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# The Need to Increase Awareness and Access to Cochlear Implantation

*Patrick S.C. D'Haese, Vincent Van Rompaey, Marc De Bodt and Paul Van de Heyning*

## Abstract

Some degree of disabling hearing loss is present in 466 million people world-wide, representing 5% of the world's population and the majority of these are adults over 65 years old. Hearing loss is associated with increased risks of social isolation, depression, dementia, stroke, vision loss, diabetes and mortality. It is in the top five causes of years lived with disability in 2015, 2016 and 2017 for males and top 10 for females. Hearing aids are a suitable treatment for mild to moderate losses but for some they do not provide enough benefit. Cochlear implantation is a proven and effective treatment for bilateral severe to profound hearing loss, yet despite good funding in high income countries, the utilisation of CI is poor (less than 10% of suitable patients), especially in the older adult population who arguably need it most. Prevalence data shows that hearing loss increases with age, but the provision of implants in the over 65s is even lower, despite there being no clinical barriers to older adults receiving a CI. Survey data shows that awareness activities are needed for both professionals and the general population to improve knowledge of what a CI is and how it can help.

**Keywords:** hearing loss, cochlear implant, health belief model, awareness

## 1. Introduction

Within Europe, we see an ageing population that is more active in their community and society than ever before. In order to sustain a high level of quality of life it is important for the European citizens to be able to communicate independently, remain active and maintain their autonomy. Untreated hearing loss very quickly leads to social isolation and depression. Patients speak of the impact of fragmented communication on their inability to participate in conversation leading to a diminishing circle of friends. Hearing loss also has the potential to restrict a person's independence, limiting their ability to take care of themselves or partners, accelerating their progression into facilitated living or social care. Whilst there are obvious benefits to living longer, such as opportunities to pursue a lengthier career, discover new hobbies, explore further education and spend quality time with family, there are also associated risks. Perhaps, when one considers these risks one thinks of increased frailty, or maybe cognitive decline, but what about the impact of hearing loss and its associated morbidities on quality of life?

Some degree of disabling hearing loss is present in 466 million people worldwide, representing 5% of the world's population and the majority of these are adults over 65 years old (93%) [1]. Our population is ageing and by 2025, 20% of the population will be over 65 years. We know that the prevalence of hearing loss increases with age and roughly 30% of men and 20% of women in Europe are expected to have a hearing loss of 30 dB HL or more by age 70 years, and 55% of men and 45% of women by age 80 years [2]. The prevalence of child and adult hearing impairment is substantially higher in middle- and low-income countries than in high-income countries, demonstrating the global need for attention to hearing impairment [3].

Fortunately, treatment for hearing loss is more advanced than ever before. Hearing aids (externally worn amplification) and hearing implants (surgically implanted and replacing the function of the middle or inner ear) are widely available. Cochlear implants have been used successfully for over 30 years and are an effective treatment used for those who experience hearing loss too severe to benefit from a hearing aid [4]. The surgery required for a cochlear implant (CI) is largely considered routine with a low complication rate and benefits are large, with significant gains in quality of life [5]. Medical technologies such as cochlear implants can play an important role in reversing the impact of hearing loss on the health and wellbeing of the individual. In addition, these technologies will also help to reduce the impact on the economy and society. For example, in a study that looked at 93 CI users, 6 years after they had been implanted, statistics demonstrated that the unemployment rate had dropped from 60 to 49%. The same study also demonstrated the impact of hearing loss on personal income. One of the conclusions is that 31% of respondents had an increased income which was high enough after treatment to move income brackets [6]. It should be noted that the positive economic impact of treating hearing loss in a child continues up until old age. Several studies have demonstrated that children with hearing loss, which is not treated, are less likely to attend mainstream education. This will have an overall impact on their employment opportunities and earnings potential. Cochlear implants are largely funded by national health care or insurance systems in high income countries and in theory should be available to all who want one and meet the clinical criteria. Yet, at present, evidence suggests that utilisation amongst suitable adults is very low (less than 10%) and more work needs to be done to ensure patients have access to this technology.

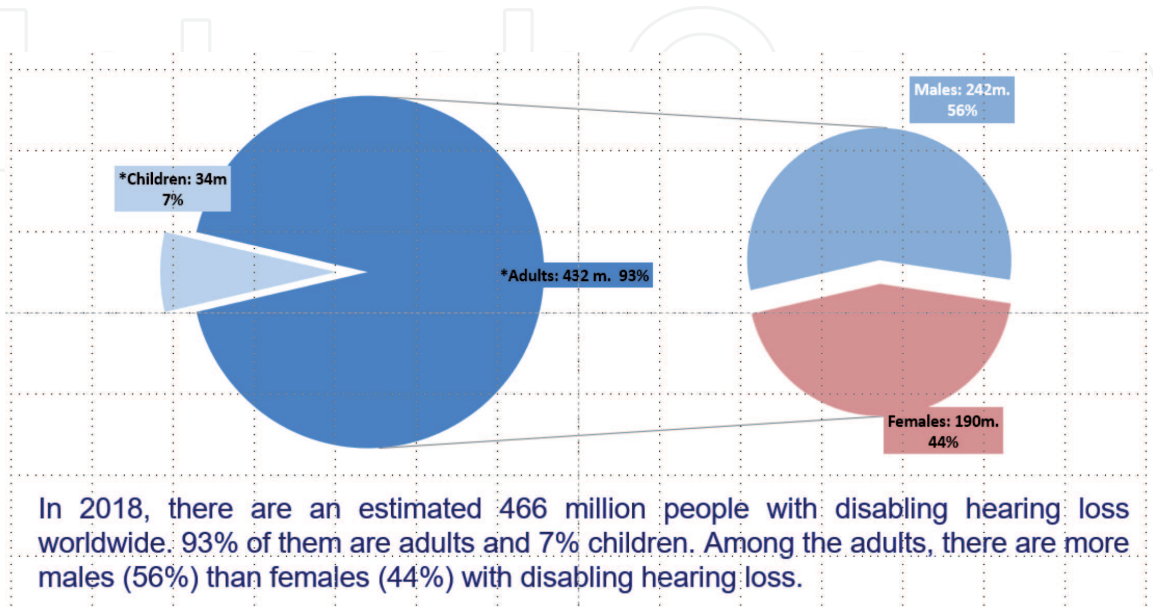
## **2. Global disease burden of hearing loss**

