ASSIST

Co-funded by the Erasmus+ Programme of the European Union

Project name:
Adult education in assistive technologies for hearing-impaired people (HIP)
Acronym: **ASSIST HIP**
Project number: **2018-1-CZ01-KA204-048059**

Name of IO1 project ASSIST HIP output:
IO1 Guide to the world of assistive technologies for primary lecturers

Characteristics of the material for IO1 Project ASSIST HIP:
Methodology for a course for primary lecturers from 3 partner countries.
Summary of innovative trends in assistive technologies for HIP divided into 4 groups (hearing aids, and other assistive technology, applications-Apps, and induction loops).
Legislative and financial support for the purchase and use of assistive devices and technologies for HIP in the partner countries of the project
Brief methodology of working with an interactive catalogue, which is the output IO3 of this project.

Note: The material is available “on-line” in English and in the national languages of all three partner countries.

Chapter I. Introduction

The material before you is a methodological guide for educating senior instructors in assistive technologies for hearing-impaired people (hereinafter HIP). Senior instructors (at least from each partner country) will attend a three-day course in January 2020 organized by the coordinator of the project. During this course, they will be acquainted with the latest trends in the development and use of assistive devices and technologies for HIP by experts on the issue, including the coordinator's experts and external experts from the partner countries, perhaps also by representatives of manufacturers of assistive devices from other countries within the EU. These duly trained senior instructors will then train "proficient" instructors in "their" countries for educating the target groups of the project.

If necessary, the course for senior instructors can be repeated or organized for senior instructors from other countries after the completion of the project (i.e. after funding from the grant provider ceases) with funding from other sources.

The course assumes that the participants have at least basic knowledge and experience in assistive and communication devices and assistive technologies for HIP. Some of the course topics therefore are not covered from the basic level, rather they form an extension. This is to say that they acquaint participants with new and interesting trends in the given areas and do not deal with basic, generally known information.

The methodological guide has a total of 7 chapters:

I. Introduction
II. Hearing aids
III. Other assistive and communication devices
IV. Applications (Apps) for smart phones
V. Induction loops
VI. Legislative and financial support for the purchase and use of assistive devices and technologies for HIP in the partner countries of the project.
VII. Interactive catalogue´user manual - basic instructions for using the interactive catalogue of assistive technology, which is IO3 of this project

Co-funded by the Erasmus+ Programme of the European Union

Chapter II. Hearing Aids

Contents

1 Introduction to chapter II Hearing Aids

1.1 The growing number of hearing-impaired people (HIP), the basic causes of this situation and the outlook for the near future:

In-depth research suggests that the number of hearing-impaired people is currently on the rise. With great probability, a growing “silent epidemic” awaits the whole of mankind in the relatively near future (perhaps in less than one generation). According to the World Health Organization (WHO), by 2050 the number of non-hearing people or people with severely impaired hearing will more than double in comparison with the end of the second decade of the 21st century. All countries and continents will be affected without distinction. In 2018 the number of people with hearing disorders stood at 466 million, in 2030, according to WHO estimates, that number will increase to 630 million, and in 2050 there will be 900 million people living on the planet who will need some form of assistance for impaired hearing.

There are several reasons why the number of people with sensory disabilities is growing:

- Increasing population growth and average age expectancy. A lot of elderly people are at risk of age-related hearing loss, which many people with disabilities do not realize at first. An affected person usually does not realize it until family members point out the fact that the television is getting louder and louder and it disturbs both family members and sometimes neighboring apartments, or the affected person ceases to understand everyday conversation.
- An ever-increasing and persistent noise that is not an integral part of the civilized development of society. Few people realize how quiet the world was until the onset of the industrial revolution.
- The resurgence of several diseases previously thought to be virtually eradicated (measles, mumps).
- The toxicity of the environment or working environment. This means both environmental degradation and the deliberate damage caused to health (drugs, smoking, excessive use of medicine, etc.).
- Genetic influences.
- Injuries, whether related to work, sports or otherwise.

For these reasons, it is necessary to pay attention to technologies that help hearing-impaired people minimize this handicap.

2 The most common causes of hearing impairment +hearing tests+ the danger of neglecting professional treatment

2.1 Types of hearing problems, their causes and methods of treatment, or assistance:

The cause of hearing loss can be in different parts of our auditory organ. In the outer ear, middle ear, inner ear, or even in the auditory nerve. Depending on the type of hearing loss, there can be other symptoms such as tinnitus (the technical term for ringing in the ears that can amplify or attenuate at various intervals). In most cases, hearing loss is permanent and it is difficult to predict how it will develop from that point on. The options for treatment and correcting hearing loss with technical means (hearing aids) are also different and basically individual.

2.1.1 Inner ear disorders.

- Age-related hearing loss (Presbycusis)

Age-related hearing loss usually begins between the ages of 45 and 65 and can gradually deteriorate due to external factors (e.g. noise). The typical feature is the gradual loss of high frequencies. It mostly occurs in both ears simultaneously. The cause is damage (essentially “wear and tear”) to the cells of the fine hairs in the part of the ear called the “cochlea”, which causes attenuation of the stimuli transmitted to the auditory nerve. Remedying the condition with medication or surgery is not possible in this case. Basically, the only effective means is to correct the hearing loss with a hearing aid.

- “Poisoning” of nerve cells (ototoxicity)

Doctors use the term ototoxicity if the hearing loss is caused by harmful substances, e.g. wrong medication. These are substances that have a negative effect on the inner ear. On the sensory cells of the auditory and balance organ, or on other brain centers. Because any damage to the nerve cells of the auditory organ is irreversible in most cases, the hearing damage is permanent. Even in this case, the only effective treatment is to use a suitable hearing aid.

- Acoustic trauma

This is injury to the inner ear caused by a very loud sound. For example, a gunshot or explosion, or very loud music (e.g. at a rock concert). The result is a feeling of blocked ears, hearing loss or tinnitus. This condition usually passes within a few hours or days. However, in some cases the damage to the hearing organ is permanent. In these cases, it is possible to compensate for the hearing problem with a customized hearing aid.

2.1.2 Outer ear disorders.

- Foreign objects in the ear canal.

An injury to the external ear or an obstruction of the ear canal can be caused by foreign objects that find their way into the ear canal. This situation is remedied by a specialist removing the foreign object from the ear canal.

- Excess earwax

The ear canal can become blocked due to poor cleaning or excessive production of earwax and this can result in considerable deterioration in hearing. This condition is remedied by a specialist cleaning the clogged canal and removing the excess earwax.

- Inflammation of the outer ear (Otitis externa)

An infection of the outer ear can affect the ear canal and sometimes also the concha. A bacterial infection is usually caused by water contaminated with bacteria (e.g. in a pool). It can lead to pain, itching and hearing impairment. It is treated with medication prescribed by an ENT doctor.

2.1.3 Middle ear disorders.

- Inflammation of the middle ear (Otitis media)

Inflammation of the middle ear caused by viruses or bacteria is usually very painful. The bacteria gets into the ear via the bloodstream or from the nasal cavity through the Eustachian tube. The inflammation is often accompanied by a significant deterioration in hearing. It is treated with medication prescribed by an ENT doctor. If the inflammation is

diagnosed and treated in time, the hearing impairment is only temporary and disappears after the inflammation is treated.

- Otosclerosis

Disease of the bone surrounding the inner ear. Otosclerosis leads to inflammatory processes and negatively affects the mobility of the ear ossicles (hammer, anvil and stirrup). The result is slow but progressive hearing loss. This disorder is often accompanied by ringing in the ears (tinnitus). Medication generally cannot cure it. But it can be successfully treated with surgery in certain cases.

- Perforation of the eardrum.

The eardrum can be perforated by foreign objects (e.g. a long thin pointed object – knitting needles), infections (e.g. middle ear inflammation) or strong pressure (e.g. when diving). Sometimes the perforation is caused by a blow to the ear or loud bang.
The hole in the eardrum leads to hearing loss. Smaller perforations generally heal themselves. In certain cases, surgery can be possible. But if the damage is severe, the hearing disruption will be permanent. The most frequent loss is the perception of high frequencies or reduced dynamics.

2.2 Professional auditory examination and auditory measurement

Whether a person admits to problems with hearing alone or they are forced to admit it by their surroundings, the first thing they should do is visit a medical specialist – a phoniatrist who will carry out an expert examination and determine the right diagnosis. The examination is painless and consists of checking the patient's hearing, ears, ear canal, eardrum, Eustachian tubes, nose and throat, etc., which are the organs that can considerably affect the quality of hearing in many cases. Everyone knows that in the case of a strong cold, the quality of hearing is significantly worse. A common cause is undesirable clogging of the entrance to the eardrum by earwax, a problem often caused not so much by poor hygiene as by poor cleaning of the ear canal.

Unless the doctor discovers the reason for the hearing loss in one of the above cases, a more detailed examination will be undertaken.

Examination with an audiometer.

This is an electronic device that generates pure tones of different high intensity. The headphones of the patient in the soundproof booth are fitted for the device. The tones are at different frequencies and in varying intensity. The patient pushes a button to confirm that they hear the tone. The device records the sounds they hear and at the end of the audiometric session they are drawn in the form of a curve on a special form. This waveform shows what loss the patient has, in what frequency bands and at what intensity of hearing. According to the waveform, the doctor can tell in what part of the auditory system the hearing disorder is and what the likely cause is. Based on this, the doctor will arrange another examination or treatment. Speech audiometry may follow, where the patient hears words from an audio player and repeats them. The attending physician or nurse records the ones that have been repeated correctly. The purpose of the examination is to determine the percentage of spoken words understood by the patient.

In some cases, the doctor will diagnose an illness behind the hearing impairment which is temporary and can be treated with medication. For example, an inflammation of the middle ear can be cured without any consequences, unless of course the patient

neglects it. In most cases addressed by a phoniatrist, treatment without medication is ineffective and the hearing loss is permanent. In this case, the hearing problem is compensated with a hearing aid.

The patient often avoids a diagnosis of impaired hearing by saying, "I can hear, but not understand." This sentence is typical from people who are starting to have or have had a persistent problem in recognizing sounds at speech frequencies and this is causing communication problems in their family, workplace and even affects their behavior in society.

