Making a noise about hearing:
Factors to consider when developing hearing health awareness messages for Australians

Prepared by the National Acoustic Laboratories for the Department of Health
May 2020
Revised September 2020

Acknowledgement
This project was funded by the Australian Government Department of Health.

Contributors
Simon Alperstein, MSc, Research Scientist
Elizabeth Beach, PhD, Department Head, Behavioural Sciences
Megan Gilliver, PhD, Senior Research Scientist
Kiri Mealings, PhD, Research Scientist
Jermy Pang, MClinAud, MAudA, Research Audiologist

Executive Sponsor
Dr Brent Edwards, NAL Director

List of abbreviations

AABR	Automated Auditory Brainstem Response
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
AIHW	Australian Institute of Health and Welfare
BIT	Behavioural Insights Team
CIRCA	Cultural and Indigenous Research Centre Australia
CSO	Community Service Obligation
dB	Decibels
dBA	A-weighted decibels
dB HL	Decibels hearing level
DMIRS	Department of Mines, Industry Regulation and Safety
ECEI	Early childhood early intervention
ENT	Ear, nose and throat specialist
ESIA	Ear Science Institute Australia
GP	General practitioner
HATS	Hear and Talk Scale
HAP-EE	Hearing Assessment Program – Early Ears
Hearing care	Hearing Care Industry Association
HSP	Hearing Services Program
ITU	International Telecommunication Union
dB L_{Aeq}	A-weighted equivalent continuous sound level
dB $L_{Aeq,8hr}$	A-weighted equivalent continuous sound level over an 8-hour period
dB L_{Cpeak}	C-weighted peak noise level
LOCHI	Longitudinal Outcomes of Children with Hearing Impairment
MBS	Medicare Benefits Schedule
MRI	Magnetic resonance imaging
NAL	National Acoustic Laboratories
NDIA	National Disability Insurance Agency
NDIS	National Disability Insurance Scheme
NHMRC	National Health and Medical Research Council
OME	Otitis media with effusion
PEACH	Parent Evaluation of Aural/Oral Performance of Children
PLUM	Parent-evaluated Listening and Understanding Measure
PPE	Personal protective equipment
RIDBC	Royal Institute for Deaf and Blind Children
SCENIHR	Scientific Committee on Emerging and Newly Identified Health Risks
TDF	Theoretical Domains Framework
WHO	World Health Organisation
WHS	Workplace health and safety

Contents

Executive summary

Following repeated calls for the Australian Government to develop a national campaign aimed at raising public awareness of ear and hearing health, the National Acoustic Laboratories was commissioned to provide a report detailing the background information required to inform the development of a national hearing awareness campaign.

The ultimate aim of any awareness-raising campaign is to build towards changes in behaviour, which in turn, lead to improved outcomes for the individual and the community. Awareness raising, therefore, is a way of promoting change – and the first step towards creating an effective awareness campaign is to understand the behaviours that are most in need of change. This requires an understanding of the hearing health landscape in Australia and the diversity of issues faced by different target groups. With this knowledge, it is then possible to identify the specific information needs and awareness gaps that a campaign should address, and start to develop appropriate messages for the general population and specific target groups.

In this report, we provide the material necessary to create an effective national hearing awareness campaign. Section 1 sets out the recent developments that have provided momentum for the development of a national hearing awareness campaign, and section 2 outlines the current hearing health landscape in Australia. Section 3 details the hearing services that are currently available for Australians, including government programs, service costs, and the various organisations that exist to provide support for people with hearing loss.

Section 4 delves deeply into the hearing experiences, information needs, and awareness gaps of seven selected target groups that represent the main audience segments that would benefit from a hearing awareness campaign. For each group, recommended messages and strategies are provided based on the group's unique context and information needs and informed by relevant constructs from the fields of health promotion and behavioural science.

1. **Young children and caregivers.** There is a need for awareness initiatives that support families to recognise signs of hearing loss in early childhood, help them understand when to seek help, and encourage them to consider hearing as an important aspect of their child's overall health (with potential impacts for social and scholastic development). There is also a need to empower families navigating the complexities of hearing healthcare choices with information that is relevant and accessible (see page 19-25).
2. **Teenagers/young adults exposed to recreational noise.** Messages designed for this group need to account for variations in the engagement that young people have with their hearing health and counteract any misplaced optimism bias they may have regarding their personal risk. Some recommended strategies include motivating young people to reduce noise exposure by focussing on consequences that are immediate and tangible, such as tinnitus, and by using their love of music itself in loss-aversion messages that highlight the impacts of noise exposure for life-long listening. Strategies enabling young people to use technology to understand and manage their noise exposure are also recommended (see pages 26-32).
3. **People with untreated or developing hearing loss from ages 50-75.** To motivate older adults to engage with hearing health, there is a need to raise awareness about early signs of hearing loss, how hearing difficulties manifest in daily life beyond a simple 'drop in volume,' and to help people appreciate the negative social and cognitive consequences associated with untreated hearing loss. There is also a need to promote regular monitoring of hearing to enable early identification of subtle changes in hearing, and to provide trusted and independent information to help guide decision-making about treatment options (see pages 32-38).

4. **Aboriginal and Torres Strait Islanders.** For Aboriginal and Torres Strait Islander people, the main hearing health issue is the prevention and management of childhood otitis media (or middle ear infection). Recommended messages and strategies need to centre on raising parents' and caregivers' awareness of the signs of middle ear infection, as well as when and how to discuss hearing with health practitioners. It is critical that campaign messages are co-designed in collaboration with Aboriginal communities and communicated by Aboriginal-led media organisations. Duplication of effort should be avoided by making use of resources from existing successful ear health programs (see pages 39-45).
5. **People exposed to occupational noise.** Strategies to reduce noise exposure for this group should take a multi-pronged approach. Management and policymakers should be encouraged to take responsibility for implementing systemic changes to reduce sound levels, make use of technology to monitor exposure, and ensure that at-risk workers' hearing is monitored on a regular basis. For employees, messages should focus on consistent use of protective equipment, and challenge the concept of loss acceptance that can lead to complacency and inaction in relation to hearing health (see pages 46-51).
6. **Farmers.** Messages for farmers need to focus on motivating them to reduce noise exposure while also encouraging those with hearing loss to engage with hearing help. Choosing quieter farm machinery, wearing appropriate hearing protection, and making use of technology are important calls to action. Raising awareness of the impacts of hearing loss and the consequent communication challenges is also essential to encourage engagement. All messages should be designed to take account of the farming context, widespread stoicism amongst farming communities, and the benefits of using trusted communication channels (see pages 51-57).
7. **People living in rural and remote locations.** The recommended strategies to support hearing awareness in rural and remote communities overlap with those of the other target groups, albeit with a focus on the unique challenges of those who do not live in major population centres. Encouraging greater awareness and use of teleaudiology services, raising the overall profile of hearing health, and providing access to trusted information are the key strategies needed for this target group (see pages 58-60).

At the end of section 4, we present the results of a prioritisation exercise, which compared the relative benefits of developing messages for each of the target groups. The analysis was based on an assessment of various factors, including size of the target group and proportion at risk, and the ease of accessing the group and persuading them to take action. The results suggest that the target groups for whom campaign messages are most likely to be effective are groups 3, 1 and 5 (see pages 60-62).

In section 5, the recommended messages and strategies for each target group are considered through the theoretical lens of two health behaviour models – the Theoretical Domains Framework (TDF) and the COM-B model. In doing so, we have arrived at a set of 10 key hearing health needs or gaps that are common across many of the target groups. Each need is classified according to the three key constructs that underpin behaviour change: capability, opportunity or motivation. A summary of the needs and examples of how they relate to target groups across the lifespan is provided as a stand-alone chart, Hearing health journeys in Australia, on pages 67-68.

In many cases, the identified needs overlap with the goals and priorities set out in the recently published *Roadmap for Hearing Health* (Hearing Health Sector Committee, 2019). This is not surprising since many of the issues identified here are long-standing systemic issues that have previously been identified as needing attention. Thus, responding to the needs identified here would also address some of the desired outcomes of the *Roadmap*, and go some way towards fulfilling several of the short-term actions items in relation to:

- Enhancing awareness and inclusion: see points 2-4 & 12 on page 7 of the *Roadmap*
- Closing the Gap for Aboriginal and Torres Strait Islander ear and hearing health: see point 4 on page 9 and points 9-10 on page 10 of the *Roadmap*
- Preventing hearing loss: see point 1 on page 13 of the *Roadmap*
- Identifying hearing loss: see points 2 & 6-7 on page 14 of the *Roadmap*
- Providing support: see points 2-4 on page 17 of the *Roadmap*

Conclusion. The creation of a national hearing health campaign represents a much-needed opportunity to lift the profile of hearing health in Australia. The current levels of awareness are low across all groups in the community (families, health practitioners, educators and members of the wider community), and so any campaign that places hearing into the public domain is likely to raise awareness and have positive impacts on engagement with hearing. If we can achieve this, we will all benefit. Building a more hearing-aware society will lead to a greater commitment to preventing hearing loss, as well as better support for those with hearing loss, resulting in improved communication, decreased stigma, and reduced social disability.

A hearing awareness campaign will require innovative evidence-based strategies that go beyond mere information provision, and take into account how best to provide all Australians with the capability, opportunity, and motivation they need to easily and effectively engage with hearing health. Regardless of whether the needs are related to hearing loss prevention or rehabilitation, and regardless of the specific needs of individual target groups, an underlying awareness gap exists as a continuum from birth to older age. At every stage of life, the focus should be on raising the profile of hearing health and awareness of positive strategies and behaviours to assist all Australians to protect, maintain, and celebrate their hearing health.

Section 1 – Background and aims

1.1. Background

Hearing loss affects one in six Australians, a prevalence rate that is higher than all other national health priorities with the exception of musculoskeletal diseases (Access Economics, 2006). It is estimated that around one-third of all hearing loss is preventable, and prevalence increases with age, with around 70% of 70+ year olds estimated to have significant hearing loss (Chia et al., 2007). The average age of first-time hearing aid users is 70 years, and the majority live with hearing loss for around nine years before seeking help (Simpson et al., 2019), with only one in three of those who would benefit from hearing aids having them (Hartley et al., 2010). Much of this inaction can be traced back to a lack of awareness about hearing loss and its impacts, and lack of knowledge of the various treatment options available. As the population ages, and hearing loss continues to go untreated, the economic costs to society in terms of healthcare expenditure, reduced workforce participation, and loss of productivity will continue to grow.

From the individual's point of view, the impacts of hearing loss can be far-reaching, with consequences for many aspects of a person's life beyond listening and communication. The following excerpt from a young farmer describes the personal experience of hearing damage and loss:

> **"I am 35 years old and live in rural SA. Farming is a tough slog at the moment. I can't hear well due to the years I have been around farm machinery. It has damaged my hearing. I have significant tinnitus which impacts on my communication and state of mind... I tried to do the right thing and I have investigated hearing aids and after paying for another hearing test (cause the community health doesn't do it!!) I found out they would cost a couple of thousand dollars – at a minimum. I've gone downhill in the past year. I'm now on antidepressants and antianxiety medication. I feel like I'm giving up. I don't go to meetings any longer, don't attend church and avoid social situations cause I can't hear. Communication with my family is very difficult and I know it is causing relationship breakdown. Sometimes it would be easier to end it all...I learnt a few years back at a field day about noise and hearing loss and now wear earmuffs all the time to protect them. But it's too late."**
>
> From the Hearing Impaired & Deaf Kindred Organisation Network's submission to the Inquiry into hearing health in Australia (2009).

Although this description is just one individual's experience of hearing loss, similar emotions and experiences are shared by many others. Many Australians will be familiar with the experience of hearing damage – whether it be from years working on the farm, hours spent in a noisy occupation, or partying in nightclubs. Many will have tried to protect their hearing from noise exposure, and many will wish that they had done so before the damage had occurred. Many will have experienced the adverse impacts that hearing loss and tinnitus have on their mental health, their ability to communicate with others, and their social interactions. Many will also recognise the experience of trying to seek help for hearing loss, the difficulties of finding out about treatment options and the financial cost of hearing aids.

This human story is telling because it highlights some of the pain points that occur in many Australians' hearing health journeys. In particular, it demonstrates how important it is to be aware of hearing and to have access to appropriate information at the right time – before the damage is done, before it's too late. These issues are well-known to hearing health professionals, who have repeatedly called for government support to help increase hearing awareness, particularly via their numerous submissions to the various hearing-related government inquiries in recent years.

In 2010, the Senate Community Affairs References Committee released its report, *Hear Us: Inquiry into Hearing Health in Australia,* and agreed that there was a need for:

> **"A large-scale hearing health awareness-raising and education campaign. Such a campaign could have three aims: to target high-risk groups about preventable hearing loss; raise the general level of community awareness about hearing loss issues; and promote access to support and resources for people with a hearing loss."**

Seven years later, the House of Representatives Standing Committee on Health, Aged Care and Sport published its report, *Still waiting to be heard...Report on the Inquiry into the Hearing Health and Wellbeing of Australia* (2017), where, again, it was recommended that the Department of Health develop and implement an education and awareness raising campaign focussed on national hearing health. Subsequently, the Hearing Health Sector Committee was established by the Hon Ken Wyatt AM, MP, when he was the Minister for Senior Australians and Aged Care and Indigenous Health. The Committee's core function was to produce a *Roadmap for Hearing Health* (2019), which was intended as a blueprint for a national effort towards improving hearing health. The *Roadmap* added further weight to the case for a national awareness campaign, listing a public awareness campaign as one of eight key actions to receive high priority in the short term.

More recently, the Hearing Health Sector Alliance has reaffirmed that a national prevention and awareness campaign is one of its top five priorities, and the Hearing Care Industry Association has also highlighted the 'glaring need for education and awareness programs' in the area of hearing health. This comes at a time when the World Health Organization (WHO) is also increasing its efforts to raise hearing awareness and guide campaign development around the world. In February, WHO released a comprehensive online resource (https://www.who.int/publications-detail/basic-ear-and-hearing-care-resource) to raise community awareness about hearing loss, and later this year the *World Report on Hearing* will be published. This report is intended to guide global public health efforts to raise awareness of hearing loss and will showcase a range of actions aimed at preventing hearing loss and mitigating its impact.

Australia has never had an ongoing, extensive national campaign aimed at raising awareness of hearing health, although there have been various small-scale ad hoc initiatives led by different advocacy groups and organisations in the past. These have most often occurred during Hearing Awareness Week, with very little attention paid to the topic apart from this brief period each year in March. Clearly, it is time to act in response to the growing chorus of voices that have been calling for a national hearing health awareness campaign for the past decade. Now is the time to raise community hearing awareness to bring about positive change and improve the experiences and hearing health journeys of all Australians.

1.2. Aims and scope

With the case for a national public awareness campaign firmly established, the Department of Health commissioned the National Acoustic Laboratories to produce a report to inform the development of a national campaign. In addition to providing background information about hearing health in Australia, and a summary of the services available, the report focuses on seven key target groups from the Australian population:

1. Young children and caregivers
2. Teenagers/young adults exposed to recreational noise
3. People with untreated or developing hearing loss aged 50-75 years
4. Aboriginal and Torres Strait Islanders
5. People exposed to occupational noise
6. Farmers
7. People living in rural and remote locations

For each target group, the report provides a contextual background on the specific hearing health issues, awareness gaps, information needs, and pain points. It also provides recommendations for potential messages and strategies based on each group's unique context, informed by relevant theoretical constructs from the fields of health promotion and behavioural science.

The material in this report has been compiled by a team of hearing researchers, with extensive experience in hearing health prevention and rehabilitation, and behavioural science. The report combines a broad-based literature review alongside information derived from consultation with other key contributors to the Australian hearing health landscape, each chosen for their extensive practical experience working with one (or more) of the seven identified target groups.

This report should not be considered a definitive blueprint for who and what should be targeted in a national hearing awareness campaign. Rather, it is intended to provide comprehensive background material for the creation of a national campaign that takes into account the current state of hearing health in Australia and the awareness gaps and information needs of key target groups. The issues identified provide the starting point for insightful market research and message testing to support the development of the campaign. Similarly, the recommended messages and strategies, and their theoretical bases are provided as an opportunity to ensure that the campaign goes beyond 'information provision' and instead focuses on motivating real behaviour change.

Section 2 – Hearing health in Australia

This section provides a brief overview of some of the key facts related to hearing health in the Australian context. The information presented includes a high-level summary of the various facets of hearing health, and associated terminology and concepts. It is included here as a reference guide that supports understanding of the following sections, and is not intended as material that would be included in an awareness campaign.

2.1. Healthy hearing

Hearing is defined as the ability to perceive sounds via the auditory sensory organ (the cochlea and associated structures in the inner ear) and the auditory nerve that carries acoustic signals to the brain, where they are processed into meaningful information (Taylor & Mueller, 2011). Along with other senses, such as vision and touch, hearing is used by individuals to form connections with people, communicate, engage with their environment, and contribute to their community (Manchaiah & Stephens, 2013), and these are important elements for the development and enrichment of a person's identity (Israelite et al., 2002). In order to optimise hearing health, policy makers, researchers, clinicians, and individuals should view hearing health as a 'capacity for life', with an emphasis on early, positive education surrounding hearing health. This requires a holistic view of the person's life, taking into account their cultural and social circumstances (Russ et al., 2018).

2.2. What causes hearing issues?

Hearing loss occurs for a variety of reasons: it may be congenital (present from birth), or acquired. It may be temporary or permanent; and it may have a progressive or sudden onset. When the cause of the hearing loss occurs in the inner ear or vestibulocochlear nerve, this is known as a sensorineural hearing loss – around 90% of all hearing losses are of this nature. When the cause is found in the middle ear, tympanic membrane (eardrum), or external ear, this is called a conductive hearing loss. Causes of conductive hearing loss include:

- Malformation of outer ear, ear canal, or middle ear
- Fluid in the middle ear
- Ear infection of the middle ear (otitis media, in which an accumulation of fluid impedes the vibration of the eardrum and bones of the middle ear)
- Perforated eardrum
- Impacted earwax
- Otosclerosis (in which a bony growth forms around one of the small bones in the middle ear, and prevents it from vibrating when stimulated by sound)

In many cases, conductive losses are treatable, and hearing sensitivity returns to normal after the cause has been identified and corrected. For example, an ear infection may resolve after treatment with antibiotics; surgery can be performed to rectify problems with the bones in the middle ear; or impacted wax may be removed from the ear canal. In other cases, such as where there is a malformation that cannot be treated, conductive hearing loss is permanent. Occasionally an individual will have hearing loss that is made up of both conductive and sensorineural components, and this is called a mixed hearing loss.

Congenital hearing loss may be caused by hereditary (genetic) factors, or non-hereditary chromosomal abnormalities. It is also possible to develop hearing loss as a result of prenatal conditions, such as rubella, cytomegalovirus, maternal exposure to alcohol and drugs; perinatal circumstances (e.g., premature birth, jaundice, and anoxia); and postnatal medical conditions, such as bacterial meningitis (Fortnum & Davis, 1993; Cone-Wesson, 2005; Kong & Coates, 2009; O'Connor et al., 2009; Goderis et al., 2014; Brewer & King, 2015; Diefendorf, 2015).

For acquired hearing loss, there are several risk factors. Presbycusis is the most common form of acquired hearing loss the deterioration of the auditory system that occurs with ageing (Gates & Mills, 2005). According to Vos et al., (2016) an ageing and increasing world population are the two most significant factors that will affect the increase in hearing loss globally. Hearing loss may also develop as a result of noise exposure – considered to be the biggest preventable cause of hearing loss. The risk from noise exposure is cumulative over time, and depends on the sound level, and duration of exposure. Other risk factors for acquired hearing loss include chronic health conditions (including cardiovascular disease and diabetes); tumours of the head, physical trauma, and exposure to chemical or medicinal substances known to be damaging to the ear. Referred to as ototoxic substances, these include solvents, paints, and fuels, as well as some antibiotics and cancer treatment drugs.

2.3. The experience of hearing loss

For hearing, as with any health condition, it is important to differentiate between the levels of *sensory impairment*, the corresponding *activity limitations* for the individual, and the *participation restrictions* that result during day-to-day life (e.g., impaired hearing resulting from presbycusis may limit ability to understand speech in noisy activities, resulting in reduced participation in social situations). Thus, the experience of hearing loss varies between individuals and is influenced not only by the nature of the impairment itself (degree of hearing loss, age of onset etc.), but also contextual factors relating to the individual and their environment (Meyer et al., 2016).

Early signs of acquired hearing impairments such as presbycusis are subtle and their onset is gradual. Often, spouses and family members will notice a change in hearing ability before the person with hearing loss (Pacala & Yueh, 2012). Individuals may report reduced hearing sensitivity; poor clarity of sounds – particularly speech sounds); sound intolerance (or hyperacusis); localisation problems (the inability to discern the direction from which the sound is coming); and tinnitus (the perception of sound, such as ringing, buzzing or pulsatile noises, in the absence of external stimuli; Baguley et al., 2013; Weinstein, 2015). In contrast, sudden hearing loss, resulting from exposure to a sudden very loud impulse noise, physical trauma, or middle ear complications is immediately apparent, and may involve physical pain or discomfort (Kreuzer et al., 2012). Temporary hearing loss (sometimes called a temporary threshold shift) often occurs after exposure to loud sound or certain ototoxins. It is experienced as a reduction in hearing sensitivity – sounds seem 'muffled' but hearing returns to normal once the underlying cause of the hearing loss has resolved.

Hearing loss is categorised by its severity. In general, the greater the degree of hearing loss the more impact it will have on a person's everyday life. There are slight differences in how average hearing thresholds are calculated and the classification systems used, but Hearing Australia uses the hearing loss categories set out in Table 1. Hearing thresholds are considered 'normal' if they are less than or equal to 20 dB HL.

Table 1: Degrees of hearing loss [dB HL = decibels hearing level]*

Degree of hearing loss	Range (dB HL)	Description
Mild	21–40	Little impact for listening to conversational speech in quiet, but softer voices are difficult to hear and may have difficulty hearing in background noise.
Moderate	41–60	Conversational speech is hard to hear, particularly when listening in background noise.
Severe	61-80	Normal conversational speech is inaudible but can be heard with a hearing aid. Visual cues are needed to help understanding.
Severe to Profound **Profound**	81–90 91 +	A hearing device is needed to access sound. Extreme difficulty hearing, even with a device.

* This scale compares a person's hearing thresholds to 'audiometric zero' – the average hearing level at each frequency for young adults with normal hearing.

Numerous research studies have examined the experience of hearing loss and its impact on individuals. As mentioned above, the impact of hearing loss is complex and multifactorial, and the lived experience of individuals with hearing loss is determined by a range of factors. Despite these individual differences, there is strong evidence that living with hearing loss is likely to have significant impacts on the individual's emotional, social and functional wellbeing, with research demonstrating increased anxiety and stress; reduced ability to communicate; increased rates of social withdrawal; feelings of isolation and negative self-image amongst people with hearing loss when compared to the general population (Hétu et al., 1988; Hallberg & Carlsson, 1991; Arlinger, 2003; Carlsson et al., 2011; Granberg et al., 2014; Weinstein et al., 2016).

For many Australians who identify as culturally Deaf (most of whom communicate in Auslan – Australian Sign Language), the sensory impairment itself is not regarded as a disability. Rather, within the Deaf community, members may experience little to no difficulties arising from lack of hearing. Instead, the activity limitations and participation restrictions that they experience arise from a lack of awareness by others in the broader Australian community of their unique language and cultural identity and the communication breakdowns that occur as a result.

2.4. Current solutions

The main approaches to managing hearing health in Australia include early detection, audiologic rehabilitation, and community education and support.

Early detection of hearing loss

Newborn hearing screening commenced in Australia in 2002. A simple non-invasive procedure is used to detect a baby's auditory brainstem responses and screen for hearing loss. Each state and territory administers its own program, and together the programs screen the vast majority of Australian newborns within the first month of life. This ensures that infants with hearing loss are fitted with hearing devices as soon as possible in order to maximise their access to speech and language. Hearing loss may develop at any age, and early detection provides the best opportunity for effective rehabilitation, however, there are no national screening programs in place for older children or adults. Beyond newborn hearing screening, detection relies on identification by the individual or those responsible for their care (e.g., family members, educators, or medical practitioners). In adults, hearing loss often goes unnoticed for several years, with caregivers and family members usually the first to notice a person's hearing problems.

Hearing devices and implantable technology

Hearing rehabilitation usually involves provision of hearing devices (hearing aids, cochlear implants, and other assistive listening devices), together with some form of hearing and/or communication training. Hearing aids amplify sounds and include technological features, such as directional microphones and automated noise reduction, that are designed to improve hearing in challenging listening conditions (Taylor & Mueller, 2011). In recent years, hearing aids have become increasingly smaller and the technology inside them has become very sophisticated. There are two main styles of hearing aid: 'behind the ear' hearing aids, which are most common, and 'in the canal' hearing aids, which are partially or completely inserted into the ear canal. For conductive hearing losses, bone conduction hearing aids may be fitted. These hearing aids bypass the middle ear and apply vibrations to the side of the head in order stimulate the cochlea through the surrounding bone.