The first question to ask is how big a problem hearing loss represents globally? Global disease burden studies bring together all currently available epidemiological data on a disease to provide comparisons of death, prevalence and loss of health over time. In order to align health systems with the populations they serve, policy-makers first need to understand the true origin and impact of their country's health challenges and how those challenges are shifting over time. This requires more than just estimating disease prevalence, such as the number of people with depression or diabetes in a population. Global disease burden research incorporates both the prevalence of a given disease or risk factor and the relative harm it causes. The tools allow decision-makers to compare the effects of different diseases, such as diabetes type 2 versus cancer, and then use that information to guide policy. Global burden of diseases, injuries, and risk factors studies provide a comprehensive assessment of prevalence, incidence, and years lived with disability (YLDs) for over 300 causes in 195 countries and territories. Health losses are expressed in terms of years lived with

disability (YLD) and is calculated by multiplying the prevalence of the condition by a ‘disability weight’ which reflects the severity of the condition in comparison with other conditions. Globally, low back pain, migraine, age-related and other hearing loss, iron-deficiency anaemia, and major depressive disorder were the five leading causes of YLDs in 2015 and 2016. In the most recent report, age related hearing loss remains in the top five for males and top 10 for females [7–9].

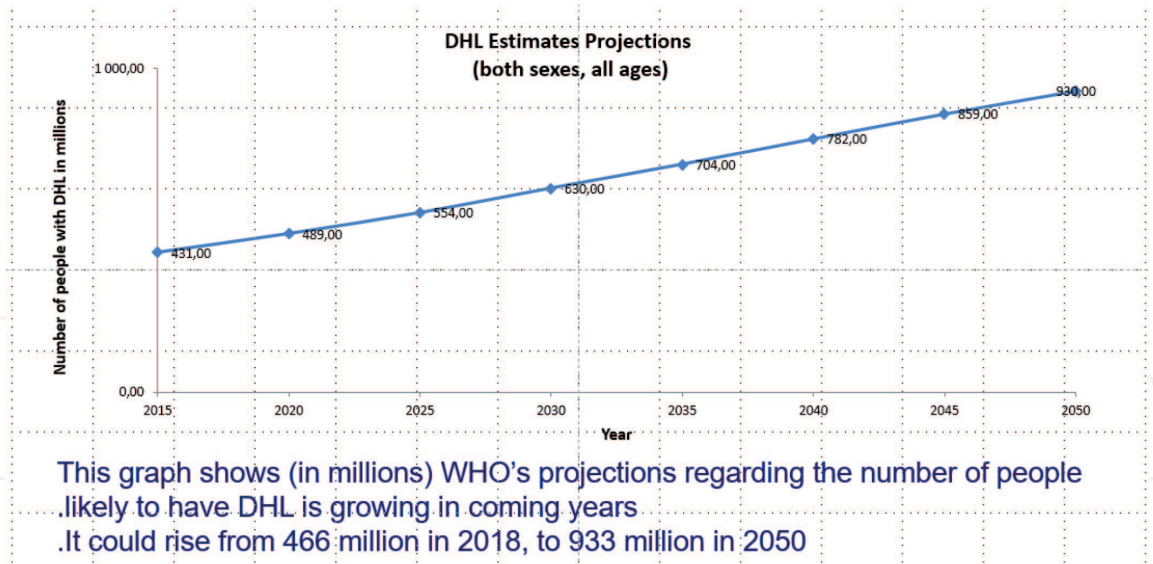
Part of the reason hearing loss ranks highly in its disease burden is due to the prevalence of hearing loss in the population. The current World Health Organisation (WHO) 2018 figures report that as many as 466 million people have a disabling hearing loss (defined as a loss in the better ear of >40 dB), i.e. 5% of the world’s population (**Figure 1**). This number is set to rise to possibly 630 million by 2030 as life expectancy increases and the population ages (**Figure 2**). As we age the sensory cells in our inner ear irreversibly degenerate resulting in age related hearing loss. This natural process can be accelerated by exposure to high levels noise during our lifetime and this is most likely to account for the difference in male and female prevalence rates due to the type of employment (**Figure 2**). Thus, we can see from the data in **Figure 3** that the prevalence of hearing loss increases with age, with less than 2% of children likely to experience hearing loss but almost one in three adults experiencing a disabling hearing loss after the age of 65 years. This pattern holds true for all regions globally, regardless of income (**Figure 3**). An important factor to mention as well is prevention. There is a need to raise awareness on several preventable causes of hearing loss such as ototoxicity and noise induced hearing loss (recreational and industrial) but also to further stress the importance of aspects such as vaccination and hearing screening. The latter can be in neonates but also in adults where progressive hearing loss is a major issue [1].

The second factor in the assessment of global disease burden is the degree of disability caused by the sensory loss. The most obvious of these come from the loss of the ability to communicate effectively and can lead to social isolation and depression. This is especially apparent when the hearing loss is severe to profound. There is a body of evidence showing that those with a hearing impairment feel lonelier or more socially isolated, anxious or distressed than their normally hearing peers and this has an impact on measures of overall quality of life (for more details see Shield report section B [10]).

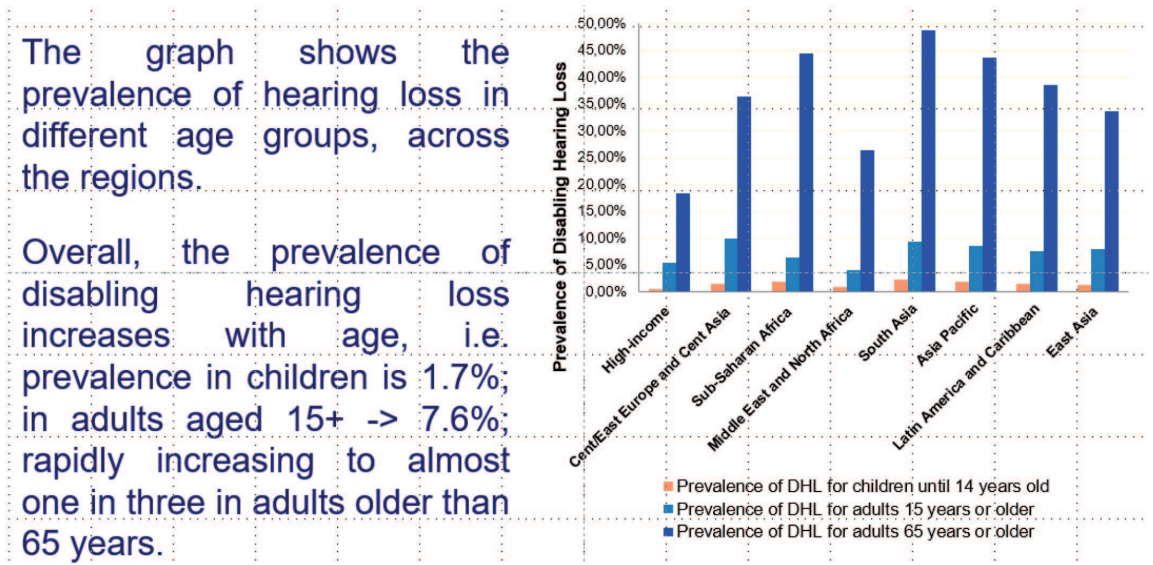


**Figure 1.**  
The 2018 figures for disabling hearing loss are shown. The left-hand pie chart shows the proportion of adults and children with a disabling loss and the right-hand pie chart shows the split between male and female.