2.3 The danger of neglecting professional treatment

An important factor in compensating for hearing problems is time. The use of hearing aids, despite the ongoing awareness of hearing impairment in civilized countries, is still a stigma for many people. They are afraid that using a hearing aid will make them look old and disabled. These worries mean that it is late before many patients with hearing impairment go to see an expert. For some even too late. Surveys show that people who suffer from hearing loss usually wait seven to eight years (!) before seeking expert care. And it is precisely this long wait that is the big problem. Scientists have discovered that after seven years our auditory center in the brain "forgets" sounds that have not been initiated over a long period of time. If these sounds are again heard after that time thanks to a hearing aid, they may not be interpreted correctly. The hearing aid user then often considers these "forgotten" sounds to be too loud and uncomfortable. Even if it is just the rustling of leaves or sounds coming from the garden next door.

3 Selecting the right hearing aid

3.1 Introduction to chapter 3

The last fifteen years have seen a sharp increase in the quality and quantity of products offered for hearing aids and other devices for hearing-impaired people. Modern hearing aids working with digital technology can be adapted to the individual degree of hearing loss. They have automatic programs for typical ambient situations (they amplify speech, suppress disturbing ambient sounds) and the function for suppressing feedback (annoying whistling created by an acoustic "loop" between the microphone and receiver in the hearing aid). With the help of other assistive technologies, they can operate wirelessly and amplify the sound directly from your television or mobile phone without interference from surrounding noise. All of this makes it easier for people to minimize the effects caused by hearing loss and to ensure a better quality of life. The number of hearing aid models has grown together with the proliferation of modern technology. This is seemingly good news. On the other hand, this fact complicates things for hearing-impaired people because it floods them with manufacturers and types of hearing aids and other assistive technologies.

3.2 Possibilities of current hearing aids

If a patient decides to get a hearing aid or aids, they need to prepare for this step. Today's hearing aid is a very complex and complicated device. When going to choose one, the prospective user will encounter a large number of obscure technical terms, different types of hearing aid design, offers of competing brands from the manufacturers of these devices, and also a wide variety of models in an equally wide price range. It is difficult to

ignore the offer of so-called miracle hearing aids, where the advertising for them in a variety of printed magazines, on the Internet and in television promise to miraculously restore hearing, at a very attractive price no less, especially for low-income buyers.

For a person who has trouble hearing, they have to remember one important fact when deciding to buy a hearing aid. A hearing aid is not a new ear! Despite its technical wonders, it is only a device that amplifies sound and modifies it to a certain extent. Many people think that turning on a hearing aid will have the same effect as a nearsighted person putting on a pair of glasses. The problem with seeing is suddenly cured and that person's vision will start to work the way it did before. Unfortunately, this is not the case with hearing aids. A hearing aid should rather be compared to a bionic prosthesis. A disabled person must learn to live with it. But even after the maximum familiarity with such a substitute is reached, the device will never fully replace a damaged or lost sensory or physical ability.

3.3 Division of hearing aids

3.3.1 According to the method of processing the audio signal

3.3.1.1 Analog hearing aids

An older type of hearing aid with analog signal processing. The sound is converted to an electrical signal in the microphone. That signal is then amplified in the amplifier and passes through an acoustic filter and volume control. The signal is then converted back into audio form in the receiver. The hearing aid is equipped with trimmers (rotating slots for control) for adjusting the power, frequency waveform, compression, and possibly other parameters. Because the possibilities of digital hearing aids far exceed analog hearing aids, the majority of manufacturers of analog hearing aids have stopped producing them today. Their users are recruited mainly from the ranks of the elderly, who are accustomed to this type of hearing aid.

3.3.1.2 Semi-digital hearing aids

These hearing aids are developed as "semi-types" between analog and digital hearing aids. The sound in them is processed in continuous analog form but the control is digital. At present, this hearing aid is no longer produced.

3.3.1.3 Digital hearing aids

These days it has all but replaced analog hearing aids.

In digital hearing aids, the audio signal is converted into an electrical signal in the microphone. An analog-digital converter digitizes that signal and transmits it to the heart of the hearing aid – the computer processor. There it is accordingly adjusted and converted in a digital-analog converter. The signal is converted back into acoustic form in the receiver. The ability of the digital hearing aid to convert the signal to a binary, i.e. discontinuous signal makes it possible to adjust the sound in ways that are not possible with an analog hearing aid. But the digital hearing aid needs to be connected to a computer that has a special program installed for adjusting the hearing aid. Setting the device using trimmers has finally stopped.

3.3.2 According to the embodiment and method of wearing it

3.3.2.1 In-the-canal hearing aids

They are placed in the ear canal. They are abbreviated as **RIC, CIC, ITC, ITE**. Because each person has a different shape of the ear canal, each shell of this type of hearing aid is manufactured individually according to an impression made at the ear clinic. Due to the miniature size of the shell, which contains the necessary electronics, the hearing aid is not designed for everyone. For a really strong loss of hearing, the electronics are limited by the power of the components, so often a future wearer of the hearing aid with greater hearing loss must be reconciled to the behind-the-ear option. However, for the behind-the-ear hearing aid of the RIC type, where the receiver is inserted into the ear canal, the miniaturization of the hearing aid is so large that it compares to in-the-canal models. In-the-canal hearing aids are further classified according to how the shell fits into the canal and concha. The smallest version is the **CIC**, which is almost completely hidden in the ear canal. The largest version is the **ITC**. In addition to the ear canal, it fills the entire area of the outer ear at the entrance to the ear canal (concha). The versions between them are the **ITC** and **ITE**. The size of the shell needs to be different because of, for example, the size of the battery that powers the in-the-canal hearing aid. The larger the shell, the greater the power of the hearing aid. However, the way the device is inserted into the ear affects the properties of listening through the hearing aid and comfort to the wearer. Smaller hearing aids are operated by remote control, where the larger models of the ITC type may contain embedded controls in in the body of the shell for the amplification or attenuation of sound and switching off the device.

3.3.2.2 Behind-the-ear hearing aids

In professional terminology, the acronym **BTE** stands for behind-the-ear, where the sound is transmitted by air. The standard hearing aids most used are connected to the ear via a plastic tube that terminates in either a universal tip (bud) of various sizes or an earmold inserted into the concha. The earmold is made to measure exactly just like the shell for in-the-canal hearing aids, whether or not the material and design are different. A poorly made earmold or ill-fitting universal tip create “feedback”, which is an annoying ringing that makes it virtually impossible to listen via the hearing aid. Like in-the-canal hearing aids, behind-the-ear aids have also undergone dynamic development in recent decades. There has been considerable reduction in the size of the embodiments, which, similar to in-the-ear devices, necessitated moving the hearing aid controls to a remote controller or to applications for mobile phones. It was no longer possible to place conventional controls in the body of **BTE** hearing aids due to the risk of the user being unable to find them in many cases or to operate them.

In addition to classic **BTE** hearing aids with a thick tube, there are also **BTE RITA** and **BTE RITE**. **BTE RITA** again relies on the transmission of sound by air, but the sound is transmitted into the ear via a hollow tube only slightly thicker than a hair. The tubes in this case do not end in earmolds but in special non-detachable endings called domes. These can be either open or closed in structure. This solution is used, for example, in the event more ventilation of the ear canal is required, or in the case of “ampclusion”, which is a troublesome sound effect that many hearing aid users hate.

BTE RITE (RIC) are miniature behind-the-ear hearing aids which, unlike other **BTE** devices, the receiver is removed from the casing of the hearing aid. The receiver is inserted into the ear canal and is connected to the rest of the hearing aid by a thin wire protected by a rigid plastic tube. This is not the case with hearing aids that use air conduction. The receiver is either

inserted into a customized earmold or mounted to detachable endings in the dome design. But these terminals are not the same as the ones used for **BTE RITA**. The miniature size of these types of hearing aids means the total elimination of manual control, which is invariably transferred to either a remote control or the controls are done using applications on mobile phones.

3.3.2.3 Pocket hearing aids (box-type)

Hearing aids about half the size of a cigarette pack were widely used in the 1960s. The hearing aid box contained alkaline batteries or another bulky power source. Two wires twisted around each other run from the hearing aid to a knob on the receiver. Nowadays, these devices are only used by hardcore users and people unable to use smaller hearing aids due to the anatomical dysfunction of their hand(s).

3.3.2.4 Spectacle hearing aids

Basically a historical artifact today. They are twofold. In the first of the two, the temples contained all the electronics of the conventional air-conduction hearing aids, including batteries. There was an outlet on the internal side connected by a tube to a tip that was introduced into the ear canal. The second type of spectacle hearing aids had no audio output, rather there was a bone vibrator in the temples. It sat precisely on the temporal bone and transmitted vibrations to the inner ear. Due to the miniaturization of hearing aids and, in the second case, the transmission of vibrations through the **BAHA** system, hearing aid spectacles are used today only by a tiny group of hardcore users who refuse other modern solutions to their hearing problems. There is no other reason today to use spectacle hearing aids.

3.3.2.5 "Miracle" hearing aids

The high cost of hearing aids, the fear of doctor visits and professional hearing tests, the personal rejection of a hearing aid as a sign of aging or other effects makes hearing-impaired people seek other options for improving their contact with their surroundings. These people often seek the offers of delivery services, pharmacies, etc., and buy devices often announced as having a miraculous effect on restoring hearing. What they really offer are weak amplifiers with low durability and poor user comfort. The life span of these "stethoscopes" is usually greater than three months, then they fall apart due to poor quality plastic, or they begin to fail and the electronic part usually cannot be repaired. In some cases, the owner is forced to buy non-standard coin-cell batteries, which can only be bought from the supplier of the "stethoscope", naturally at considerable cost. Users could avoid these unpleasantries by choosing from any number of solid, reputable manufacturers of hearing aids.

3.3.3 According to the ending

3.3.3.1 Earmolds, tips, their design and use

An essential part of the behind-the-ear hearing aid are the ear inserts. They are at the end of the tubes running from the hearing aid to the concha and further into the ear canal. They differ in design and the material used. To some extent, their selection, design and material are determined by the hearing-aid wearer, but their final form and parameters, particularly for custom-made endings, are the joint work of otoscopic laboratories and

hearing-aid specialists, and the future wearer of the earmold can influence the result only minimally.