Cochlear implants are an option for people with severe to profound sensorineural hearing loss, and are comprised of two elements: an external device (which includes a microphone and speech processor) and a surgically implanted component, which converts sound into electrical signals to stimulate the hearing nerve in order to generate perception of sound in the brain. The rehabilitation that is provided to individuals after they are fitted with a hearing aid or cochlear implant varies significantly, but the emphasis is on improving listening ability and communication skills (Ferguson & Henshaw, 2015).

Assistive listening devices are technological devices that help people to hear more clearly in certain situations, and they are usually paired with a person's hearing aids. For example, FM systems are used in classrooms to stream the teacher's speech from a microphone directly to a child's hearing aids. Other devices stream audio directly from the television or the phone, and more recently, a range of tabletop devices has become available to help people hear better in multi-talker situations, such as meetings or social gatherings.

A new category of hearing devices has emerged in recent times. These devices are not fitted by an audiologist, but are purchased directly from the supplier, and are therefore known as over-the-counter or direct-to-consumer hearing aids. Hearables have also become more popular recently (Hunn, 2016). These are not hearing aids per se, but they provide the listener with similar features (enhanced speech recognition and noise reduction capabilities) that improve hearing. They are designed to look more like consumer electronics and are more affordable and accessible than traditional hearing aids (Edwards, 2020).

Hearing healthcare service delivery

Hearing healthcare is provided by audiologists – health professionals who have completed post-graduate training in the field of audiology. Their role is to offer a full range of audiological services, which includes diagnostic hearing assessments, and rehabilitation, which involves helping people with hearing loss to use hearing aids, other assistive devices and communication strategies to improve their ability to communicate. Some audiologists may specialise in paediatric audiology or cochlear implants, while others may have expertise in hearing-related conditions, such as tinnitus or balance disorders.

Audiologists work closely with GPs and ear nose and throat (ENT) specialists, and clients will be referred for further investigation if there is an indication of a medical condition underlying a person's hearing loss. For example, an asymmetrical hearing loss may be referred to an ENT specialist to rule out presence of a tumour or other pathology. ENT surgeons conduct surgery to correct treatable hearing conditions, such as insertion of grommets to resolve chronic middle ear infections; and they also perform cochlear implant surgery.

In Australia, most audiology services are delivered through the government hearing service provider, Hearing Australia, or private clinics, which may operate independently or as part of a large chain. There are some state-based hearing services in hospitals and community health settings, with considerable variation from state to state. Delivery of hearing services using teleaudiology is becoming more common, with recent advances in communication technology enabling clients to access audiology services remotely. The recent impact of COVID-19 has seen the rapid adoption of telehealth services by audiologists (and other health practitioners), and the Australian Government has introduced temporary Medicare Benefits Schedule items to support this alternative to face-to-face service delivery.

Hearing assessments involve otoscopy (observation of the eardrum and ear canal to assess for middle ear disease); tympanometry (a test of middle ear function); a hearing test or pure-tone audiometry (to determine a person's hearing thresholds, i.e., the softest sounds that can be heard) and tests of speech understanding. Although these assessments are usually performed by audiologists, they may also be provided by an audiometrist, audiometry nurse, or industrial hygienist (in cases where the hearing test is required for occupational health purposes). These practitioners are hearing health technicians, who have been trained in audiometric testing.

Some organisations offer hearing screening or 'free hearing checks'. These are short tests that assess a person's hearing at a limited number of frequencies to determine whether a full hearing assessment is warranted.

Community education and support

The role of hearing health advocacy groups and support agencies is to empower individuals with hearing loss and their families to make informed decisions about their hearing care. Organisations such as Better Hearing Australia, Hearing Matters Australia, Hear For You and Tinnitus Australia provide information on hearing health and its management, and also offer and peer-to-peer mentoring and support programs to people with hearing loss. More information is provided in sections 3 and 4.

2.5. Costs associated with hearing loss and benefits of treatment

The benefits of treating hearing loss in children as early as possible is well supported by a large body of research. Children whose hearing loss is identified by six months of age demonstrate significantly better language outcomes than children identified at a later stage (Yoshinaga-Itano et al., 1998; Moeller, 2007; Ching et al., 2013). NAL's Longitudinal Outcomes for Children with Hearing Impairment (LOCHI) study has tracked the progress of more than 400 Australian children born with hearing loss since 2005. Results show that early fitting of hearing aids and/or cochlear implants is crucial for children to achieve better speech, language and functional performance outcomes (Ching et al., 2018). Early detection and fitting of devices is also associated with improved cognitive outcomes and psychosocial development in these children (Wong et al., 2018).

In adults, hearing loss negatively impacts communication and social engagement with others, which leads to poorer health and wellbeing (Davis et al., 2016). The psychosocial consequences of untreated hearing loss are complex, and include social isolation (Heffernan et al., 2019), loneliness (Pronk et al., 2011), mental health problems (Mener et al., 2013) and reduced quality-of-life (Davis et al., 2007). Untreated hearing loss is associated with an increased risk of cognitive decline (Dawes et al., 2015; Lin et al., 2013), dementia (Lin et al., 2011), falls (Viljanen et al., 2009), hospitalisation (Genther et al., 2015) and healthcare utilisation (Reed et al., 2019). Furthermore, hearing loss is the top modifiable risk factor for dementia (Livingston et al., 2017). The economic costs of hearing loss are substantial, approx. $12 billion annually from healthcare expenditure, reduced workforce participation, and loss of productivity (Access Economics, 2006). These costs will only increase as the population ages, and it is therefore critical that hearing loss is managed effectively to minimise the negative consequences not only for individuals, but to reduce the societal burden as well.

Section 3 – Existing hearing services available to the Australian public

3.1. Hearing services in Australia

The provision of hearing services in Australia is complicated, and the staged introduction of the National Insurance Disability Scheme (NDIS), in addition to the Government's Hearing Services Program (HSP), has contributed to the complexity. However, the arrangements for hearing services from 1 July 2020 have recently been confirmed, and up-to-date details can be found at: https://www.ndis.gov.au/understanding/ndis-and-other-government-services/hearing-supports.

In general, hearing services for children in Australia are well funded and there are strong service and support mechanisms in place for this group. Similarly, aged pensioners and Aboriginal and Torres Strait Islander people over 50 years of age are well supported by the HSP. However, there is a lack of support for people with hearing impairment between the ages of 26 and 64 years, who do not meet the requirements of either the HSP or the NDIS.

3.2. Hearing health diagnostic and rehabilitation services and costs

Infants and pre-school children

For children aged 0-6 years who are diagnosed with a hearing loss, there is a special pathway for families to follow. The pathway has been devised by Hearing Australia and the National Disability Insurance Agency (NDIA). Hearing Australia is the sole provider of hearing services for this group under the Community Service Obligation (CSO) component of the Government's HSP. The NDIS operates alongside the HSP, with the HSP providing hearing services, while the NDIS funds additional early intervention support that is critical to achieving the best outcomes for each child. This is in line with the NDIA's 'early childhood early intervention' (ECEI) approach, which applies to all disabilities, including hearing.

When an infant or young child is diagnosed with a permanent hearing loss (that is greater than or equal to 25 dB HL in either ear at two or more adjacent frequencies) and needs a hearing aid, they are referred to Hearing Australia. When a problem is identified through newborn hearing screening, the child is first referred to a diagnostic service to confirm the hearing loss. The arrangements differ in each state, but diagnostic services for babies and children are generally provided by audiology departments of children's hospitals and other state-run hearing services. Where these services are publicly funded, there are no out-of-pocket costs for families. Private children's hearing centres offer hearing tests and Hearing Australia also perform children's hearing tests on a fee-for-service basis. The cost of a children's hearing test can range from $80 to $175 (see Appendix A). Medicare rebates are available, with higher rebates for certain tests and for those performed on special populations, such as children with autism (see Appendix B). Some private health insurers provide benefits to offset these costs (see Appendix C).

Children aged up to 26 years are provided with hearing aids from Hearing Australia. If the child's hearing loss is in the severe to profound range, they may receive only limited benefit from hearing aids. These children will be referred to a centre specialising in cochlear implants. The cost of the implants and associated hospital costs and ENT surgery fees are covered by state government funding through hospitals, and through private health insurance where available. Repair services, speech processor upgrades, and batteries are covered through Hearing Australia.

Hearing Australia helps families apply for the NDIS at the first appointment or families can do this independently. Hearing Australia forwards the child's hearing loss diagnosis to the NDIA and they will then receive confirmation that they have access to the NDIS, i.e., they become an NDIS participant. An NDIS planner then contacts families to help develop the child's NDIS plan. This plan will provide funding for early intervention supports that the child needs, and families can choose which early intervention providers to use. These centres provide multi-disciplinary care, with speech pathologists, audiologists and psychologists providing a range of services for families. Some examples in different states are listed in Table 2. Most of these centres are members of 'First Voice' (https://www.firstvoice.org.au/) – an advocacy organisation that represents early intervention services that provide support for children with hearing loss to help them listen and speak.

Table 2: Early intervention services for children with hearing loss in Australia.

State	Service	Website
NSW & outreach support for rural/ remote Australia	Royal Institute for Deaf and Blind Children (RIDBC)	https://ridbc.org.au/
	Catherine Sullivan Centre (an RIDBC service)	https://www.catherinesullivancentre.org.au/
NSW, ACT & outreach support for rural/remote Australia, including Tasmania	The Shepherd Centre	https://shepherdcentre.org.au/
Victoria	Taralye (an RIDBC service)	https://taralye.org.au/
	Aurora School for Young Deaf and Deafblind Children	https://www.auroraschool.vic.edu.au/
SA	Can:Do 4 Kids, Townsend House	https://www.cando4kids.com.au/
	Cora Barclay Listening and Spoken Language program (part of Can:Do 4 Kids)	http://www.cando4kids.com.au/cora-barclay-listening-and-spoken-language-gr/
QLD	Hear and Say	https://www.hearandsay.com.au/
WA	Telethon Speech and Hearing	https://www.tsh.org.au/

Children and young adults under 26 years of age

For those aged between 7 and 25 years, the pathway is similar to the pathway for younger children, except for the fast-tracking provisions that are in place to ensure that children aged 0-6 years receive their hearing devices and enrol in an early intervention program within a matter of weeks. That is, when a child or young adult is diagnosed with a permanent hearing loss (that is greater than or equal to 25 dB HL in either ear at two or more adjacent frequencies) and needs a hearing aid, they are referred to Hearing Australia and they also apply to become participants in the NDIS at this time.

As for infants, free diagnostic services for children are found within audiology departments of children's hospitals and other state-run hearing services. Private children's hearing centres and Hearing Australia can also provide hearing tests for children and young adults, with Medicare rebates and private health insurance benefits available to offset the costs. See Appendix B.

Hearing aids are provided by Hearing Australia under the CSO component of the Government's HSP, and cochlear implants are recommended for those with hearing loss in the severe to profound range, who receive limited benefit from hearing aids. Implantation surgery is performed by an ENT surgeon and the funding arrangements are the same as for infants: costs are covered by state government funding and private health insurance where available, while repairs, speech processor upgrades and batteries are covered through Hearing Australia.

NDIS funds cover the cost of additional support for children, including assistive technology and school-support programs. Most of the service providers listed in Table 2 provide school-support programs in addition to the early intervention services offered for preschoolers. Some school systems, such as the NSW Department of Education, employ itinerant teachers of the deaf to support students with hearing loss as they progress through school.

Adults aged 26 years and over

For adults aged 26 and over who have a permanent hearing loss, their access to hearing services depends on which eligibility criteria they meet. They may access:

1. The Voucher component of the HSP
2. The CSO component of the HSP
3. The NDIS
4. Self-funded hearing services

The Voucher component of the HSP. This option is for aged pensioners, war veterans, and others receiving specified government benefits, who have a hearing loss that is greater than or equal to 23 dB HL (calculated using the average hearing thresholds at 500, 1000, and 2000 Hz in one or both ears), but who do not meet the NDIS criteria (see below). In some cases, people with milder hearing losses may also be eligible but they have to meet two additional criteria to demonstrate their need. To obtain access to hearing services through the HSP, people must apply for a voucher, which may then be used at one of 280 different service providers – this includes Hearing Australia, a wide range of private hearing service providers (e.g., Connect Hearing, National Hearing Care, Specsavers, Bay Audio), and numerous smaller independent clinics. All providers offer fully and partially subsidised hearing aids, a subsidised maintenance program to cover the cost of batteries and minor repairs for a small fee (approx. $50 annually), and audiological services including assessments, follow-up, counselling and support. Hearing aids can be provided at no cost to the client (if they choose a fully subsidised device) or they can cost up to around $6,000 for a pair of partially subsidised hearing aids with the highest level of technology.

All services provided under the HSP must be conducted in accordance with guidelines set by the Department of Health, including the type of service and the devices that are provided. The Department also determines the schedule of fees payable for each service and device, and these are paid directly to service providers, who then provide the fully or partially subsidised devices and services to their clients. Until recently, participation in the program required referral from a GP. However, since 1 October 2019, eligible individuals may apply directly online, or through a HSP provider.

The CSO component of the HSP. This option, which is also referred to as Specialist Hearing Services, is for aged pensioners, war veterans, and others receiving specified government benefits, who have complex communication needs, such as a profound hearing loss (>80 dB HL), significant visual impairment in addition to a hearing impairment or other disabilities that heighten communication difficulties. In addition, Aboriginal and Torres Strait Islander people with hearing loss, who are aged 50 years and over are also eligible. The sole provider of CSO services is Hearing Australia, who will provide fully subsidised hearing aids and other assistive devices such as remote microphone systems. For cochlear implant recipients, Hearing Australia provides speech processor maintenance and repairs. In some cases, a person may become eligible for the CSO component of the HSP while they are using a voucher with another hearing service provider, and in most cases they will transfer to Hearing Australia at this time.

The NDIS. To access hearing support as an adult through the NDIS, an individual needs to meet the relevant eligibility requirements. That is, they must be aged under 65, and have a permanent hearing loss that is 65 dB HL or more (calculated using the average hearing thresholds at 500, 1000, 2000 and 4000 Hz in their 'better' ear); or they may have a milder hearing loss, but in conjunction with other permanent impairments (e.g., vison or cognitive impairments) or they may demonstrate substantially reduced functional activity due to poorer than expected speech perception). For those who also meet the requirements of the HSP (Voucher or CSO components), subsidised hearing aids are provided through the HSP, whereas the individual's NDIS plan funds the cost of additional supports, including Auslan interpreter services and a range of assistive technologies (alert systems (vibrating or flashing smoke alarms), wireless streaming devices (for the TV, phone or group conversations), remote controls, cochlear implant speech processor accessories (including waterproof accessories) and speech processor upgrades). For NDIS participants who do not meet HSP eligibility requirements, NDIS funding can be used to cover the cost of hearing assessments, hearing aid fittings and devices, and additional supports.

Self-funded hearing services. For people who do not meet the criteria for the HSP Voucher or CSO components, or the NDIS, they will need to self-fund the cost of hearing devices, maintenance and all audiological services. Hearing assessments are available from Hearing Australia and a wide range of audiology providers. The cost varies from around $49 to $250 (see Appendix A). As shown in Appendix B, Medicare rebates are claimable for hearing assessments. The scheduled fee for a standard audiogram is $21.40, a more comprehensive hearing assessment is $61.70, and for specialised audiometry that assesses hearing using brainstem responses, the fee is $156.40. Higher rebates are paid for certain tests performed on special populations, such as adults with complex care needs. Medicare rebates for audiology services vary depending on who conducts the test, and most require a referral in order to claim the Medicare rebate. Some private health insurers also provide benefits for hearing assessments, subject to waiting periods. Private health insurance benefits range from $17-$80 per assessment, and annual limits range from $80-$1,400. See Appendix C.

In cases where a person has developed a hearing loss as a result of their job, they may be able to make a workers' compensation claim for the costs of their hearing assessment and hearing aids and/or they may claim lump sum compensation through the relevant state workplace insurance provider, e.g., such as the State Insurance Regulatory Authority in NSW, WorkCover in Queensland, etc. Arrangements vary from state to state, with each authority specifying the level of compensation payable for the degree of hearing loss, and whether assessments can be conducted by audiologists or ENT specialists.

3.3. Hearing devices

A summary of the approximate costs of hearing devices is provided below, as at April 2020.

Hearing aids

The cost of hearing aids can range from around $1,500 to $15,000 per pair (see Appendix D), and those who are self-funded may be able to access private health insurance to offset these costs. Almost all (24 out of 26) of the health funds listed in Appendix C provide benefits for hearing aids. The benefits range from $400-$2,000 and limits are applied over one, three or five years. Four funds provide rebates for hearing aid repairs – up to $100-$150 annually, and one health fund provides a rebate for hearing aid batteries, with an annual limit of $200. Most private health insurers require clients to serve a waiting period before accessing benefits – and this ranges from 12 to 36 months.

There are a number of hearing aid banks that help low-income people access hearing devices. For example, Hearing Matters Australia collects unused hearing devices, and has them checked and reprogrammed before they are offered to eligible clients for a small fee at the Macquarie University Hearing and Speech Clinic. To be eligible for the hearing aid bank the person must hold a Government Health Care card or be a low-income earner.

Cochlear implants

The cost of cochlear implants is approximately $30,000 – which includes the costs of the device and associated ENT surgery fees. Bone-anchored hearing aids, which are suitable for certain conductive hearing losses, also require surgery and cost approximately $10,000. In some cases, and depending on eligibility, funding for adult cochlear implant surgery may be provided by the Department of Veterans Affairs or the relevant State Government. Arrangements vary between states with wait lists for adults between 12 and 36 months. Some funding may also be available through private health insurance or charitable support.

Hearables and personal amplifiers

Some people with hearing difficulties, who are not yet ready for a hearing aid, may opt to purchase a hearable or personal amplifier – a wireless in-ear device that supplements and enhances listening for people with hearing difficulties. There are various models available, and they cost around $300-$500. These can be purchased over-the-counter as a private customer, and some devices are also available through the HSP for voucher clients.

3.4. Support services

Adults

There are several not-for-profit organisations, charities, and support groups that provide information and support to adults with hearing loss. Many of them also provide services, including audiology, NDIS planning, employment assistance, and Auslan interpreters. Some of the main groups are:

- Deafness Foundation https://deafness.org.au/
- Hearing Matters https://www.shhhaust.org/
- Better Hearing Australia http://www.betterhearingaustralia.org.au/
- Deafness Forum of Australia https://www.deafnessforum.org.au/
- Deafblind Australia https://www.deafblind.org.au/
- The Deaf Society https://deafsociety.org.au/
- Deaf Australia https://deafaustralia.org.au/
- Able Australia https://ableaustralia.org.au/
- Expression Australia https://www.expression.com.au/
- Cicada Australia https://www.cicada.org.au/
- John Pierce Centre Victoria https://www.jpc.org.au/
- Deaf Can:Do South Australia https://www.deafcando.com.au/

Other support services include the National Relay Service (NRS) – a Federal Government service that allows people who are deaf or who have a hearing or speech impairment to make and receive phone calls. The National Auslan Interpreter Booking and Payment Service (NABS) provides interpreters for people who use sign language and need an interpreter for private medical appointments. NDIS participants can fund these services under the NDIS plan. Sign for Work is a free Specialist Disability Employment Service that helps deaf and hard of hearing jobseekers find work and organise the supports and modifications they may need in the workplace.

Children

There are a number of support organisations aimed at helping to support children with hearing loss and their families. In addition to the early intervention services listed earlier, other groups include:

- Aussie Deaf Kids https://www.aussiedeafkids.org.au/
- Deaf Children Australia https://www.deafchildrenaustralia.org.au/
- Parents of Deaf Children https://www.podc.org.au/
- Hear for You https://hearforyou.com.au/

Section 4 – Analysis of potential target groups for awareness campaign

4.1. Introduction

The following section provides an overview of the target groups agreed by the Department of Health and NAL as potential recipients of messages as part of a national hearing awareness campaign. These groups were selected based on existing research highlighting the risks for individuals within the groups to experience hearing loss. The seven target groups featured in this section are:

1. Young children and caregivers
2. Teenagers/young adults exposed to recreational noise
3. People with untreated or developing hearing loss aged 50-75 years
4. Aboriginal and Torres Strait Islanders
5. People exposed to occupational noise
6. Farmers
7. People living in rural and remote locations

The content covered for each target group includes the hearing issues facing the group, the hearing services (or touchpoints) available, and potential gaps in information and services. For each group, the main focus of their hearing issues is either *prevention* or *rehabilitation* (i.e., treatment) of hearing loss. For example, groups 1 and 3 need access to appropriate diagnostic services to enable *rehabilitation* (or treatment) of hearing difficulties. For them, the main focus is therefore on identifying common symptoms, and motivating and empowering individuals to seek help at the appropriate time. In contrast, for groups 2 and 5 maintaining good hearing health is centred more around the *prevention* of hearing loss arising from noise exposure. For groups 4 and 6, good hearing health involves both *prevention* and *rehabilitation*, and this is also the case for group 7, since it includes members from all of the other target groups.

Included for each group are details of any current and previous hearing campaigns and hearing-related initiatives. This information is provided to avoid duplication of effort, and to reduce the potential for conflicting or confusing messaging to these groups. Finally, recommendations for potential strategies to support each group and address their needs in relation to hearing health behaviours and awareness gaps is provided.

At the end of this section, we present results of a prioritisation exercise using the TARPARE model. This model is designed to assist public health practitioners in understanding the various target groups in a population of interest and assessing the potential viability of messages directed at each group (Donovan et al., 1999).

4.2. Target group 1: Young children and caregivers

4.2.1. Hearing issues facing this group

Children aged 0-12 years represent a unique group when it comes to hearing health awareness. For this group, hearing health engagement is generally undertaken by others on their behalf – predominantly caregivers. For most young children, hearing health is only considered when diagnostic and rehabilitation services are required – that is, when a hearing problem is noticed, or hearing help is required. Hearing issues facing this group and subsequent pathways vary according to the nature of the loss, and the age at which it occurs.

Access Economics estimates that childhood hearing loss prevalence in Australia is 1.2 births per 1000 live births for hearing losses developed up to the age of 4 years, with 3.2 per 1,000 experiencing hearing losses between 4 and 14 years of age. Hearing loss in early childhood takes on particular significance because it is 'prelingual', and therefore has the potential to impact on speech and language which is developing during this time period.

Sensorineural hearing losses may be present congenitally (detected through newborn hearing screening) or result from other causes during early childhood. There are a number of potential causes of childhood hearing loss, including genetics, birth complications, and viral infections. However, in many instances, the exact cause of a child's hearing loss cannot be determined, and in any case, aetiology is generally not a significant factor for decision making about subsequent treatment.

In contrast, the impact of hearing loss and available treatment options is very much influenced by the level of hearing loss. For children up to the age of 15 years, the majority of hearing losses are classified as mild or moderate (36.7% and 38.3% respectively), and there are smaller, rates of severe and profound hearing losses (13.3% and 11.7% respectively) (Access Economics, 2006).

The presence of additional disabilities also impacts on the experience of childhood hearing loss. Approximately one-third of children with a hearing loss have a significant additional disability, including autism spectrum disorder, cerebral palsy, developmental delay, and/or vision-related difficulties (Cupples et al., 2018). For these families, there are multiple services and interventions to manage alongside hearing services.

A large number of young children may also be impacted by conductive hearing losses resulting from middle ear infections (otitis media), where fluid is trapped behind the eardrum and is often accompanied by pain and fever. The conductive hearing loss resulting from middle ear infections may fluctuate, and it is not uncommon for small children to experience multiple infections, often during or after a cold. Where pressure from fluid build-up is very high, the eardrum may burst, with discharge occurring from the ear. Repeated ear infections can result in 'glue ear' (otitis media with effusion, OME), so named when the fluid in the ear is trapped and thickens, like glue.

4.2.2. Current hearing services available to this group

Identifying hearing difficulties in neonates

Newborn hearing screening commenced in Australia in 2002, providing free screening to infants using the automated auditory brainstem response (AABR). Administered separately by each state and territory, these programs test the hearing of over 95% of newborns within their first month of life (Australian Government, 2017). It is one of many health checks provided to newborn infants and generally occurs before babies are discharged from hospital. Results of newborn hearing screening are noted in the child's Personal Health Record (in many states colloquially known as the 'blue book') on a dedicated page for 'Statewide Infant Screening'.

Where a newborn passes the hearing screening, no further follow-up testing is conducted. However, families may be recommended to monitor hearing with follow-up assessments over time, particularly if a child is considered 'high risk' (e.g., where there is family history of hearing loss).

Newborn hearing screening aims to detect the presence of a permanent hearing loss. However, failure to pass the screening may also result from temporary hearing impairment due to the presence of fluid in the ear after birth. Thus, babies who fail the test in the first instance undergo repeat screening to confirm the result before proceeding to follow-up. Babies who fail both hearing screenings are referred to a diagnostic service for a full hearing assessment.