**Figure 2.**  
This graph shows in millions the number of people with disabling hearing loss over time and the WHO's projections for the number of people likely to have a disabling hearing loss in the future.



**Figure 3.**  
The graph shows the prevalence of hearing loss in the different age groups across the regions. Overall the prevalence of disabling hearing loss increases with age to almost one in three adults after 65 years old.

People are less aware of the relationship between hearing loss and other aspects of overall health: these include the risks of more falls, an association with diabetes, stroke and sight loss [11–15]. For adults aged 70 and older, hearing loss is independently associated with hospitalisation and poorer self-reported health [16]. There is also good evidence that an increased mortality rate is associated with hearing loss; this is most likely to be via three mediating variables: disability in walking, cognitive impairment and vision loss [17–19]. However, more recent data questions these results: Schubert et al. followed over 2400 participants in the US for up to 17 years, and found that although initially hearing loss was associated with mortality, when taking account of additional risk factors for cardiovascular and other diseases, the association between hearing loss and mortality was no longer significant [20]. They also found that participants who developed hearing impairment during the follow up period did not have an increased risk of mortality. Similarly, Amieva et al., in a 25 year longitudinal study in France, found no difference in risk of mortality between subjects with and without self-reported hearing loss [21].

Archbold et al. [29]	UK (all hearing loss)	30 billion pounds per year
WHO [30]	Global (all hearing loss)	\$700–800 billion per year
Deloitte Access Economics [31]	Australia (all hearing loss)	15 billion Australian dollars per year
Mohr et al. [32]	USA (severe to profound hearing loss)	\$400,000 per person over lifetime

**Table 1.**  
*Examples of estimates of the costs of untreated hearing loss in high income countries [10].*

Hearing loss has also been strongly linked to cognitive decline and dementia [22, 23]. A hearing loss as little as a 25 dB was found to be equivalent to the cognitive reduction associated with an age difference of 6.8 years [24]. People with mild hearing loss are twice as likely to develop dementia as those without hearing loss and five times more likely to develop it if they have a severe loss [25]. Hearing loss not only increases the risk of developing dementia but accelerates the rate of cognitive decline [26]. The Lancet commission on Dementia Prevention, Intervention, and Care describes the new life-course model of dementia prevention incorporating nine modifiable risk factors and their potential effect in reducing an individuals' risk of dementia [27]. They were surprised to find that hearing loss was the largest contributor, almost doubling the risk. Overall, they concluded that the most promising intervention targets were increasing education in early life, increasing physical activity and social engagement, reducing smoking, treating hypertension, diabetes, and hearing impairment.

As well as having a significant impact on the individual in terms of a reduction in their quality of life, there is also a significant cost to society as a result of unmanaged hearing loss. A value can be calculated for lost productivity in terms of income and taxes. Employment rates for hearing impaired individuals are on average about 20% lower compared to those without hearing loss and those who are in work often take lower paid jobs, work part time and retire early [10, 28]. There is also a cost associated with increased pressure on health services, for example more visits to the general practitioner or from social services [29]. By combining these figures and including an amount for loss of quality of life, various estimates have been made for the costs associated with hearing loss of 25 dB or more in various high-income countries (**Table 1**). World-wide estimates are as high as 700–800 billion dollars per year globally, and ranges from around 476 to 581 billion euros in Europe. Restricting the calculations to hearing loss of 35 dB and above, the cost to the EU ranges from approximately 185–261 billion euros, and to the wider European community from approximately 216–303 billion euros, depending on whether or not the use of hearing aids is accounted for.

### 3. Treatment options and their use

Although hearing loss is not always preventable, it is treatable. The degree of loss can be described in four categories from mild to profound (**Table 2**) and for those with a mild to moderate loss, hearing aids are an effective intervention, as can be seen from the list of reported benefits described in **Table 3**. However, when these are no longer sufficient, most commonly in severe to profound hearing loss, CI is indicated.

A CI is a neural stimulator providing electrical stimulation directly to the hearing nerve and is different to a hearing aid, which amplifies sound and presents

Degree of hearing loss	Quietest sound heard (dB HL)	Effects
Mild	25–39	Can sometimes make following speech difficult
Moderate	40–69	May have difficulty following speech without hearing aids
Severe	70–94	Usually need to lipread or use sign language, even with hearing aids
Profound	95 dB or greater	Usually need to lipread or use sign language

**Table 2.**  
*Action on hearing loss classifications of hearing loss (<https://www.actiononhearingloss.org.uk>).*

Over 80% of hearing aid users report improvements in their overall quality of life.
Over 60% of hearing aid users in Europe and the USA report improvements in the ability to communicate effectively and over 50% in the ability to participate in group activities.
Hearing aid users in Eurotrak surveys report less physical and mental exhaustion, better sleep, less depression and better memory than non-users.
There is an association between hearing aid use and reduction in cognitive ability; recent research suggests that hearing aid use reduces the rate of cognitive decline.
There has been conflicting research evidence concerning the impact of hearing aids on depression but there is a suggestion that the use of hearing aids may reduce depressive symptoms.
Results of studies concerning the impact of hearing aids on loneliness and social isolation are inconclusive.
Hearing aid users earn significantly more than non-users, the differential between the two groups increasing with the severity of hearing loss.
Unemployment rates of non-users are approximately twice those of hearing aid users.

