustic reflex measurements completed on both ears.

7. Any other testing relevant to hearing aid prescription may be completed at the discretion of the audiologist (e.g., loudness balance testing, binaural word discrimination testing, etc.).

8. Target gain or output expressed as 2 c.c. coupler values should be completed at this point to help the member select and prescribe a hearing aid for each ear. Real-ear-to-coupler difference (RECD) should be measured for the prescription of the hearing aid, except in exceptional circumstances (e.g., client factors) (see Appendix B for suggested protocol). This process may vary when using programmable or digital hearing aids. Any changes in prescription process must be documented in the client's record.

Hearing should be assessed minimally within the first year of hearing aid use. Further follow-up should be dictated by client need.

Documentation is required. The details of procedures including results summary and recommendations should be documented in full.

¹³ American Speech-Language-Hearing Association (1992). External auditory canal examination and cerumen management. *ASHA*, 34(Suppl.): 22-24.

¹⁴ American National Standards Institute (1992). Method for manual pure-tone audiometry (ANSI S3.21 1978 (R1992)). New York: Acoustical Society of America.

¹⁵ American Speech-Language-Hearing Association (1990). Guidelines for audiometric symbols. *ASHA*, 32(Suppl. 2): 25-30.

¹⁶ American Speech-Language-Hearing Association (1988). Guidelines for determining threshold level for speech. *ASHA*, 34(Suppl.), 85-89.

¹⁷ Heckendorf A.L., et al (1997). Performance norms for the VA compact disc versions of CID W-22 (Hirsh) and PB-50 (Rush Hughes) word lists. *J Am Acad Audiol.*, 8(3): 163-72.

¹⁸ Stach, B.A., Davis-Thaxton, M.L. & Jerger, J. (1995). Improving the efficiency of speech audiometry: computer-based approach. *Journal of the American Academy of Audiology*, 6(4): 330-3.

¹⁹ Cox, R. (1989). Comfortable loudness level: Stimulus effects, long-term reliability and predictability. *Journal of Speech and Hearing Research*, 32(12): 816-828.

Appendix B

Procedures for Predicting Real Ear Performance of a Hearing Aid Using Real Ear to Coupler Difference

Background:

In 1994, Moodie, Seewald, and Sinclair described a procedure for predicting the real ear performance of a hearing aid using coupler measures of the device. This procedure uses the Real Ear to Coupler Difference (RECD) measure in the calculation of a transform that converts coupler measures to the real ear. Two related procedures are used, one for speech-level measures, and one for maximum output measures.

The procedures listed below are often implemented automatically in real ear systems and/or hearing aid related software. This protocol is provided so that audiologists will have access to the recommended procedure so that they may ensure its correct use, whether manual or automatic.

Speech-level measures:

1. Measure the hearing aid's gain in the 2cc coupler for a speech-weighted, speech level input signal.
2. Measure²⁰ the client's RECD using an insert phone. If the client will use an earmold, couple the earmold to the insert phone for this measurement.
3. Use the following equation to predict the Real Ear Aided Response (REAR) at each frequency. Note that Microphone Location Effects (MLE) are different for each style of hearing aid. In particular, MLE for Completely in the Canal (CIC) hearing aids are much larger than for other hearing aid style. Use of style-specific values is important:

$$\text{REAR (dB SPL)} = \text{gain} + \text{RECD} + \text{MLE} + \text{speech input level (dB SPL re: free field)}$$

Maximum output measures:

1. Measure the hearing aid's output for a high-level input. Minimally, this input level should be 90 dB SPL. For WDRC devices, this may not be sufficient to fully saturate the hearing aid. In these cases, a 100 dB input level may be used. When the hearing aid is fully saturated, MLE are not included in the formula.
2. Use the following formula to predict the Real Ear Saturation Response (RESR):

$$\text{RESR (dB SPL)} = \text{output} + \text{RECD} + \text{input level (dB SPL re: free field)}$$

²⁰ RECD measurement protocols are different for different measurement systems. Consult the manual or manufacturer for procedures for specific systems.