Diagnostic hearing services provide a comprehensive hearing assessment, which often includes diagnostic imaging (e.g., MRI). Where permanent hearing loss is confirmed, children are referred for hearing services to Hearing Australia, where children are seen by an audiologist within two weeks. Hearing Australia is currently the sole provider of hearing services to all children with hearing loss up to the age of 26 years. See section 3 for further information about rehabilitation services for children.

Identifying hearing difficulties in childhood

Following newborn screening, the onus is generally on caregivers to be aware of potential signs of hearing difficulty and to take responsibility for monitoring their child's hearing. The child's Personal Health Record includes questions for caregivers about whether they (or others) have concerns about their child's hearing. These checklist items are repeated at various health check timepoints. However, in many cases, families do not consider their child's hearing unless other concerns occur where hearing may be implicated, such as ear infections, behavioural issues, or developmental or language delays.

Ear infections

Children with ear infections are most likely to first present to GPs for treatment. For otitis media, treatment options are primarily aimed at reducing associated pain with appropriate analgesic methods, and antibiotics may also be prescribed. Monitoring is recommended to check for progression to otitis media with effusion, which may occur asymptomatically.

Whilst the impacts of otitis media tend to be temporary, repeated infections do have the potential to cause damage that leads to a permanent hearing loss. In these cases, managing OME requires careful monitoring with long-term or repeated cases referred to specialist ENT services for further investigation. Some cases will require surgery to insert small tubes known as 'grommets' into the child's eardrums to help fluid drain from the ears and prevent recurrent otitis media (Browning et al., 2010; Venekamp et al., 2018). Surgery is generally considered only when glue ear has been present for at least three months, or where a minimum of three ear infections have occurred in a 6-12 month period.

The procedure is performed under general anaesthetic, and is classified as elective surgery. Costs can vary, with reported average costs ranging from $800-$2,000, and waiting times also vary. In 2018/19, there was a median wait time of 68 days (AIHW, 2019). Accessing ENT services is problematic with overall ENT wait lists increasing from a median wait time of 66 to 84 days between 2011/12 and 2018/19. In some cases where there is an extended wait time for ENT services – particularly in rural/remote areas children may be referred for hearing aids or other devices to mediate the effects of conductive hearing loss experienced while waiting for further treatment.

Developmental/language delays

Families may be referred to hearing services at any time throughout childhood where language delays or behavioural issues occur. In many cases concerns do not immediately relate to hearing, but hearing assessments are often conducted as part of a standard investigative battery. Those who work with paediatric clients note common triggers that prompt such help-seeking in early childhood include speech and language delays (commonly around 18 months), or concerns about developmental delays (including autism; around 3-4 years). In later childhood, difficulties with concentration, learning, or behaviour may result from underlying (undiagnosed) hearing problems. These may become particularly noticeable when a child starts school and is faced with the complex listening environment in the classroom. Caregivers usually raise their concerns with a trusted health professional (such as a child health nurse or GP) or a teacher or early childhood educator may identify a problem and suggest further investigation.

Some early childhood centres and private providers offer hearing screening/assessments as part of school-readiness programs, but these do not reach all families. Currently, evidence to support the efficacy of school screening is limited. The need for further investigation to evaluate long-term value of such programs is a key action in the *Roadmap for Hearing Health* (2019). One strategy currently under investigation is the use of hearing screening apps to encourage hearing checks at this critical period. For example, the Australian-developed Sound Scouts embeds a variety of hearing checks within a game aimed at detecting common hearing difficulties early. The Australian Government has provided $4 million to fund the rollout of this program with the aim of assessing 600,000 school aged children over a 5-year period.

Currently, Hearing Australia provides free hearing assessments only for children known or suspected to have a significant hearing loss or who have high-risk factors (such as a family history of hearing loss). Alternatively, caregivers may access free hearing assessments through state-based diagnostic hearing services, however availability of these services is limited, often resulting in lengthy delays. Families also have the option of booking a fee-for-service hearing assessment, either at a private provider or with Hearing Australia (who may subsequently waive the fees if children are found to have a permanent hearing loss and are therefore eligible for the CSO component of the HSP).

Following diagnosis: Accessing hearing services

After children are diagnosed with a hearing loss, families have access to a range of rehabilitation and intervention services aimed at minimising the impact of the hearing loss and maximising language and social development.

As outlined in section 3, the Australian Government provides children with access to hearing rehabilitation services, including hearing aids, up to the age of 26 years, free of charge. Under this program, children visit Hearing Australia on a regular basis for assessment and monitoring by paediatric audiologists, who also provide advice and support to their families. Hearing Australia is generally the first contact for families, and the primary source of information and advice about the many hearing-related choices in front of them.

One of the first decisions that caregivers must make is whether to obtain a hearing device for their child. The devices that are most commonly fitted to children with hearing loss are either hearing aids or cochlear implants. Because the evidence shows that early fitting of hearing devices is associated with significant benefits for language development (Ching et al., 2018), discussions and decisions about hearing devices are generally made as soon as possible after a diagnosis is confirmed.

If considered appropriate, children receive hearing aids. Children with more severe hearing loss who receive only limited benefit from hearing aids will be referred to a cochlear implant centre to undergo assessment to determine their candidacy for implantation. Activation of the device occurs a few weeks after surgery, and families are provided with rehabilitation exercises and support which aims to maximise the benefit provided by the device.

Whether a child is fitted with a hearing aid or cochlear implant, they require ongoing services to monitor their hearing and ensure that the device(s) used are appropriate for their needs. Families have regular contact with audiologists and hearing rehabilitation professionals who regularly assess hearing levels and provide information and advice about communicative strategies and other assistive listening devices, such as FM systems.

In some cases, caregivers of children decide that a hearing device is not suitable for their child. For example, children with a mild or unilateral hearing loss may not be fitted with a hearing aid, or children from culturally Deaf families who use Auslan to communicate may decide against a hearing device. In other cases, absence of an auditory nerve precludes use of a hearing device.

Early intervention and support services

Audiologists are just one part of children's early intervention support network, alongside other professionals who provide additional speech and language therapy and educational support services.

For children with pre-lingual hearing loss, accessing early intervention services is strongly recommended for promoting language development (see Table 2). Agencies may offer an auditory-verbal approach which focuses on helping children make use of their residual hearing and the sounds provided through their hearing aids or cochlear implants to develop spoken language skills. Other programs provide access to Auslan, often in a bilingual program, where signing and spoken English are used. Sessions are conducted by qualified therapists in a one-on-one format or group sessions, or both. Caregivers are provided with information about the various intervention choices via Hearing Australia, and they may also seek out information or advice from other support services and agencies (see below).

A number of factors influence families' decisions about intervention services including the child's level of hearing loss, presence of other medical conditions/disabilities, geographical location, financial considerations and the family's desire for their child to acquire spoken and/or sign language.

Prior to starting school, families also find themselves carefully considering their choice of childcare centre or preschool. In a small number of cases, they may have access to a centre that specialises in supporting children with hearing loss (where these are available in their area), but in many cases local services may have no previous experience with hearing loss or use of hearing devices.

During primary school and high school, a number of services provide support to children with hearing loss and their families. The type and level of support varies depending on the needs of the child and the school attended. However, families will commonly seek support from their audiologist, and specialist support teachers such as itinerant teachers of the deaf who work within the school system to provide support to students and teachers. Most children with hearing loss are in mainstream school settings. Where additional support is required, children may also access teacher's aides, support classes (e.g., a hearing unit within schools), or other specialised school services to support reading development and other needs. Access to educational services is usually funded through the educational system in which the child is enrolled, based on their relevant policies, but this varies across states and between private and public school systems.

Supporting families

It is important that families themselves are supported whilst navigating the services and decisions for their child's hearing loss. Many families seek information from online sources. The Australian Government's parenting website provides impartial, general information about hearing loss in childhood (https://raisingchildren.net.au/disability/guide-to-disabilities/assessment-diagnosis/hearing-impairment) and NSW Health has published a guide for parents (https://www.health.nsw.gov.au/kidsfamilies/MCFhealth/Publications/hearing-loss-and-your-baby-the-next-step.pdf). Families may also access information from specific hearing organisations or services, such as RIDBC.

Contact with others who are, or who have been, in a similar situation can be extremely beneficial in helping families dealing with a whole new world of hearing. Organisations such as Aussie Deaf Kids have played an important role in providing support to families through access to independent information and resources across a range of topics. This charity works at providing online support and advocacy for children with hearing loss and collaborating with other relevant groups to improve services. They also facilitate parent-to-parent support through online discussion forums allowing families to share their experiences and advice. Similarly, Deaf Children Australia provides parent-to-parent support and access to additional resources. All of these groups include fact sheets about hearing loss and assessments, family life, educational support and hearing service information, parental support and so on.

Additional services

There are a number of other services that families of young children with hearing loss may access, the scope of which are wide-ranging. Where families have sufficient knowledge of what type of service they require, they can access information by searching online, or through various lists collated by other hearing-related services, such as the services directory compiled by Hearing Australia, https://www.hearing.com.au/Our-services/Find-other-services-support-for-your-child

4.2.3. Potential awareness and service gaps

As outlined above, a number of services are available in Australia to assist families look after their young child's hearing health from identification and diagnosis through to accessing rehabilitation, intervention and ongoing support. However, navigating these services is not always straightforward, and there are a number of gaps where access to information and improved awareness would likely result in better outcomes for children and their families. These are described below:

Nature of childhood hearing loss: Signs and symptoms

Newborn hearing screening provides an important opportunity to identify children at a time which offers the best opportunity to enable beneficial early intervention. It is not, however, intended as an awareness-raising activity. In fact, a lack of awareness that hearing loss can develop at any age can mean that some families are over-reliant on newborn hearing screening results, assuming (incorrectly) that a 'pass' at birth eliminates any risk of hearing difficulties later in childhood.

Caregivers may lack awareness of the importance of health hearing for social, scholastic, and linguistic development, and are less likely to view hearing as a concern compared to other health issues that are more prominent at key milestones (e.g., vaccinations and vision screening occur prior to starting school). Parents are rarely prompted to consider their young child's hearing health unless significant difficulties are noted.

A lack of awareness about the nature of hearing loss itself can also be a barrier for anyone responsible for a child with a hearing loss. Many people fail to understand that hearing loss exists on a continuum, and has impacts for listening clarity, particularly in background noise. Thus, hearing may not immediately be considered for children who have difficulty in some contexts but not others. Delays in diagnosis can occur when this lack of awareness means behaviours are mistakenly considered to be behavioural, cognitive or related to poor attention, and often hearing will not be included in investigations. Medical professionals themselves may lack awareness of when an investigation of hearing is warranted, and may fail to appropriately weight caregiver concerns about hearing when help is sought. Where no behavioural or cognitive concerns are raised, greater awareness of the behaviours associated with hearing difficulties and/or a checklist of age-appropriate listening skills (e.g., PEACH; Ching & Hill, 2007) can empower families and others around them to support children's hearing.

Hearing-related information and services in early childhood

Even where the issues outlined above do not exist, families may still be hindered when they attempt to seek hearing help for their child. For families with limited resources and/or in areas where access is more limited, stress and delayed diagnoses may result from difficulties understanding and navigating the necessary services. Where a hearing problem is identified or implicated, families need access to relevant, clear information about the services available, and appropriate pathways for help-seeking. Professionals, such as teachers and GPs, who advise families about these issues also need access to appropriate information to ensure that where hearing is implicated, they can help support caregivers to access help quickly and easily.

Access to ENT services

Accessing ENT services for middle ear infections can be delayed by lack of available services, especially in regional areas. The fluctuating nature of middle ear infections means that the accompanying hearing loss may also vary over time. It is important for families to be aware of this and to work with appropriate hearing professionals to monitor their child's symptoms and hearing. They also need to be aware that sometimes ear infections may be asymptomatic in nature, especially when glue ear develops after a history of repeated and often painful middle ear infections. A lack of awareness that children's hearing can be affected, even when no pain is present, can delay timely access to appropriate treatment.

Support for families of children with hearing loss

Where young children have been diagnosed with a hearing loss, caregivers are faced with a plethora of decisions to make on behalf of their child. Whilst hearing professionals are on hand to offer advice and support, it is ultimately the caregivers who must choose whether devices will be fitted, what services they will access, and any decisions about schooling. Awareness of the pros and cons of different options, and their limitations is important for making informed choices.

Even where some decisions may be reasonably straightforward from a hearing professional's point of view, for each parent the world of hearing loss is a new one. Childhood hearing loss experts suggest that the hearing referral process is often poorly understood by those outside of it, and there is a need for families to be able to access information and advice about childhood hearing loss and rehabilitation from a trusted independent source.

A further difficulty is the role of 'caregiver as advocate'. It often falls on families to explain their child's hearing loss to those around them and educate others (e.g., schools) about their needs. A greater awareness of hearing loss in the community would help to decrease this burden.

Recognising that hearing devices are not a 'cure'

Hearing devices can improve access to sounds, including speech, but they do not provide the same experience as unimpaired hearing. Difficulties will still arise in challenging listening environments, or when devices are not worn or are not functioning optimally. Greater awareness of the limitations of devices would reduce unrealistic expectations on children and their families.

Psychosocial support for teens with hearing loss

Finally, it has been noted that hearing services have a strong focus on technology and educational support. But those who work with children, teens, and young adult with hearing loss (e.g., Hear for You, Deaf Children Australia) note the importance of supporting psychosocial development. More awareness is required about the difficulties faced by children with hearing loss in non-educational settings – they need better support in terms of making and maintaining friendships and a stronger focus on mental health.

Hearing health promotion

Although the main focus of childhood hearing health is primarily rehabilitation for children with hearing loss, recent years have seen an increasing interest in maintaining hearing health. Increasing community interest in earmuffs for infants and children, and concerns about headphone listening suggest a need for greater information and awareness about steps that can be taken to promote good hearing health for life. With the exception of a few school-based programs (e.g., *Cheers for Ears* (ESIA, 2013) and *Hear4tomorrow* (NAL, 2012)), hearing loss prevention activities in Australia have predominantly focussed on older age groups. However, research shows that there may be benefit to introducing awareness early. An evaluation study of *Dangerous Decibels*, a US school-based hearing conservation program found that 4th graders were more likely than 7th graders to maintain improved attitudes to hearing health practices three months after completing the program (Griest et al., 2007).

4.2.4. Recommendations for strategies to support this group

There is widespread agreement that in Australia universal newborn hearing screening and government services provide strong support for childhood hearing loss. This is particularly true in the early years – an age where hearing health has significant implications for language, education, & psychosocial outcomes. As outlined above, many of the gaps that do exist are related to service accessibility – issues unlikely to benefit directly from awareness campaign strategies. Where awareness initiatives may be beneficial, however, is by supporting families as they navigate the unfamiliar world of hearing loss & deafness.

Recognising signs of hearing loss

Whilst prevalence of hearing loss in childhood is relatively low, potential consequences of not seeking assistance can be far-reaching. Thus, there is a need to support families so that they know when it is appropriate to seek help – encouraging them to consider hearing as an important aspect of their child's overall health. A focus should be on raising awareness of how hearing difficulties can impact development and behaviour in early childhood – targeted at those who are most likely to be in a position to notice potential signs of hearing difficulty. This includes not only caregivers but also trusted 'first-responder' professionals, such as community health services, GPs, and early childhood educators.

Information initiatives

Support is available for children with hearing loss in a variety of ways – but awareness of how to access it is often low for both parents and 'first-responders'. The complexity of the information that caregivers need to navigate to make decisions for their child means that information initiatives rather than awareness campaigns may be more appropriate. For example, providing a centralised, comprehensive, independent, accessible source of information would allow individuals to confidently seek out information relevant to their particularly needs at any given point in time.

Community awareness

Greater awareness of hearing health in the community generally is likely to be beneficial in minimising the barriers faced by families of young children with hearing loss. Where a community understands and appreciates the difficulties associated with hearing loss, children and families are more likely to feel supported. This can serve to minimise potential 'social disability' resulting from hearing loss, and improve mental health outcomes for both children and families.

4.3. Target group 2: Teenagers and young adults exposed to recreational noise

4.3.1. Hearing issues facing this group

Recreational sound exposure

Young adults and teenagers are at risk of hearing loss from recreational sound exposure, with young people engaging in a range of activities that have the potential to damage hearing. NAL research suggests that around 14.1% of young Australian adults may be at risk of hearing loss from leisure noise exposure (Beach, Williams, & Gilliver, 2013), which extrapolates to around 860,600 young people. The main sources of hearing risk – where sound levels are consistently high – are shown in Table 3. These participation data, collected during the Sound Check Australia project, show that a significant proportion of younger adults engage in loud sound exposures on at least a monthly basis.

Table 3: Number of Australians aged 18-34 years engaging in loud recreational activities events at least monthly. Percentages indicate proportion of young adult population.

Music-related events/activities	Size of population n (%)		Other events	Size of population n (%)	
Personal listening devices	4.64 million	(76%)	Sports events	1.13 million	(19%)
Live gigs	2.85 million	(46%)	Gym classes	1.08 million	(18%)
Nightclubs	2.65 million	(43%)	Shooting	236,000	(4%)
Concerts	1.48 million	(24%)	Motorsports	152,200	(2%)
Festivals	681,000	(11%)			

Young people who attend high-risk venues, such as nightclubs and live music venues, report experiencing early symptoms of hearing damage following high-volume exposures (Gilles et al., 2013; Smith et al., 2000). Accumulated noise exposure is also correlated with tinnitus and other symptoms of hearing damage (Williams & Carter, 2017; Beach, Gilliver & Williams, 2013). In a large sample of 11-to 35-year-olds, Williams and Carter (2017) found 63% had experienced tinnitus and people with higher levels of accumulated noise exposure were more likely to experience tinnitus more often. Furthermore, those who experienced tinnitus were more likely to notice deterioration in their hearing ability over time and to experience difficulties hearing in quiet and/or noisy situations. Similar results have been found in other studies conducted overseas (Moore et al., 2017; Davis et al., 1998).

While there is a clear link between tinnitus and recreational sound exposure in young people, measurable noise-induced hearing loss from recreational sound is unlikely to be observed until later in adulthood. This is because audiometric thresholds are not a sensitive enough measure for detecting the early stages of noise-related hearing damage. The early stages of damage occur at the neural level and the impact on auditory structures is not easily observed in humans, although it is well established in animals (Kujawa & Liberman, 2009).

Personal listening devices

Significant attention has been paid to personal music players as a hazard to hearing, with many media and academic reports indicating that use of these devices at high volumes will damage hearing. Studies have found that the output levels vary depending on the device and the type of earphones or headphones used, with maximum levels in the range of 97-107 dBA (Keith et al., 2008; Williams & Purnell, 2010). Loud volumes are most common when listening occurs in high background noise levels, such as when travelling on public transport. This is because people tend to compensate for the poor listening conditions by increasing the volume on their devices. Differences between output levels for different devices/earphone combinations make it difficult to quantify the volume setting that constitutes a potentially risky listening level. However, general guidelines suggest that the volume should be set below 70-80% of total volume, and listening times should be restricted to around 90 minutes per day (Portnuff et al., 2011).

In 2008, the EU's Scientific Committee on Emerging and Newly Identified Health Risks identified the potential health risks relating to noise exposure to noise from personal music players and mobile phones (SCENIHR, 2008). More recently, the WHO has been actively promoting safe headphones listening through its Make Listening Safe initiative (see below). However, self-report and objective measurements of MP3 listening volumes suggest that the majority of users are listening at relatively safe levels (Williams, 2009; Gilliver et al., 2012), although young users are more likely to listen at louder volumes and for longer periods than older counterparts. A recent study of over 4,000 Australians found that the listening behaviour of 17% of 18-to 35-year-olds put them at risk of hearing loss (Gilliver et al., 2017). Even though only a small proportion of users are listening at potentially risky levels, the widespread use of these devices equates to a large number of users overall.

As with loud sound exposure from other leisure activities, listening to music through personal listening devices in and of itself is not associated with increased rates of hearing loss. There is, however, evidence that use of personal listening device use is associated with early signs of hearing damage in the form of poorer extended high-frequency hearing thresholds (Kumar et al., 2017), reduced otoacoustic emissions (Sulaiman et al., 2014), and temporary hearing threshold shifts (Keppler et al., 2010). Furthermore, since the risk to hearing is from cumulative noise exposure, these devices represent a potentially significant contribution to overall exposure.

4.3.2. Current hearing campaigns and initiatives for this group

KnowYourNoise

There are only a handful of campaigns aimed at raising awareness amongst young people exposed to loud sound. Know Your Noise (http://knowyournoise.nal.gov.au/) was developed by NAL and the Hearing Cooperative Research Centre in 2014. It is an outreach website targeted at young Australians with a focus on music and leisure noise. It comprises an online speech-in-noise test, and risk calculator allowing users to determine whether they are at risk for hearing loss based on their noise exposure activities. The results provide a breakdown of how each of their exposures contributes to their overall risk. Participants are also provided with advice and tips on how to manage their noise exposure. During the past 12 months, more than 35,000 users have visited the site (which has grown from 9,800 annual users in the first 12-month period). An evaluation study (Gilliver & Beach, in preparation) has demonstrated that the Know Your Noise website is an effective tool for engaging a wide range of people of different ages and geographic locations. Although targeted at 18-35 year-olds, the mean age of users is 40 years, and engagement is strong with users spending an average of four and a half minutes on the site. Around 63% of eligible users showed increased engagement with hearing health after completing the noise risk calculator.

HEARsmart

The same group also created the HEARsmart website (http://www.hearsmart.org) – a repository of information regarding hearing health and noise exposure reduction aimed at music venues, patrons, musicians and sound engineers. It includes a review of music earplugs, a video to educate viewers about tinnitus, and tips and advice about how to enjoy music safely.

WearLessNoise
WearLessNoise (https://wearlessnoise.com.au/) is a new organisation set up by a group of students from Melbourne. Their aim is to raise awareness of hearing protection amongst music patrons. They sell high-fidelity earplugs at festivals and online, and their aim is to use the proceeds to fund innovative projects related to hearing health and earplug distribution.

Make Listening Safe
Internationally, the most relevant campaign is the World Health Organization's Make Listening Safe initiative (https://www.who.int/deafness/make-listening-safe/). Work commenced in 2015 to address the fact that 1.1 billion teenagers and young adults are estimated to be at risk of developing hearing loss due to the unsafe use of personal audio devices and exposure to damaging levels of sound in noisy entertainment venues. In addition to publishing advocacy materials, a group of researchers from around the world meets annually to discuss action plans and strategies. One of the main achievements so far has been publication of the WHO-ITU global standard for safe listening devices and systems published in 2019. It recommends that personal listening devices include a) a dosimetry function to enable users to monitor their sound dose; b) volume limiting features; and c) personalised and general information about safe listening practices.

Other international campaigns
The *I love my ears* campaign from the Netherlands (http://www.ilovemyears.com/) encourages music lovers with the slogan: 'plug, place, pause', i.e., 'plug: wear those plugs, place: what spot do you pick? pause: give your ears a rest.' In the UK, the Action on Hearing Loss charity runs the *Don't Lose the Music* campaign which distributes earplugs and provides tips to help young people protect their hearing (https://www.actiononhearingloss.org.uk/you-can-help/campaigns-and-influencing/campaigns-by-country/dont-lose-the-music/). The US program *Dangerous Decibels* was developed in 1999 and is perhaps the longest running campaign targeted at noise-induced hearing loss. Its 50-minute classroom-based education program can be adapted for pre-teens, teenagers, and adults in schools, worksites or community settings, and is delivered by trained educators that are certified by the *Dangerous Decibels* program (http://dangerousdecibels.org/).

4.3.3. Previous campaigns and initiatives for this group

The Music to My Ears Campaign
This campaign was developed by Daniel Lalor in August 2010 who developed tinnitus after attending a music venue. The campaign was aimed at adolescents and young adults – particularly those attending noisy music venues and was active until around September 2012. It was largely an online awareness-raising campaign and used Facebook and a website to provide information relating to hearing health. The program gained some traction with sponsorship from audiologists and other groups concerned with hearing health, but is no longer active.

The Sonic Silence exhibition
This interactive exhibit was developed by researchers from Edith Cowan University and was on display at Scitech in Perth from 2012. The exhibit comprised auditory simulations of hearing loss and graphical information mounted in an over-sized pair of headphones and was aimed at raising awareness of noise exposure in school-aged children and young adults (12-25 year-olds). Prior to launching the exhibit, preliminary research was conducted to assess whether auditory simulations of hearing loss and tinnitus are an effective method of conveying a 'health-based fear appeal'. An evaluation study showed that the simulations and an associated education program resulted in increased motivation to protect hearing, improved attitudes towards hearing health, intentions to change listening habits, and fear of overexposure to loud noise when compared to a control group (Chang, 2010; Chang et al., 2013).