**Table 3.**  
*Proven benefits of wearing a hearing aid taken from a comprehensive analysis of the published data in the Shield report [10], addressing all the consequences of hearing loss listed above.*

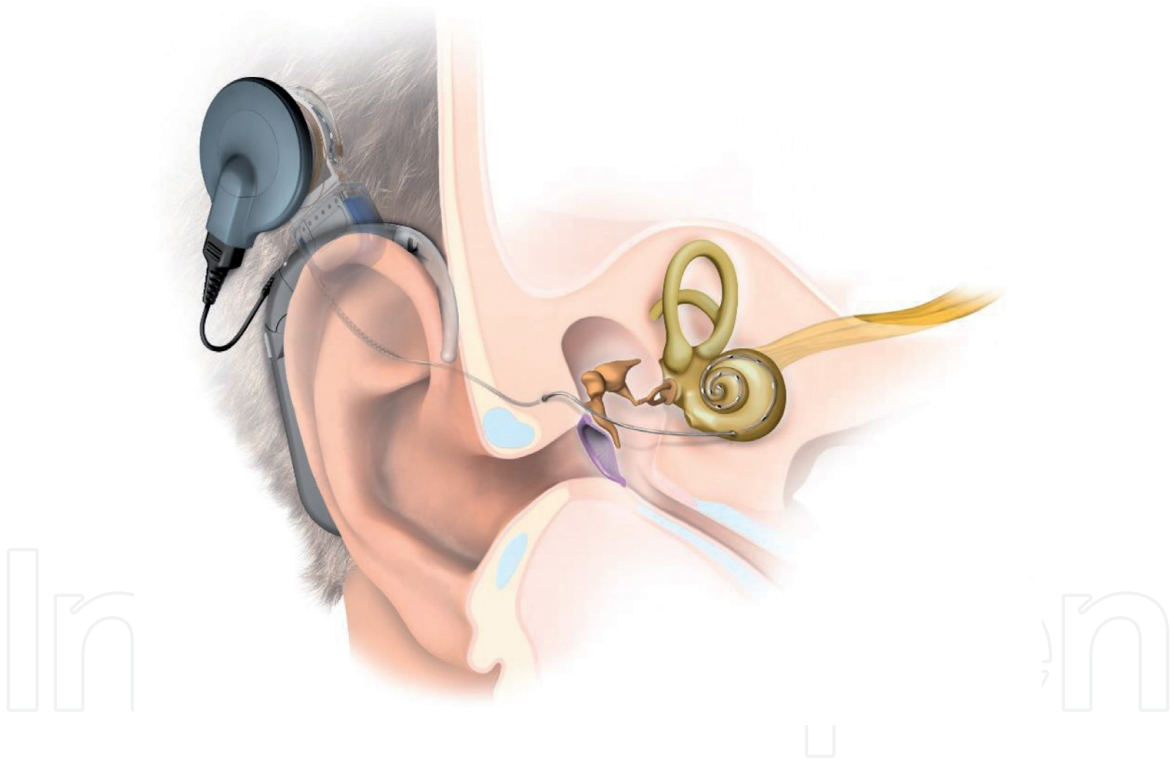
it through the damaged hearing system. It consists of an implanted device and externally worn audio processor (**Figure 4**). During surgery an electrode array is inserted into the cochlea which provides stimulation directly to the spiral ganglion cells. The external processor picks up the sound via a microphone and converts it into a series of coded signal which are transmitted via a RF link to a receiver placed into a shallow well in the mastoid bone, which is connected to the electrode array via the middle ear cavity (**Figure 5**). A CI is an effective treatment for profound hearing loss [33–35]. Adults, who have normal speech development as a child and have acquired their hearing loss in later life, can expect to be able to use the phone, interact in social groups in quiet and for some of the better performers, even hear effectively in noise and enjoy music. Some of the comments implant users have made post implantation include: going out for a meal is a pleasure again because I do not feel excluded from the conversation. I feel less isolated knowing I can hear the doorbell ring. I can relax when I watch TV instead of straining to hear and reading the subtitles. The results are not instant, and the first 3 months show the largest changes in what people can hear and understand, although improvement continues over the first year. However, despite the magnitude of the benefits and the significant impact of implantation on quality of life the take up of CI in adults is poor.

Utilisation rates for CI, in both adults and children with severe to profound loss, were reported in Sorkin and Buchman for Germany, Austria, Sweden, United Kingdom, Australia and the USA [36]. These were based on the known implanted population and prevalence data collected in the respective countries. Adult





**Figure 4.**  
*Image of a cochlear implant showing the implanted and externally worn audio processor parts (behind-the-ear audio processor and single unit audio processor (courtesy of MED-EL GmbH).*



**Figure 5.**  
*Image showing the cochlear implant in situ. The external microphone picks up the sound, which is then transmitted wirelessly to the internally implanted parts (courtesy of MED-EL GmbH).*

penetration was found to be less than 10%, regardless of geographic region. This is surprising given that rates for adult hearing aid use in people with a severe or profound hearing loss are high, at an average of 63% across Europe [10] and leads us to question why the uptake of CI in the adult population is so poor. Prevalence data has shown that hearing loss increases with age, but the provision of implants in the over 65 s is lower than in younger people, despite there being no clinical barriers to older adults receiving a CI [36–39]; for example in Australia, utilisation in the over 65 s is 0.3%. The benefits to older adults of the CI are almost the same as the benefit to the younger person and the poor uptake of treatment might be due to the perception of hearing loss as a natural consequence of the ageing process by both patient



Reasons for non-ownership	%
Hear well enough in most situations	64.3
Hearing loss not severe enough	61.8
Uncomfortable	56.0
They do not restore your hearing to normal	54.2
They do not work well in noisy situations	54.2

**Table 4.**  
*Average percentages of respondents citing reasons for non-ownership of hearing aids.*

and professional. This acts as an additional barrier to treatment for this group and it has been shown that people who regarded hearing loss as being inconsequential and accepted it passively, are less likely to seek treatment [40]. Paediatric use of CI does not follow the same pattern with much higher penetration rates in all regions (e.g. 97% in Australia, 50% in the USA), highlighting the different approach to childhood hearing loss.

To seek treatment for a condition, individuals must perceive that they have a hearing loss which is severe enough to be perceived as a threat to their overall wellbeing [41]. They must also feel that there are more benefits than barriers to the treatment sought. Factors identified as acting as barriers to hearing rehabilitation in general include financial limitations, stigma of hearing devices, inconvenience, competing chronic health problems and unrealistic expectations [42] The Eurotrak survey data collected in 2015 illustrates this and found that the main reasons given for not wearing a hearing aid were that the hearing loss was not severe enough and that hearing aids were uncomfortable and embarrassing to wear (**Table 4**) [43].