3.3.3.2 Factory-made endings

3.3.3.2.1 Hearing aids with thick tubes

Some wearers of behind-the-ear hearing aids prefer to have tubes with factory endings, which are called ear tips. The tube ends with a non-detachable ending shaped like a plug, a bud made of soft plastic or foam mounted on a plastic tube. These ear tips are available in six sizes; size 1 is the smallest in dimensional design. The tube typically has an outer diameter of 3.1 mm, inner diameter of 2 mm.

Prior to fitting the hearing aid behind the ear, the tube must be cut to a length that allows the tip to sit in the ear without the risk of it being pulled out of the ear canal due to the hose being too short. A hose that is too long can cause the same problem, in addition to hanging off the ear in an unaesthetic fashion, and in the event of a jerk of the head, there is the risk of the hearing aid slipping off the ear and onto the floor, which can result in the complete destruction of an expensive device.

Although the acoustic parameters of factory ear tips cannot be adjusted, these hearing aids still remain popular among wearers, whether out of habit or because they find customized tips to be unsatisfactory.

Cleaning ear tips remains a disadvantage, especially the internal cavities. It is imperative to regularly replace tubes and tips due to the material hardening. Perspiration, UV radiation and cerumen yellows causes them to lose their elasticity and over time they develop microcracks invisible to the eye. This greatly reduces the comfort of wearing the hearing aid and also interferes with transmitting sound from the device to the ear canal. At first the hearing aid will start whistling, later the ear tip will break. In some cases the hook, which in time virtually becomes a permanent integral unit with the tube, will also break. Naturally repairing it is considerably more expensive than simply replacing the tube and ear tip combination.

3.3.3.2.2 Hearing aids with thin tubes in the RITA and RITE design

For hearing aids of the RITA and RITE type, the ends come with a detachable connection to the thin tubes. But the tube for RITE is not hollow. The sound is fed to the receiver via a thin wire. The tube is therefore not in-the-canal, rather serves as a protection for the wire lead. The receiver for the hearing aid is inserted inside the detachable ending at the end of the tube, i.e. in the dome. The ending may be open or closed. The open solution for inside the canal means it in not completely closed – the dome is held in the ear by a flexible plastic ring anchored to the lower edge of the concha. This solution is used for users who request the smallest behind-the-ear hearing aid while at the same time needing more ventilation of the ear canal.

3.3.3.2.3 Hearing aids with a thin in-the-canal tube – the so-called discrete design or RITA.

Hearing aids of this type have no hook into which the tube inserts. The tube has a threaded end used to screw it directly onto the body of the hearing aid. The means of insertion can vary, however, according to the manufacturer of the hearing aid. The end of the tube can again be inserted into the dome of the open or closed design.

3.3.3.3 Customized ear endings

3.3.3.3.1 Hearing aids with thick tubes

Ear tips made to order are identified by the name of the earmold. Their design ensures a more comfortable wearing of the hearing aid behind the ear, limits feedback (whistling), and in some cases, reduces the occlusion effect, where the sound from the hearing aid rings uncomfortably hollow. Earmolds may have different forms of embodiment, from filling the entire concha to various lightweight versions, which fill some of the anatomy of the outer ear and are therefore less noticeable. The tubing must be changed from time to time, because it is subject to the same adverse effects as the case of the aforementioned factory manufactured tubing with ear tip endings.

Earmolds may or may not be equipped with a vent port for venting. It removes excess moisture from the ear canal and in some cases helps with more natural listening.

The material of earmolds for hearing aids with a thick tube is twofold. They use either hard acrylic or soft silicone. An earmold made of acrylic is easy to clean and maintain and has a long life. Acrylate, however, is brittle and breaks easily if dropped or impacted. Silicone earmolds are resistant to drops, but their life is shorter because the material is not resistant to UV radiation or sweat. Over time the earmold turns brown and begins to crumble. They are therefore not suitable for people with chemically aggressive sweat. They should rather use the first type of earmold.

3.3.3.3.2 Hearing aids with thin tubes

Individual designs of the earmold can be chosen for both RITA discrete hearing aids and hearing aids of the RIC and RITE types. The design and material, however, can greatly vary, where sometimes the receiver is placed inside a hard acrylic case and sometimes the design and material are more suggestive of an in-the-ear hearing aid.

3.4 Brief summary of the procedure for choosing hearing aids

1. Visit an ear doctor immediately in the event of any suspicion of hearing loss.
2. Consider your choice of hearing aid or aids based on the results of an examination and recommendation of the doctor.
3. Choose the right consultant, best audiologist (hearing care technician) or social worker focusing on deaf education.
4. When choosing a hearing aid, consider your professional, personal and financial needs and options and determine accordingly whether to choose one or two hearing aids, in what design and with what technical parameters and equipment. Do not forget to ask for the servicing available for hearing aids.
5. It is your choice to consult with both a doctor and social worker.
6. Find out what other mobility aids will be necessary or advisable to use in addition to a hearing aid and find out how they work, their prices, the possibility of grants from the Labor Office, etc. Again use the advice of a social worker focusing on this area of sensory disability.
7. Make your final selection of the hearing aid(s) and ask your doctor or dealer about the opportunity to try them out at home, in the workplace, etc.
8. Follow the warranty inspections and tuning of the hearing aid determined by the doctor or manufacturer.

9. In case of problems in adapting to the hearing aid, try to enroll in a training program for first-time users of hearing aids.
10. For a severe loss of hearing and persistent communication problems, try to master the art of lip reading with a lecturer.

4 Professional audiological, non-medical, social and technical advice for hearing-impaired people.

Division of hearing-impaired people according to access to consulting.

In principle, clients can be divided into two groups. It must be emphasized that in both cases they are adults, not children or adolescents. Technical assistance for hearing problems in children and juveniles falls exclusively and only in the domain of doctors specialized in this group of patients.

4.1. Group - A: People who have never had a hearing aid or assistive device for the deaf and have decided under pressure from problems arising from their disability to consult with someone who is able to handle this problem.

4.1.1. Individual steps in providing advice to group A.

4.1.1.1. Identifying the individual approach of the client to their hearing problem.

The first thing is to determine how the client approaches their difficulties with hearing. This involves getting information in a way that requires a lot of empathy, patience and a diplomatic approach. However, if a positive effect is to be achieved, then it is necessary to establish a sufficiently mutual and helpful relationship with the client.

Clients in Group A are divided into three basic subgroups. A slightly different approach needs to be taken with each of them. At this point it does not matter whether a doctor has sent the client or the client is seeking a consultant independent of a doctor. In all the cases listed below, one basic observation applies.

Only a person who wants to hear better can be helped!

Unless a hearing-impaired person adopts such an assertive auto mode, then all efforts to improve the quality of their hearing and therefore their life are usually in vain.

a) **The client comes on their own, because they know they have a hearing problem and want to do something about it.** This is the ideal case. A hard-of-hearing person just wants to hear better and is willing to do a lot for it. When searching for a solution to their problem, they work hard with a consultant, they make notes, willingly answer everything, try to comprehend their medical condition and understand how to compensate for their disability. If a doctor's examination is necessary, they order it as soon as possible. They work with their consultant and seek answers in other cases relating to their hearing disability.
b) **The client comes with somebody, usually a family member who has persuaded them or is still persuading them that they need help with their hearing problem.**

The client still takes their handicap lightly, but peer pressure forces them to seek professional help. Communication with a consultant is more arranged by family or friends; the client makes no appointment, does not try in the least to remember something or understand. The client is frequently apathetic during the visit to the doctor; they still see their hearing deficiency more as a not too serious health problem blown out of proportion by the people around them. They often say they hear quite well, it is the people around them who are mumbling or else speaking way too fast, and so on. Often they express interest in hearing aids and assistive devices only when they are told that it will improve their listening to the television.

c) **A third type of client also comes with somebody, but with a very skeptical attitude towards the offer of help.** They refuse to admit they have a hearing problem, refuse a technical solution like using a hearing aid, assistive device, etc., usually because of aesthetic reasons. Their negative attitude usually changes when they are convinced that their behavior is actually rude to the people around them. Although attempts are made to communicate with them, they continue to arrogantly stick by their attitude and this causes stress and discomfort to the people around them. For such hearing-impaired people, changing their view of their medical condition, if it succeeds, often turns out to be so surprising that they finally begin to cooperate on finding a solution to their problem.

4.1.1.2. Objective diagnosis

After resolving point one, meaning determining whether the client is even interested in fixing their hearing problem, we then begin to look for the source of their problem and find out exactly what the client needs. The first thing we need to do is identify the symptoms of the hearing impairment, how it originated, how it disrupts the client's quality of life, and how they have been dealing with it. The most common complaint in this case is that the client does not hear the television, which they play very loudly so that it disturbs their family, neighbors, etc. Often it concerns the beginnings of age-related hearing loss, which can start to show up in people after the age of 40. But in some cases it may be a simple problem with too much secretion of earwax. If the ear canal is not cleaned out properly, the wax can create blockage around the eardrum, resulting in poor listening. If this turns out to be the case for the client, they need to visit a doctor who will professionally remove the wax plug. When the ear canal has become unclogged and the examination has eliminated a health problem of another nature (rupture of the eardrum, sudden sharp deterioration in hearing, discharge from the ears, etc.), it is possible to consider the use of assistive devices – for example, wireless headphones for listening to the television. An examination with an audio meter would probably show that the client has a loss of up to 20db throughout the voice band, which is still in the range of healthy hearing. However, for listening to today's flatscreen TVs, where the sound from the speaker is often directed down or backward and not forward, there may be a problem with speech clarity, especially if someone is sitting far from the TV.

If the loss of hearing turns out to be of a greater nature, it is essential to recommend a visit to the ear clinic to find out what is the cause of the hearing impairment and whether

the problem can be solved with medical resources. For this situation, the specialist will determine the hearing loss curve and the resulting type of hearing defect. In case the client refuses to visit the doctor for whatever reason, only certain hearing assistive devices can be offered to improve listening and with it quality of life. Without the client taking at least an audiometric examination, practically no expert advice on hearing aids of any design, model or brand can be offered to them.