4.3.4. Recommendations for strategies to support this group

For this group the main aim is to motivate young people to reduce their noise exposure, particularly from recreational sources. Motivating noise reduction in such leisure settings (particularly those that involve music where the 'noise' is also the point of the activity) requires creative strategies that are different from those used in workplace settings, where noise is usually an unpleasant by-product of the occupation. Messages need to acknowledge and address the fact that participants are actively seeking out the music/noise, and perhaps look to other health areas that also aim to limit enjoyable but risky behaviours (e.g., smoking, alcohol consumption).

Design messages that align with attitudes

Research shows that the vast majority of young people are aware of the link between noise and hearing damage (Bogoch et al., 2005; Australian Hearing, 2010). However, this knowledge doesn't necessarily result in motivation to reduce leisure noise exposure, and as with many other population groups, hearing is not seen as a priority when compared to other issues (Hunter, 2018). Around 40-45% of young Australians take steps to protect their hearing or reduce their exposure – either by wearing hearing protection or minimising time spent in loud environments (Australian Hearing, 2010; Gilliver et al., 2015). The remaining 55-60% are less engaged with hearing health behaviours. According to the Stages of Change model (Prochaska & Velicer 1997), this group are 'pre-contemplators' or 'contemplators'. Any hearing health campaign will need to design a different messages that take into account the profile of the target audience. For the contemplators and pre-contemplators, messages need to raise awareness of, and interest in, the potential for noise to impact on hearing, whereas for those who are already engaged, simple calls to action which promote self-efficacy, and highlight the benefits of protecting hearing are likely to be more relevant.

Communicate decibels and noise dose clearly

The decibel scale is not well understood by the community, and young people are no exception – they are not generally aware of the actual sound level in their environment, and there is little appreciation of the fact that risk from noise exposure relies not on decibels alone, but also duration. This so-called noise dose is somewhat similar to sun exposure, in that the degree of risk from ultra-violet (UV) radiation also relies on duration and intensity, and the UV index is not necessarily intuitive or well understood. Nevertheless, messages and strategies have been developed to help people understand the risks associated with UV exposure, and similar strategies could be applied in relation to noise. This includes use of simple messaging ('slip, slop, slap') and simple, colour-coded exposure ratings in appropriate contexts (such as the UV index, which is included in most weather reports). Applying these principles to noise exposure could help create greater knowledge and understanding of decibels and noise risks in general. For example, messages could be similar to the calls to action from the *I love my ears* campaign or *Dangerous Decibels* ('turn it down, walk away, protect your ears'). Innovative methods of communicating the noise dose and risk level associated with music concerts or sporting events could also be developed to alert people to risky situations.

Address optimism bias

Optimism bias refers to when an individual overestimates their likelihood of experiencing a positive event, whilst underestimating their likelihood of experiencing a negative event (Sharot, 2011). In the context of hearing, young people are generally aware of the risk posed to hearing by noise, and most are aware that once damaged, hearing cannot be repaired (Australian Hearing, 2008, 2010; Gilliver et al., 2013, 2015). However, many young people believe that they are not likely to be at risk of hearing loss despite nearly a quarter of them reporting that their lifestyle posed a risk to hearing, and having experienced at least one symptom of hearing damage themselves (Gilliver et al., 2013). Similarly, many young people acknowledge the potential for personal listening devices to cause hearing damage, but report that they themselves listen at high levels (Australian Hearing, 2010). It will be important to develop messages and strategies that take into account this optimism bias in relation to young people's hearing behaviours.

Use loss aversion

For teens, it could be effective to demonstrate the importance of hearing in relation to their ability to interact with others or consume digital content. Impaired hearing loss would affect their ability to plug in, consume and interact with the digital world on platforms such as Netflix, Spotify, Snapchat, YouTube, TikTok. The risk of losing the ability to fully participate in their online world is likely to motivate action or raise awareness in this group. Invoking the concept of loss aversion could also be applied to young music lovers, who are at particular risk of damaging their hearing. Messages such as 'don't lose the music' or 'listen lower, listen longer' will appeal to this group's desire to maintain their love of music in the long-term to ensure lifelong enjoyment. Furthermore, music apps such as Spotify are popular amongst young people and represent an ideal channel for transmitting campaign messages in context and salient behavioural cues that aim to inhibit unsafe behaviours at the very time they are most relevant.

Focus on tinnitus

The immediate symptoms of hearing damage, such as ringing in the ears and muffled hearing that occur after loud sound exposure are usually temporary and resolve after a short period of time. This can suggest to people that no long-term damage has been done. However, if these symptoms accumulate over time, there is a good chance that noise-induced hearing loss will eventually develop. The process is gradual and occurs over many years, and it is often not noticed until at a well-advanced stage. This lengthy process means it is difficult to create a sense of urgency in those at risk and whose behaviour we are seeking to change. In contrast, ringing in the ears is something that most young people have experienced – NAL research suggests just over 60% experience it at least sometimes (Gilliver et al., 2015; Williams & Carter, 2017). Tinnitus is more immediate, its effects are easier to understand than hearing loss, and there is a strong sense that it can be a debilitating condition if it becomes permanent – all of which makes it may be a good candidate for campaign messaging. Research has shown that those who experience symptoms of hearing damage after noise exposure are more motivated to take protective action (Widén et al., 2009), and so messages that highlight, say, the risk of temporary ringing in the ears becoming permanent could be an effective approach (although this needs to be balanced against the possibility that those with permanent tinnitus could be alienated or distressed by such messages).

Calls to action

Achievable and specific calls to action that focus on reducing risks from common noisy activities are needed to motivate young people to reduce their noise exposure. Some relevant examples are provided below.

Listen safely on personal devices. Given the number of young people using personal listening devices and the general perception that the younger generation are 'always plugged in' it makes sense to target this behaviour to raise awareness and reduce the risk of noise-related hearing damage. As recommended by Portnuff (2016), tips for safe listening should be simple messages that focus on minimising the time spent listening, reducing volumes, being aware of background noise levels, and choosing well-fitting or noise-cancelling headphones. Messages that refer to the consequences of prolonged listening are more likely to motivate young people to set their devices at lower volume levels than messages that focus on noise damage at the cellular level (Serpanos et al., 2016).Messages that use colour may also be particularly salient. Knox (2009) suggests that colours representing volume levels can be an effective visual cue for users to understand and change their listening behaviour. Using standard traffic light colours (green, yellow, and red) to signify safe, potentially hazardous, and hazardous sound levels, the study showed that those who were exposed to the coloured visual cues selected significantly lower volumes than a control group that received no visual feedback.

Wear earplugs. Although reducing sound levels at the source is the most effective way of reducing the risk of hearing damage, for the purposes of a population-based campaign, messages that focus on individual behaviour change are needed. In music venues and sporting stadiums, there is an expectation of loud sound levels, and yet research has shown that many regular attendees of music venues actually prefer lower volumes (Beach & Gilliver, 2019; Gilles et al., 2014). One way for patrons to achieve this for themselves is by using high-fidelity earplugs that are designed for listening to music without compromising sound quality (Beach, 2018). This simple behaviour could be one of the key calls to action for young adults and teens who frequent noisy venues. Our research has shown that simply providing earplugs to young people will increase earplug use (Beach et al., 2016) regardless of whether hearing health information is provided, and having experience with earplugs can lead to sustained positive attitudes toward the devices (Nielsen et al., 2014). Current earplug usage rates amongst young Australians are only around 17% (Goggin et al., 2008) and therefore wearing earplugs will need to be portrayed as something desirable – an action associated with feeling good, something that people *want* to do, rather than something they *have* to do. Presenting earplugs as one of the essential items to take to a music festival (along with sunglasses, water, sunscreen etc.) or an essential accessory for health-conscious millennials wishing to avoid tinnitus could help to normalise their use amongst the target audience. Positive experiences of people who already use earplugs could be conveyed using peer role models, musicians or other celebrities.

Use of technology

Campaign messages and strategies could be designed to take advantage of young people's familiarity with technology, such as smartphones, wearables, and watches, as detailed below.

Smartphone noise apps. Noise level apps could play a role in raising awareness of sound levels. There are numerous apps available to measure sound levels, and although levels of accuracy vary, there are a handful of reputable options that could be promoted as part of a campaign. These include the NIOSH sound level meter app, NoiSee, SoundMeter, and SPLnFFT. NAL has also developed an app, SoundLog, which has good accuracy and reliability (Williams et al., 2017). Interestingly, Becker et al., (2013) showed that regular app users can predict sound levels with increasing accuracy after repeated use, and they also tend to rate noisy environments less favourably than naïve users. These findings suggest that apps can help change our perceptions and increase awareness and negative attitudes to noise, all of which are the desired outcomes of a hearing and noise awareness campaign.

Smart devices, wearables, and watches. Increasingly, smartphones, smartwatches and other wearable devices enable monitoring of our health (Swan, 2012). Since the release of the WHO-ITU standard (2019), new features related to noise exposure have been incorporated into Apple iPhones and Apple watch. Real-time headphone audio levels and ambient sound levels can be monitored, and users can receive alerts when the sound level reaches a specified threshold. A summary of the user's noise exposure is stored in the iPhone Health app, together with their hearing test results. The use of these tools for measurement and feedback has the potential to encourage young people to monitor their behaviour, reflect on it, and change it. It is likely that at least some young people will feel empowered to change their behaviours, and some may even be motivated to advocate for reduced sound levels at venues where excessive sound levels have been recorded.

Which age group should be targeted?

It is important to consider the best age at which to provide hearing health messages to young people. Some suggest that education at an earlier age is more effective, as is the case with *Dangerous Decibels*, which was found to be more successful with 4th graders than 7th graders (Griest et al., 2007). However, others argue that later in high school is a more appropriate time when students are soon to be exposed to significant noise levels from nightclubs and other 18+ venues. This approach has been shown to be effective in Belgium. Gilles and van de Heyning (2014) evaluated a government hearing health campaign that was aimed at high school students. The tagline was: 'Anything less is the max' and the campaign was launched during music festival season. It was promoted through television and radio commercials, social network sites, posters and a (now defunct) website. The attitudes of students (with a mean age 16.8 years) exposed to the campaign shifted significantly, with greater negativity towards noise exposure and greater positivity towards using earplugs. Less successful was a high school education program implemented in Austria – *PROjectEAR*. Here, a didactic in-school approach was used, and an evaluation study found that apart from taking more breaks in loud venues, participants' hearing health behaviours did not change (Weichbold & Zorowka, 2007). The authors concluded that education alone is insufficient to motivate behavioural change in teens and young adults.

4.4. Target group 3: People with untreated or developing hearing loss aged 50-75 years

4.4.1. Hearing issues facing this group

From the age of 50 years, rates of hearing loss show a marked increase in comparison to other age groups. Rates continue to increase with age, with males showing higher prevalence than females (see Table 4). Based on 2019 population figures, this represents 3,483,211 individuals aged 50+ years with hearing loss. Across all ages, hearing represents a prevalence rate that is higher than all other national health priorities with the exception of musculoskeletal diseases.

Table 4: Hearing loss prevalence by age, as a percentage of the population (better ear, adapted from Access Economics, 2006)

		Gender		Hearing Loss		
Age	**Total %**	**Male**	**Female**	**Mild**	**Moderate**	**Severe**
15-50	3	4	2	2	<1	<1
51-60	17	26	8	14	3	<1
61-70	48	55	40	40	7	2
71+	64	87	47	55	6	3

Presbycusis is irreversible sensorineural loss that is more pronounced in the high frequencies (often referred to as a 'sloping' loss due to the shape of the audiogram). It results from degeneration of the hearing structures over time and is usually bilateral. For some people, at least some of their hearing loss may also be due to noise-related deterioration – males in their late 50s are particularly likely to have noise-induced hearing loss as a result of occupational noise (Safe Work Australia, 2014).

The gradual decline of hearing that occurs with age and/or noise exposure leads to speech perception difficulties, particularly for higher pitched speech sounds (e.g., 's' and 'f') and voices (e.g., children and female). This can result in reduced hearing clarity with individuals often describing speech as sounding muffled or indistinct. Difficulties are generally more pronounced in noisy situations, with a decreased ability to attend to target speech in background noise, and difficulty locating sources of sound in the environment. Increased difficulties also occur in situations where there are multiple speakers or where the speaker is not facing the listener.

The gradual onset of presbycusis means that hearing difficulties often go unnoticed for a long period, with difficulties attributed to other causes (e.g., speakers are mumbling, restaurants are too noisy). Individuals (and their families) often report noticing a need to increase the volume of TV or radio – often to levels that others find uncomfortable. Difficulties with telephone conversations are also common. However, particularly in cases of milder hearing loss, individuals may continue to show little difficulty in less complex listening environments, such as quiet rooms and one-to-one conversations.

Hearing loss in older adults is associated with several other health conditions. Recent research findings have highlighted the potential flow-on effects of untreated age-related hearing loss for physical and psychological wellbeing. This includes increased risk of cognitive decline, dementia, anxiety, frustration, and depression. There are also associations between hearing loss and cardiovascular health, increased risk for falls, and reduced overall quality of life. Social isolation is also a problem. People with hearing loss report increased difficulty with communication and this can often result in socially avoidant behaviours.

Hearing loss in older people can be a barrier to seeking help in relation to non-hearing related health matters, particularly in institutional settings such as hospitals and nursing homes. Communication difficulties can impede individuals' interactions with medical staff, which has negative impacts for accessing treatment effectively and ongoing management of chronic conditions.

For those aged 50-65 years (i.e., older working-age adults) hearing loss rates range from approximately 20-40% representing, approximately 1 million people (HCIA, 2020). Hearing loss is known to have a significant impact on participation in paid employment, with studies showing that employment rates for older adults with hearing loss are approximately 20% lower than hearing peers (HCIA, 2020). Within the workplace, hearing loss can impact individuals' communication with colleagues, clients, and managers. This in turn can have consequences for productivity and engagement, with flow-on effects for recognition, promotion, satisfaction at work, and related mental health.

For the majority of individuals in this age group, access to hearing devices can assist with mitigating negative impacts in the workplace. However, access to devices is largely dependent on the individual's willingness to advocate on their own behalf (which they may feel hesitant to do), and their ability to cover any associated costs. Workplaces may provide some support (e.g., access to assistive listening devices for meetings, or accessible phone technology) which may be funded through the NDIS or the Employment Assistance Fund, which is administered by Job Access (https://www.jobaccess.gov.au/employment-assistance-fund-eaf).

The impact of hearing loss is not limited to the affected individual. A decline in hearing affects communication with others, particularly partners and close family and friends. Partners of people with hearing loss often find themselves navigating social and listening situations on their significant other's behalf, and there is often a decrease in the level of intimacy within relationships due to communication difficulties resulting from the hearing loss (Scarinci et al., 2008).

4.4.2. Current hearing services available to this group

A range of hearing services are available to older Australians aged 50 and over. Pathways to hearing services depend on a number of factors including the individual's eligibility for government support programs, as outlined in section 3.

One of the first touchpoints for older adults who suspect they have a hearing loss is with a hearing clinic. Individuals may contact hearing providers directly or as the result of a referral from a health professional, such as a GP or ENT specialist, or after participating in a hearing screening. Different types of hearing screenings exist. Some use modified pure-tone audiometry, i.e., they assess hearing levels at a limited number of frequencies. Others check for hearing difficulties using speech-in-noise testing. Depending on the nature of the screening and the provider, users may complete the screenings face-to-face (at a dedicated hearing screening event) or indirectly via the internet or over the phone. Many audiology providers now offer online hearing screenings with online 'referrals' linked to an appointment booking process within their organisation's system.

Depending on eligibility, individuals may access either the Voucher or CSO component of the HSP. Individuals who are not eligible for these must access audiological services on a fee-for-service basis, either from a private provider or Hearing Australia.

Hearing technology

Where a hearing loss is confirmed, individuals are presented with a range of rehabilitation options, including hearing aids and assistive listening devices. For the most part, hearing aids are considered the primary management tool for reducing the impact of hearing loss. In the last financial year, under the HSP program just over 300,000 hearing assessments were conducted, with approximately 180,000 people fitted with hearing aids, of which 88% were binaural fittings (Department of Health, 2019).

For significant or advanced hearing losses, individuals may be advised to consider cochlear implants. Candidacy for implants is assessed by an ENT specialist or cochlear implant provider taking into account hearing status and other relevant health information. Due to limited government funding, for many older adults, the cost of cochlear implants is generally self-funded. However private health insurance may cover some costs. The *Still waiting to be heard* report (2017) noted that cochlear implantation for adults is under-utilised in Australia.

A range of other technology solutions are available in addition to, or instead of hearing devices, including hearables; assistive listening devices, such as tabletop streaming devices; alert technology, such as vibrating alarm clocks, visual doorbells; and phone apps which allow the user to control their hearing device.

In addition to technological solutions, individuals with hearing loss can mediate the impact of their loss and improve communication via communication training. General advice about communication strategies is offered as part of the rehabilitation counselling process following a hearing loss diagnosis. However, specific programs may also be offered either in place of hearing technology, or to supplement its use. For participants in the Voucher component of the HSP, communication training is funded only in cases where hearing aids are not fitted. For adults in the CSO component with complex needs, communication assessment and training is carried out as part of the program. Alternatively, communication training may be offered privately by hearing professionals, or community hearing support groups.

Support groups

There are a number of support and advocacy groups in the area of hearing health particularly focussed on older adults with untreated or developing hearing loss. These groups exist to provide support, advice and information for those wanting assistance managing their hearing loss. They also advocate for improved accessibility for people with hearing loss, particularly in relation to TV and film captioning, Auslan interpreters, and other communication supports. Some of the larger groups include:

- **Better Hearing Australia.** Better Hearing Australia is a national independent organisation with a focus on providing information and support to people with hearing loss. With branches across Australia, the focus is on providing people of all ages with the information and skills to manage their hearing health. It also advocates for individuals with hearing loss where opportunities arise, and contributes submissions to relevant inquiries and commissions, particularly in relation to the social impacts of hearing loss.

- **Deafness Foundation.** Deafness Foundation aims to "improve well-being and promote equality for people who are deaf and hard of hearing by focusing on access, awareness, diagnosis, treatment, and prevention." It provides information about hearing health to those who have a hearing loss and the wider community. It also provides financial support in the form of grants and fellowships for research and activities that support hearing health.
- **Deafness Forum.** Deafness Forum is "the peak national body representing the interests of Australians who are concerned with the quality of their hearing and the effects it has on their lives and the people around them." Deafness Forum advocates on behalf of those with hearing loss, makes public statements about hearing-related issues, contributes to government policy discussions in relation to hearing and improving accessibility for people with hearing loss. They also provide information about hearing matters to the general community and circulate a regular e-newsletter, *One in Six* – a reference to the prevalence of hearing loss in the Australian population.
- **Hearing Matters.** Previously known as Self Help for Hard of Hearing (SHHH), Hearing Matters is a "a voluntary, non-profit educational organisation, dedicated to helping Australians with a hearing loss whose primary method of communication is through speech." It provides support, assistance, information, and education to people with hearing loss, and promotes research into hearing-related matters. It also publishes a regular newsletter, *Hearing Matters*.

4.4.3. Potential gaps in the services available to this group

Engagement with hearing health

Treating hearing loss reduces the negative impacts on an individual's physical, psychological and social wellbeing (Amieva et al., 2015; Dawes et al., 2015), and there are benefits associated with timely uptake of hearing services, with early adopters more likely to gain greater benefits and experience lesser difficulty in adjustment than late adopters (Davis et al., 2007). However, for this age group, hearing health is often not ranked high on an individual's list of health priorities, and older adults often receive little encouragement to seek out hearing services.

While individuals in this age group will often seek out screening of other health conditions as the result of large-scale targeted health campaigns (e.g., bowel cancer and breast cancer), there are no similar campaigns that encourage hearing screening. In general, GPs do not include hearing screening as part of regular health checks due to limited time, equipment, expertise, and confidence. In any case, research shows that many GPs have low awareness of when patients should seek hearing help and the benefits of hearing rehabilitation, which further decreases the likelihood of patients being referred for hearing services (Gilliver and Hickson, 2011). As a result, when it comes to hearing, individuals generally need to take more personal responsibility than they do for other health concerns.

Recognising the signs of hearing difficulty is an important step for help-seeking. Denial of hearing difficulties, or a failure to recognise the source of the difficulties contributes to delays in help-seeking and engagement in hearing rehabilitation options. The insidious nature of hearing loss means that hearing difficulties usually develop relatively unnoticed by the individual over a number of years, and difficulties may, at first, be attributed to external factors, such as poor sound quality on TV/movies, or an increase in the prevalence of mumbling, rather than hearing loss. Individuals may characterise their hearing difficulties as attention or concentration problems rather than hearing difficulties (particularly for milder losses).

These behaviours may arise from an unwillingness to acknowledge difficulties and engage with hearing health, and/or a poor understanding of the nature of hearing loss and how it manifests. For an individual who experiences few hearing difficulties when engaged in quiet one-on-one conversations, it may be hard to appreciate that their difficulties in more complex environments are primarily hearing-related rather than related to external factors.

Low uptake and use of hearing aids

Hearing aids are often the most appropriate clinical intervention for managing difficulties. However it has been estimated that people spend around nine years on average before seeking help for hearing difficulties (Simpson et al., 2019) and that only one-third of people who would benefit from a hearing aid, wear one. Of those who do acquire devices, a significant proportion do not use them long-term for reasons including poor perceived benefit, scepticism about their need to use them, as well as wearing discomfort (Kochkin, 2000).

Little interest in non-device solutions

Auditory rehabilitation activities have the potential to benefit hearing aid users and non-users alike. The aim is to help the individual (and often those around them) develop communication skills to overcome difficulties resulting from impaired hearing. This may include counselling and providing practical strategies for how to manage difficult listening situations. However, there is little focus on these programs, with many older adults unlikely to be offered them, nor are they likely to seek them out. The device-centred focus of the hearing industry is reflected in the prominence of hearing aids in the marketing and service offerings of hearing service providers and even within the HSP. This device focus means that most older adults (and the general community) consider that hearing help is a matter only for the *individual* with hearing loss, and there is a corresponding focus on individual treatment, via hearing aids. There is a failure to recognise that the communication difficulties arising from hearing loss are a *shared* problem for those close to the individual with hearing loss. Particularly in cases where there is disinterest in hearing aids, greater awareness and knowledge of alternative rehabilitation solutions is much needed.

Hearing as a chronic health issue

Obtaining support for hearing difficulties means individuals can remain connected to those around them and minimise the deleterious impacts of social isolation. Hearing loss is managed differently to other chronic health conditions, such as diabetes or a long-term injury in which family members are usually engaged in discussions about changing needs and supportive behaviours. Similarly, in institutional settings, such as nursing homes and rehabilitation hospitals, hearing health professionals do not generally form part of allied health teams (with physiotherapists, occupational therapists etc.) to support holistic care.

Ineligibility for hearing health care

For most adults aged 50 years and over with hearing loss, the majority is either mild or moderate. Many will be ineligible for government support, either because they fail to meet the eligibility requirements of the Voucher component of the HSP (due to age or pension status) or the NDIS (due to an insufficient level of hearing loss). Others may be ineligible due to citizenship status. A small number may be able to access State Government or charitable support, but this is often targeted at particular groups in need (e.g., low-income earners). Navigating the different eligibility criteria, services available, and support programs can be complex. Whilst advocacy organisations like Better Hearing Australia provide advice and support across many client groups, the lack of a 'one-stop shop' or central reference point from which individuals with hearing loss (or those who support them) can seek information adversely affects individuals' ability to navigate services. Hearing professionals themselves note that they are not always aware of all the various programs and support services. They too would benefit from a one-stop shop where they could easily access information on behalf of their clients.

Lack of access in rural and remote areas

As for many healthcare issues, access to services outside of urban areas can be limited. Some regions may be serviced by a visiting hearing professional (either on a regular or adhoc basis) whilst in other areas, individuals may need to travel to larger centres to access services. The patient assisted travel scheme (PATS) for rural and remote communities is not available for hearing support and so travel must be self-funded. These issues are likely to lead to delays in help-seeking for individuals for hearing, especially those with multiple health concerns, who may prioritise other health issues over hearing. While there are various online hearing screening tools available for older adults, most are attached to specific hearing providers, which can undermine users' confidence in the independence and validity of the results.

Lack of information to guide decision-making

Newcomers to hearing rehabilitation generally make decisions with little to no knowledge of, or experience with, hearing loss or hearing devices. New clients account for nearly a third of all clients serviced by the HSP (Department of Health, 2019). For these individuals, navigating the world of hearing rehabilitation and understanding the wide array of constantly changing technology options is a complex task. There is a need for service providers to offer effective and understandable information for their clients, and this has been noted by the Australian Competition and Consumer Commission (ACCC): "Clinicians expressed concerns that consumers are not provided with adequate information to make an informed choice about which hearing aid is appropriate for their needs and budget." (ACCC, 2017, p. 3). There is also a need for information to be presented in a way that is accessible and independent: "[There is a] lack of an independent source of information that allows for comparison … in a way that is easy to understand, aligns with health literacy requirements, and abides by standardised terminology." (PWC, 2017, p. 44).