Appendix C

Glossary

Term	Definition
Attack Time	The time between the abrupt increase from 55 to 90 dB SPL and the point where the level has stabilized to within 3 dB of the steady value for the 90 dB input SPL. ²¹
Band	Range of frequencies. ²²
Channel	In a hearing aid, a frequency region that is processed independently of other regions. Typically refers to a region of compression processing. ²²
Circuit	(1) path or line of an electric current; (2) combination of electric components that carry an electric current. ²²
Compression	In hearing aid circuitry, nonlinear amplifier gain used either to limit maximum output (compression limiting) or to match amplifier gain to an individual's loudness growth (dynamic range compression). ²²
Compression Amplification	A hearing aid with compression limiting and/or wide-dynamic-range-compression circuitry. ²²
Dispensing	The act of filling the prescription to the specifications provided and distributing it.
Dispensing Audiologist	An audiologist who dispenses hearing aids. ²²
Distortion	Undesired product of an inexact, or nonlinear, reproduction of an acoustic waveform. Can be of many types: amplitude, harmonic, transient, etc. For the purposes of hearing aid measurement the percentage of total harmonic distortion is calculated according to the ANSI S3.22-1996 definition. ²¹
Electroacoustic	Pertaining to the conversion of an electric signal to an acoustic signal or vice versa. ²²
Electroacoustic Analysis	Electronic measurement of various parameters of the acoustic input of a hearing aid. ²²
Fitting	The process of ensuring the comfortable fit of the dispensed device and teaching the user about care and maintenance of the device.
Frequency Response	Output characteristics of a hearing aid, expressed as output (dB SPL) or gain as a function of frequency. ²²
Functional Gain	F.G.; difference in decibels between aided and unaided hearing sensitivity thresholds. ²²
Gain	In hearing aids, the amount in dB by which the output level exceeds the input level. ²²
In Situ	In position; e.g., in the case of hearing aids, on the patient in position for use. ²²
In Situ Audiometry	Assessment of hearing in which pure-tone thresholds and loudness discomfort levels are measured and expressed in ear canal SPL. ²²
In Situ Measurement	Evaluation of hearing aid performance while the hearing aid is being worn. ²²
Linear Amplification	A hearing aid with circuitry that provides the same amount of gain for every input level until the maximum output level is reached. ²²

²¹ ANSI S3.22-1996. American National Standard Specification of Hearing Aid Characteristics.

²² Stach, B.A. (1997). *Comprehensive Dictionary of Audiology Illustrated*. Baltimore, Md.: Williams & Wilkins.

Term	Definition
Maximum Output	The highest level of output that can be measured from a hearing aid, regardless of input level. May be measured in the coupler (see OSPL) or the ear (see RESR). Also known as Maximum Power Output (MPO).
Microphone Location Effects	MLE; measurement of the difference, in dB as a function of frequency, between the SPL at the hearing aid microphone and the SPL at a field reference point for a specified sound field with the hearing aid in place.
OSPL90	SPL developed in a 2-cm ³ earphone coupler when the input SPL is 90 dB, with the gain control of the hearing aid full-on. ²¹
Otoscopy	Inspection of the external auditory meatus and tympanic membrane with an otoscope. ²²
Prescriptive fitting	Strategy for fitting hearing aids by the calculation of a desired gain, frequency response and maximum power output based on any of a number of formulas that incorporate pure-tone audiometric thresholds and may incorporate uncomfortable loudness information. ²²
Real-Ear Aided Gain	REAG; measurement of the difference, in dB as a function of frequency, between the SPL in the ear canal and the SPL at a field reference point for a specified sound field with the hearing aid in place and turned on. ²²
Real-Ear Aided Response	REAR; probe-microphone measurement of the sound pressure level, as a function of frequency, at a specified point near the tympanic membrane with a hearing aid in place and turned on; expressed in absolute SPL or as gain relative to stimulus level. ²²
Real-Ear Coupler Difference	RECD; measurement of the difference, in dB as a function of frequency, between the output of a hearing aid measured by a probe microphone in the ear canal and the output measured in a 2-cc coupler. ²²
Real-Ear Insertion Gain	REIG; probe microphone measurement of the difference, in dB as a function of frequency, between the real-ear unaided gain and the real-ear aided gain at the same point near the tympanic membrane. ²²
Real-Ear Insertion Response	REIR; probe-microphone measurement of the difference, in dB as a function of frequency, between the real-ear unaided response and the real-ear aided response at the same point near the tympanic membrane. ²²
Real-Ear Saturation Response	RESR; probe-microphone measurement of the SPL, as a function of frequency, at a specified point near the tympanic membrane with a hearing aid in place and turned on, with sufficient stimulus level to drive the hearing aid at its maximum output. ²²
Release Time	The interval between the abrupt drop from 90 to 55 dB SPL and the point where the of the steady-state value for the 55-dB input SPL. ²²
Speech Recognition	The ability to perceive and identify speech targets, SYN: speech intelligibility, speech discrimination. ²²