If the client goes to see an audiologist at the request of their physician, or they make the effort themselves but with documents provided by their physician and a fresh audiometric examination, the search can begin for a suitable hearing aid(s) if the client wishes it. If the client's hearing defect is on both sides, it is advisable to suggest the possibility of using two hearing aids. This option improves listening by at least thirty percent plus it adds better audio and spatial orientation. The only exception to this option are people who hear with only one ear and those who reject two hearing aids because of financial or aesthetic reasons, or simply because they would not be able to deal with new sounds from two sides and so two hearing aids would more confuse them than help them.

4.1.1.3. **Advice for choosing a hearing aid and support programs for first-time hearing aid users.**

The next procedure is the same as for clients in Group B, which will be discussed below. It is also consultancy on a new hearing aid plus an offer of additional programs for first-time users of hearing aids. These programs make it possible to shorten the adaptation time to the hearing aid for newcomers to this device. It includes explanations and practical training in setting up and operating the hearing aid, carrying out maintenance and using it in practice. This program includes the **"Communication and listening skills training course designed primarily for first-time users of digital hearing aids".** It also includes training in listening to sounds and voices through the hearing aid, from the simplest to the more complex ones, such as spoken speech with ballast sound in the background. The program also includes a **Lip Reading Course**. Attendees will learn how to read lips and thus greatly improve their communication skills when talking face to face. Fast and quality adaptation to the hearing aid, along with the ability to read lips, allows hearing-impaired people to considerably suppress their communication disability and often end their isolation from the hearing majority of society. In severe cases of hearing loss, or where there is a risk of further deterioration in hearing loss, or even complete deafness, a **Sign Language Course** ought to be recommended to the client. Sign language broadens the communication skills of the affected individual and helps them integrate within the community of the deaf and hard of hearing.

When adapting to a new hearing aid, the ability of the client to focus on and process incoming sounds is an important factor. To improve these capabilities, EEG Biofeedback therapy has been used experimentally in t\he activities of the Brno Deaf Union to help eliminate attention disorder. EEG Biofeedback is a training method that, in the form of a computer game, makes it possible to harmonize brain activities through bioregulation, and self-learning helps the brain improve and accelerate the process of adaptation to the hearing aid. Although testing is far from over, because it is a time-consuming procedure (minimum of 20 sessions), the first observations show that the procedure has had positive effects on

hearing aid users, mainly in the area of eliminating stress in the hearing aid wearer. This calms the mind, freeing it to focus on incoming sound sensations.

4.2. Group B – clients who already use a hearing aid

4.2.1. Individual steps in providing advice to group B

If people from this group turn to a social counselor engaged in and with experience in deaf education, it is almost always to improve the functionality of existing hearing aids, to find out about new hearing aid models, or to find information on assistive devices that supplement existing hearing aid(s). In many cases, people in this group seek advice because they have decided to purchase new hearing aids and need advice on new models, equipment, pricing, maintenance, etc.

At this stage, the client needs to be consulted about their ideas, expectations and needs, and their financial means regarding new devices. Others are communication needs, for example, with a company manager, and others for a senior living in a family circle. In this case, the price/performance ratio must be carefully consulted, so that a low-income client receives a device within their financial limit that offers them adequate added value. In the event the client has come to consult on an hearing aid recommended by an ear doctor, it is usually necessary to explain the individual features of that hearing aid, its potential, and possibly any specialized applications installed on a mobile phone that are used to control the hearing aid(s). Doctors often do not explain these parameters in detail and the client is left to fumble around with the possibilities of the device, especially a technically advanced device. **If the doctor suggests more than one hearing aid from different manufacturers, it is better to recommend a hearing aid from a manufacturer already familiar to the client. Otherwise, the client may have to undergo at least a month of adaptation before becoming used to the new hearing aid brand. The client should be notified of this issue. Otherwise, it is not worthwhile to prefer a brand of hearing aid, perhaps only if there is a locally available service for the brand and the client has limited mobility and the service would have to be handled through a middleman, post office, etc.** When searching for a suitable hearing aid, a hearing aid catalogue from manufacturers should be used. If the client has their own audio chart, the hearing aid vendor can be directly asked to recommend the most suitable model based on the chart.

It sometimes happens that a client has been wearing a behind-the-ear hearing aid(s) for a long time and after many years decides to switch to in-the-ear hearing aids, usually for aesthetic reasons. In recent years, there has been a significant shift among these models towards devices suitable for severe hearing impairments, so change here is possible. It is, however, necessary to explain the differences in both technical concepts to the client. For example, the receivers in in-the-ear hearing aids are considerably smaller, so the resulting sound can be perceived negatively by a hard-of-hearing person accustomed to listening with a big behind-the-ear hearing aid. Again, an adaptation phase for the new hearing aid may be necessary. **In-the-ear hearing aids are also much more difficult to handle, so they are not suitable for people with limited motor skills in their hands or fingers. Compared to behind-the-ear hearing aids, they can have less battery life and need to have their cerumen filter replaced, something that does not happen with conventional BTE hearing aids. Given the**

miniature size of the filters, a lot of seniors are unable to replace them and they must turn for help to family members, nurses at the ear clinic, or a social worker knowledgeable about hearing aids and the differences in cerumen filters. A client interested in changing from a behind-the-ear hearing aid to an in-the-ear one needs to be informed of these facts. As an alternative, the client can be presented with the possibility of replacing their current behind-the-ear hearing aid with a BTE hearing aid with the receiver in the ear – i.e. RIC models.

Occasionally, there are cases where a client wants to change from an in-the-ear hearing aid to a behind-the-ear one. If the client wishes a BTE hearing aid with the receiver in the canal, it is necessary to explain to them the importance of quality tips and the differences between factory-made tips, custom-made tips and the choice of soft and hard earmolds. With these hearing aids, the choice of tip is almost always at the discretion of the hearing aid wearer. For hearing aids with the receiver in the ear, there are also big differences between the types of tips, but here it more depends on the recommendation of the doctor. There are more factors involved in the choice of tips for these RIC hearing aids than for BTE in-the-ear hearing aids with a thick tube, and the choice has bigger influence on hearing through the device. In this case, it is therefore better to explain to the client what options the tips for RIC hearing aids have and leave the final decision to the phoniatrist or maker of the tips.

However, additional programs can also be offered to the experienced hearing aid users mentioned above. These primarily include the Lip Reading Course and Sign Language Course.

For people who are used to hearing aids(s), there is usually no need to explain the maintenance of the hearing aid, how to use it, operate it, etc. There can still be exceptions here that need to be addressed individually. It is important to realize that the social work of helping people with hearing impairment has its own peculiarities that are specific only to this area of disability. Almost every case is individual and cannot be generalized into individual boxes according to a formula, because problems with hearing loss affect everyone differently and each HIP approaches the solution to their hearing impairment individually.

5 Glossary of basic terms for hearing aids

Audiometer – specialized electronic device for measuring hearing loss. It sends pure tones at different frequencies audible for people and at different volumes. The patient undergoing the examination hears the sounds through headphones and confirms the audibility of the sound by pressing a button. The device records the result on a curve, which tells the doctor whether the patient has suffered hearing loss and what type.

dB - decibel – generally a measure of the proportion of two values that are used in many fields. It is not an absolute unit (e.g. meter, kilogram, amps, etc.), but expresses the relationship between two variables. The decibel is a logarithmic comparator unit. In acoustics, it expresses the ratio of the intensity of the sound stimulus, i.e. Sound Pressure Level (SPL), or volume (VOL), which is a criterion of the subjective perception of sound by an individual against zero level - the threshold of hearing (= the smallest average intensity of the sound stimulus that the human ear can pick up).

Eustachian tube – anatomical organ connecting the nasopharynx and the space of the middle ear. It is there to equalize the pressure on the eardrum.

Phoniatrist – specialist, usually a physician, who works in the field of phoniatrics.

Phoniatrics – a branch of medicine dealing with the investigation and treatment of disorders of the human voice, speech and hearing.

Tip – simple ending for the ear of factory design

ENT – abbreviation for the medical discipline of Otorhinolaryngology. It deals with the diagnosis of and surgery for diseases of the ear, nose and throat and diseases of the head and neck.

Presbycusis – age-related hearing loss. It affects a considerable portion of the senior population. In recent years, it has been occurring in ever younger people, the so-called Social Acoustic phenomenon, which is hearing impairment due to the sound burden of civilization (listening to loud music, noise exposure in the workplace, genetic predisposition, medicines, drugs, nicotine....)

Hearing aid – electronic device that amplifies and modifies sound so that a hard of hearing person hears it the best and understand spoken language. Hearing aids can be analog, semi-digital and digital.

Analog hearing aid – an electronic device that continuously processes incoming sounds in the simplest embodiment, therefore amplifying and attenuating all sounds the same on all frequencies.

BAHA hearing aid – device for transmitting sound through bone conduction directly into the inner ear. It is used for severe hearing loss and connected to the head via a surgically inserted titanium screw.

BTE hearing aid – hearing aid suspended behind the ear that conducts sound through the air via a thick tube.

CIC hearing aid – smallest type of hearing aid, which is completely inserted into the ear canal.

Digital hearing aid – electronic device whose circuitry performs the binary processing of incoming sounds, meaning not continuous. It can work with a much larger number of channels than analog hearing aids can.

ITC hearing aids – largest type of hearing aids in the ear canal.

ITE hearing aid – in-the-ear hearing aid that partly projects from the ear canal.

Semi-digital hearing aid – hearing aid with analog signal processing, but it can be connected to a programmable unit that improves the output signal from the hearing aid.

RITA hearing aids – BTE hearing aids where the sound is transmitted with air conduction via a thin tube.

RITE hearing aids – BTE hearing aids where the receiver is inserted in the ear canal.

In-the-canal hearing aid – individual hearing aid inserted at various depths into the ear canal.

Earmold – shell made to precisely fit the hearing aid wearer.

Venting – vent channel in an in-the-canal hearing aid or in the earmold.