4.4.4. Hearing campaigns and initiatives for this group

There have been few hearing campaigns for older adults with developing or untreated hearing loss. Where they do exist, they tend to be ad hoc, and are often focussed on promoting a specific service, such as encouraging people to book a hearing appointment at a particular clinic. For example, Hearing Australia promoted the *Big Aussie Hearing Check* in 2018 and 2019, which aimed to promote hearing health while also increasing the number of in-clinic hearing assessments.

This campaign was timed to coincide with World Hearing Day (3 March) which is held during Hearing Awareness Week every year. This is an opportunity for all hearing organisations to carry out awareness-raising activities and initiatives aimed at promoting hearing health in the community. In 2017 Cochlear launched a short film, *Does Love Last Forever?* as a way of raising awareness of hearing loss, while also promoting cochlear implantation as an option for adults with hearing loss. The campaign was developed to highlight the experience of hearing loss and how it develops over time, using subtle sound editing to replicate the experience of conversational listening difficulties.

Other campaigns are aimed more at politicians, than individuals. For example, Deafness Forum launched the *Make it number 10* campaign in 2014 to push for hearing to be added to Australia's list of nine health priorities. At a more local level, community-based groups that service older adults (e.g., Men's Sheds, Probus) will occasionally include hearing health as a topic of interest for their members – often in the form of a guest speaker at a regular meeting.

4.4.5. Recommendations for strategies to support this group

There are a number of barriers faced by older adults with untreated or developing hearing loss that could be helped by greater awareness and information.

Recognising and acknowledging hearing loss

Whilst there is a high prevalence of hearing loss in this group, uptake of services is relatively low due in no small part to a lack of acknowledgement of hearing difficulties. A number of approaches could be used to address this:

- **Identifying early signs.** Raising awareness of how hearing difficulties manifest in daily life beyond a simple 'drop in volume' could help individuals and those around them identify signs of hearing loss earlier than is currently the case.
- **Understanding outcomes associated with untreated hearing loss.** For many older people, concerns about treatment for hearing loss (e.g., wearing hearing aids) are more prominent than concerns about the outcomes that may eventuate from lack of treatment. Making older adults aware of the negative psychosocial and cognitive consequences (including impaired cognition, poorer mental health, increased possibility of falls, social isolation) associated with untreated hearing loss is important to motivate engagement in their hearing health.
- **Regular monitoring.** The insidious nature of hearing loss, and the tendency of individuals to delay accessing services means there is a need to monitor hearing to identify changes over time before hearing problems become significant. Campaigns to include hearing as an aspect of overall health that should be checked regularly (at set intervals) would increase awareness of hearing health and expedite help-seeking.

Navigating hearing services

Individuals who seek help for hearing difficulties are faced with a number of options and decisions in relation to hearing – including whether they are eligible for government support, which service provider to choose, and what are the most appropriate rehabilitation options. Where hearing aids are chosen, individuals require accessible, trusted, independent information to assist them to make informed decisions. Whilst this information would obviously be targeted to individuals with hearing loss, it is also important to raise awareness for those around them, and provide the same information for family, friends and medical professionals to ensure appropriate support for all those who need to access and engage with hearing health.

Reducing social impacts via greater community awareness

According to Lin et al. (2016) "supporting individuals with hearing loss requires adaptable solution that *span society* – not just solutions geared toward individuals" (p. 235). There is a need to recognise the impact of hearing loss beyond simply being a sensory impairment for the individual. Rather, hearing loss needs to be regarded as a communication impairment that can negatively impact relationships and social wellbeing. Greater community awareness about the difficulties posed by hearing loss and ways to address these to reduce social impacts will have positive benefits for both individuals and society. Building a more hearing-aware society would increase ease of communication, help to decrease stigma, and minimise the disability faced by those with hearing loss.

4.5. Target group 4: Aboriginal and Torres Strait Islander people

4.5.1. Hearing issues facing this group

Aboriginal and Torres Strait Islander people suffer from significantly higher rates of hearing loss and ear disease than non-Indigenous Australians (Jervis-Bardy et al., 2014). Results from the hearing tests conducted during the National Aboriginal and Torres Strait Islander Health Survey in 2018/19 shows that 43% of Aboriginal and Torres Strait Islander people aged 7 years or more had hearing loss in one or both ears, with a much higher percentage in remote areas (59%) compared to non-remote areas (39%). For children aged 7–14 years, 29% had hearing loss in one or both ears (ABS, 2020).

Otitis media, which occurs predominantly at a young age, is the main contributing factor to hearing loss among Aboriginal and Torres Strait Islander people, and is both treatable and preventable. For Aboriginal people, otitis media occurs much earlier, more persistently and more severely than the rest of the population, and they suffer from conductive loss for longer periods as well (Jervis-Bardy et al., 2014). This has life-long impacts on overall health, educational participation and outcomes, psycho-social development (including speech development) and economic outcomes.

On average, one in three Aboriginal and Torres Strait Islander children experience chronic middle ear disease, and in some remote parts of Australia, up to 90% of children experience some form of ear disease at any time (Australian Government, 2017). Aboriginal and Torres Strait Islander children are four times more likely to undergo ear surgery and are three times more likely to suffer permanent hearing loss compared to non-Indigenous Australian children. In severe cases, people can die from the complications of middle ear disease – three to five Australian children die each year, and deaths are more likely to occur among Aboriginal and Torres Strait Islander children. Due to the high prevalence of otitis media, conductive hearing loss is far more common than sensorineural hearing loss in Aboriginal children, with up to 95% of hearing loss cases in the Northern Territory being conductive (AIHW 2014).

There is not one single cause of otitis media in Aboriginal and Torres Strait Islander children that can be identified as the key contributor. Instead, a combination of multiple environmental and socioeconomic factors can cause and exacerbate the infections that occur. These include premature birth, not being breastfed and nutritional deficiencies. Children are also more likely to have ear or hearing problems if they have been exposed to household crowding, poor hygiene, and inadequate access to running water, functioning sewerage and waste removal systems. Second-hand tobacco smoke and exposure to wood smoke also contributes to increased risk of otitis media (Burns & Thomson, 2013; Kong & Coates 2009).

Because Aboriginal and Torres Strait Islander children in lower socioeconomic segments tend to develop chronic ear infections very early, there is a pressing need for their ears to be assessed as early as possible and monitored regularly over time. This is so that when a middle ear infection becomes chronic, it can be treated effectively (with appropriate analgesic methods or antibiotics), and if a hearing loss is detected, referrals can be made to remediate hearing loss, via surgery or with a hearing aid to avoid speech and language development problems.

4.5.2. Current hearing services available to this group

Hearing health pathways for Aboriginal and Torres Strait Islander communities vary depending on location and context, however they usually start in primary health clinics. Primary health care is provided in community-based settings such as general practices, private medical practices, community health centres, and local government or non-government service settings, such as Aboriginal community-controlled health services. Safe community spaces (e.g., the Child & Parent Centre in Midland) are trusted by families to help them navigate the health system and connect with services.

Treatment for hearing loss from otitis media

If a child has hearing loss resulting from otitis media, one treatment option is to fit hearing aids. Last year, 430 Aboriginal children were fitted with hearing aids for the first time and 90% of these cases were due to middle ear disease. Although fitting rates have almost doubled in the past six years, only 20% of Aboriginal and Torres Strait Islander children aged up to 5 years with moderate hearing loss or worse are currently being treated. Access to hearing aids varies according to location, with fewer fittings for children in urban areas (17%) compared to regional (22.5%) and remote areas (31%). In some states, such as Western Australia, there has been no statistically significant improvement in age of first fitting between 2009-2018. However, Queensland is one of the two jurisdictions where there have been statistically significant improvements in age of first fitting, especially in remote areas where the rate of fitting is 52%. These higher fitting rates for regional and remote areas are likely a result of targeted ear health programs, such as *Deadly Ears* and the Northern Territory Hearing Health Program (see below).

The 715 health check

Although not a hearing check, the 715 health check is a free annual check-up for Aboriginal and Torres Strait Islander people that sometimes includes a discussion of hearing health. The health checks are available at Aboriginal Medical Services and bulk-billing clinics. Information about the patient's health, including blood pressure, blood sugar levels, height and weight is recorded. After the appointment, the patient may be told of additional health services related to heart health, vision, hearing etc.. According to the Department of Health, only about 30% of Aboriginal and Torres Strait Islander people access this health check.

4.5.3. Potential gaps in the services available to these groups

Treatment pathways for otitis media can be confusing and there is a lack of continuity

An effective pathway relies on a health practitioner checking children's ears on a regular basis, recognising they have an ear infection or chronic middle ear disease and getting them the correct medical treatment quickly. There are several factors that contribute to chronic middle ear disease being missed for Aboriginal and Torres Strait Islander children:

- **Treatment gaps.** Middle ear infection tends to start in the weeks and months after birth and therefore it is not usually picked up in a newborn hearing screening. Additionally, when an infection occurs, it may not be picked up by health practitioners as obvious symptoms are not always present.
- **Parents' lack of awareness.** Caregivers may lack the knowledge or empowerment to ask their GPs to check their child's ears. There may also be a lack of knowledge around the signs and impacts of middle ear disease. Furthermore, parents may not be aware that ear disease is connected to hearing or that hearing is connected to language development, and may not realise the importance of seeking treatment as soon as possible.
- **Discontinuity of care.** Families may not see the same health practitioner or have a consistent health care provider. This makes it more difficult for the health practitioners to establish when ear disease has become chronic, as they lack knowledge of the child's previous ear problems. There is no system of regular check-ups for a child's ears and hearing, nor is the previous medical history universally accessible for health practitioners.
- **Lack of specialists in regional and remote regions and long wait times.** In analysis carried out by the Australian Institute of Health and Welfare, it was found that over 4,000 children and young people were waiting for hearing health services in the Northern Territory in 2017 (AIHW, 2018). This includes outreach audiology services and ENT tele-otology services. The high number of outstanding referrals can largely be attributed to a shortage of available specialists.

- **Knowledge of treatment pathways.** There is growing concern that Aboriginal and Torres Strait Islander children are getting lost in hearing referral pathways, particularly in urban settings, and therefore being diagnosed too late or missing a diagnosis altogether. In major cities and large towns, there may be greater access to the hearing services, ENT specialists, and paediatricians, however there are long wait times for public ENT consultations and surgery, and the referral pathway is often confusing when it comes to middle ear disease, all of which contributes to the later age of first fitting of hearing aids for Aboriginal and Torres Strait Islanders in cities compared to those in rural and remote communities. As well as the confusion for families, GPs and other health practitioners find the referral pathway confusing and may lack an understanding of the various touchpoints, timing and referral processes that are necessary for children to have their conductive hearing loss managed appropriately. In many cases, GPs may be unaware of the *Otitis Media Guidelines* that set out the treatment pathways for Aboriginal and Torres Strait Islander children (Department of Health, 2010).
- **Normalisation of ear infections.** Because otitis media is so common, in many cases, it may be considered normal by caregivers and community members for children to have ear infections and hearing problems. In this way, the disease has become normalised and is not regarded as something that needs treating. In other cases, behaviours related to not hearing well may be confused for 'disruptive behaviour' or 'selective hearing', and so symptoms of chronic ear disease are ignored.
- **Low engagement with health services.** For some families, there is little to no engagement with health services and a suspicion of doctors and medical literature (CIRCA, 2017). Front desk processes at health clinics can be alienating for Aboriginal and Torres Strait Islander parents.

4.5.4. Previous and current hearing campaigns and initiatives for this group

Recent hearing health campaigns and targeted outreach services focused on Aboriginal and Torres Strait Islander hearing health have proven successful in increasing hearing health awareness, motivating increased interactions with hearing health practitioners and most importantly, improving hearing health. Lessons can be learnt from these programs to inform future programs, although future campaigns should consider any existing state-led or local programs to avoid duplication and confusion, and to make the most of ongoing successful programs. For example, specific calls to action directed at parents could point them directly to local services or outreach clinics, such as those in the *Deadly Ears* program in Queensland (see below).

Care for Kids' Ears campaign

The *Care for Kids' Ears* campaign launched on 1 July 2011 was the first national campaign to cover ear health in Aboriginal and Torres Strait Islander communities (CIRCA, 2013). The campaign primarily consisted of the national distribution of *Care for Kids' Ears* resources, including resources for parents and carers; resource kits for teachers and teachers' aides, early childhood and community groups and health professionals (who received the *Otitis Media Guidelines*). There is also a *Care for Kids' Ears* campaign website, http://www.careforkidsears.health.gov.au/, which provides information on otitis media and links to download or order the resources.

The campaign, which did not use traditional media advertising, was deemed successful in delivering messages that ear disease can have significant long-term consequences. Research undertaken with mothers and female carers found that campaign exposure (which reached around 40% of the target population) was linked to increased knowledge of symptoms of middle ear disease, and increased preventative and help-seeking behaviours. Among those who had read or looked at the resources, the majority said that the materials were easy to understand and helpful.

A localised and culturally relevant media strategy was deemed to be a key factor contributing to the success of the campaign. Local media partnerships allowed for specific ear health services to be identified, and for people to be given very specific treatment messages. Because the media organisations already had the trust, respect and confidence of the Aboriginal and Torres Strait Islander communities they are part of, they were able to effectively engage local communities in the campaign.

Deadly Ears program

The *Deadly Ears* program is led by Queensland Health (https://www.childrens.health.qld.gov.au/service-deadly-ears-program/), and aims to reduce the rate and impact of middle ear disease and conductive hearing loss for Aboriginal and Torres Strait Islander children across Queensland. It forms part of the larger *Deadly Kids, Deadly Futures* policy. A key component of the program is delivering frontline clinical services (including an ENT clinic and surgery) and building local capacity in 11 locations across rural and remote Queensland. The program delivers workforce training for healthcare practitioners and educators, and coordinates policy and practice changes across health, early childhood and education to improve the prevention, treatment and management of middle ear disease (Queensland Health, 2019).

Several teams work together to deliver the program. A primary health team works in local communities to ensure services are regularly conducting ear and hearing checks, prioritising 0-to 4-year-olds, and making appropriate referrals to the program's ENT team. An ENT outreach team concurrently delivers clinic, surgery, and audiology services in remote communities. Additionally, an allied health team supports children with hearing loss, working with local services to address children's early development and education needs. All of these teams employ Aboriginal and Torres Strait Islander staff with community ties for appropriate and relevant cultural communication and engagement. Results from the program show that the rate of children in the 0-4 years age group who have attended clinic and accessed audiology services has increased from 53% in 2014 to 94% in 2019. Early hearing loss diagnosis has also enabled timely connections with local early intervention services, and over 89% of referrals made by the program in 2017 were actioned by local allied health services.

Under this program, a number of resources have been developed to help families play a greater role in their child's hearing health. This includes an explanatory 'clinic findings' resource to assist families to understand their child's diagnosis and to undertake post-clinic care. ENT specialists in the program also use a video otoscope so that families can see live video of their child's ear canal and eardrum during clinic, which has led to increased awareness and engagement.

Deadly Kids, Deadly Futures program

The Queensland *Deadly Kids, Deadly Futures* framework was launched in 2016 by the Queensland Departments of Health and Education, aiming to improve ear and hearing health as well as educational outcomes for Aboriginal and Torres Strait Islander children. The program worked with the Queensland Department of Education to develop *Deadly Kids Can Listen and Learn,* a training package to give teachers a better understanding of the best ways to interact with Aboriginal and Torres Strait Islander children who experience conductive hearing loss as a result of otitis media. Within 18-24 months, state-school teacher enrolments had reached 220, with a further 368 teachers outside the state-school system also accessing modules from the program.

The Northern Territory Hearing Health Program

The Northern Territory Hearing Health Program is an example of a successful service-focused hearing initiative, demonstrating that targeted outreach hearing services can lead to better hearing and health outcomes for Aboriginal and Torres Strait Islanders. Health education, promotion, and prevention initiatives developed as part of the program include training for Aboriginal community hearing health workers and providing ear health promotion material such as handouts, posters and audio-visual messages. In 2018, 128 training sessions for hearing health education, promotion and prevention activities were provided to health-care staff.

Blow Breathe Cough

Hearing Australia and Charles Darwin University's Menzies School of Health Research collaborated to create animations of a *Blow Breathe Cough* activity for schools and day care centres (https://www.hearing.com.au/Hearing-loss/Children-young-adults/Blow-Breathe-Cough). The activity helps teachers and early childhood educators teach young children about nose blowing, coughing into elbows, and hand and face hygiene. These actions are important for preventing the spread of the germs that cause ear infections, coughs, and colds. The evidence-based techniques aim to improve children's hearing, reduce runny noses and ears, coughs and colds, and lead to improved attention in class. The animations are available in nine languages, including Kimberley Kriol, Martu, Ngaanyatjara, Eastern Arrernte, Warlpiri and English.

Hearing Australia's HAP-EE program

The HAP-EE program is a major new outreach program for Aboriginal and Torres Strait Islander children that aims to test children's hearing and also build capacity within Aboriginal communities. It has been rolled out with assistance from Aboriginal community engagement officers, who have been crucial in bridging the cultural gap between community members and health practitioners. They work in regions where they have cultural ties and use their knowledge of community to effectively consult with locals. Although still in its early stages, preliminary data from the program has revealed that testing young infants' hearing soon after a pass on the newborn hearing screening test is worthwhile because it allows for early-onset ear infections to be identified as soon as possible. Data from the program also suggests there is a greater need to link middle ear disease to hearing problems, and relay to parents that middle ear disease is not a just health problem, but also a developmental problem that affects speech, development and interaction with others. It can also affect aspects of Aboriginal and Torres Strait Islander people's lives that are seen as extremely important to their culture, such as their ability to pass on and understand stories.

PLUM & HATS tools

The PLUM and HATS are language screening tools developed by NAL in conjunction with Hearing Australia (https://www.hearhappy.nal.gov.au/). They are designed to be used by primary health and early childhood practitioners to identify potential hearing and communication problems in Aboriginal and Torres Strait Islander children aged 0-5 years. The tools have been shown to assist health and early childhood workers in talking with parents and carers about their child's listening and talking skills. In particular, participants highlighted the tools' utility in raising awareness with parents and carers about the everyday signs to look for when monitoring hearing development so as to detect possible problems that may need further investigation.

4.5.5. Recommendations for strategies to support this group

The hearing issues facing Aboriginal and Torres Strait Islander people are well-known and with several initiatives and campaigns already in place to address these issues, there exists good insight into what is needed and which strategies are likely to be effective. A summary of these are listed below.

Key prevention messages and strategies for parents and caregivers

- Convey the message that having a middle ear problem is a key health problem.
- Create awareness of the connection between middle ear infection and hearing loss.
- Create a link between hearing loss and speech, language and learning development, and highlight that hearing is an integral part of life.
- Raise awareness about specific signs to look for when monitoring hearing development and stimulate conversations about listening and talking skills, and how these relate to hearing.
- Raise greater awareness of the links between breastfeeding and smoking with ear infections and hearing loss.
- Point out the actions related to a child's ear health that are within parental control and emphasise that parents can make a difference, e.g., teaching hand and face washing, nose blowing; asking for ear checks; and taking children to health-related appointments.
- Highlight the importance of getting children's ears checked early and regularly in the early years.
- Emphasise the need to always ask the GP about their child's ears and hearing.
- Help them to understand what hearing treatment pathways are available in their community, and how to navigate them.
- Highlight the relationship between hearing health and 'cultural transmission', i.e. the telling of important cultural stories from one generation to another, and use this to motivate preventative or treatment-related action.
- Use positive messages around hearing and how it can help children on the path to becoming future leaders of the community.

Key prevention messages and strategies for health practitioners and other intermediaries

- Highlight the need to investigate the history of every child's hearing health.
- Foster a renewed focus on treating children for hearing issues as early as possible, and well before they start school.
- Encourage knowledge-sharing with parents to help them understand their child's previous hearing issues and what it means so you can work together to prevent and treat the problems.
- Increase the awareness and use of the *Otitis Media Guidelines* for Aboriginal and Torres Strait Islander children in health clinics.
- Increase understanding of the treatment pathways available for parents and caregivers in the community.

Delivery channels and campaign approaches

- Aboriginal and Torres Strait Islander-run media, especially radio, is one of the most valued and trusted sources of media and considered culturally safe.
- Shape messages so that they are locally appropriate, and consult with community members to understand the unique needs and appropriate communication methods of the community. Different locations will require different messages and strategies.
- Make use of existing materials and resources from successful programs such as *Care for Kids' Ears* and *Deadly Ears*.
- Use schools and early childhood settings to enhance and promote use of existing tools and campaign resources.

- Combine health promotion and media campaigns with the delivery of direct ear health services, and build partnerships between health services, media outlets, and communities – this will enhance community capacity and strengthen the overall response to ear health.
- Use intermediaries such as health professionals, teachers and early childhood educators to help explain ear health promotion messages, especially in remote communities. Encourage these intermediaries to become 'ear health champions'.
- Understand the needs of different communities and their level of engagement with hearing health and the health system, and adapt the delivery strategy as appropriate, e.g., in some locations, large sporting events, such as football carnivals, may be a good touchpoint.
- Promote resources through the Indigenous HealthInfoNet and other digital modes.

CIRCA research insights on effective messages

Previous research by the Cultural and Indigenous Research Centre Australia (CIRCA) has also uncovered some useful insights around effective messages for parents, particularly in relation to ear health for people from different socioeconomic backgrounds (CIRCA, 2010, 2017). See Table 5.

Table 5: CIRCA and Hearing Australia insights on effective messages for Aboriginal and Torres Strait Islander people based on socioeconomic status.

Group	Messages	Message channels
Lower socioeconomic backgrounds	• Highlight the main causes of hearing problems amongst babies and children. • Ear infections and hearing problems in young children is not "normal". • Highlight the short-term and life-long impacts of ear disease. • Provide information that explains the ongoing consequences related to language development and the potential to hinder long-term participation in family and community life.	• Face-to-face support/dissemination of information vital. • Trusted community members (i.e. other mothers of young children, community Elders) as disseminators of ear health information. • Messages transmitted via Indigenous radio and TV. • Potentially, teachers as a conduit for dissemination of information and support. • For visiting ear health services, high visibility in community (away from health services) is beneficial. • Nursing staff may also play a key role in building relationships, with face-to-face explanations preferred.
Mid socioeconomic backgrounds	• Explain how to avoid ear infections. • Explain the early symptoms • Educate around age-appropriate remediation. • Provide information that explains the ongoing consequences related to language development and the potential to hinder long-term participation in family and community.	• Local community events, including playgroups and 'Mums & bubs' sessions. • Face-to-face with health professionals. • For outreach ear health services, high visibility in the community is beneficial.
Higher socioeconomic backgrounds	• Explain the impact of hearing loss on educational attainment. • Explain the long-term consequences for employment and independence.	• Provide information via reading materials, e.g., pamphlets and resources handed out by doctors and health professionals at medical services.

4.6. Target group 5: People exposed to occupational noise

4.6.1. Hearing issues facing this group

Occupational noise-induced hearing loss represents a very significant health, social and economic burden for Australia. Nationally, an estimated 1.1 million employees in Australia are exposed to hazardous levels of noise at work (Lewkowski et al., 2019). Most of those at risk are male, with 19.5% of men and 2.8% of women exceeding the noise exposure limit on their last work shift. Men who are younger, have trade qualifications and who do not live in a major city are most at risk (Lewkowski et al., 2019). Noise-induced hearing loss accounted for 540 workers' compensation claims per million employees in 2010/11, making it the third highest occupational disease occurring in Australia, with the majority of claims coming from males aged 55-59 years (Safe Work Australia, 2014). Safe Work Australia, the agency responsible for workplace health and safety, has designated noise-induced hearing loss as a priority disorder for national action under the Australian Work Health and Safety Strategy 2012-2022 because of the severity of the consequences and the estimated number of workers affected.

Exposure to noise at work

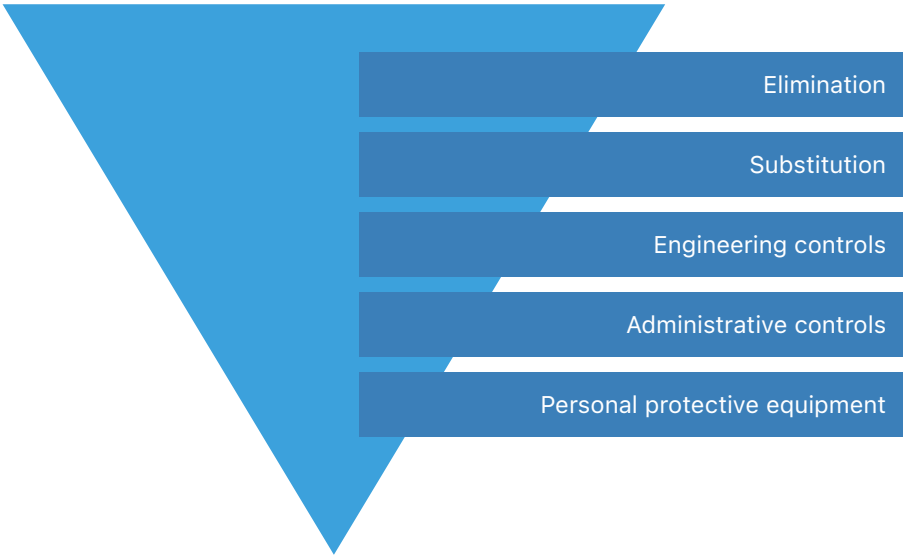
Noise exposure in the workplace is considered hazardous if it exceeds the Australian noise exposure standard (Standards Australia, 2005). For continuous noise, the permissible exposure limit is: 85 dB $L_{Aeq,8hr.}$ When sound is measured in dB L_{Aeq}, it is like taking an 'average' of the sound level over a specified period and in this case, exposure should not exceed an equivalent continuous sound level of 85 dB in an 8-hour shift. A 3-dB exchange rate is applied, which means that if the sound level increases by 3 dB, exposure time must be halved. If the sound level is 88 dB L_{Aeq}, the maximum exposure time is 4 hours; at 91 dB, the limit is 2 hours and son on. For impulse noise (short sounds of high intensity), the maximum permissible peak sound pressure level is 140 dB L_{Cpeak}.

