

Efficacy of programmable analog hearing aids

SUMMARY

Agence d'évaluation des technologies et
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Technical note prepared for AETMIS
by François Bergeron

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FOREWORD

EFFICACY OF PROGRAMMABLE ANALOG HEARING AIDS

As part of the review of the *Programme d'aides auditives*, the *Ministère de la Santé et des Services sociaux* formed an advisory group mandated to recommend appropriate amendments to ministry officials. The work of the subcommittee on new technologies led the group to ask the *Agence d'évaluation des technologies et des modes d'intervention en santé* (AETMIS) to rule on the clinical efficacy of programmable analog hearing aids.

The technological options offered by conventional hearing aids do not always achieve auditory-assistance objectives. Several technological approaches have been explored to offer well-fitted hearing aids to people with a hearing loss, regardless of the sound environment. Work on programmable analog hearing aids has pursued this goal.

According to AETMIS's evaluation, there is a consensus that these hearing aids are at least as effective as conventional hearing aids in improving hearing. Additional benefits are nevertheless limited, the indications for clinical use compared with those of less advanced technologies are not clear, and costs are higher. Further controlled trials will be required to gather more information on the effectiveness of these approaches.

Although this innovative technology may be offered to certain candidates in need of well-fitted hearing aids, there are no grounds for its routine clinical use. This prudence is even more necessary since manufacturers are increasingly losing interest in programmable analog hearing aids in favour of fully digital technologies: therefore the need for cost-benefit analyses of this approach appears even more vital.

In submitting this report, AETMIS wishes to provide decision-makers in the Québec health-care system with the necessary information to offer appropriate services to people with a hearing loss.

Renaldo N. Battista
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SUMMARY

Origin of the request for evaluation

Since 1979 the *Ministère de la Santé et des Services sociaux* (MSSS) has offered a program giving free access to hearing devices to Québec residents with a hearing loss. Administered by the *Régie de l'assurance maladie du Québec*, this program has since undergone several changes in both its coverage and its eligibility requirements. Initially limited to hearing aids for people up to the age of thirty-five, the program now includes a wide range of hearing devices available to people of all ages.

To take into account technological advances and to better meet people's needs, the MSSS formed an advisory group mandated to review this program and to recommend appropriate amendments to ministry officials. The work of the subcommittee on new technologies led the advisory group to ask AETMIS to rule on the clinical efficacy of programmable analog hearing aids.

Description of hearing aids

Deafness is essentially manifested by a reduced ability to perceive sound signals in the surrounding environment. By selectively amplifying sounds rendered inaudible through hearing loss, an attempt is made to compensate for the loss of audibility of the sound environment and, more particularly, of speech. However, while the proposed adjustments ensuing from theoretical models for hearing-aid tuning are becoming increasingly precise, the technological options available on conventional hearing aids do not always achieve target values. Even after audibility has been restored, people with impaired hearing need better listening conditions than people with normal hearing in order to perform well on speech-intelligibility tasks. Moreover, given the wide variety of listening conditions, hearing-aid wearers must be able to adjust the amplification configurations to match these conditions. Several technological solutions have been explored to offer well-fitted hearing aids to people with a hearing loss, regardless of the sound environment. Work on programmable analog hearing aids has pursued this goal.

Programmable analog hearing aids process sound signals in a way comparable to conventional hearing aids. The control potentiometers, however, are replaced by one or more microprocessors that handle all the functions of the hearing aid. Moreover, the gain in space allows for the integration of a greater variety of adjustment parameters. These parameters are programmed (and reprogrammed) by computer or by a specialized programming unit. Memory storage also makes it possible to quickly compare different configurations and to find the most effective and comfortable adjustments for different listening situations.

Analysis of scientific data

The literature-search strategy for querying the databases located eighteen articles. Nineteen supplementary documents were obtained from the expert group or taken from the bibliographic references cited in the articles. This literature includes ten studies reporting on clinical trials on programmable analog hearing aids. Almost all of them involve non-randomized crossover trials, sometimes containing a retrospective analysis. The sample sizes are generally limited.

Irrespective of the level of evidence, almost all of the studies identified show that programmable hearing aids are superior to personal amplifiers, which are usually linear single-channel hearing aids without an advanced signal-processing system. This superiority is seen in terms of both speech-intelligibility performance and users' subjective impressions in different listening situations.

Conclusion

If only studies with the highest levels of evidence are taken into account, programmable analog hearing aids must be designated "innovative." In fact, despite the limited number of well-conducted studies, there is a consensus that this formula is at least as effective as conventional hearing aids in compensating for hearing impairment. Additional benefits nevertheless seem limited, and the indications for clinical use compared with those of

less advanced technologies are not clear. Further controlled trials must be undertaken to gather more information on the efficacy of these solutions. Considering the extra costs and the limited gains found thus far com-

pared with those of conventional hearing aids, cost-benefit analyses must be undertaken before the routine clinical use of programmable analog hearing aids can be recommended.

GLOSSARY

Analog hearing aid (conventional):

Hearing device using electronic circuits to amplify and control incident sound signals.

Assistive listening device (ALD):

Any device that is part of a user's environment and designed to compensate for a hearing impairment, to prevent or alleviate a handicap situation.

Binaural:

Involving both ears. Binaural means that a hearing aid is fitted to each ear, as opposed to a monaural system in which only one ear is fitted with a hearing aid.

dB HL (hearing level):

Unit of measurement of the ratio of sound intensities where the reference sound pressure is based on thresholds established for a normal-hearing population. A sound intensity of 0 dB HL corresponds to an intensity of 7.5 dB SPL at 1000 Hz (ANSI S3.6-1996).

dB SPL (sound pressure level):

Unit of measurement of the ratio of sound intensities where the reference sound pressure is 0.000020 Pa or 20 μ Pa. A sound pressure of 20 μ Pa corresponds to a sound intensity of 0 dB SPL.

Dynamic range:

The difference, expressed in decibels (dB), between a person's auditory threshold and pain threshold.

Hearing aid:

Any device worn by a user that is designed to correct a hearing impairment, to compensate for a hearing disability, to prevent or alleviate a handicap situation.

Hearing device:

Any device designed to correct a hearing impairment, to compensate for a hearing disability, to prevent or alleviate a handicap situation.

Linear hearing aid:

Hearing device that provides a fixed level of amplification regardless of the intensity of the incident sound signal. By definition, these devices do not have compression circuits allowing for more or less advanced methods of processing the dynamic range of the sound environment.

Programmable analog hearing aid:

Hearing device that uses electronic circuits to amplify incident sound signals as well as algorithms programmed into one or more microprocessors to control the sound signals.

Speech reception threshold (SRT):

The sound intensity required for recognition of 50% of two-syllable words, expressed in decibels (dB).