Term	Definition
SRT	Speech reception threshold; threshold level for speech recognition, expressed as lowest intensity level at which 50% of spondaic words can be identified. ²²
Speech Level Input	A range of input levels that correspond to the average level of real speech. The overall level of conversational speech typically ranges from 60 to 70 dB SPL in the free field. The frequency response of conversational speech is low-frequency weighted.
Telecoil	T Coil; and induction coil often included in a hearing aid to receive electromagnetic signals from a telephone or a loop amplification system. ²²
Telecoil Switch	T Switch; switch circuit on some hearing aids that permits use of an induction coil to receive electromagnetic signals from a telephone or loop amplification system. ²²
Word Discrimination Score	Word recognition score, speech recognition score, speech discrimination score, percentage of correctly identified words. ²²

Appendix D

Service Locations for the Prescription of Hearing Aids for Adults

Term	Definition
Acute care	A facility classified as a general or chronic care hospital under the <i>Public Hospitals Act</i> . This includes active treatment hospitals for alcoholism and drug addiction.
Private Practice	A service provided through a privately owned facility that may receive payment from a number of different sources.
Long Term Care	A facility such as a nursing home or home for the aged that provides extended care services including nursing and personal care on a 24-hour basis. A charitable home for the aged under the <i>Charitable Institutions Act</i> is also considered a long-term care facility.
Adult Rehabilitation	A facility that provides diagnostic and special rehabilitation services to handicapped or disabled individuals to restore them to health or assist them to function at the best physical, mental, social and vocational level of which they are capable.
Mental Health	A facility that provides services for adults suffering from mental, emotional or psychiatric disorders or any combination thereof.
Home Care (CCACs)	A facility that provides community health programs and services for adults (Community Care Access Centres).
Specialized Centres	A facility that provides specialized care such as an adult day program or elderly persons' centre that provides extended care services.
Supportive Living	A facility which provides personal support services and essential homemaking in permanent community residential settings for individuals who require the availability of 24 hour on-site assistance, such as frail and/or cognitively impaired persons, persons with physical disabilities or acquired brain injuries and those living with HIV/AIDS.
Public Health Units	A facility established by a group of municipalities to provide community health programs. These programs include health promotion and disease prevention programs to inform the public about healthy lifestyles, communicable disease control, immunization, food premises inspection, healthy growth and development, health education and selected screening services.
Other	There may be other service locations not described in this document.