Workers' noise exposure regularly exceeds this standard in a wide range of industries, including mining, manufacturing, construction, farming, and the Defence Force, and for many in these industries, noisy environments are unavoidable. While many traditionally noisy workplaces will have relatively well-established protocols in place to minimise noise exposure, workplaces in other industries pay less attention to reducing noise exposure. This includes the hospitality, entertainment, and retail industries.

Reducing noise exposure

As shown in Figure 1, there is a hierarchy of control measures for reducing the risks associated with noise exposure. Most effective are measures that involve elimination of the noise or substitution of loud equipment for a quieter alternative. Engineering controls include measures such as placing barriers and shields around noisy equipment or increasing the distance between workers and noise sources. Administrative controls include warnings or changes to rostering to reduce time workers spend in noisy environments. Finally, provision of personal protective equipment (PPE), such as earplugs or earmuffs, is regarded as the least effective method of control and should only be considered when other solutions on the hierarchy of control have been exhausted. Earplugs and earmuffs are regarded as an option of last resort because their ability to protect workers relies on them being worn correctly and consistently during all noise exposures – if removed for even for short periods, their effectiveness is dramatically reduced.

Figure 1. Hierarchy of controls (adapted from NIOSH).



Exposure to ototoxic chemicals

An additional hearing risk for workers comes from exposure to ototoxic chemicals in the workplace that damage the ears and neural-auditory pathways. Ototoxic chemicals include organic solvents, metals and asphyxiates, with toluene and carbon monoxide two of the more common substances encountered at work. These chemicals are found in paints, degreasers, solvent-based glues, mineral spirits, petrol, and exhaust from vehicles and generators. Co-exposure to chemicals and noise can exacerbate noise-induced hearing loss (Sliwinska-Kowalska et al., 2005), with co-exposed workers around twice as likely to develop hearing loss compared to those exposed to noise alone (Schaal et al., 2018; Choi & Kim, 2014). In Australia, it is estimated that over 80% of workers who are noise-exposed are also exposed to at least one ototoxic chemical in their workplace (Lewkowski et al., 2019).

Productivity impacts

Noisy workplaces are not just an issue for workers' safety, but can also reduce efficiency and productivity, affect the ability to concentrate, and cause safety issues as a result of not being able to hear nearby hazards (Picard et al., 2008). High noise levels are also associated with stress, headaches, tinnitus, fatigue, and increased absenteeism, and they have the potential to cause other health effects such as increased heart-rate, increased blood pressure, and increased likelihood of cardiovascular disease (Basner et al., 2014).

4.6.2. Current hearing services available to this group

Regulatory oversight

Each of the Australian states and territories has its own WHS legislation, most of which are based on the national model workplace health and safety legislation (Safe Work Australia, 2019). Included in this legislative framework are model regulations and model codes of practice, which were introduced as a way of harmonising WHS practices across the country. While the process of harmonisation has not been entirely successful, with Victoria and WA yet to update their laws, there is a great deal of consistency amongst the states and territories in relation to the regulation of noise. All states and territories adhere to the national exposure standard limits, control measures are required when noise levels exceed the standard, and there is a focus on ensuring that noise emissions are as low as reasonably practicable, with PPE to be used as a last resort. Where PPE is used, it needs to comply with the relevant standard, and in most states, workers who regularly use PPE are required to undergo a hearing test every two years.

While Safe Work Australia is the national body, it is up to the regulators in each state and territory (e.g., SafeWork NSW, WorkSafe Victoria) to ensure that WHS regulations are implemented and enforced. Workers' compensation insurance schemes are administered either by the regulator or an affiliated entity. Some states have quite convoluted arrangements which can be hard for employers to navigate. For example, in Western Australia, WorkSafe WA is a division of the Department of Mines, Industry Regulation and Safety (DMIRS), and there are several different divisions within DMIRS that deal with different industry sectors, each with different regulations, guidelines and codes of practice. Worksafe WA handles general industry, whereas the mining industry sits under Resources Safety.

Audiometric checks and company health checks

As mentioned earlier, the model WHS laws stipulate that noise-exposed workers should have their hearing tested when they start work and at two-yearly intervals. This may be a stand-alone check conducted by a private audiometry provider, or in some larger organisations, it may be included as part of an overall health check. In NSW, there is an exemption in place until the end of 2020, which means that employers are currently not required to comply with the audiometric testing requirement. The extent to which audiometric testing is conducted in other states and territories is unknown, although anecdotally, compliance levels are low, and high rates of contract employment in high-noise industries, such as construction, are likely to contribute to overall low rates of industrial hearing tests.

4.6.3. Potential gaps in the information and services available to this group

Noise exposure is a low priority for employers and regulators

In general, noise exposure is not regarded as a high-priority WHS issue by employers, employees, or regulators. Research by Safe Work Australia (2010) has found that particularly in small to medium-sized businesses, there is insufficient knowledge of the effects of loud noise on hearing and the impact of hearing loss on quality of life, and there is little consideration of the potential benefits of effective noise control. It has been noted by members of the occupational hygiene training industry that their noise recommendations are largely ignored by management, who do not realise the serious impact noise exposure can have on employees.

Some industries take noise exposure more seriously than others. For example, the mining industry in WA is considered to have one of the strongest and most effective set of regulations in place for noise training and awareness of any industry nationally. This can be attributed to the particularly stringent approach taken by the WA mining regulator, Resources Safety, with regard to procedures for dealing with noise in the workplace. As a result, employers in the mining industry are typically more aware of their obligations and have a greater level of understanding around appropriate remediations. This is supported by the high ratio of mining inspectors to mine sites compared to the much lower ratio of Worksafe inspectors, who cover the thousands of businesses that fall into the 'general industry' category.

Over-reliance on personal protective equipment in workplaces

Research undertaken by Safe Work Australia shows that noise exposure is primarily controlled in workplaces through use of PPE like earplugs and earmuffs, and there is little evidence that higher-order controls are used to eliminate or minimise noise at the source. Where they are used, they are most commonly engineering controls, such as noise barriers (Safe Work Australia, 2010). The reliance on PPE stems from the fact that it is considered the easiest and cheapest way to offer protection, despite it being least effective on the hierarchy of control measures. Most workplaces do not have a system in place for monitoring of PPE use, and in variable noise environments, it can be difficult for individuals to know or predict when an unsafe level of noise will occur. Many workers are reluctant to use PPE because they are uncomfortable, or interfere with job performance and communication (Morata et al., 2001).

4.6.4. Current and previous campaigns and initiatives for this group

There are no ongoing national or state-wide awareness campaigns to combat noise-induced hearing loss in the workplace. Instead, noise exposure is sometimes a component of broader safety-in-the-workplace initiatives, such as Safe Work Australia's *Be a Safety Champion* campaign. Some examples of recent campaigns and materials related to noise in the workplace include:

- **National Safe Work Month – Be a Safety Champion.** The aim of this 2019 campaign was to encourage organisations and self-nominated safety champions to raise awareness about workplace health and safety, including noise safety. Materials included posters, checklists and factsheets provided on Safe Work Australia's website for free distribution and use.
- **Mines Safety Bulletin.** This is a free email communication sent out regularly by the DMIRS in WA. The aim of the communication is to provide organisations and employees with useful tips to stay safe in the workplace. A recent bulletin was dedicated to managing noise-induced hearing loss: https://www.dmp.wa.gov.au/Documents/Safety/MSH_SB_153.pdf
- **Protecting Hearing at Work.** Created by Safe Work Australia, this webinar was intended for business owners or anyone with an interest in managing occupational noise, as part of an online webinar series called *Let's Talk Safety*. Participants receive a certificate of attendance at end of webinar, and gain eligibility to receive a small business rebate up to the value of $500 which can go towards a workplace safety inspection.
- **Webinar on occupational noise in small business.** Created by Kristy Thornton and Kate Cole from the Australian Institute of Occupational Hygienists and promoted by Safe Work Australia, this webinar called *Practical Challenges of Workplace Health and Safety for Small Business* aimed to raise awareness of noise-induced hearing loss, and occupational noise in small businesses, introduce the code of practices, as well as the practical ways to measure noise. Practical advice was provided in relation to noise exposure assessments, checklists and tools, and hearing protection.

4.6.5. Recommendations for strategies to support this group

Involve management in noise prevention initiatives and messages

While WHS officers and occupational hygienists who work in noisy industries have specific knowledge of the necessary procedures to reduce the level and risks of occupational noise, they may lack the influence and resources to effect organisational-wide change. Ideally, the directors and managers of companies will take a leading role in implementing noise-safe initiatives in the workplace because they have the authority to mobilise staff and allocate funds to upgrade or replace equipment to low-emission alternatives and make other higher-order changes to reduce noise exposure for staff.

Messages about the harmful effects of noise exposure and the need to reduce noise at the source should be directed at all levels of the workforce, including company directors, executives, and managers. Messages should point out the prevalence of noise-induced hearing loss as the most common preventable workplace injury and the fact that the risk can be significantly reduced through effective management of its underlying sources. Pointing out the financial benefits of reducing noise exposure in terms of worker productivity and fewer compensation claims could also act as an incentive for this group.

Encourage workplace hearing testing and personalised hearing information for workers

Hearing tests or more general health checks that include hearing tests could be a useful means of reaching high-risk noise-exposed workers and raising their levels of awareness. These tests provide an opportunity to have a one-on-one conversation about noise-induced hearing loss generally and help employees to understand and monitor their own hearing levels. Providing personalised messages and information to employees at the time of testing can motivate them to take a more active role in protecting their hearing. During the test, they can receive advice about the need to select appropriate hearing protection that is well-fitted, well-maintained and consistently used, and a discussion can be had about possible higher-order controls that could be implemented in their specific work situation. Williams et al., (2004) showed that workers had more positive attitudes towards noise and hearing loss prevention after undergoing hearing testing, and this was sustained for at least 12 months, although there was no significant improvement in hearing protector use or noise exposure levels (suggesting that awareness of a perceived health threat alone is not sufficient to change behaviour).

Ensure that messages describing noise are accessible and easy to understand

Noise exposure tends to be one of the more difficult workplace hazards when it comes to the general understanding of the language around decibels, exposure, and hazard reduction. One of the biggest barriers to proactivity in managing and reducing noise is that most people lack a technical understanding of how noise exposure works and are unfamiliar with decibel measurements. Additionally, the language of acoustics is foreign to many and can act as a deterrent to taking action. Therefore, messages for those in the workplace should use clear, simple language to describe the dangers of noise and effective methods to reduce noise and lower the risk of noise-induced hearing loss in the workplace.

Encourage the use of noise apps in the workplace

Developments in software and smartphone features now enable any individual with a smartphone to understand and track their noise exposure over time. This is a potentially powerful tool for behaviour change. Individual employees can receive real-time feedback on whether a specific noise is too loud, change their behaviour or adjust the noise, and then receive further feedback to check they have been successful in reducing the noise. This improves self-efficacy and is likely to result in greater awareness of sound levels in general. Becker et al., (2013) reported that when a person's awareness of the actual sound level of a particular noise source increases, they are better able to predict the sound level of other noises in their environment, and therefore better able to assess when they are at risk. It should be noted that although smartphones can help individuals better understand their noise exposures, calibrated sound level meters must be used for regulatory and monitoring purposes, as set out in the WHS laws.

Improve workers' understanding and use of PPE

Although reducing noise levels at the source is the most effective way of reducing the risk of hearing damage, PPE is, and will likely continue to be, a common control measure for the foreseeable future. Previous campaigns have tended to characterise use of PPE as the sole responsibility of the employee and something that needs to be done to meet WHS rules. However, a new approach that positions PPE as a shared responsibility, and just one element of the employer's commitment to protect their workers' hearing is recommended. Helping workers and employers to understand the value of PPE and the importance of using it consistently is crucial for increasing self-efficacy. Previous research found that workers were more likely to use PPE if they perceived its benefits, felt at risk of hearing damage, were annoyed by noise, felt supported in using it and had a strong sense of self-efficacy in relation to its use (Lusk & Kelemen, 1993; Melamed et al., 1996). A 'feel-good' message that helps workers feel that their employer values their hearing, and that gives them confidence that PPE will assist in reducing their risk of long-term hearing loss and short-term effects (like headaches or ringing in the ears) is likely to be effective. There is also an opportunity to use social norms and peer group support to encourage consistent use of PPE amongst workers and help individuals feel supported in taking protective action.

Reduce the attitudes of 'loss acceptance' and 'she'll be right'

Research conducted by Safe Work Australia (2010) revealed a number of attitudes that are likely contributing to inertia and a lack of hearing-protective behaviours across industries. For some workers, there is a belief that hearing loss is inevitable, and an unavoidable fact of working in a loud industry. If they have been working in the industry for a few years, they might believe that they already have hearing loss, and therefore there is no point protecting themselves. These attitudes suggest that a bias towards the status quo is operating and inertia exists because of the desire to keep doing things as they have always been done. To overcome this bias, messages need to highlight the importance of ensuring that any existing hearing loss does not get worse, and also help workers appreciate what hearing loss would mean for their quality life. Messages should balance the need to create a heightened awareness of the risks associated with noise, while still being positive and geared towards the benefits of taking protective action.

Another issue is the belief amongst some workers that hearing loss 'won't happen to me'. This is an example of optimism bias that occurs when an individual underestimates their likelihood of experiencing a negative event (Sharot, 2011), and it is also observed in teens and young adults (see section 4.3). To overcome this bias, it is important that noise-exposed workers are informed of the very real chance of developing hearing loss using real-world examples of when and how and it happens.

Targeted messaging for males

Noise and ototoxic chemical exposures in the workplace are much more common for men than women largely due to the differences in employment patterns by gender (Lewkowski et al., 2019). Therefore, messaging directed at workers in industries such as construction, where more men are employed, should use imagery and wording appropriate for motivating behaviour change in males. Messages designed to play on masculinity stereotypes or the role of mateship in encouraging protective behaviours could be effective in this instance.

4.7. Target group 6: Farmers

4.7.1. Hearing issues facing this group

Farmers, both male and female, young and old, are at risk of hearing loss from high levels of noise exposure. They suffer from high rates of hearing loss, and there is a need for hearing screening and farm-specific education and communication support. Farmers have been noted as a group in need of a national prevention and awareness program in previous hearing inquiries, most recently in recommendation 7 of the *Still waiting to be heard report* (2017).

Exposure to noise and ototoxins

Statistics show that 35.7% of males and 17.8% of females employed in farming were exposed to noise exceeding the workplace limit on their last working day (Lewkowski et al., 2019). These figures extrapolate to 73,339 male farmers and 14,374 female farmers at risk of noise-induced hearing loss. Almost all people employed in farming (93.5%) are exposed to ototoxic chemicals, and 34.8% are co-exposed to noise and ototoxins, which has been shown to have an additive deleterious effect on hearing.

High-risk tools and activities

Farmers' hearing is at risk due to high levels of noise exposure from regular activities, such as shooting, driving tractors, chainsawing, using post-hole drivers, and shearing. Use of common farming tools such as angle grinders, ride-on mowers and quad bikes also contribute to noise exposure and increase the risk of hearing loss (see Table 6). Measurements conducted by Williams et al. (2015) showed that on a typical day, Australian farmers are exposed to noise that is up to 15 times the recommended exposure standard.

Table 6: Noise levels of selected commonly used farm equipment (Source: Williams et al., 2015).

Noise source		Noise level range (dB L_{Aeq})
Vehicles	Ride-on mower	98-101
	Tractor	72-99
	Motorbike	89-93
	Quad bike	79-98
Tools and equipment	Drop saw	102
	Grinder	90-102
	Chainsaw	99-119
	Log splitter	82-102
	Generator	92
	Auger	85-98
	Post driver	101-110

Hearing loss and tinnitus

Hearing loss amongst farmers and agricultural workers is widespread. The most recent Australian statistics indicate that audiometric hearing loss is present in 65% of farmers aged between 15 and 75+ years (Depczynski et al., 2011). Compared to the general population, young farmers are around seven times more likely to have hearing loss than the general population of the same age. To put it another way, farmers' average hearing-age profile is 10-15 years worse than the general Australian population (Williams et al., 2002). That is, they develop hearing loss when they are younger, and their hearing loss tends to be more advanced at earlier ages.

There is clear evidence that farmers' hearing loss is linked to their noise exposures. Depczynski et al. (2011) reported that for farmers aged 35-44 years, there was an association between specific noise sources and hearing loss. That is, farmers exposed to noise from firearms, chainsaws, workshop tools, heavy machinery and tractors with cabins had significantly poorer mean hearing thresholds at 3-8 kHz compared to non-exposed farmers. Almost 50% of farmers report tinnitus, and half of these experience it continuously (Depczynski et al., 2011).

Hearing loss and accidents

Data from the US suggests that farmers and agricultural workers with hearing loss are more prone to having farm accidents, many of which are serious and life-threatening. Audiometric and self-reported hearing loss were significantly associated with higher risk of agricultural injuries. Farmers with existing hearing loss who also experienced noise exposure were at elevated risk (Choi et al., 2005).

Communication difficulties

Untreated hearing difficulties result in communication problems for farmers and their family members. Because of the limited audiology services in rural areas, farmers who have been prescribed hearing aids often struggle to obtain the necessary assistance to manage them. Audiologists may change from one appointment to the next, resulting in a lack of care continuity and limiting the development of rapport and trust. This reportedly leads to low device usage, which in turn leads to people resorting to other strategies to manage their hearing – turning up the radio and TV. This can lead to conflict and communication difficulties within families as well as increasing exposure for others around them.

Social withdrawal

Farmers with hearing difficulties report withdrawing from social activities, avoiding functions and staying home rather than socialising as a direct result of not being able to hear well. According to Hogan et al. (2015), farmers who reported that: a) they were stressed and tired due to hearing impairment; b) their partner did not understand their difficulties; and c) they had low capacity to manage hearing and listening impairments, were more likely to have elevated blood pressure and blood glucose levels.

Anecdotally, the social isolation of hearing impairment, together with geographic isolation experienced by farmers exacerbates feelings of social awkwardness, stress and anxiety; and reduces social interaction. It is likely that these factors play at least some role in the higher rates of anxiety, depression, anxiety and suicide found in farming communities compared to urban counterparts (Page & Fragar, 2002).

4.7.2. Current hearing services available to this group

Like all Australians in rural areas, farmers and agricultural workers rely on their local primary care services and GPs etc. for referral to audiology and ENT specialist services. Hearing Australia and some private hearing providers operate in rural locations. Community health centres may also offer hearing tests, although these are most often for children, and they depend on the availability of state-based public nurse audiometrists (most of whom are based in NSW).

National Centre for Farmer Health

The National Centre for Farmer Health in Hamilton, Victoria, conducts health assessments for farmers and agricultural workers. Included in the assessment is a specific screening question regarding self-reported hearing loss. If a person self-reports hearing difficulties, this is investigated, farmers are asked if they have had a hearing test, and are provided with information about their options for exploring that further. Since 2006 over 5,400 farmers have been screened with over 43% reporting difficulty hearing in one or both ears.

The National Centre for Farmer Health also runs Agrisafe clinics. These involve a detailed workplace health and safety assessment, and a hearing test. In relation to noise exposure, the clinic provides farmers with information about how to understand the decibel scale, how to reduce noise exposure, how to insert earplugs, and the different classes of hearing protectors (which can be obtained from the centre's online safety shop). Approximately 420 farmers or agricultural workers have been assessed over a 2-3 year period with 48% reporting difficulty hearing in one or both ears.

The National Centre for Farmer Health also runs Australia's only agricultural health and medicine course, the Graduate Certificate of Agricultural Health and Medicine, which is completed by rural and agricultural professionals, health practitioners, students, and others who need upskilling before working in agricultural communities. Of the week-long course, around 40 minutes is spent on hearing loss and hearing protection.

4.7.3. Potential gaps in the services available to this group

According to the Farmsafe Australia (2009) submission to the *Inquiry into hearing health in Australia*, "access to hearing services in rural Australia is highly fragmented and variable, both in terms of scope of services and coverage." (p. 8). For further details, see section 4.8.

4.7.4. Current hearing campaigns and initiatives for this group

Although there are no current hearing campaigns directed at farmers, there are several online resources developed by various organisations as listed below:

- National Centre for Farmer Health: Noise Prevention webpage https://www.farmerhealth.org.au/page/safety-centre/noise-prevention
- National Centre for Farmer Health: Safety Shop – sells earmuffs and earplugs online https://www.farmerhealth.org.au/shop/
- Farmsafe: Farm Noise Hearing Injury webpage https://www.farmsafe.org.au/Farm-Noise-Hearing-Injury
- Workplace Health & Safety Queensland: Agriculture industry: Manual tasks and noise webpage https://www.worksafe.qld.gov.au/agriculture/workplace-hazards/manual-tasks-and-noise
- Farmsafe Australia: Shooting – Aim to keep your hearing brochure http://keo-cms.appspot.com.storage.googleapis.com/sites/farmsafe/assets/dad2bd67-212f-4aa3-8b39-a6f36b74ce39.pdf
- Worksafe Western Australia: Noise in agriculture Identification, assessment & control https://www.commerce.wa.gov.au/sites/default/files/atoms/files/noise_newsletter_-_agriculture.pdf
- Australian Centre for Agricultural Health & Safety: Farm noise and hearing loss brochure http://keo-cms.appspot.com.storage.googleapis.com/sites/farmsafe/assets/015f2cc3-dcfb-4ff1-ad97-092a0bfda4ad.pdf
- Australian Centre for Agricultural Health & Safety: Rural noise injury factsheet http://keo-cms.appspot.com.storage.googleapis.com/sites/farmsafe/assets/1674d541-bdbf-44df-a428-7344f407cb4f.pdf
- Worksafe New Zealand: Preventing noise induced hearing loss on farms – guidelines https://worksafe.govt.nz/topic-and-industry/agriculture/noise-in-agriculture/preventing-noise-induced-hearing-loss-of-farms-gpg/

4.7.5. Previous campaigns and initiatives for this group

The NSW Rural Noise Injury Prevention Program (originally known as the NSW Rural Hearing Conservation Program) was operating from the late 1980s until 2019. The program offered free hearing screening for farmers and agricultural workers at NSW farm field days (i.e., trade shows for agricultural industry and equipment). These were conducted by trained nurse audiometrists and audiologists, who also provided counselling about hearing conservation. Data from 8,309 participants showed that farmers' hearing status and their use of hearing protection improved between 1994-2001 and 2002-2008 (Depczynski et al., 2011). Furthermore, high-risk exposures to chainsaws declined, and the use of tractors with cabins (which offer greater hearing protection) increased over this 14-year period. While these improvements cannot be directly attributed to the program, they provide evidence to support the provision of farm-specific recommendations about reducing noise exposure to avoid noise injury. Similar programs were also run in Queensland, South Australia, and Tasmania, however by 2009, only the NSW program was operating (Farmsafe Australia, 2009), and as of 2019, the program has ceased entirely due to lack of funding and staff.

Shhh hearing in a farming environment

In 2010, the NHMRC funded a research project, 'Shhh hearing in a farming environment' that focussed on prevention of hearing loss, and understanding the greatest risks on farms by conducting noise audits and teaching farmers some simple skills about measuring farm noise exposures using sound apps. The Shhh hearing project also studied farmers with a hearing loss and the strategies they could undertake to a) prevent it getting worse and b) remain socially connected and active using the Montreal Health Hearing Program (Brumby, 2016).

Farm noise audits
The on-farm noise audits conducted as part of the Shhh hearing project were well-received by farmers and considered very valuable. The audit included noise exposure measurements for specific tools and activities, tagging the equipment to remind users to wear hearing protection while operating and providing information about how to wear earmuffs and earplugs. All participants received a report detailing the noise exposures and suggested actions to limit exposure and protect themselves. An evaluation study found that the vast majority of farmers (95-99%) agreed that the on-farm noise audit had updated their knowledge about farming tasks that are a risk to hearing and motivated them to use hearing protection (Williams et al., 2015).