There are a number of factors which may adversely affect the uptake of CI compared to hearing aids. Firstly, it is a more costly treatment with an adult surgery and follow up. However, CIs have been shown to be highly cost effective with low complication rates and in most developed economies, funding is provided either by a national health programs or employer based or private insurance schemes [33, 44]. None the less, lack of funding has the potential to restrict the number of suitable adults who are implanted, particularly in undeveloped economies. However, the costs of not effectively treating hearing loss have been shown to be much greater and, as we have seen earlier, investment in treatment at an early stage may reduce the burden on health services of other diseases such as dementia. Poor awareness of the treatment amongst professionals and patients or even a negative perception of implants in the general population, due to the political issues around the impact implantation has on deaf culture and the deaf community is also a factor.

4. Raising awareness

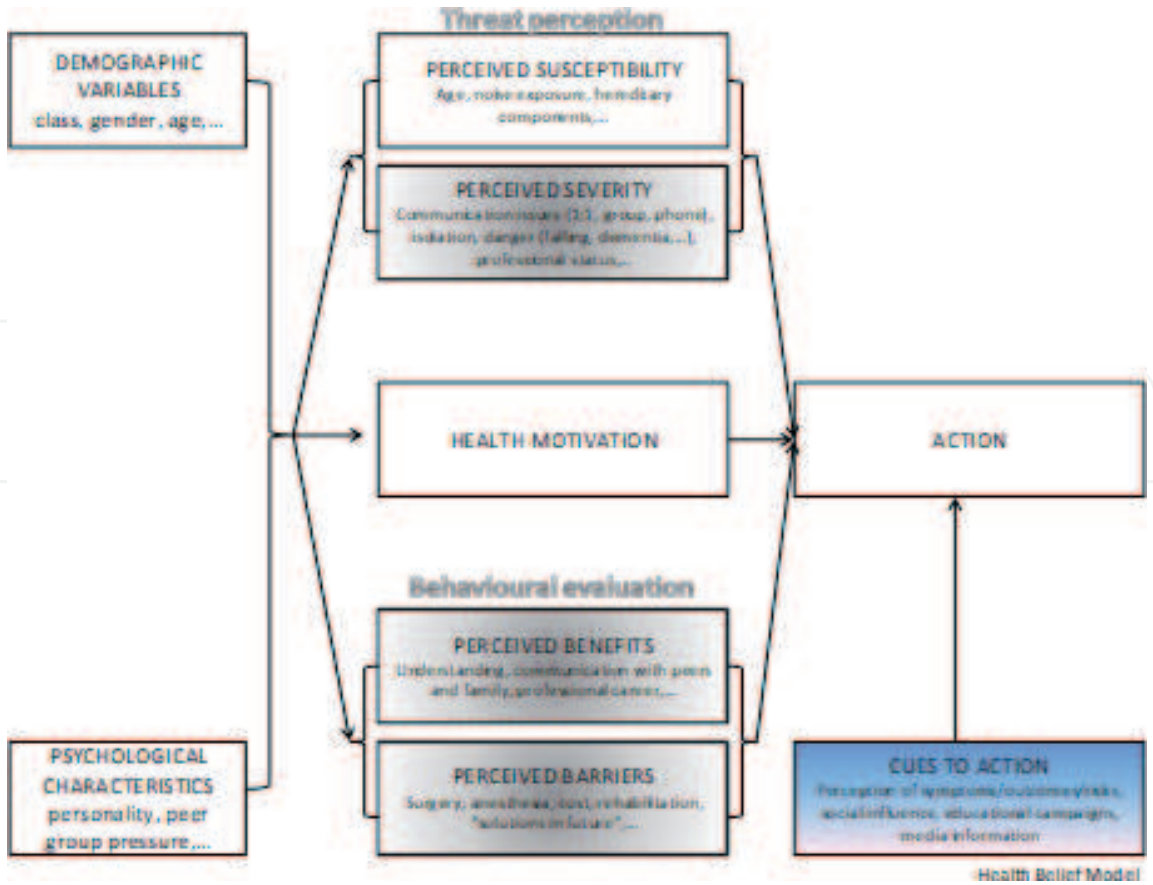
One of the issues which may be inhibiting adults from coming forward to be assessed for a CI is lack of awareness of the treatment in both professionals and potential recipients. Good knowledge of the risks verses benefits is especially important for cochlear implantation as it requires an invasive surgical procedure to insert the electrode array into the cochlea, in contrast to a hearing aid which can be fitted at any time. It is therefore beholden to the professionals to provide accurate information to enable potential patients to balance the risks verses benefits and make an informed choice. Evidence has shown that uninformed professionals can act as an additional barrier to implantation and improved education

of audiologists and ENT specialists can greatly improve referral rates [41, 45]. It would be reasonable to assume that professionals such as audiologists and otorhinolaryngologists were well informed about the benefits and limitations of a CI and were able to refer appropriately. However, very little published data exists and the most recent of these studies, Chundu and Buhagiar, indicate that less than half of the audiologists surveyed were confident that they knew when to refer a patient for a CI assessment [46].

Behaviour patterns are explained and modified by using different theories of learning use models. One of these models is the health belief model by Rosentstock. It provides a framework to describe how people can be influenced to change their health-related behaviour [47]. Within the model it is stated that there are three conditions required to change behaviour: (1) the existence of sufficient motivation (or health concern) to make health issues salient or relevant. (2) The belief that one is susceptible or vulnerable to a serious health problem or to the sequelae of that illness or condition (often termed 'perceived threat'). (3) The belief that following a particular health recommendation, at a subjectively acceptable cost, would be beneficial to reducing the perceived threat. Within this latter condition, cost refers to the perceived barriers that must be overcome in order to follow the health recommendation. This cost refers to, but is not restricted to, financial outlays. Applying this into the area of disabling hearing loss, we must consider that people will take action to seek treatment for disabling hearing loss if they view this disabling hearing loss as a serious issue, they feel sufficiently concerned about the severity of their disabling hearing loss, and that there are more benefits than barriers to amplification or an alternative way of stimulation/amplification [46].

More healthcare choices are driven by patients and the internet than ever before. If utilisation of cochlear implants is to increase, awareness of the impact of hearing loss and the knowledge of the benefits and limitations of cochlear implantation must be improved, and any misconceptions corrected. One way of doing this is to put in place an education campaign. The purpose of any such campaign would be to improve individuals' motivation to take action and seek treatment. In order to address this a large market research study, funded by MED-El GmbH, was undertaken to try to establish the levels of awareness in the older adult population. The aim of this study was to assess the factors that contribute to individuals' health motivation to take action and address their hearing loss. The older adult population (50–70 years old) was targeted as the prevalence of hearing loss is higher in this group. An online questionnaire with 13 closed set questions was completed by 500 subjects at home in Austria, Germany, France, Sweden and the United Kingdom (100 subjects in each country). The different questions were based around the health belief model, as shown in **Figure 6** and looked at subject's perceived susceptibility to hearing loss, its severity (the perceived threat that hearing loss presents) and the barriers to action. Different questions were presented to assess subject's perceptions in three areas: (1) their susceptibility to disabling hearing loss, its importance to them and its impact (the threat); (2) the barriers that may prevent them from seeking appropriate treatment; (3) the actions that subjects currently take to address any hearing concerns.