III. **Other assistive technology**

Content:

1. Division of assistive devices
   1.1. Compensation devices
   1.2. Communication devices

2. Methods for transmitting sound to improve the hearing of hearing-impaired people.
   2.1. Induction loop
   2.2. FM Radio System 2.4GHz
   2.3. Infrared system
   2.4. Personal assistive earphones

1. **Division of assistive devices**
   Assistive devices for hearing-impaired people are divided into:

1.1. **Compensation** devices

They compensate for hearing loss for both deaf and hard of hearing persons. These include alerting devices such as vibrating alarm clocks, visual alert signaling phones, visual alert alarms depending on the situation the hearing-impaired person finds themselves in.

According to individual needs, the signaling is often a visual **flash** or **vibration**, or **sound**. Or it can be a combination of these signals. For example, a vibrating alarm with a flashing light and soft vibration. The parents of young children need combined signaling according to the time of day. It is likewise necessary to know the architectural layout of the home. Other requirements include a door bell alert signal in a block of flats, where it rings on the ground floor and on the floor, and in a single-family home, where the ringing is from one place and usually it is enough to have one bell wirelessly connected to the button. Telephoning has changed recently and so a signal alert is necessary for both an incoming landline and mobile phone. For smart mobile phones, the setup is relatively simple thanks to various applications. For example, WhatsApp, SMS, Facetime, Facebook communication application and more. (See Chapter IV of this manual)

When grouping multiple functions into signaling, it is possible to identify the type of situation, i.e. perception, by using colored LED lamps and a flashing rhythm or vibrating receiver.

1.2. Communication devices help **with lighter types of hearing loss.** They help to hear ordinary television, radio, and running conversations through a system of induction loops and FM (frequency modulated radio waves). Visual aids are available **for severe hearing impairment**, including closed captions for television shows. For telephoning there is a telephone operator service for the deaf, mediating a telephone call between the deaf and hearing, and online interpreting into sign language. It remotely mediates a call between a deaf person and their hearing employer, with the typist transcribing spoken words, e.g. during lectures, etc. Smart mobile phones can be activated for the automatic transcription of spoken words without the need of a transcriber. This feature can cover greater distances, e.g. between a teacher and deaf student, using a special microphone.

2. **Methods for transmitting sound to improve the hearing of hearing-impaired people.**

The manufacturers of communication systems for HIP offer a variety of hearing solutions in large spaces. For example, in classrooms, theaters, at work, in the train

station, for other transport means or at the airport. These are then adapted to the individual needs of the user of a hearing aid or cochlear implant or a person who uses no hearing aid.

Induction loop systems, FM radio systems, and infrared sound transmission are used for large spaces. These spaces are identified with an international logo with the letter T to alert the user of the hearing aid that they can customize their listening to their hearing aid.

A smaller space where individual amplifying communication devices need to be used can also use a system for a larger space, but the use of **Bluetooth** connected to a smart phone is also possible.

2.1. Induction loop

An induction loop is a device that sends sound into space using a modulated electromagnetic field.

In public places the loop amplifier is connected to the audio sound system, to a television or radio in the home, or to the phone or other audio source. The actual loop in the household is a thin wire that is wound around a room or other space that has the sound system. Inside, the loop can be placed under the carpet. A miniature receiver is embedded in the hearing aid or cochlear implant. Some devices use a signal receiver with a loop formed by a wire hanging around the neck of the recipient.

Using an induction loop provides a purely audible sound without disturbing background noise. The manufacturers of hearing aids and amplifiers of induction loops are obliged to comply with the international standard IEC 60118-4 for transmitting an electromagnetic signal.

2.2. FM Radio System 2.4GHz

The FM radio system 2.4GHz broadcasts a radio audible signal. It is often used in classrooms where the teacher puts on a small lapel or headset microphone connected to the transmitter. The students have their receiver switched to the desired frequency channel. The receiver can be a small box with a wire around the neck. The electromagnetic signal is received from the box by a cable around the neck transmitted to the hearing aid or cochlear implant. In this way the signal is distributed to larger distances. The disadvantage is that the signal passes through walls and can affect the lessons e.g. in the next classroom. It is therefore necessary to tune the system in individual classrooms or other rooms where the transmission is used to an unoccupied frequency channel. This type of equipment enables it.

Another option is to attach a miniature “boot” to the bottom of the hearing aid. It then transmits the signal to the receiver of the hearing aid or cochlear implant. The FM system can also be used for communication between two persons, in places where the noise is very disruptive.

Figure 1: Boot for the Widex hearing aid

2.3. Infrared system

The infrared system uses infrared to transmit sound. The transmitter converts the sound into the infrared spectrum. The receiver decodes the infrared audio signal back into sound, like for the FM system. Recently, there are manufacturers who offer an infrared system capable of sending the signal over longer distances. For example, in churches, cinemas, etc. Infrared transmission is good for both households and institutions. For example, in the courtroom where discreet information is discussed - the infrared signal does not go through walls. Conversely, it is not suitable in areas where there are many light sources, or outdoors, where the sun and strong street lighting may interfere with it.

2.4. Personal assistive earphones

Personal assistive earphones are useful in situations where the aforementioned systems are not available. They are popular for listening to television, radio, mobile phones in outdoor environments, or when traveling in a car. The dimensions of the device allow manufacturers to create individual level amplification, suppress distracting sounds and provide the benefits of listening. Some devices are equipped with directional microphones that can be adjusted to the speaker, TV or other audio sources. Assistive headphones are made with a dock that connects to the audio source (e.g. TV or radio) via an optical cable. Recently, it has been necessary to buy a reduction (sound converter), because the Scart or jack (3.5mm) are no longer the normal equipment of smart TVs.

IV. Applications for “smart” phones

Applications for “smart” phones play an increasingly important role in the communication of hearing-impaired people (HIP). And both in the mutual communication of HIP and in the communication of HIP with the majority intact society. At present, there are dozens of them available and new ones are appearing all the time. For HIP, it is sometimes difficult to navigate around all the offers. As part of this catalogue and its corresponding methodology, 18 of the best-known and proven applications have been selected to show the wide range of options offered by these applications.

In terms of the communication of hearing-impaired people, applications for “smart” phones can be divided into 3 groups:

1) Audio-visual communication applications for the hearing and non-hearing. This category includes:

- FaceTime,
- WhatsApp
- Skype
- Messenger Facebook
- Instagram
- Snapchat
- Glide
- Viber

2) Audio-visual applications specially designed for the communication of hearing-impaired people with the hearing population (using an online translation into sign language or online transcription of spoken words into written text format). This category includes:

- Silent line
- Signlate
- Dialog
- Pedius

3) Special applications for hearing-impaired people:

- Signia Hearing Test
- Sorenson BuzzCards
- Alarmed ~ Reminders + Timers
- Signal
- myControl
- The Tonelink App
- ReSound Smart 3D

V. Induction loops

Content:

1. Why, where, how and for whom to install an induction loop?
2. Who uses an inductive loop?
3. How does an induction loop work?
4. Why to install an induction loop?
5. Where is a good place to use an induction loop?
6. Where is not a good place to use an induction loop?
7. Types of induction loops
8. Recommendations

V. Induction loops

1. **Why, where, how and for whom to install an induction loop?**

An induction loop is an assistive device for the hard of hearing, used to facilitate their communication with their surroundings. Induction loops can be permanently installed or portable. They work so that the sound received from any source, such as a television, telephone, players, etc., is emitted into the space in the form of a variable magnetic field modulated according to the input signal. Through special hearing aid circuits frequently referred to as "Dot" or "Coil", this field is received and processed into sound frequencies audible to the user's hearing aid.

An induction loop is a device that allows people with residual hearing to enjoy full listening in various situations where the hearing aid alone is not enough.

For hearing aid users, understanding the voice received by the microphone in the hearing aid is a serious daily problem. In addition to voice communications, the microphone captures distracting noises from the speaker's surroundings. When the human ear is fully functional, it has the ability to filter out noises in the space where the communication is taking place and so perceive only useful sounds. The hearing aid does not have this capability.

In public places such as large shopping centers, banks, post offices, conference rooms, train station halls, etc., the audio information is disrupted by surrounding noise. Installing induction loops in these places makes the problems disappear. An example might be broadcasting a report at the train station. The great level of background noise would interfere with the intelligibility of the report to people with hearing impairments. A well designed and installed induction loop solves this problem effectively.

The induction loop is an electronic device whose correct scientific name is an audio-frequency induction amplification system. Spaces equipped with this system are marked with an internationally accepted graphic symbol.

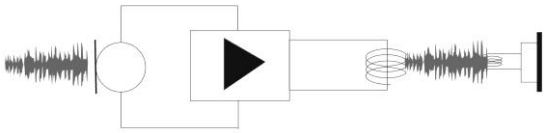
2. **Who uses an induction loop?**

Especially hearing-impaired people who compensate for their disability by using a hearing aid or they are fitted with a cochlear implant.

Induction loops are not meant for people with total deafness, because they have no use for them. They are meant for those individuals whose hearing loss is between 21 to 90 db in the better ear.

3. **How does an induction loop work?**

The principle of the induction loop is simple.



The sound source, most commonly the human voice, is captured by a microphone placed near the mouth of the speaker. This suppresses noises interfering from the surroundings.

The audio signal is converted into an electrical one in the microphone and transmitted to the loop amplifier. The electrical signal, modulated by the original audio source, is amplified and powers the induction loop.

The loop is typically a copper wire mounted in the spaces of a hall, public transport means, a transaction counter and the like. This loop is induced into the area of a modulated magnetic field.

The magnetic field generated by the loop is captured by the user's hearing aid. Specifically, by a coil known as a T-coil (in the past it was used only to convey telephone calls – hence the name "T"). An electrical signal is induced in this coil of the magnetic field and transmitted to the sound reproduction device in the hearing aid.

The actual loop transmitting the magnetic field modulated by voice information can be placed on a counter top, on the floor beneath it or at another suitable location.