Noise Injury Prevention Strategy for the Australian Farming Community
In 2002, Farmsafe published a 5-year strategy for noise injury prevention for Australian farmers, and within this framework, the 'Better hearing for farming families' project was implemented in Broken Hill, Tamworth and Casino. This project comprised a range of local demonstration activities related to noise exposure and prevention of hearing loss. The evaluation report concluded that "locally based hearing health initiatives for farming families" were effective for increasing general awareness of hearing health (Lower et al., 2010).

4.7.6. Recommendations for strategies to support this group

Address lack of general awareness
As in the general community, there is widespread lack of awareness of hearing loss, and a poor response to people with hearing loss within farming communities. This extends to medical settings, where nurses and doctors may ignore the possibility that a farmer has an untreated hearing loss, and are unlikely to check for hearing problems or ensure that they can hear and understand important medical information. In many cases, practitioners are unaware of basic communication strategies that can assist people with hearing difficulties, and are unlikely to know how to help people with hearing aids that aren't working. General practitioners rarely prioritise hearing, and in the case of experienced rural GPs, hearing is often ignored precisely because it is so common – there is almost an expectation that farmers will have a hearing loss. Given the limited time in a GP consultation, unless there is an acute problem related to hearing, it is likely never discussed. This is further exacerbated by the 'she'll be right' attitude that many farmers exhibit. This stoicism applies not only to hearing, but health issues in general. Given that hearing is a lower priority than other health conditions, it is even less likely to be acted upon.

Calls to action
There are a number of specific calls to action that would be suitable for this group:

- **Buy quiet tools and machinery.** The most effective way to reduce noise exposure is to reduce the source of the noise, either by substituting with quieter equipment, repairing noisy machinery, using barriers and noise insulation, and other strategies. Wherever possible, these methods should be promoted amongst farming communities.

- **Wear hearing protection.** Although less effective than reducing the noise source, when used appropriately, hearing protection reduces the risk associated with noise exposure, and farmers should be encouraged to wear appropriate hearing protectors when engaged in noisy activities. Although most farmers are familiar with earplugs and earmuffs, they are less familiar with the classification system which relates to levels of sound attenuation provided, correct methods of usage and insertion, and how to calculate the reduction of noise exposure when wearing protection (Brumby, 2016). Use of hearing protectors is inconsistent – with only 12.7% of farmers in the Brumby study indicating that they *always* used hearing protection in noisy situations; 34.5% indicated that they did so *mostly;* 25.5% *sometimes,* and 27.3% *rarely*. The call to use hearing protection should be supplemented with supporting information to maximise the effectiveness of taking this action. For example, providing simple guidelines about typical noise levels for particular tools and activities and how to select the appropriate class of hearing protector to the circumstances; encouraging people to choose quality earmuffs that are comfortable and fit properly; explaining the need to wear hearing protectors consistently; and guidance about proper insertion techniques for earplugs. Messages that help farmers use hearing protection as a matter of habit are recommended – this could include tips about how to store hearing protectors with noisy tools to so that they are readily available when needed. An acknowledgement of the particular challenges that farmers face with wearing hearing protectors on farms may improve the credibility of campaign messages. For example, farmers may not have time to reach for hearing protectors when faced with a more immediate danger, such as shooting a snake. Other times, when working with livestock or machinery, farmers choose not to wear hearing protection so that they can be alert to problems with the animals or the engines and react accordingly.
- **Use a noise app to check noise levels.** The Shhh hearing project found a lack of awareness amongst farmers about smartphone apps for measuring noise. However, many farmers are tech savvy and comfortable with smartphone technology. Therefore, encouraging farmers to use noise and hearing-related apps to improve their hearing health is likely to be a good strategy. For example, after completing the Shhh hearing program, farmers reported making use of a free noise app (recommended to them during the program) when deciding on a new brand of tractor and other equipment. Although some older farmers may be less confident with computers, they regularly use mobile phones and tablets and are interested in learning to do more. They use SMS and email to communicate and access apps to check commodity market reports, weather forecasts, price predictions, so using an app for noise measurements is a viable option for this group and could result in farmers being more aware of noise levels on the farm, being able to identify quieter tools, and knowing when hearing protection is needed.
- **Ask for quiet.** For the many farmers who have already developed hearing loss, encouraging them to advocate for themselves and seek out places that are conducive to communication is important to guard against the social isolation that arises when people start to avoid going out because of their hearing difficulties. For example, the Shhh hearing program found that farmers were reluctant to ask for 'a quiet table' when going out to a pub or restaurant and 'put up' with loud background music rather than ask for it to be turned down. They also need encouragement to let others know that they have a hearing loss and to ask for adjustments to improve communication, such as asking people to sit opposite them and face them while talking. Like many other groups, farmers often do not tell people that they have hearing loss – and a strong stigma persists.

The farming context is important

Addressing the hearing needs of farm women and men requires an understanding of the context of farming communities, and the various barriers that inhibit interaction, including the strong cultural identity of self-reliance (Brumby, 2014). Farmers also have enormous respect for their peers, who are strong influencers of attitudes and behaviours. Farmers value others that have walked in their shoes. Providing advice from people that understand the farming context is crucial. It engenders trust and familiarity and forms the basis for effective education. For example, most of the staff from the National Centre for Farmer Health are from an agricultural background and have done further study in agricultural health and medicine, and can talk knowledgeably about farming activities and tools that farmers are likely to be using on the farm. They understand the practical challenges that farmers face, and farmers listen to them. From a campaign point of view, this suggests that a grassroots, locally based campaign would be more effective than a generic approach. Images and messages should be authentic and delivered by respected and competent peers.

Communication channels

Events and activities that are well-embedded within farming communities are an opportunity to communicate effectively with farmers:

- **Farm field days.** Farm field days and other agricultural trade show events are an important way of reaching farming communities. In the past, hearing assessments were conducted regularly in several states, although these services have been discontinued in recent years. Appropriate soundproof vans are required, such as those operated by the Wimmera Hearing Society and Hearing Australia. There is an opportunity to consider field days as a way of reaching significant numbers of farmers. Campaign materials could be distributed via local services, such as Hearing Australia, who currently attend field days on a sporadic basis to provide hearing screenings. Campaign initiatives could also be integrated with other trusted local agencies already working with farming families on other aspects of safety, health and wellbeing to ensure this community is given appropriate advice for the farming context.
- **Farm noise audits.** Although on-farm noise audits as conducted as part of the Shhh hearing project are beyond the scope of an awareness campaign, key elements of the audit could be provided as an online tool or smartphone app. Farmers could look up the noise levels of their specific farming tools and activities, and obtain information about quieter alternatives, and other strategies for noise reduction, including the appropriate level and class of hearing protection required when using tools and equipment. Estimates of a farmer's cumulative daily noise exposure could be calculated and provided to farmers.

Message development for farmers

Although important, knowing about noise levels is not enough to motivate action. Rather, farmers need awareness of the impacts of hearing loss and an appreciation of the communication challenges that come with hearing loss, as described by one of participants in the Shhh hearing project: "There is nothing sexy about sitting and going, "What? Pardon?" or coming in inappropriately with a joke or something when you've totally misheard it or misunderstood."

Farmers also need an awareness of the long-term impact of repeated episodes of noise damage. Sunsafe messages that make a connection between short-term sunburn and long-term skin cancer are a good example of this type of messaging. A similar formula could be used to create appropriate messages that connect short-term noise exposure and long-term hearing loss.

4.8. Target group 7: People living in rural and remote locations

4.8.1. Hearing issues facing this group

People living outside major cities are more likely to have hearing disorders than those who live in cities. This is partly due to these areas being home to an older population, with 40% of all Australians 70–74 years of age living outside Australia's capital cities compared with only 25% of people aged 25–29 (National Rural Health Alliance, 2014).

One of the biggest contributors to the risk of hearing loss in rural and remote communities is noise exposure, most likely occurring at work. During an average workday, Australian men living in regional or remote locations are twice as likely than those in major cities to be exposed to noise levels higher than the permissible exposure limit (Lewkowski et al., 2019). Women outside of major cities are also proportionately more likely to be exposed to these noise levels.

In towns like Broken Hill, the mining industry has traditionally been one of the main employers for people in the region, with workers being exposed to noisy conditions throughout their working life. Between 2008-2011, mining was amongst the top 10 occupations with the highest rates of workers' compensation claims for noise-induced hearing loss (Safe Work Australia, 2014). In addition, many older Australians in rural towns have worked as farmers and been exposed to noise from rifles and heavy machinery.

In 2016, almost two-thirds of Aboriginal and Torres Strait Islander people (499,500 people) lived outside of major cities in Australia (ABS, 2018). This includes 53,500 (7%) people who lived in remote Australia and 95,200 (12%) in very remote Australia. With a significant proportion of Aboriginal and Torres Strait Islander children experiencing otitis media and associated conductive hearing loss, this represents another key hearing issue facing people living in rural and remote locations in Australia.

4.8.2. Potential gaps in the services available to these group

Access to hearing services

People with hearing impairment in rural and remote areas face barriers to accessing audiology services. In many cases, there are no local hearing services and people are required to travel to access them, costing the individual both time and money. Where private audiology services exist, they may be too expensive for families from lower socioeconomic backgrounds. Audiology services in public hospitals tend to have long waiting times and/or they require a specialist referral, which usually means another trip to the city. Families with children who need a hearing assessment may be directed to a community health service to attend an audiometry nursing clinic, but the wait times are between 6 weeks and several months.

Access to ENT specialist services is also limited in rural and remote areas. In Broken Hill for example, there is only one ENT specialist available in the town for one day a month. In Mildura, there is one resident ENT surgeon, and the current waiting time to access a consultation is 18 months. In Shepparton, there is no ENT specialist. This lack of availability means that many patients will need to travel to capital cities or larger regional towns to see an ENT specialist, placing a burden on families who cannot afford the travel costs, or who are too unwell to travel. Individuals who require cochlear implants need to travel to Sydney or another capital city for surgery. As a result, many people living in the country go without hearing services and 'make-do' with what's available to them locally.

Stretched primary health services

Rural GP services are in high demand, and while GPs are trusted touchpoints for people in rural and remote locations, they have limited time, and other health issues are usually considered higher priority than hearing. There is also a general lack of awareness about hearing amongst GPs, and a need for better collaboration between GPs and audiologists to ensure timely and appropriate referrals. Making use of other practitioners could help to overcome some of these issues. For example, community health nurses and nurse practitioners can support GPs by running regular community hearing health days and conducting hearing screening and monitoring. These initiatives would not only provide a valuable service, they would also serve to increase the incidental visibility of hearing within trusted health settings, which raises overall community awareness of hearing health. Models exist in other health areas (such as diabetes and smoking cessation counselling) and these could be used to inform initiatives in the hearing space.

Discontinuity of care

Discontinuity of care is another issue in rural or remote areas. Because GP and health practitioner turnover is higher in these areas, patients may find it difficult to sustain an ongoing relationship with a health practitioner who understands their health history and unique needs. This situation can make it hard to move through a referral pathway and patients may not receive appropriate care based on their hearing health history. For example, a child may see a GP with a middle ear infection, that GP may leave the town, and when the child sees another GP, they may not realise that the infection is now chronic.

More hearing screening is needed

Better access to hearing screening in rural and remote communities is needed, particularly for the paediatric population. The success of programs such as *Deadly Ears* is a good example of how the 'screening gap' can be filled when there is a team of audiologists targeting otitis media in Aboriginal and Torres Strait Islander families.

Bridging the divide – 'holistic' hearing clinics

There are some good examples of rural clinics that are overcoming geographical barriers to help clients access hearing services in regional towns. The Mallee District Aboriginal Services Centre in Mildura, for example, contracts a private ENT specialist to work for the clinic for two days every month. They have also hired an audiologist to conduct hearing assessments, and a hearing health nurse has been appointed to promote hearing health in the community, and raise awareness of ear and hearing health with 'mums and bubs' groups. All of these services are coordinated to occur on the same days that the Hearing Australia clinic is open, and the clinic employs a transport officer to bring people who have no access to transport to the clinic. Services such as these help to reduce the long wait lists for specialist services in the public hospital system, and provide an excellent model for other rural towns to follow.

Access to telehealth

Telehealth, or the provision of health services via the internet, is a valuable method for increasing access to hearing health services in rural areas (and one that is likely to be used more widely in future as a result of the impact of COVID-19). Greater access to telehealth generally and teleaudiology specifically would help to improve overall provision of hearing health. For example, telehealth methods could be used to identify a patient's hearing loss remotely. Often hearing screening and speech rehabilitation can be performed effectively via telehealth methods, and is a quick, effective and relatively inexpensive alternative to face-to-face visits. There are a number of GPs, ENT specialists, and speech pathologists who offer telehealth services and are listed on The Australian College of Rural and Remote Medicine Telehealth Provider Directory (http://www.ehealth.acrrm.org.au). Some of the early intervention providers for children, such as RIDBC and the Shepherd Centre also offer telehealth services to clients in rural and remote areas.

4.8.3. Previous campaigns and initiatives for this group

There is little evidence of hearing health campaigns directed at individuals in rural or remote locations. Individuals may have been exposed to hearing campaigns directed specifically at farmers, but preventative health messages for rural communities tend to focus on other health issues such as diabetes, smoking and mental health.

4.8.4. Recommendations for strategies to support this group

Many of the strategies to support hearing awareness in rural and remote communities have already been outlined in the earlier target group sections since at least a proportion of the other target populations also reside in rural and remote communities. However, some additional strategies that are particularly relevant to rural and remote communities are detailed below:

- Bring hearing into the conversation with GPs and encourage GPs to raise hearing issues as part of regular primary healthcare checks to ensure that hearing is not lost amongst competing priorities.
- Encourage parents to talk to their GP about their child's ears and hearing, and to get their children's ears checked regularly. Reinforce the link between ear health and hearing, learning and development.
- Place hearing on the overall health agenda and create more visibility around ear and hearing health and elevate its status to that of a key component of one's overall health.
- Create awareness of alternative methods for interacting with health practitioners.
- Encourage telehealth as an inexpensive and effective tool to support hearing health services, and provide information about where and how to gain access to these services.
- Provide trusted, independent information so that people living in rural and remote areas who do not have ready access to face-to-face services can access the hearing health support they need.

4.9 Using the TARPARE model for target group prioritisation

4.9.1. Overview of the TARPARE model

The TARPARE model was designed to assist public health practitioners to understand the various target groups in a population of interest and assess the potential viability of public health campaign messages directed at each group (Donovan et al., 1999). The model can be useful when there is a need to prioritise which population segments to target, especially when there are budgetary constraints or other factors that limit campaign resources.

To use the TARPARE model, each population segment is scored on the six TARPARE criteria and a total score is calculated for each group. The scale used for each criterion is 1-5, with 5 indicating a high priority score and 1 a low score. Equal scores are possible when target groups are considered approximately equal with respect to the criterion in question. Each of the six criteria receives an equal weighting, however, this can be varied if one or more are considered particularly relevant in the context of the campaign under consideration. The criteria are as follows:

- **T: The Total number of persons in the segment.** In general, the greater the number of people, the higher the priority of the segment. This criterion is particularly important for mass interventions where small percentage shifts in large proportions of the population yield substantial benefits.
- **AR: The proportion of 'At Risk' persons in the segment.**
- **P: The Persuasibility of the target audience.** This refers to a consideration of how feasible it would be to change attitudes and behaviour in the segment. In general, the more persuasible, the more likely an intervention can be cost effective, and the higher the priority.
- **A: The Accessibility of the target audience.** This refers to how easy is it to reach the segment via mass communication or other channels, such as worksites, community centres, entertainment venues, schools and other institutional settings.
- **R: Resources required to meet the needs of the target audience.** A consideration of the financial, human and structural resources needed to service the segment. This refers to the extent to which interventions can be directed towards each segment with current services and facilities versus the need for additional resources. A higher score indicates that the less additional resources are needed to service the segment.
- **E: Equity.** The inclusion of social justice considerations. Groups like Indigenous people and homeless teenagers might constitute a very small proportion of the population, but for equity reasons warrant special programs.

The authors of the TARPARE model suggest that campaign messages that are targeted at those segments with higher scores are likely to result in greater impact than for groups with lower scores. Of course, this does not mean that lower-scoring groups should be ignored or omitted from campaigns. It may be that a low score is an indication that other non-campaign initiatives or methods would be better suited to reaching these groups. Alternatively, a closer look at the particular elements of the TARPARE model that received low scores could highlight where there are likely to be challenges in communicating with these groups.

4.9.2. Using TARPARE for a national hearing awareness campaign

The TARPARE model was used to evaluate the likely effectiveness of directing a national hearing awareness campaign message at six potential target groups. The rural and remote target group was omitted from the exercise because many of the individuals who fall into this group also fall into one of the other target groups, making it difficult to draw meaningful comparisons.

To determine the 'total size' of each group and the number of people 'at risk', we used data from the Australian Bureau of Statistics and other relevant data referenced in the respective target group sections. The remaining dimensions were scored by the authors of this report, based on our experience and expertise in relation to persuasibility, accessibility, resources and equity for each of the groups.

As shown in the table below, the TARPARE model revealed that *People with untreated or developing hearing loss aged 50-75* was the target group with the highest score, with *Children* and *Workers exposed to noise* also scoring 20 or more out of a possible 30. A closer examination of the scores highlights some of the challenges that are likely to arise when raising awareness within the various target groups. For example, the Aboriginal and Torres Strait Islander group is at high risk of experiencing hearing loss, but received a lower overall score because of low levels of accessibility and persuasibility. These scores are related to systemic issues that apply to the Aboriginal and Torres Strait Islander population in all areas of health and suggest that careful messaging and sensitive engagement with this population is needed if hearing health campaign messaging is to be effective.

Table 7: TARPARE model for prioritising target groups for a national hearing awareness campaign.

	TARPARE elements						
Target group	Target group size (% of Australian population)	At Risk of hearing loss (% at risk)	Persuas-ibility	Access-ibility	Resources	Equity	Total score
Young children and caregivers*	3 (18.7%)	2 (0.25%)	4	4	4	4	**21**
Teenagers and young adults	4 (23.1%)	3 (14.1%)	1	4	4	3	**19**
People aged 50-75 years	4 (27.2%)	5 (17-64%)	3	4	4	4	**24**
Aboriginal & Torres Strait Islanders	2 (3.3%)	4 (43%)	2	2	3	5	**18**
Workers	5 (50.7%)	3 (11%)	2	4	3	3	**20**
Farmers	1 (1.1%)	4 (30.7%)	2	3	3	4	**17**

* Population figures are for children aged 0-14 years.

Section 5 – Using health promotion theory to effect behaviour change

5.1. Behaviour change theory and hearing health promotion

Why raise awareness?

The aim of all awareness raising campaigns is to build towards behavioural changes which lead to improved individual and/or community outcomes. In this way, awareness raising should be considered as a means to promote change rather than an end in and of itself. Determining how and where to raise awareness, therefore, is inextricably linked with an understanding of the behaviours that are most in need of change.

The preceding section highlighted the varied hearing issues faced by the seven target groups. For all groups, certain needs were identified that are unlikely to be addressed by a generalised awareness campaign, such as access to hearing services. Although these needs are beyond the scope of the current project, they have been noted because they contribute to the current Australian hearing health landscape, and are important considerations in raising awareness – these is little point raising awareness that prompts people to seek services if those services are over-stretched or non-existent.

If we now turn our attention to where awareness-raising is needed, the next step is to distil the information we have gathered on each target group into recommendations for effective and efficient messaging to maximise the positive impact on hearing health. We need to ask, what do Australians need most in order to look after their hearing health?

5.2. Lessons learned from behavioural science and health promotion

Models of health behaviour change

Until recent times, hearing heath messaging (both in Australia and overseas) focussed predominantly on strategies aimed at 'information provision'. For example, messages aimed at preventing noise-induced hearing loss often focussed on the biological processes that occur when the hearing system is damaged by loud noise, and provided directives on how to reduce exposure. Such messaging treats individuals as rational decision makers, whose behaviour reflects their access to, and evaluation of, available evidence.

However, behaviour change is complex, and having evidence or knowledge is rarely sufficient to generate a change in a person's behaviour. Research from the fields of health promotion and behavioural science has helped us to understand that a person's decisions to undertake certain behaviours are driven by not just knowledge, but also their beliefs and attitudes and the context in which they occur. Therefore, in order to develop effective campaign messages, it is important to consider all the nuanced factors that impact on behaviour.

Several models and theories have been developed to explain the impact of these factors. For example, a person's perceived susceptibility to a negative health outcome and the perceived severity of that outcome are considered important factors within the Health Belief Model (Janz & Becker, 1984; Rosenstock, 1974). Similarly, a person's perception of the benefits of making a behaviour change, and the perceived barriers to those changes are also important factors that influence our behaviours. The Theory of Planned Behaviour (Ajzen, 1991) highlights that our beliefs about the attitudes of others towards the behaviour change can be very influential, as well as how we feel about our own ability to engage in the behaviour (our self-efficacy). Social Cognitive Theory (Bandura, 1986) makes reference to the social environment, and points out how we can be influenced by what we learn from observing others.

The benefit of using behavioural models to develop effective health promotion activities in a range of areas has become increasingly recognised in recent years. In particular, the Theoretical Domains Framework (TDF), the Behaviour Change Wheel and its associated COM-B model (described below) have attracted strong interest from hearing researchers as a way of identifying the factors that are most effective for developing messages and interventions aimed at changing health behaviours (Coulson et al., 2016). These models are used here as a framework for addressing the awareness gaps identified for each target group. A brief overview of the development of these theoretical constructs is provided below.

Theoretical Domains Framework and COM-B

The TDF was created when a group of researchers recognised several overlapping or common theoretical constructs that occur across the various models of behaviour change. After undertaking a review of 33 behaviour change theories, the TDF was proposed to encapsulate 14 key domains that influence behaviour (Cane et al., 2012). Originally developed in relation to the behaviour of health professionals, the TDF has subsequently been used to examine a wide range of health behaviours, providing a "theoretical lens through which to view the cognitive, affective, social and environmental influences on behaviour" (Atkins et al., 2017).

The domains and associated constructs of the TDF were later mapped onto the COM-B model from the Behaviour Change Wheel (Michie et al., 2014). This model proposes that there are three key elements that affect whether a person performs a certain behaviour (B): capability (C), opportunity (O), and motivation (M). The authors argue that interventions should be designed in line with the elements or domain(s) that are most relevant for bringing about the desired behaviours or changes in behaviour.

When considering hearing health messaging in Australia, the TDF and COM-B provide a relevant framework for identifying domains that are most in need of targeting in order to change behaviour. As outlined in the preceding sections, hearing health encompasses a wide range of issues and behaviours, but all of these can be considered along a continuum of 'maintaining good hearing health'. This includes the preventative actions that are required to reduce the likelihood of developing hearing loss through to the rehabilitation activities that are aimed at reducing the disability experienced as a result of impaired hearing. It should not be surprising, therefore, that many of the needs identified in the preceding sections can be related back to common TDF domains, and common strategies can be used to address many of the issues raised. Table 8 lists the relevant TDF domains (within the associated COM-B model) and in section 5.3, we outline how the needs identified in each of the target groups might be best addressed by campaign interventions and messages. Please see also the chart on page 67-68, which provides a summary of these recommendations.

Table 8: Overview of COM-B components and TDF domains identified as relevant for hearing health (modified from Cane et al., 2012).

COM-B component		TDF domain	Description
Capability	Psychological	Knowledge	An awareness of the existence of something (includes knowledge of condition/scientific rationale).
		Decision processes	The ability to retain information… and choose between two or more alternatives.
Opportunity	Social	Social influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours (includes social support & social norms).
	Physical	Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour (includes material resources).
Motivation	Reflective	Professional role & identity	A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting (includes leadership and organisational commitment).
		Optimism	The confidence that things will happen for the best or that the desired goals will be attained (includes unrealistic optimism).
		Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation.

5.3. Developing messages for hearing health using the COM-B and TDF

Capability

Knowledge – Identifying the signs of hearing loss. A common difficulty identified across several groups was a lack of understanding of the experience of hearing loss, specifically how hearing loss manifests beyond 'reduced volume'. In various target groups, there is a need for individuals, those who interact with them, and the general community to have a deeper knowledge of hearing loss. This knowledge can then be used to identify potential signs of hearing loss, such as a child's behavioural issues; or an adult's need to expend greater listening effort to participate in conversations; or symptoms of middle ear disease. Knowing about these and knowing that they are signs of hearing loss should lead to earlier and better help-seeking.

Knowledge – Understanding noise exposure. Reducing the risk to hearing from excessive noise exposure requires a basic understanding of the nature of the 'noise dose' (particularly the fact that it is a combination of both intensity and time). This is true regardless of whether the exposure is from occupational or leisure sources. Because scientific measures of risk based on sound levels measured in decibels are not easily understood, it makes it difficult for individuals to monitor their exposure or change their behaviour. Therefore, increasing awareness of the risk in a way that empowers the individual to take appropriate action is required. This might include providing information about specific tools that are available to support noise reduction behaviours (e.g., how to evaluate/monitor noise exposure using a simple rule of thumb or a smartphone app, how to use PPE to reduce risk) or finding creative ways to represent the relationship between PPE, noise, and risk.