Possible barriers to treatment of the disabling hearing loss were selected based on the personal experience of the authors. In addition, they were gained from focus groups and talking to existing CI users and clinicians involved in CI programmes. The following barriers were identified: the visibility of the device or cosmetics, convenience of use for all situations, including sports or going to bed, and management of the device. To assess the perception of both implants and hearing aids, as a hearing aid is the alternative treatment option, questions were designed. Barriers such as fear of surgery, losing residual hearing, and identity considerations were



**Figure 6.**  
Flow diagram describing the different factors from the health believe model which stimulate individuals to take action to address disabling hearing loss.

not considered as they were not identified by the focus groups at the time. However, these are also key areas for potential candidates to consider, even before referral to a specialist CI centre takes place. Questions were asked to the respondents whether they thought there was any difference between a hearing aid and a hearing implant and whether there was any difference in hearing sensitivity between hearing aids and implants. The underlying concept was to assess if a potential lack of perceived benefit or differences between implants compared to hearing aids was acting as a potential barrier to implantation.

In the resulting data, good hearing was regarded as being important in all countries and when motivated to do so, people sought information from medical professionals, mostly GPs and ENT specialists, about their hearing problems [48]. There was agreement that the main sign of hearing loss was turning up the TV or radio. This is a useful self-assessment measure which can prompt individuals to seek help. In more than the majority of the participating countries, hearing aids were thought to be not particularly visible, not require much maintenance nor servicing or a hindrance whilst doing sport. The majority of participants knew that they must be removed before bed. Perceptions of hearing implants were that they were permanently fitted, not externally visible and do not need to be removed before bed. This is a persistent and significant misconception and is discussed further in the next paragraph, where attitudes of professionals are also considered. In general, subjects knew that there was a difference between hearing aids and hearing implants (range of agreement 72–40%). When asked if there was *no* qualitative difference (in terms of hearing sensitivity) between them, median scores tended towards disagree, this means that a subjective difference is also perceived. However it remains unclear whether the respondents understood what the differences were.



Data has also been published relating to awareness of CI in doctors with an ear nose and throat (ENT) specialist training [49]. A random sample of 240 doctors were surveyed and their referral patterns, attitudes and beliefs towards CIs recorded. The results showed that they shared many common beliefs about hearing loss, hearing aids, and CIs, although some national variation in opinion was present. Most were aware that hearing implants and hearing aids were different, but nearly all would recommend a hearing aid over an implant if both were suitable. However, some doctors surprisingly agreed that there was no difference between hearing aids and hearing implants in terms of hearing sensitivity (5–36%) and we would also have expected a strong disagree from well informed respondents to that statement. There was also some confusion over the need to still wear and maintain an external speech processor with a CI. Responses to the statements covering the types of issues which may come up in an initial consultation with a patient who is considering a CI were not as clear as could be expected, with Likert values falling within the middle of the range for most questions. Implants were still regarded by some as not externally visible and permanently fitted, without the need to remove them at night. This indicates that even in the professional group, not all were aware of the basic structure of a cochlear implant with a concealed implanted part and an external speech processor, which is worn much like a hearing aid. Without the external speech processor, the CI does not function and providing reassurance to patients that they can remove the external part of the CI at any time and return to their non-hearing state could be a key factor in the decision-making process. Conversely, misleading patients that a CI provides an invisible hearing solution, when currently it does not, can also be a hindrance. When initial discussions about hearing implants are taking place, the realisation by patients that the external parts of a hearing implant are not very different practically from a hearing aid may deter patients from pursuing a treatment option which they thought would be invisible.

Personal experience has shown that many potential CI recipients are not aware of the significant hearing benefits of a CI compared to a hearing aid. Potential implant recipients need to be able to make an informed choice about going forward for assessment. Individuals who would be suitable candidates are often resistant to considering an elective surgical procedure to address their hearing loss and accurate information on the risks and benefits needs to be available. The surveys indicated that in both the professional group and the general population more work needs to be done to improve awareness of the substantial benefits of CI and knowledge of the basics of the technology. The study results reinforced the importance of the internet in accessing information about health and hearing loss in the general population, but interactive new media were low down the list of preferred means of keeping abreast of medial issues for professionals in all countries. Whilst an online awareness campaign could be a cost-effective way of improving awareness of CI, professionals tended to rely on conferences and conversations with colleagues to keep up to date.

An awareness campaign was funded MED-EL GmbH which placed a series of banners in online newspapers and health magazines. If the reader clicked on the advert they were taken to the MED-EL GmbH web site. This was a very broad approach with the objective to target a wide range of individuals, both professional and the general public. The campaign was run over a 2 week to 3 month period depending on the publication chosen. Click rates for the adverts were recorded and were at a median of around 0.2%, although some outliers such as had considerably more traffic of 3–5% for health publications such as Audiology World News. Although an average click rate of less than 1% seems very low, comparisons to industry data show that this is within the expected range for this type of advertising in the general population. It is reasonable to assume that the medical publications



had a readership that were already interested in health topics and were thus more likely to click on the advert. This approach seemed promising, however, follow up awareness data collected from another random sample showed that there was little change in the attitudes of either the professional or general groups. Future campaigns should be focused on those who have already been identified as having a hearing loss but what form it should take or how this group could be accessed directly is less clear. Should the patients themselves be made aware of CI as a treatment option or should audiologists and ENT professionals be the focus? The pathway to improving awareness of CI is unclear, but it is certain that better management of hearing loss will be essential for the future in our ageing population.

## 5. Conclusions

- The prevalence of hearing loss is high with around 5% of the world's population effected and this number is set to rise as the population ages.
- The burden of hearing loss as a disease is also high with hearing loss in the top five causes of years lived with disability in 2015, 2016 and 2017 for males and top 10 for females along with low back pain, migraine, iron-deficiency anaemia, and major depressive disorder.
- Cochlear implantation is a proven and effective treatment for bilateral severe to profound hearing loss, yet the **utilisation** of CI is poor (less than 10% of suitable patients), especially in the older adult population who arguably need it most.
- Survey data shows that awareness activities are needed for both professionals and the general population to improve knowledge of what a CI is and how it can help.
- Online activities are a cost-effective approach to improve awareness in the general public. However, professionals still get their information from conferences, colleagues and medical books and journals.