References

- American National Standards Institute (1981). Reference equivalent threshold force levels for audiometric bone vibrators. New York: Acoustical Society of America.
- American National Standards Institute (1986). Artificial headphone for the calibration of audiometer bone vibrators. New York: Acoustical Society of America.
- American National Standards Institute (1987). Specifications for instruments to measure aural acoustic impedance and admittance (ANSI S3.39-1987). New York: Acoustical Society of America.
- American National Standards Institute (1991). Maximum permissible ambient noise levels for audiometric test rooms (ANSI S3.1-1991). New York: Acoustical Society of America.
- American National Standards Institute (1992). Method for manual pure-tone audiometry (ANSI S3.21-1978 (R1992)). New York: Acoustical Society of America.
- American National Standards Institute (1996). Specifications for audiometers (ANSI S3-1996). New York: Acoustical Society of America.
- American National Standards Institute (1996). Specifications for hearing aid characteristics (ANSI S3.22-1996). New York: Acoustical Society of America.
- American Speech-Language-Hearing Association (1987). Calibration of speech signals delivered via earphones. *ASHA*, 29(6): 44-48.
- American Speech-Language-Hearing Association (1988). Guidelines for determining threshold level for speech. *ASHA*, 34(Suppl.): 85-89.
- American Speech-Language-Hearing Association (1990). Guidelines for audiometric symbols. *ASHA*, 32(Suppl. 2): 25-30.
- American Speech-Language-Hearing Association (1992). External auditory canal examination and cerumen management. *ASHA*, 34(Suppl): 22-24.
- American Speech-Language-Hearing Association (1998). Guidelines for hearing aid fitting for adults. *ASHA*, 40 (Suppl. 18): p. 126.
- Beattie, R.C., et al; (1986). Relationship between pure-tone and speech loudness discomfort levels among hearing-impaired subjects. *Journal of Speech and Hearing Disorders*, 51(5): 120-125.
- Byrne, D., et al; (1985). Relationships of HTLs, MCLs, LDLs, and psychoacoustic tuning curves to the optimal frequency response characters of hearing aids. *Australian Journal of Audiology*, 7(1): 7-16.
- Cornelisse, L.E. & Moroso, M.J. (1990). Test conditions, stimuli and calibration values for sound-field testing. *Journal of Speech-Language Pathology and Audiology*, 14(1): 21+.
- Cox, R.M. (1985). A structured approach to hearing aid selection. *Ear and Hearing*, 6(5): 226-239.
- Cox, R. (1989). Comfortable loudness level: Stimulus effects, long-term reliability and predictability. *Journal of Speech and Hearing Research*, 32(12): 816-828.
- Fikret-Pasa, S., & Revit, L.J. (1996). Individualized correction factors in the pre-selection of hearing aids. *Journal of Speech and Hearing Research*, 35(4): 384-400.
- Hawkins, D.B., Beck, L.B., Bratt, G.W., Fabry, D.A., Mueller, H.G., & Stelmachowicz, P.G. (1991). Vanderbilt/VA Hearing Aid Conference 1990 Consensus Statement. *ASHA*, 37: 37-38.
- Heckendorf A.L., et al (1997). Performance norms for the VA compact disc versions of CID W-22 (Hirsh) and PB-50 (Rush Hughes) word lists. *Journal of the American Academy of Audiology*, 8(3): 163-72.
- Martin, F.N., Champlin, C.A., & Chambers, J.A. (1998). Seventh survey of audiometric practices in the United States. *Journal of the American Academy of Audiology*, 9(2): 95-104.
- Sammeth, C.A., Birman, M. & Hecox, K.E. (1989). Variability of most comfortable and uncomfortable loudness levels to speech stimuli in the hearing impaired. *Ear and Hearing*, 10(2): 94-100.
- Seewald, R.C., Moodie, K.S., & Zelisko, D.L.C. (1993). Critique of current approaches to the selection and fitting of hearing aids. *Journal of Speech-Language Pathology and Audiology*, Suppl. 1: 29-38.

Stach, B.A., Davis-Thaxton, M.L. & Jerger, J. (1995). Improving the efficiency of speech audiometry: computer-based approach. *Journal of the American Academy of Audiology*, 6(4): 330-3.

Stach, B. A. (1997). *Comprehensive Dictionary of Audiology Illustrated*. Baltimore, Md.: Williams & Wilkins.

Stach, B.A. (1998). Word recognition testing: Why not do it well? *The Hearing Journal*, 51(6): 10-16.

Tillman, T.W. & Jerger, J. (1959). Some factors affecting the threshold in normal hearing subjects. *Journal of Speech and Hearing Research*, 2(2): 141-146.

Wiley, T., Stoppenbach, D., Feldhake, L., Moss, K. A & Thordardottir, E. (1995). Audiologic practices: What is popular versus what is supported by evidence. *Journal of the American Academy of Audiology*, 4(3): 26-34

Wilson, R.H. & Margolis, R.H. (1983). Measurements of auditory thresholds for speech stimuli. In D.F. Konkle & W.F. Rintelmann, *Principles of Speech Audiometry*, Baltimore: University Park Press: 79-126.