4. Why to install an induction loop?

4.1. Legislation and social support for the installation of induction loops in the Czech Republic:

The right to spatial and barrier-free communication in the Czech Republic is enshrined in the Constitution of the Czech Republic and the Charter of Fundamental Rights and Freedoms, which the Czech Republic adopted as Act 2/1993 Coll. The actual fulfillment of the principle of full access to information for hearing-impaired people is treated by MMR Decree 398/2009 Coll., which states in Section 8 that "a space for gathering 50 people or more or every sound system or translation service of cinemas, theaters and halls must enable induction hearing for hard-of-hearing people".

4.1.1. Legislation and social support for the installation of induction loops in Austria.

In Austria, the legislation related to this issue is similar to that in the Czech Republic. For example, Vienna's building regulations (Viennese Bauverordnung – Section 5, p. 70, dated 3 June 2019) states that "buildings with communal areas (with the exception of buildings with one apartment, buildings with a height of up to 7.5 m, with a maximum of two apartments and terraced houses), public buildings, educational buildings, buildings with conference rooms, buildings for cultural and sporting events, retail buildings, banks, churches, health care and social buildings, doctor's offices and pharmacies, public toilets and all other buildings with a capacity of more than 50 people must be barrier-free by law." According to the Austrian Constitution, barrier-free access applies to all types of disability, including hearing disorders. The law does not exhaustively determine what assistive

technology should be used in each specific case. Only standard ÖNORM B 1600 (https://www.bauberufe.eu/images/doks/_Oenormb1600.pdf) recommends using equipment that enables people with hearing loss to receive audible information directly and without distortion in their hearing aid. This requirement is generally and completely met by the proper installation of an inductive loop, which is the most effective and also simplest and cheapest solution. This standard is supplemented by ÖNORM B 1602, dealing with barrier-free access in schools and educational areas and explicitly favors the use of induction loops. But it is on the order of a recommendation and not obligation.

The only significant difference between legislation defining the obligation of barrier-free access in the Czech Republic, Slovenia and Austria is the quite large legal autonomy of individual federal states. Austria is a federal republic composed of 9 states. The legislative bodies of the individual states can thus modify legal standards applicable in their jurisdictions. In principle, however, they cannot question the right to barrier-free access, because it is guaranteed by the Constitution. And it is binding for all the states of the federal republic.

4.2. Legislation and social support for the installation of induction loops in Slovenia.

In Slovenia, the issue of induction loops is especially treated by the Building Construction Act. Article 7 of this law ensures no barriers to people with disabilities. According to its provisions, all new public buildings and renovated public buildings must provide barrier-free access and movement without any restrictions on construction and communication.

A regulation on free access and the use of publicly used facilities specifies that theaters, cinemas, concert halls, spaces for other cultural events and conference rooms must be equipped with suitable equipment, preferably an induction loop with an amplifier for good audio reception by people using hearing aids.

The main disadvantage of this regulation is that it does not include existing buildings or other public spaces. Nor does it set a time limit for buildings to comply with any adaptation accordingly.

Barrier-free access for all people, including people with disabilities, to which the above laws are linked, is enshrined in the Slovenian Constitution.

5. Where is a good place to use an induction loop?

Transport terminals – airports, railway stations, trams and other terminals for public transport, parking areas.

Means of transport – trams, buses, trains, taxis and other means of passenger transport.

Public buildings – theaters, cinemas, concert and lecture halls, stadiums, sports facilities, churches.

Contact points – reception desks, information stands, contact points.

Meeting and conference room, open space offices.

Apartments – living room and other rooms where TV is watched and phone calls are made.

Schools – auditoriums and classrooms.

Other places – anywhere news is locally broadcast, where alarm voice systems are operated, such as fire sound and voice alarm systems.

6. Where is not a good place to use an induction loop?

Wherever considerable noise reduces the clarity of any voice message
Wherever an induction loop cable cannot be installed
Wherever electromagnetic smog interferes with the induction group
(It can be generated by e.g. electric guitars, dynamic wireless microphones in the zone where induction loops are working, thyristor dimmers, etc.).

7. Types of induction loops.

The equipment needs to be mounted by a specialist who will evaluate the conditions for the distribution of the magnetic field, including possible interference, and so choose the type and power of the loop amplifier and embodiment accordingly. Loops are divided in principle into three basic groups:

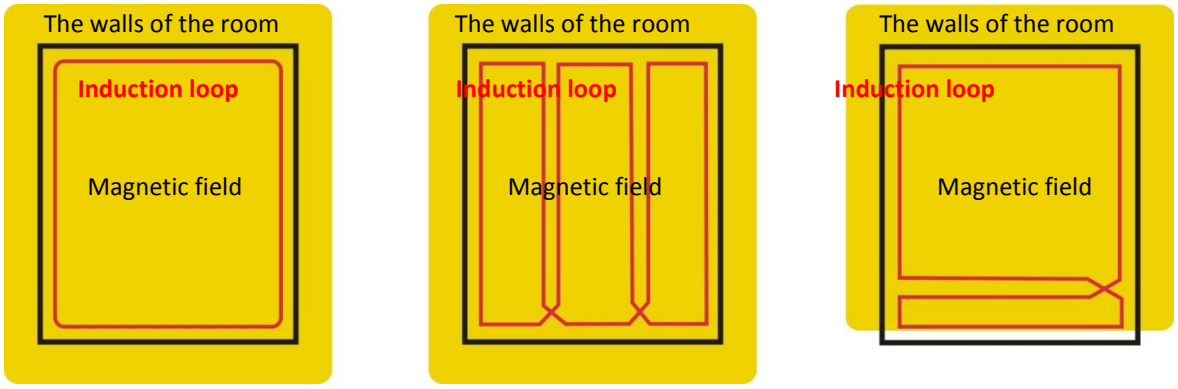
Loops for personal home use
Loops for across the counter
Loops for the hall (or exteriors)

Loops for personal home use are designed as a compact portable equipment that improves the listening conditions of people with hearing disabilities in the apartment, in a house, etc. (e.g. listening to the television, communicator for the doorbell, etc.).

Over-the-counter loops also have to have the compact form of small, portable equipment. They differ from "home" loops notably by their higher performance. They are used anywhere a person with a hearing impairment has a problem with communication because of disruptive noises or a glass barrier across counter tops in offices, at train stations, in the bank, elevator, etc.

Loops in a hall design are used, as the name implies, in various halls (lecture and conference halls, theaters, churches, sports halls...) or outdoor in sports stadiums. They consist of a microphone or other sound source to be processed and distributed by the induction loop, a special loop amplifier and the actual loop of unshielded copper wires. In principle, the loop can be in two versions.

Around the perimeter of the room or multiple placements.



But there are also other sophisticated ways of creating the loop. For example, those that suppress the emission of electromagnetic fields into the surrounding area. Such a loop is used, for example, in courtrooms.

8. Recommendations.

Unless the induction loop is properly and professionally designed and installed, there can be an unpleasant noise in the audio signal caused by the surrounding electronic smog, as well as the undesired transmission of information into a space where it ought not to be received. In addition, the loop amplifiers could be either oversized or undersized, creating a weak, scratchy output signal or, on the contrary, a distortion caused by the over-excitation of the loop, etc.

VI. Legislative and financial support for the use of assistive devices and technologies for hearing-impaired people in the project partner countries

Czech Republic:

The amount of the reimbursement for medical devices in the CR, including hearing aids, is determined by current legislation. This is Decree 48/1997 Coll., Annex 3, Section C. In spirit, it calls for hearing-impaired people to receive an allowance from their insurance agency*) for the purchase of a hearing aid once every 5 years. It should be emphasized that this reimbursement is for only 1 hearing aid in one ear. The amount of the allowance is fixed by the aforementioned decree and the insurance agencies are excluded from influencing the amount. The specific amount of the allowance is divided into 3 categories:
Allowance of 2,700 CZK (hearing loss up to 59 db)
Allowance of 3,900 CZK (hearing loss up to 79 dB)
Allowance of 5,100 CZK (hearing loss over 80 db) for adults 18 years and older.
Allowances for children and minors under 18 years old are higher, but the principle is the same. The amount of the allowance is independent of the design of the hearing aid (the amount is the same for the behind-the-ear type and for the hearing aid in the ear or canal). Neither the brand nor manufacturer matter.
The allocation of the allowance is possible only on the recommendation of a doctor licensed to prescribe hearing aids.

The problem is that the legislative provisions specifying the amount of the allowance was adopted more than 20 years ago. During that time, the prices of hearing aids and other assistive and communication devices for the deaf have greatly increased.

With regards to other assistive and communication devices for hearing-impaired people (for this project, the category OTHERS), the situation is somewhat different. For this category, the legislative framework consists of Act 329/2011 Coll. and Decree 388/2011 Coll. According to these standards, the Czech Labor Office provides the allowance. People earning less than eight times the subsistence level are entitled to the allowance and their contribution to the final price of the device is 10%, but at least 1,000 CZK.

Austria:

In Austria, the issue of supporting hearing-impaired people is enshrined (in relation to the Constitution) in the Medical Disability Act. Articles 3 and 4 define the support measures and technologies, as well as the source of funding for these measures. The law does not define the specific amount each individual can receive. After receiving a request for an allowance from a hearing-impaired person, the appropriate authorities make their decision on a case by case basis. They look at a number of factors:

**) The Czech Republic imposes the legal obligation to be insured by any health insurance agency.*

- Where the applicant lives – in Austria some budgets are federal, while regional governments are responsible for others – that is why the amount of the allowance in individual states may vary depending on the spending priorities of the region.
- Degree of disability
- Occupation/employment
- Ability to access charitable resources
- Health and pension insurance
- Other factors

The brunt of funding is borne by health insurance companies. There are three levels of allowances:

Tarifversorgung 1
Degree of disability: deafness in one ear
Prerequisites:

- Hearing loss in the "better" ear of least 30 dB within one of the test frequencies between 500 and 3000 Hz
- Comprehension of monosyllables, monophonic test with earphones, at 65 db the sound volume is a maximum of 80%
- Little or no possibility of improving hearing through surgery

When these prerequisites are met, the insurance company will pay a lump sum of 792 EUR for new devices.