## Conflict of interest

Patrick D'Haese is an employee of MED-EL GmbH, Innsbruck, Austria. Prof. Van de Heyning receives grants to the institution from MED-EL and Cochlear.

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## References

- [1] World Health Organisation. Global Estimates on Prevalence of Hearing Loss. 2018. Available from: <https://www.who.int/pbd/deafness/estimates/en/> [Accessed: 28 March 2019]
- [2] Roth TN, Hanebuth D, Probst R. Prevalence of age-related hearing loss in Europe: A review. *European Archives of Oto-Rhino-Laryngology*. 2011;**268**(8):1101-1107
- [3] Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M. Global burden of disease hearing loss expert group. Global and regional hearing impairment prevalence: An analysis of 42 studies in 29 countries. *European Journal of Public Health*. 2013;**23**(1):146-152. DOI: 10.1093/eurpub/ckr176
- [4] Bond M, Mealing S, Anderson R, Elston J, Weiner G, Taylor R, et al. The effectiveness and cost-effectiveness of cochlear implants for severe to profound deafness in children and adults: A systematic review and economic model. *Health Technology Assessment*. 2009;**13**(44):1-330
- [5] Lenarz T, Muller L, Czerniejewska-Wolska H, Vallés Varela H, Orús Dotú C, Durko M, et al. Patient-related benefits for adults with cochlear implantation: A multicultural longitudinal observational Study. *Audiology & Neuro-Otology*. 2017;**22**(2):61-73. DOI: 10.1159/000477533
- [6] Lavis JN, Posada FB, Haines A, Osei E. Bending the spend: Expanding access to hearing technology to improve health, wellbeing and save public money. *Lancet*. 2004;**364**:10
- [7] GBD. Disease and injury incidence and prevalence collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: A systematic analysis for the global burden of disease study 2015. *Lancet*. 2015, 2016;**388**(10053):1545-1602. DOI: 10.1016/S0140-6736(16)31678-6. Erratum in: *Lancet*. 2017;**389**(10064):e1
- [8] GBD. Disease and injury incidence and prevalence collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the global burden of disease study 2016. *Lancet*. 2017;**390**(10100):1211-1259. DOI: 10.1016/S0140-6736(17)32154-2. Erratum in: *Lancet*. 2017;**390**(10106):e38
- [9] GBD. Disease and injury incidence and prevalence collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: A systematic analysis for the global burden of disease study 2017. *Lancet*. 2018;**392**(10159):1789-1858. DOI: 10.1016/S0140-6736(18)32279-7
- [10] Shield B. Hearing Loss Numbers and Costs-Evaluation of the Social and Economic Costs of Hearing Impairment. 2018. Available from: <https://www.hear-it.org> [Accessed: 28 March 2019]
- [11] Lin FR, Ferrucci L. Hearing loss and falls among older adults in the United States. *Archives of Internal Medicine*. 2012;**172**(4):369-371. DOI: 10.1001/archinternmed.2011.728
- [12] Oh IH, Lee JH, Park DC, Kim M, Chung JH, Kim SH, et al. Hearing loss as a function of aging and diabetes mellitus: A cross sectional study. *PLoS One*. 2014;**9**(12):e116161. DOI: 10.1371/journal.pone.0116161

- [13] Gopinath B, Schneider J, Rochtchina E, Leeder SR, Mitchell P. Association between age-related hearing loss and stroke in an older population. *Stroke*. 2009;**40**(4):1496-1498. DOI: 10.1161/STROKEAHA.108.535682
- [14] Chia EM, Mitchell P, Rochtchina E, Foran S, Golding M, Wang JJ. Association between vision and hearing impairments and their combined effects on quality of life. *Archives of Ophthalmology*. 2006;**124**(10):1465-1470
- [15] Mitchell P, Gopinath B, McMahon CM, Rochtchina E, Wang JJ, Boyages SC, et al. Relationship of type 2 diabetes to the prevalence, incidence and progression of age-related hearing loss. *Diabetic Medicine*. 2009;**26**(5):483-488. DOI: 10.1111/j.1464-5491.2009.02710.x
- [16] Genther DJ, Betz J, Pratt S, Martin KR, Harris TB, Satterfield S, et al. Association between hearing impairment and risk of hospitalization in older adults. *Journal of the American Geriatrics Society*. 2015;**63**(6):1146-1152. DOI: 10.1111/jgs.13456
- [17] Genther DJ, Betz J, Pratt S, Kritchevsky SB, Martin KR, Harris TB, et al. Association of hearing impairment and mortality in older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2015;**70**(1):85-90. DOI: 10.1093/gerona/glu094
- [18] Karpa MJ, Gopinath B, Beath K, Rochtchina E, Cumming RG, Wang JJ, et al. Associations between hearing impairment and mortality risk in older persons: The blue mountains hearing study. *Annals of Epidemiology*. 2010;**20**(6):452-459. DOI: 10.1016/j.annepidem.2010.03.011
- [19] Gopinath B, Schneider J, McMahon CM, Burlutsky G, Leeder SR, Mitchell P. Dual sensory impairment in older adults increases the risk of mortality: A population-based study. *PLoS One*. 2013;**8**(3):e55054. DOI: 10.1371/journal.pone.0055054
- [20] Schubert CR, Fischer ME, Pinto AA, Klein BEK, Klein R, Tweed TS, et al. Sensory impairments and risk of mortality in older adults. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2017;**72**(5):710-715. DOI: 10.1093/gerona/glw036
- [21] Amieva H, Ouvrard C, Meillon C, Rullier L, Dartigues JF. Death, depression, disability, and dementia associated with self-reported hearing problems: A 25-year study. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2018;**73**(10):1383-1389. DOI: 10.1093/gerona/glx250
- [22] Deal JA, Betz J, Yaffe K, Harris T, Purchase-Helzner E, Satterfield S, et al. Hearing impairment and incident dementia and cognitive decline in older adults: The Health ABC Study. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2017;**72**(5):703-709. DOI: 10.1093/gerona/glw069
- [23] Lin FR, Ferrucci L, An Y, Goh JO, Doshi J, Metter EJ, et al. Association of hearing impairment with brain volume changes in older adults. *NeuroImage*. 2014;**90**:84-92. DOI: 10.1016/j.neuroimage.2013.12.059
- [24] Lin FR, Ferrucci L, Metter EJ, An Y, Zonderman AB, Resnick SM. Hearing loss and cognition in the baltimore longitudinal study of aging. *Neuropsychology*. 2011;**25**(6):763-770. DOI: 10.1037/a0024238
- [25] Lin FR, Metter EJ, O'Brien RJ, Resnick SM, Zonderman AB, Ferrucci L. Hearing loss and incident dementia. *Archives of Neurology*. 2011;**68**(2):214-220. DOI: 10.1001/archneurol.2010.362