Research notes

Purpose

This document provides a summary of research supporting the hearing aid prescription practice guideline for adults. Practice guidelines have been defined by the Institute of Medicine as "systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances."²³ One of the key attributes of a sound practice guideline is that it be evidence based; that is, based on strong scientific evidence where evidence exists. This document summarizes research literature which was reviewed in the development of this PPG and upon which decisions regarding clinical practice were based.

Definition of adult

- There is no definite research to indicate at which age a prescriptive formula designed for adults is more appropriately used than one designed for children.
- However, research suggests that pinna and ear canal characteristics, as well as most auditory skills, mature by adolescence.
- As well, hearing aid prescription for children needs to take into account the differences in environment and auditory demands present in a school environment (for example, considering the need for compatibility with FM systems). The CASLPO definition of adult as age 18 years therefore is also consistent with the age when most students finish high school.
- Finally, the definition of adult as age 18 years used in this PPG is consistent with that of the Assistive Devices Program of the Ministry of Health, which governs the funding of hearing aids for children and adults.

Speech recognition/ reception threshold (SRT)

- Recent literature suggests that measurement of an SRT may not always be necessary, particularly for the purposes of hearing aid prescription.^{24,25}
- Familiarization is important. Research indicates that familiarization can cause the SRT to be 4-5 dB lower than if patient is not familiarized.²⁶
- 1988 ASHA guidelines strongly recommend familiarization.²⁷

²³ Field, M.J. & Lohr, K.N. (1990). *Clinical Practice Guidelines: Directions for a New Program*. Washington: National Academic Press, p. 8.

²⁴ Wiley, T., Stoppenbach, D., Feldhake, L., Moss, K. & Thordardottir, E. (1995). Audiologic practices: What is popular versus what is supported by evidence. *Journal of the American Academy of Audiology*, 4(3): 26-34.

²⁵ Wilson, R.H. & Margolis, R.H. (1983). Measurements of auditory thresholds for speech stimuli. In D.F. Konkle & W.F. Rintelmann, *Principles of Speech Audiometry*, Baltimore: University Park Press: 79-126.

²⁶ Tillman, T.W. & Jerger, J. (1959). Some factors affecting the threshold in normal hearing subjects. *Journal of Speech and Hearing Research*, 2(2): 141-146.

²⁷ American Speech-Language-Hearing Association (1988). Guidelines for determining threshold level for speech. *ASHA*, 34(Suppl.): 85-89.

- Studies have consistently shown that approximately 50% of audiologists familiarize patients with the SRT word list.²⁸
- As recently as the 1997, AAA survey of audiometric practices, 99.5% of audiologists reported routinely doing an SRT, 94% use monitored live voice, only 58% of respondents familiarize.
- 60% were found to NOT comply with ASHA guidelines for SRT testing in this survey.
- Therefore, it seems important for this PPG to stress the importance of adhering to standardized test protocol for the measurement of SRT, and to recommend the use of recorded test materials.

Word discrimination testing

- A recent survey showed that the majority of audiologists continue to use monitored live voice (82%), while only 16% use some type of recorded material.²⁹
- W22s and NU6s are the most commonly used materials;²³ however, a variety of studies have indicated that neither can reliably predict degree or type of hearing loss (see Wiley, et al, for listing of studies).¹⁷
- However, recorded materials have been shown to have better test/retest reliability and the use of recorded materials is recommended by many researchers.³⁰

Suprathreshold measures

- Current research studies indicate clearly that threshold testing is not always a good predictor of suprathreshold loudness perception, particularly for hearing losses which are not flat.^{31,32,33}
- However, the research is clear that UCL information IS important for the setting of MPO on hearing aids, and that hearing aid settings in which the MPO exceeds UCL are one of the primary causes of rejection of hearing aids among users.