Tarifversorgung (2)
Degree of disability: deafness in both ears
Prerequisites:
• The hearing aids must be worn at the same time
• Indicated improvement of at least 20% (at least 10% with background noise) versus a single hearing aid
The lump sum for purchasing hearing aids for both ears is 1,425 EUR.

Sonderversorgung
The tariff for people with extraordinary hearing impairment and / or multiple disabilities.
This is for special care, a non-tariff regime for hearing aids and services that are tailored to the personal situation of people with extraordinary hearing impairment. The additional payment is adjusted to individual requirements:
Class I: 900 EUR / 1,620 EUR
Class II: 1,560 EUR / 2,808 EUR
Class III: 2,100 EUR / 3,780 EUR

In addition to allowances from public health insurance, other allowances from supplementary pension insurance can be paid to active employees to purchase assistive devices, namely up to 3,780 EUR

The cost of repairing some models (within the standard tariff) is also paid by health insurance, unless there is evidence of negligence. But this only concerns standard models. Repairs for top models of hearing aids with premium features must be paid by the user. This also applies to their maintenance and servicing.

Slovenia:

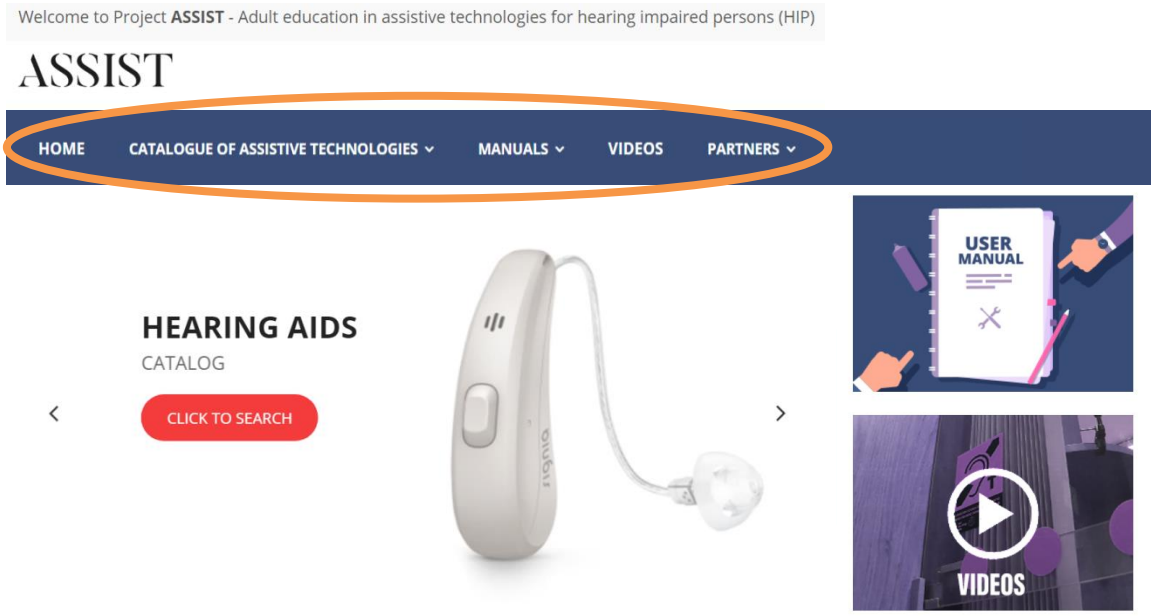
Questions of providing financial aid to hearing-impaired people for the purchase of assistive and communication devices are dealt with in Slovenia by the Medical Care and Insurance Act. Specifically article 85 of this law. It entitles a hearing-impaired person to receive 300 EUR from health insurance every 6 years for the purpose of purchasing a hearing aid. But this interval of 6 years is only indicative/recommended, not fixed. The insurance company decides on the actual length of the interval for providing the hearing aid allowance based on the age of the client, the actual state of wear, possibly the obsolescence of the hearing aid used by the client, and other factors. The statutory period of 6 years is the maximum. It cannot be exceeded.

The payment of an allowance for additional assistive and communication devices (in this methodology, the category OTHERS) is governed by the Equal Opportunities for People with Disabilities Act. Specific questions on what, when, how and how much are dealt with in Part III, Articles 17, 18, 19, 19a and 20 of this Act. The common provisions for subsidies under this category is the fact that a person with disabilities who is granted the allowance contributes 15% as part of a deductible amount.

VII. User manual for interactive catalogue of assistive technologies (for HIP) with search engine.

The search engine allows you to select from a catalogue that contains 83 types of hearing aids of various embodiment, performance, design, etc.; 48 assistive devices for HIP using a whole range of ways to get important information to HIP in real time despite their hearing impairment (blinking, vibration, premium enhanced sound, etc.); 18 applications for smart phones good for or intended directly for HIP; and 10 listening devices using induction loops. It also allows you to select assistive devices or technology that best fit your needs and possibilities. The above list of items in the interactive catalogue is only a fraction of what the market for assistive and communication devices and technologies currently offer. But to a certain extent it is a representative selection to help guide the users of this catalogue in this regard.

Using the interactive menu in this catalogue:



The blue bar at the top of the screen has the main MENU. It contains 5 items:

Home page

Catalogue of assistive technologies

Manuals and methodologies:

a) IO1 Guide to the world of assistive technologies for primary lecturers

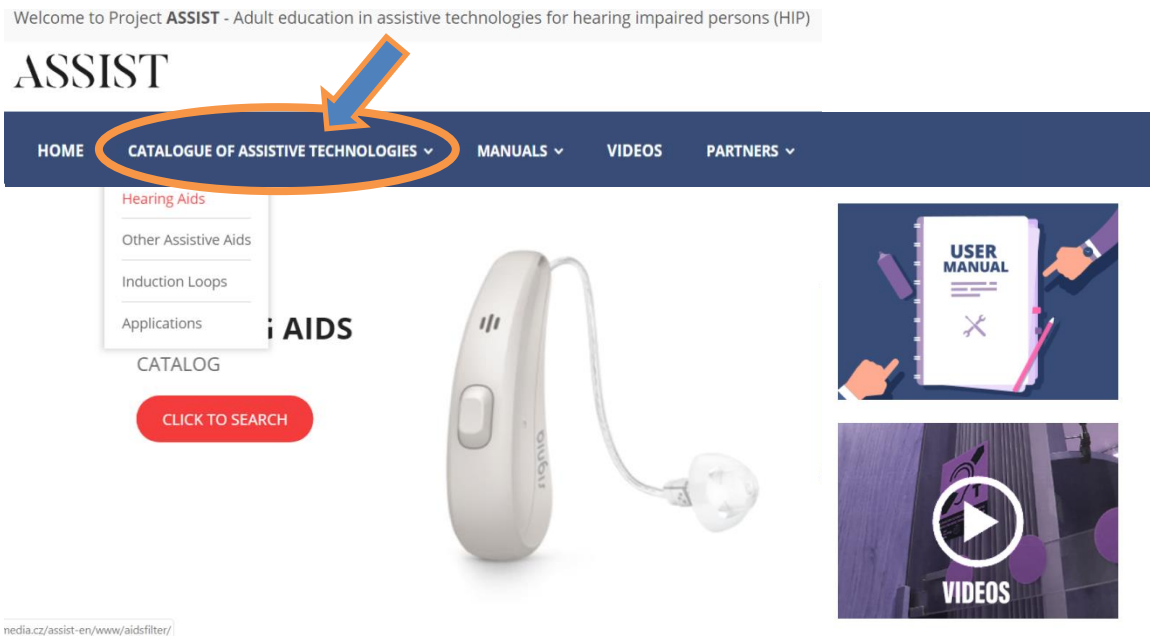
b) IO2 Programme of educational activites for project target groups

c) IO3 User manual for interactive catalogue of assistive technologies with search engine

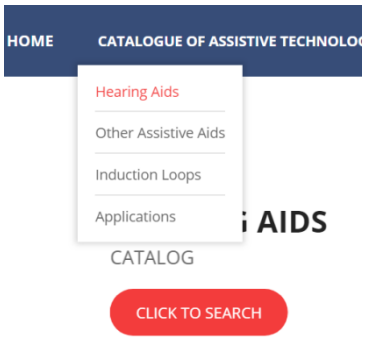
Video material (model situations and instructional videos)

Brief information about the project partners

To begin searching in the catalogue, click "**Catalogue of assistive technologies**" in the main MENU.

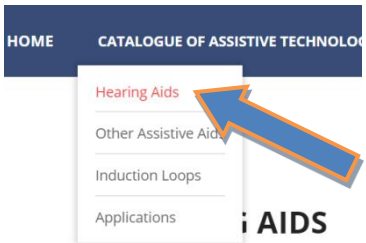


It will open up with the following drop-down stack:

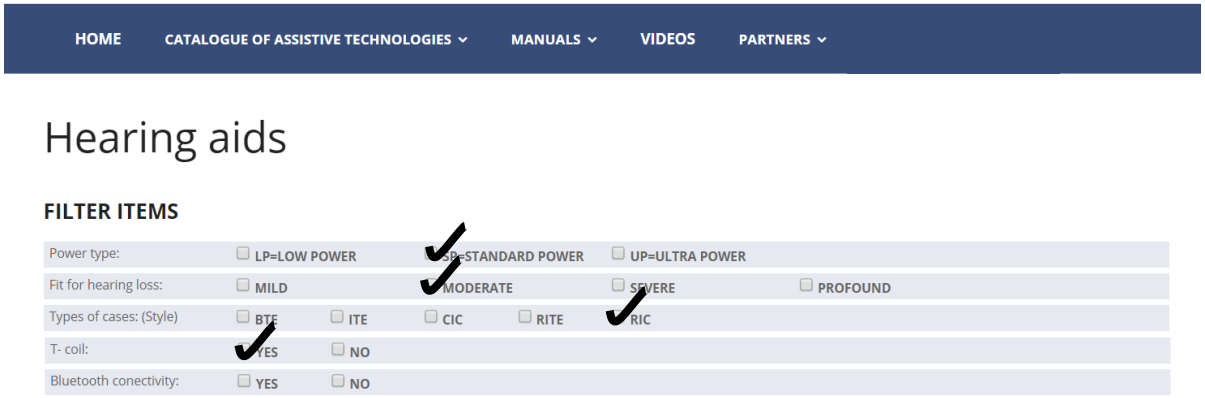


Select the desired group of assistive or communication devices and technologies by clicking on the appropriate item in the drop-down stack.