- [26] Gurgel RK, Ward PD, Schwartz S, Norton MC, Foster NL, Tschanz JT. Relationship of hearing loss and dementia: A prospective, population-based study. *Otology & Neurotology*. 2014;**35**(5):775-781. DOI: 10.1097/MAO.0000000000000313
- [27] Orgeta V, Mukadam N, Sommerlad A, Livingston G. The lancet commission on dementia prevention, intervention, and care: A call for action. *Irish Journal of Psychological Medicine*. Jun 2019;**36**(2):85-88. DOI: 10.1017/ipm.2018.4
- [28] Kochkin S. MarkeTrak VIII: The efficacy of hearing aids in achieving compensation equity in the workplace. *The Hearing Journal*. 2010;**63**(10):19-28
- [29] Archbold S, Lamb B, O'Neill C, Atkins J. The Real Cost of Adult Hearing Loss. 2014. Available from: <https://www.earfoundation.org.uk/research/adult-strategy-reports/the-real-cost-of-adult-hearing-loss-2014> [Accessed: 28 March 2019]
- [30] World Health Organization. Global Costs of Unaddressed Hearing Loss and Cost-Effectiveness of Interventions: A WHO Report. Geneva: World Health Organisation. 2017. Available from: <http://www.who.int/iris/handle/10665/254659> [Accessed: 28 March 2019]
- [31] Deloitte Access Economics. The Social and Economic Cost of Hearing Loss in Australia. Report Prepared for Hearing Care Industry Association (HCIA). 2017. Available from: [www.hcia.com.au](http://www.hcia.com.au) [Accessed: 28 March 2019]
- [32] Mohr P, Feldman J, Dunbar J, McConkey-Robbins A, Niparko J, Rittenhouse R, et al. The societal costs of severe to profound hearing loss in the United States. *International Journal of Technology Assessment in Health Care*. 2000;**16**(4):1120-1135
- [33] Bond M, Elston J, Mealing S, Anderson R, Weiner G, Taylor R, et al. Systematic reviews of the effectiveness and cost-effectiveness of multi-channel unilateral cochlear implants for adults. *Clinical Otolaryngology*. 2010;**35**(2):87-96
- [34] Foteff C, Kennedy S, Milton AH, Deger M, Payk F, Sanderson G. Cost-utility analysis of cochlear implantation in Australian adults. *Otology & Neurotology*. 2016;**37**(5):454-461. DOI: 10.1097/MAO.0000000000000999
- [35] Smulders YE, van Zon A, Stegeman I, van Zanten GA, Rinia AB, Stokroos RJ, et al. Cost-utility of bilateral versus unilateral cochlear implantation in adults: A randomized controlled trial. *Otology & Neurotology*. 2016;**37**(1):38-45. DOI: 10.1097/MAO.0000000000000901
- [36] Sorkin DL, Buchman CA. Cochlear implant access in six developed countries. *Otology & Neurotology*. 2016;**37**(2):e161-e164
- [37] Chen DS, Clarrett DM, Li L, Bowditch SP, Niparko JK, Lin FR. Cochlear implantation in older adults: Long-term analysis of complications and device survival in a consecutive series. *Otology & Neurotology*. 2013;**34**:1272-1277
- [38] Davis A. Hearing in Adults: The Prevalence and Distribution of Hearing Impairment and Reported Hearing Disability in the MRC Institute of Hearing Research's National Study of Hearing. London: Whurr Publishers; 1995
- [39] Zwolan TA, Henion K, Segel P, Runge C. The role of age on cochlear implant performance, use, and health utility: A multicenter clinical trial. *Otology & Neurotology*. 2014;**35**(9):1560-1568

- [40] Van den Brink RH, Wit HP, Kempen GI, van Heuvelen MJ. Attitude and help-seeking for hearing impairment. *British Journal of Audiology*. 1996;**30**(5):313-324
- [41] Meyer C, Hickson L. What factors influence help-seeking for hearing impairment and hearing aid adoption in older adults? *International Journal of Audiology*. 2012;**51**(2):66-74
- [42] Barnett M, Hixon B, Okwiri N, Irungu C, Ayugi J, Thompson R, et al. Factors involved in access and utilization of adult hearing healthcare: A systematic review. *The Laryngoscope*. 2017;**127**(5):1187-1194. DOI: 10.1002/lary.26234
- [43] European Hearing Instrument Manufacturers Association (EHIMA). Euro Trak Surveys. 2015. Available from: [www.ehima.com](http://www.ehima.com) [Accessed: 28 March 2019]
- [44] Vickers D, Kitterick P, Verschuur C, Leal C, Jenkinson L, Vickers F, et al. Issues in cochlear implant candidacy. *Cochlear Implants International*. 2016;**17**(Suppl 1):1-2. DOI: 10.1080/14670100.2016.1163104
- [45] Raine C. Cochlear implants in the United Kingdom: Awareness and utilization. *Cochlear Implants International*. 2013;**14**(Suppl 1):S32-S37
- [46] Chundu S, Buhagiar R. Audiologists' knowledge of cochlear implants and their related referrals to the cochlear implant Centre: Pilot study findings from UK. *Cochlear Implants International*. 2013;**14**(4):213-224. DOI: 10.1179/1754762812Y.0000000025
- [47] Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. *Health Education Quarterly*. 1988;**15**(2):175-183
- [48] D'Haese PSC, De Bodt M, Van Rompaey V, Van de Heyning P. Awareness of hearing loss in older adults: Results of a survey conducted in 500 subjects across 5 European countries as a basis for an online awareness campaign. *Inquiry*. 2018;**55**:46958018759421. DOI: 10.1177/0046958018759421
- [49] D'Haese PSC, Van Rompaey V, De Bodt M, Van de Heyning P. The knowledge and beliefs regarding practical aspects of cochlear implants: A study of otorhinolaryngologists in a secondary setting in a multi-country study. *Cochlear Implants International*. 2018;**19**(1):14-21. DOI: 10.1080/14670100.2017.1385141