- There does not appear to be clear consensus regarding which stimulus is preferable for these measurements.^{25,26} Where prescriptive formulas incorporate this data, it is important for the audiologist to be aware of this, and to perform the corresponding measurement using the same protocol.
- A recent survey indicated that audiologists do not routinely do MCL, UCL and dynamic range measurements for all clients; however, they do perform these measurements for hearing aid candidates (80% routinely do UCL, 44% do MCL and 45% do a measure of dynamic range).
- Research shows that test/retest reliability of supra-threshold measurements can be acceptable provided that a standardized method is consistently applied.²⁴
- A review of recent literature suggests that prescriptive formulas which incorporate loudness perception measurements are preferable to those based solely on threshold measurements.^{34,35}

Need for real ear /RECD measurement

- Real ear measurement is clearly the preferred method for verifying the performance of hearing aids.^{36,37}
- During the pre-selection stage, measuring the individual's real ear to coupler difference (RECD) is an important step in the process.³⁸
- Verification of the adequacy of the hearing aid characteristics can be accomplished using real ear measurements in three ways - direct measurement in situ, indirect measurement in the test box using the RECD, and indirect measurement in the test box using average ear canal resonance characteristics. Direct measurement is the preferred method as it accounts not only for individual ear canal resonance characteristics, but also effects of variables such as microphone location, venting, tubing, etc.³⁵

²⁸ Martin, F.N., Champlin, C.A., & Chambers, J.A. (1998). Seventh survey of audiometric practices in the United States. *Journal of the American Academy of Audiology*, 9(2): 95-104.

²⁹ Martin, F.N., Champlin, C.A., & Chambers, J.A. (1998). Seventh survey of audiometric practices in the United States. *Journal of the American Academy of Audiology*, 9(2): 95-104.

³⁰ Stach, B.A. (1998). Word recognition testing: Why not do it well? *The Hearing Journal*, 51(6): 10-16.

³¹ Sammeth, C.A., Birman, M. & Hecox, K.E. (1989). Variability of most comfortable and uncomfortable loudness levels to speech stimuli in the hearing impaired. *Ear and Hearing*, 10(2): 94-100.

³² Byrne, D. & Murray, N. (1985). Relationships of HTLs, MCLs, LDLs, and psychoacoustic tuning curves to the optimal frequency response characters of hearing aids. *Australian Journal of Audiology*, 7(1): 7-16.

³³ Beattie, R.C. & Boyd, R.L. (1986). Relationship between pure-tone and speech loudness discomfort levels among hearing-impaired subjects. *Journal of Speech and Hearing Disorders*, 51(5): 120-125.

³⁴ Cox, R.M. (1985). A structured approach to hearing aid selection. *Ear and Hearing*, 6(5): 226-239.

³⁵ Seewald, R.C., Moodie, K.S., & Zelisko, D.L.C. (1993). Critique of current approaches to the selection and fitting of hearing aids. *Journal of Speech-Language Pathology and Audiology*, Suppl. 1: 29-38.

³⁶ American Speech-Language-Hearing Association (1998). Guidelines for hearing aid fitting for adults. *ASHA*, 40 (Suppl. 18): p. 126.

³⁷ Hawkins, D.B., Beck, L.B., Bratt, G.W., Fabry, D.A., Mueller, H.G., & Stelmachowicz, P.G. (1991). Vanderbilt/VA Hearing Aid Conference 1990 Consensus Statement. *ASHA*, 37: 37-38.

³⁸ Fikret-Pasa, S., & Revit, L.J. (1996). Individualized correction factors in the pre-selection of hearing aids. *Journal of Speech and Hearing Research*, 35(4): 384-400.

■ Membership Contributions to Development

Team Members

Glen Sutherland (Chair), Pam Millett, Penny Parnes,
David Pfingstgraef, Betty Ann DeKraker, Jill Taylor, Max
Setliff, Dana Storms, Neil Hockley and Susan Scollie.

Field Test Sites

Niagara Peninsula Rehabilitation Centre, St. Catharines
Ottawa Civic Hospital
Lydia Kreuk Hearing Services, Mississauga
Baycrest Centre for Geriatric Care, Toronto
St. Joseph's Hospital and Home, Guelph
London Audiology Consultants
Thunder Bay Audiology
Timiskaming Health Unit, New Liskeard
Helix Hearing Care of America, Windsor
Peterborough Regional Health Centre
Hotel Dieu Hospital, Kingston.

Staff Support

Penny Parnes (1998-1999), Deborah Saville (1999-2000),
Robin Waldman (2000+).