Let's choose the group HEARING AIDS.



The main page of the interactive search program appears. On this page, which is the communication point for determining the optimal filter, you can click the criteria you want the search program to use to "serve up" the device or technology that best suits your expectations and needs.



In our example we have chosen the filter:

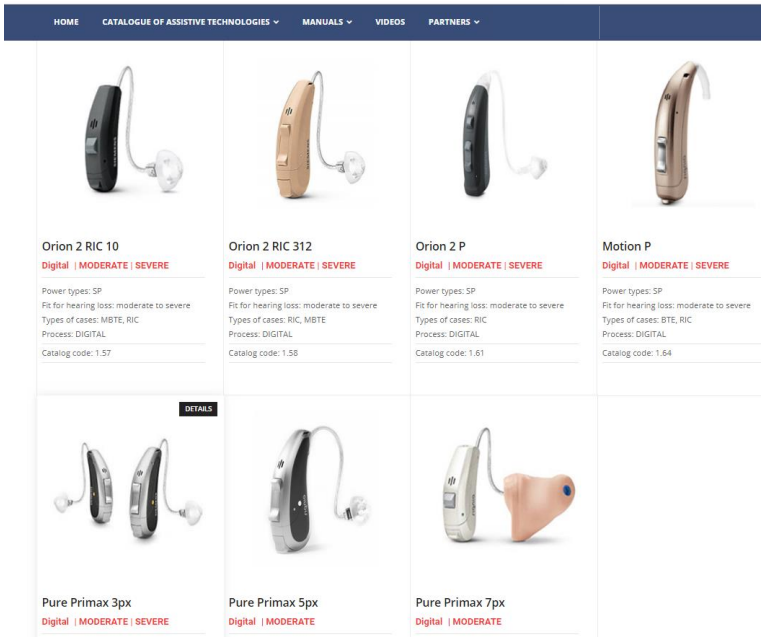
Performance: SP = Standard power

Hearing loss: moderate = 40-60%

Type of embodiment: RIC = receiver-in-canal

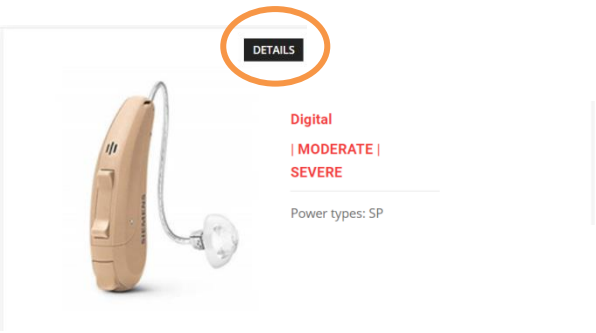
T coil = receiving a signal transmitted by an inductive loop or telephone

After clicking the above requirements, the search program has offered us these hearing aids:



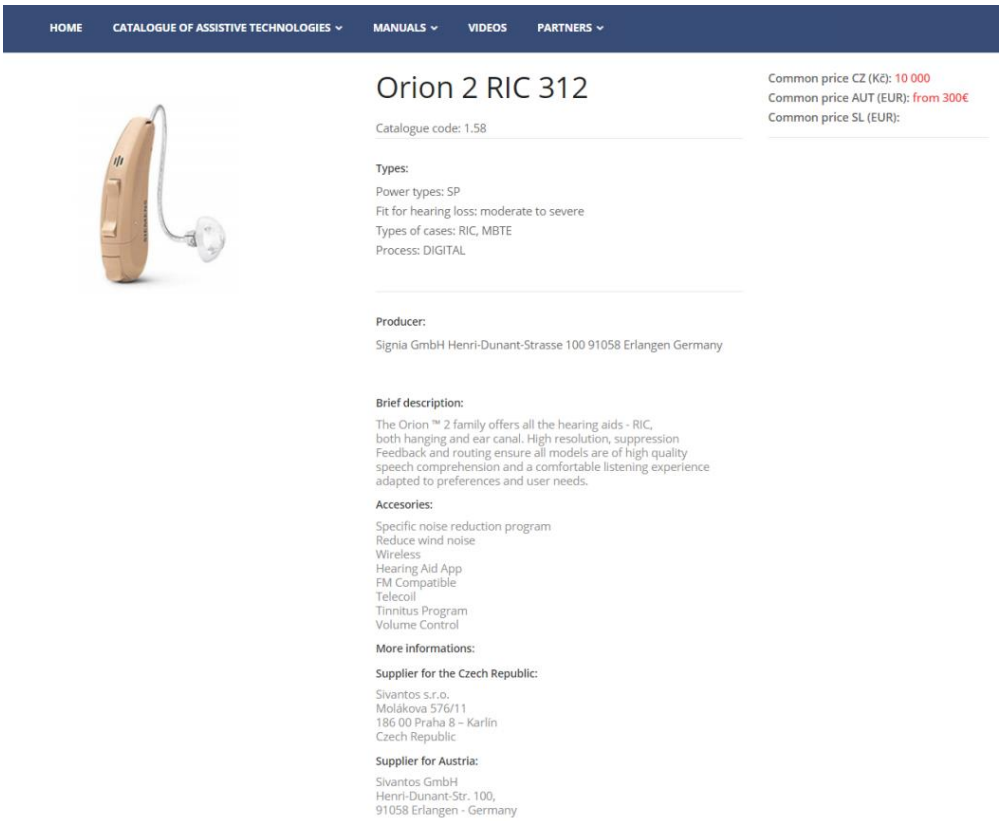
If we zoom with the mouse on the selected hearing aid,

“DETAILS” will appear.



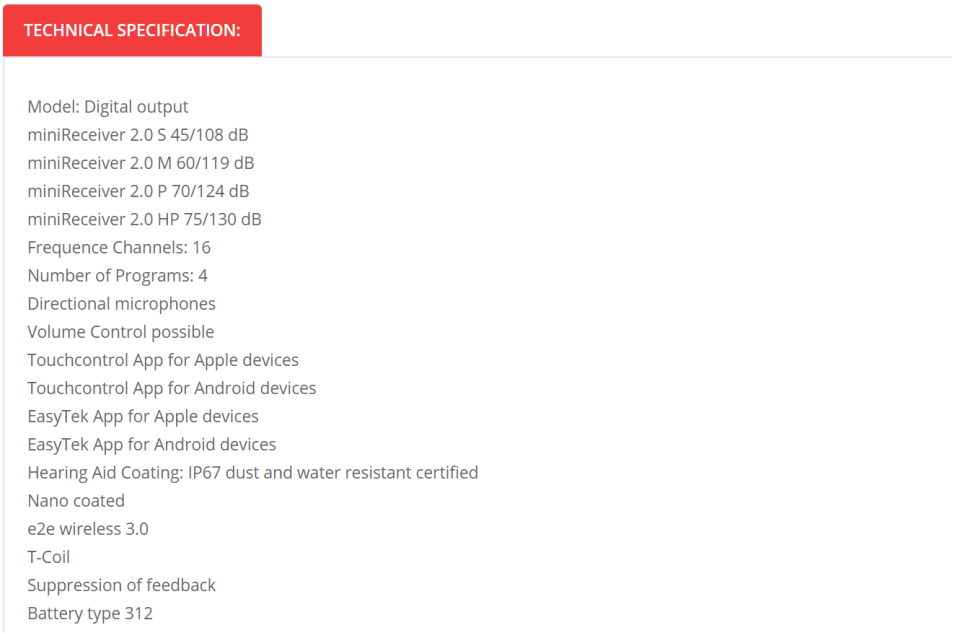
Clicking the Details button will expand a more detailed description of the selected hearing aid. It contains this information:

Type of hearing aid, manufacturer (and contact), description of what the hearing aid is for and how to optimize its use, accessories, any additional information, and important information about suppliers in the partner countries. Most items usually include a typical indicative price.



The lower left corner of the search program will automatically offer

TECHNICAL SPECIFICATION



TECHNICAL SPECIFICATION:

Model: Digital output
miniReceiver 2.0 S 45/108 dB
miniReceiver 2.0 M 60/119 dB
miniReceiver 2.0 P 70/124 dB
miniReceiver 2.0 HP 75/130 dB
Frequence Channels: 16
Number of Programs: 4
Directional microphones
Volume Control possible
Touchcontrol App for Apple devices
Touchcontrol App for Android devices
EasyTek App for Apple devices
EasyTek App for Android devices
Hearing Aid Coating: IP67 dust and water resistant certified
Nano coated
e2e wireless 3.0
T-Coil
Suppression of feedback
Battery type 312

The number of items we choose in the specification filter will narrow the final selection. It is possible that in some cases none of the 83 types of hearing aids contained in this catalogue will satisfy the combination of requirements you provided[*)]. We therefore recommend using 2, maximum 4 criteria in the filter. This will enable the search program to offer you more suitable hearing aids, some of which may inspire you beyond what you thought was the ideal solution before using this catalogue. The basic criterion for the optimal choice of hearing aid should be the level of hearing loss (MILD=10-40%, MODERATE=40-60%, SEVERE=60-80%, PROFOUND=80-95%) to be matched against the desired output of the hearing aid (LP = low performance, SP = standard performance, UP = ultra performance) and the type of embodiment that the user of the hearing aid prefers **(CAREFUL – The chosen type may not be suitable for a particular user, so the specialist must ultimately decide about the type of hearing aid)**. These criteria may be supplemented with, e.g. price. The price range of hearing aids is on the order of thousands to tens of thousands of crowns. So for many users the price can play a big role in making their decision.

CAREFUL – The hearing aids chosen by this interactive catalogue according to the user's requirement are only suggestive, meant to help the hearing aid wearer or professional consultant-audiologist navigate the offers currently available in individual partner countries (Czech Republic, Austria and Slovenia). When actually selecting a hearing aid, it is necessary to consult a specialist on the choice!!!

It is possible to work with the catalogue similarly in other groups of assistance aids and devices.