Decision processes – Supporting choice. For both rehabilitation and preventative behaviours, individuals are often required to decide on an appropriate action (e.g., selecting the right type of hearing protection, buying quieter tools, choosing appropriate hearing aids or other devices). To support this, there is a need to ensure that information is presented in a way that provides the best opportunity to navigate these decisions and make informed choices.

Opportunity

Environmental context and resources – Centralising access to material. For many target groups, there was low awareness of where to seek independent, trustworthy, comprehensive information and advice about hearing health issues they face. An accessible 'one-stop shop' that covers a) how/where to seek help; b) the support available for different groups, and c) advice for those making choices about their hearing health could reduce many of the difficulties arising from the current situation, where information is fragmented and hard to find. Ideally, the information would be available online and designed so that individuals, families, and professionals could all access information from a single hub to ensure consistency and transparency across all groups.

Environmental context and resources – Promoting hearing monitoring. Across all target groups, hearing is an area that is 'under-considered' by individuals within the broader context of health generally. Reframing the importance of hearing health requires resources that support and encourage monitoring – particularly monitoring that focuses on identifying and addressing 'red flag' situations, such as middle ear infections in Aboriginal and Torres Strait Islander populations, school difficulties for young children, and loss of hearing in early ageing.

Social influences – Understanding social responsibilities. Much of the help currently available is directed at the individual with hearing loss, and there is a pressing need to raise awareness of the social context of hearing. Much of the disability associated with impaired hearing comes from communication breakdowns between individuals with and without hearing loss. This is true for both individual relationships, and also in the workplace and broader community. There is a need to raise awareness of how all of us – family members, friends, teachers, medical professionals, colleagues and those in the wider community – can improve our habits to improve communication experiences for all.

Social influences – Reducing normalisation. People look to the behaviour of those around them when making decisions about their own behaviours. When hearing loss becomes normalised as a common experience within a target group, this can hinder preventative and rehabilitative behaviours. For example, an older person might think, "my hearing is normal for my age"; an Aboriginal mother might assume that, "middle ear infections in childhood are part of life"; a boilermaker might expect that "hearing loss is just something that happens to people in my industry". Just because these experiences are expected or normalised, it doesn't mean that they can't or shouldn't be addressed – thus there is a need to raise awareness of these common hearing experiences and use them to motivate, rather than stymie, behaviour change.

Motivation

Beliefs about consequences – Understanding outcomes of hearing loss. For many groups, there is a lack of awareness of the outcomes associated with not taking action in relation to hearing health. People are generally loss averse, concerned more about reducing negative outcomes than seeking out positive ones. Highlighting the potential impacts of hearing loss, such as social isolation and cognitive decline in adulthood, or reduced access to language and learning in childhood, can be beneficial for promoting behaviours across the entire hearing health continuum.

Professional role and identity – Improving top-down support. In the context of hearing loss prevention – particularly reducing noise exposure – responsibility for behaviour change extends beyond the individual to the organisational context. There is a need to raise awareness of the responsibility held by employers and venue owners to try to reduce the risk of hearing loss and support individuals who wish to protect their hearing while in a high-risk workplace or other venue.

Optimism – Addressing individuals' estimation of risk. Whilst many acknowledge the facts of hearing health (e.g., that noise can damage hearing, specific behaviours carry risk, prevalence of loss increases with age), many people are disproportionately optimistic that negative consequences won't apply to them. There is a need to understand and address the possible causes of this unrealistic optimism to encourage behavioural change.

Hearing health journeys in Australia: Needs and gaps in capability, opportunity, and motivation to change hearing health behaviours

	0–1 years	1–5 years	5–12 years	12–25 years	25–45 years	45–65 years	65+ years
Anne was diagnosed with permanent hearing loss as a baby 	Newborn hearing screening, moderate hearing loss diagnosed	Starts early intervention and has hearing aids fitted by *Hearing Australia* 6 weeks after birth	Support from itinerant teachers of the deaf at school and *Hearing Australia* care continues		From age 26, self-funds hearing aids and maintenance costs		Retires and applies for a HSP voucher to support hearing aids
Barney was diagnosed with hearing loss when he started school 		Parent notices a language delay and school teacher notices disruptive behaviour	Referred to GP, speech pathologist, paediatrician, audiologist. Mild hearing loss diagnosed at age 6	Hearing aids fitted by *Hearing Australia*, care stops at age 25			
Colin experienced a sudden hearing loss in his 40s 					Experienced sudden hearing loss. Severe-to-profound hearing loss diagnosed at age 45	Referred to ENT for cochlear implant surgery, joins NDIS, applies for HSP CSO program	
Deidre first noticed hearing difficulties when she was getting ready to retire 						Family members start to notice hearing difficulties, TV volume high, gets hearing screened at age 55 but ignores result	Finally gets hearing tested at age 65. Moderate hearing loss diagnosed and hearing aids fitted at private clinic
Ella has had multiple ear infections throughout her childhood 	First ear infection 3 months after birth	Ear infections become chronic. ENT referral at age 5	Hearing aids fitted by *Hearing Australia* while waiting for surgery for grommets	Hearing problems continue intermittently		Hearing loss deteriorates, accesses hearing care through HSP CSO program at age 50	
Flynn is a music lover with early signs of noise damage 				Listens to music on headphones for several hours a day at high volume, plays in band, has ringing in the ears often	Works in noisy pub, goes to gigs twice a week, plays in band occasionally, doesn't consider earplugs	Has trouble hearing in noisy places, at age 48 starts using hearables to improve listening	
Garry is a tradesperson with workplace noise exposure 				Trains as a carpenter and gets job on building site	Works on noisy building sites, wears earmuffs sometimes, spends weekends at motorcross track	Starts new job at age 45 and gets hearing check, shows noise-induced hearing loss	
Hilary is a farmer with lifelong exposure to farm noise 			Rides motorbikes and tractors	Learns to use a gun and power tools around the farm	On the tractor for hours at a time and regularly shooting pests, never wears earplugs	Starts to have trouble with hearing at age 42, but ignores it, withdraws from social situations	

Shown on the previous page are eight hearing health journeys for Australians with hearing loss, showing the key hearing issues, behaviours, decisions, touchpoints, and pain points.

Ten hearing health needs or gaps have been identified (see below) and these are mapped across the journeys. Six are specific needs occurring at a particular time or event, and the remaining four are ongoing needs that are relevant across the lifespan.

The needs have been classified according to two health behaviour models – the Theoretical Domains Framework (TDF) and the COM-B model. For each need, the relevant TDF domain is underlined and the symbol has been colour coded to reflect the relevant COM-B construct, Capability, Opportunity or Motivation.

Specific needs: These needs occur in a range of contexts, but are generally triggered by specific hearing health events

Knowledge of how to identify the signs of hearing loss: We need to increase our awareness of the early signs & symptoms of hearing loss & damage.

Knowledge of how to monitor noise exposure: We need to increase our awareness of 'noise dose' for better risk management and noise monitoring.

Decision processes that support choices for hearing health: We need to improve the information available to enable specific decision-making re hearing rehabilitation, devices, earplugs etc.

Environmental resources that frame hearing as a health issue: We need to provide more hearing monitoring opportunities at critical timepoints

Social influences that question the normalisation of common hearing difficulties: We need to raise awareness that taking action on hearing loss will make a difference

Professional role and identity that acknowledges the need for top down support: We need organisations and managers to take the lead on hearing health at work and public venues

Ongoing needs: These needs are relevant across groups and across the lifespan for improving overall hearing health

Environmental resources that provide centralised access to information and support materials: We need to provide a one-stop shop to support hearing health at all life stages.

Social influences that promote shared responsibility for communication: We need to raise awareness of how we can all change our habits to improve communication for all.

Beliefs about consequences that accurately reflect experience of hearing loss: We need to increase awareness of the everyday impacts of poor hearing health to motivate action at all life stages.

Optimism that is realistic and provides accurate estimation of risk: We all need to think about our hearing health with a realistic understanding of what can go wrong.

5.4. Developing interventions: Lessons from behavioural science

The MINDSPACE and EAST are two frameworks from the behavioural sciences that can be used to optimize the design of campaign messages and interventions to effectively influence behaviour. Both have been used by governments in the UK, US and Australia to influence or 'nudge' behaviours in a variety of health-related contexts, and they are also relevant here.

MINDSPACE

MINDSPACE was created through a collaboration between the UK Institute of Government, the London School of Economics, and Imperial College London (Dolan et al., 2012). The framework is essentially a checklist for users to consider and select those that are most relevant for their particular context. In the table below, each of the MINDSPACE dimensions is listed with an indication of how each one could be applied in the context of a hearing health awareness campaign.

Table 9: The MINDSPACE framework for behaviour change (adapted from Dolan et al., 2012).

Dimension	Description
Messenger	We are heavily influenced by who communicates information to us: *Consider using celebrities and peer role models as messengers*
Incentives	Our responses to incentives are shaped by predictable mental shortcuts such as strongly avoiding losses: *Focus on losses associated with impaired hearing, such as impacts on music, communication with loved ones*
Norms	We are strongly influenced by what others do: *Use peer role models to show desired behaviours*
Defaults	We 'go with the flow' of pre-set options: *Consider whether healthy hearing behaviours can be made the default option*
Salience	Our attention is drawn to what is novel and seems relevant to us: *Understanding the target audience is critical*
Priming	Our acts are often influenced by sub-conscious cues: *Use traffic light colours to communicate safe vs. dangerous sound levels*
Affect	Our emotional associations can powerfully shape our actions: *Rely on emotion (not information) to convey campaign messages*
Commitments	We seek to be consistent with our public promises, and reciprocate acts: *Consider whether encouraging a personal commitment to hearing health will lead to behaviour change*
Ego	We act in ways that make us feel better about ourselves: *Construct positive and uplifting messages that focus on the lifelong benefits of healthy hearing*

EAST

The EAST framework was developed by the UK Behavioural Insights Team (BIT) in 2012, and is now used by many government departments worldwide to inform policy design, messages and behaviourally-informed interventions. The evidence-based framework outlines four key principles that can be applied to messages and initiatives to encourage behaviour change (BIT, 2015).

Table 10: The EAST framework for behaviour change (reproduced from BIT, 2015).

Principle *Make it...*	Subcomponents
Easy	• Harness the power of defaults • Reduce the 'hassle factor' of taking up a service • Simplify messages
Attractive	• Attract attention • Design rewards and sanctions for maximum effect
Social	• Show that most people perform the desired behaviour • Use the power of networks • Encourage people to make a commitment to others
Timely	• Prompt people when they are likely to be most receptive • Consider the immediate costs and benefits • Help people plan their response to events

Both the MINDSPACE and EAST frameworks should accompany a deep understanding of the specific context of the individual or group whose behaviour is being nudged. In addition, messages or initiatives for each group should be tested and iterated through experimentation before wide-scale deployment. The 'test, learn, adapt' methodology provides a useful guide for designing randomised control trials to test the effectiveness of campaign messages or initiatives (Haynes et al., 2012).

Conclusion

This report has set out the background needed to support the design of a successful national hearing awareness campaign for Australia. For seven target groups, needs have been identified, alongside theory-driven strategies for addressing them. In addition to targeting the individual needs of the groups, it is essential that the campaign also seeks to increase general community awareness of hearing health more broadly. To do this, the campaign will need to go beyond mere provision of information, and take into account how best to provide people with the capability, opportunity, and motivation they need to engage with hearing health at whatever stage of life they are in. Hearing health is a lifelong journey and a successful campaign that raises awareness along this continuum will benefit everyone. A more hearing-aware society will lead to greater attention being placed on the prevention of hearing loss, as well as better support for people with hearing loss – it will increase the ease with which we communicate with each other, decrease stigma, and minimise the social disability that people with hearing loss face on a daily basis.

References

Access Economics. (2006). *Listen hear! The economic impact and cost of hearing loss in Australia.* Victoria, Australia: Access Economics Pty Ltd.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.

Amieva, H., Ouvrard, C., Giulioli, C., Meillon, C., Rullier, L., & Dartigues, J. F. (2015). Self-reported hearing loss, hearing AIDS, and cognitive decline in elderly adults: A 25-year study. *Journal of the American Geriatrics Society, 63*(10), 2099-2104.

Arlinge, S. (2003). Negative consequences of uncorrected hearing loss: A review. *International Journal of Audiology, 42*(sup2), 17-20.

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., ... Michie, S. (2017). A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science, 12*, 77.

Australian Bureau of Statistics (ABS). (2018). 3238.0.55.001 – Estimates of Aboriginal and Torres Strait Islander Australians, June 2016. Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/mf/3238.0.55.001

Australian Bureau of Statistics (ABS). (2020). 4715.0 – National Aboriginal and Torres Strait Islander Health Survey, 2018-19. Retrieved from https://www.abs.gov.au/ausstats/abs@.nsf/mf/4715.0

Australian Competition & Consumer Commission (ACCC). (2017). *Issues around the sale of hearing aids: Consumer and clinician perspectives*. Retrieved from https://www.accc.gov.au/system/files/Issues around the sale of hearing aids – Consumer and clinical perspectives.pdf

Australian Hearing. (2008). *Is Australia Listening? Attitudes to hearing loss*. Sydney: Australian Hearing.

Australian Hearing. (2010). *Binge Listening: Is exposure to leisure noise causing hearing loss in young Australians?* Sydney: Australian Hearing.

Australian Institute of Health and Welfare (AIHW). (2014). *Ear disease in Aboriginal and Torres Strait Islander children. Resource sheet No.35.* Retrieved from https://www.aihw.gov.au/reports/indigenous-australians/ear-disease-in-aboriginal-and-torres-strait-island/formats

Australian Institute of Health and Welfare (AIHW). (2018). *Northern Territory Outreach hearing health program: July 2012 to December 2017.* Retrieved from https://www.aihw.gov.au/reports/indigenous-health-welfare-services/nt-hearing-program-2012-2017/contents/table-of-contents

Australian Institute of Health and Welfare (AIHW). (2019). Elective surgery waiting times multilevel data. Retrieved from https://www.aihw.gov.au/reports-data/myhospitals/sectors/elective-surgery

Baguley, D., McFerran, D., & Hall, D. (2013). Tinnitus. *The Lancet, 382*(9904), 1600-1607.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *The Lancet,* 383(9925), 1325–1332.

Beach, E. F., Gilliver, M., & Williams, W. (2013). Leisure noise exposure: Participation trends, symptoms of hearing damage, and perception of risk. *International Journal of Audiology, 52*, S20-S25.

Beach, E. F., Williams, W., & Gilliver, M. (2013). Estimating young Australian adults' risk of hearing damage from selected leisure activities. *Ear and Hearing, 34*(1), 75-82.

Beach, E. F., Nielsen, L., & Gilliver, M. (2016). Providing earplugs to young adults at risk encourages protective behaviour in music venues. *Global Health Promotion, 23*(2), 45-56.

Beach EF (2018) What plug? Choosing high-fidelity earplugs for music listening. *Spectrum, 35*(2), 12-16.

Beach, E. F., & Gilliver, M. (2019). Time to listen: Most regular patrons of music venues prefer lower volumes. *Frontiers in Psychology, 10*, 607.

Becker, M., Caminiti, S., Fiorella, D., Francis, L., Gravino, P., Haklay, M. M., ... & Servedio, V. D. (2013). Awareness and learning in participatory noise sensing. *PloS One, 8*(12).

Behavioural Insights Team (BIT) (2015). EAST: Four simple ways to apply behavioural insights. Retrieved from https://www.bi.team/publications/east-four-simple-ways-to-apply-behavioural-insights/

Bogoch, I. I., House, R. A., & Kudla, I. (2005). Perceptions about hearing protection and noise-induced hearing loss of attendees of rock concerts. *Canadian Journal of Public Health, 96*(1), 69-72.

Brewer, C. & King, K. (2015). Genetic Hearing Loss. In J. Katz (Ed.), *Handbook of Clinical Audiology* (7th ed., pp. 477-500) Philadelphia: Wolters Kluwer.

Browning, G. G., Rovers, M. M., Williamson, I., Lous, J., & Burton, M. J. (2010). Grommets (ventilation tubes) for hearing loss associated with otitis media with effusion in children. *Cochrane Database of Systematic Reviews, 10*.

Brumby, S. (2016). *Shhh hearing in a farming environment*. Report prepared for the Department of Health And Ageing. Retrieved from http://hearingservices.gov.au/wps/wcm/connect/hso/b9d22d92-5370-4dec-a95b-2abf97ca9b59/Shhh!+Final+report+31.pdf?MOD=AJPERES

Brumby S.(2014). *Making Connections: The 2014 Libby Harricks Memorial Oration*. Sydney: Deafness Forum Limited. Retrieved from https://www.deafnessforum.org.au/wp-content/uploads/documents/research_publications/2014_lhmo.pdf

Burns J., & Thomson, N. (2013). Review of ear health and hearing among Indigenous Australians. *Australian Indigenous Health Bulletin, 13*(4).

Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science, 7*(1), 37.

Carlsson, P. I., Hall, M., Lind, K. J., & Danermark, B. (2011). Quality of life, psychosocial consequences, and audiological rehabilitation after sudden sensorineural hearing loss. *International Journal of Audiology, 50*(2), 139-144.

Chang, P. (2010). *Using auditory simulations to enable prevention of noise exposure in school-age children and young adults*. Report prepared for the Department of Health And Ageing. Retrieved from https://www.ecu.edu.au/__data/assets/pdf_file/0004/689242/Final-Report-Auditory-Simulations-Research-Project-June-2010.pdf

Chang, P., Noel, M., & Design, L. (2013). Sonic Silence Exhibit: Demonstrating the Consequences of Noise-Induced Hearing Loss and Tinnitus. Retrieved from https://www.ecu.edu.au/__data/assets/pdf_file/0003/689241/ECU-Sonic-Silence-report.pdf

Chia, E. M., Wang, J. J., Rochtchina, E., Cumming, R. R., Newall, P., Mitchell, P. (2007). Hearing impairment and health-related quality of life: The Blue Mountains Hearing Study. *Ear and Hearing, 28*(2), 187-95.

Ching, T. Y. C., & Hill, M. (2007). The Parent's Evaluation of Aural/Oral Performance of Children (PEACH) Scale: Normative data. *Journal of the American Academy of Audiology, 18*(3), 220-235.

Ching, T. Y., Dillon, H., Marnane, V., Hou, S., Day, J., Seeto, M., Crowe, K., Street, L., Thomson, J., Van Buynder, P. & Zhang, V. (2013). Outcomes of early-and late-identified children at 3 years of age: Findings from a prospective population-based study. *Ear and Hearing, 34*(5), 535-552.

Ching, T. Y. C., Dillon, H., Leigh, G., & Cupples, L. (2018). Learning from the Longitudinal Outcomes of Children with Hearing Impairment (LOCHI) study: summary of 5-year findings and implications. *International Journal of Audiology, 57*(Sup2), S105–S111.

Choi, S. W., Peek-Asa, C., Sprince, N. L., Rautiainen, R. H., Donham, K. J., Flamme, G. A., ... & Zwerling, C. (2005). Hearing loss as a risk factor for agricultural injuries. *American Journal of Industrial Medicine, 48*(4), 293-301.

Choi, Y. H. & Kim, K. (2014). Noise-induced hearing loss in Korean workers: Co-exposure to organic solvents and heavy metals in nationwide industries. *PLoS One,9*, e97538

Cone-Wesson, B. (2005). Prenatal alcohol and cocaine exposure: Influences on cognition, speech, language, and hearing. *Journal of Communication Disorders, 38*(4), 279-302.

Coulson, N. S., Ferguson, M. A., Henshaw, H., & Heffernan, E. (2016). Applying theories of health behaviour and change to hearing health research: Time for a new approach. *International Journal of Audiology, 55*(sup3), S99-S104.

Cultural & Indigenous Research Centre (CIRCA) (2010). Indigenous ear health: *Developmental research to inform Indigenous social marketing campaigns: Final report*. Retrieved from https://www1.health.gov.au/internet/publications/publishing.nsf/Content/oatish-indigenous-ear-health-toc

Cultural & Indigenous Research Centre (CIRCA) (2013). *Evaluation of the National Indigenous Ear Health Campaign: Final report*. Retrieved from: http://www.circaresearch.com.au/wp-content/uploads/Consultation-and-testing-underpin-success-of-Indigenous-ear-health-campaign.pdf

Cultural & Indigenous Research Centre (CIRCA) (2017). *Social research into hearing loss and amplification for Aboriginal and Torres Strait Islander children: Final report*. Retrieved from https://www.hearing.com.au/HearingAustralia/files/10/10ef7c96-27f4-4e1c-96d7-e356fb25ec99.pdf

Cupples, L., Ching, T. Y., Button, L., Leigh, G., Marnane, V., Whitfield, J., ... & Martin, L. (2018). Language and speech outcomes of children with hearing loss and additional disabilities: Identifying the variables that influence performance at five years of age. *International Journal of Audiology, 57*(sup2), S93-S104.

Davis, A. C., Lovell, E. A., Smith, P. A., Ferguson, M. A. (1998) The contribution of social noise to tinnitus in young people – a preliminary report. *Noise and Health 1*, 40–46.

Davis, A., Smith, P., Ferguson, M., Stephens, D., Gianopoulos, I. (2007). Acceptability, benefit and costs of early screening for hearing disability: A study of potential screening tests and models. *Health Technology Assessment, 11*(42).

Davis, A., McMahon, C. M., Pichora-Fuller, K. M., Russ, S., Lin, F., Olusanya, B. O., et al. (2016). Aging and hearing health: The life-course approach. *The Gerontologist, 56*(sup2), S256-S67.

Dawes, P., Emsley, R., Cruickshanks, K. J., Moore, D. R., Fortnum, H., Edmondson-Jones, M., et al. (2015). Hearing loss and cognition: The role of hearing AIDS, social isolation and depression. *PLoS One, 10*(3), e0119616.

Depczynski, J., Challinor, K., & Fragar, L. (2011). Changes in the hearing status and noise injury prevention practices of Australian farmers from 1994 to 2008. *Journal of Agromedicine, 16*(2), 127-142.

Department of Health (2010). *Recommendations for clinical care guidelines on the management of otitis media in Aboriginal and Torres Strait Islander populations*. Retrieved from https://www1.health.gov.au/internet/main/publishing.nsf/Content/indigenous-otitismedia-clinical-care-guidelines

Department of Health (2019). Annual Voucher Program Statistics 2018-2019. Retrieved from http://www.hearingservices.gov.au/wps/portal/hso/site/about/program_stats/annual-program-stats/annual-stats-2018-2019/

Diefendorf, A. (2015). Assessment of Hearing Loss in Children. In J. Katz (Ed.), *Handbook of Clinical Audiology* (7th ed., pp. 459-475) Philadelphia: Wolters Kluwer.

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology, 33*(1), 264–277.

Donovan, R. J., Egger, G., & Francas, M. (1999). TARPARE: A method for selecting target audiences for public health interventions. *Australian and New Zealand Journal of Public Health, 23*(3), 280–284.

Ear Science Institute Australia (ESIA) (2013). Cheers for Ears: A health promotion for children on noise induced hearing loss. Retrieved from http://www.hearingservices.gov.au/wps/wcm/connect/8c6fc19a-4f10-4307-93f3-d350f50fbe5b/cheers-for-ears.pdf?MOD=AJPERES

Edwards, B. (2020). Emerging technologies, market segments, and MarkeTrak 10 insights in hearing health technology. *Seminars in Hearing, 41*(1), 37-54.

Ferguson, M. A., & Henshaw, H. (2015). Auditory training can improve working memory, attention, and communication in adverse conditions for adults with hearing loss. *Frontiers in Psychology, 6*, 556.

Farmsafe Australia (2009). Submission no. 33 to the Senate Community Affairs References Committee Inquiry into hearing health in Australia. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Completed_inquiries/2008-10/hearing_health/submissions/sublist

Fortnum, H., & Davis, A. (1993). Hearing impairment in children after bacterial meningitis: incidence and resource implications. *British Journal of Audiology, 27*(1), 43-52.

Gates, G. A., & Mills, J. H. (2005). Presbycusis. *The Lancet, 366*(9491), 1111-1120.

Genther, D. J., Betz, J., Pratt, S., Martin, K. R., Harris, T. B., Satterfield, S., et al. (2015). Association between hearing impairment and risk of hospitalization in older adults. *Journal of the American Geriatrics Society, 63*(6), 1146-1152.

Gilles, A., Van Hal, G., De Ridder, D., Wouters, K., & Van de Heyning, P. (2013). Epidemiology of noise-induced tinnitus and the attitudes and beliefs towards noise and hearing protection in adolescents. *PLoS ONE, 8*(7), e70297.

Gilles, A., Thuy, I., De Rycke, E., and Van de Heyning, P. (2014). A little bit less would be great: Adolescents' opinion towards music levels. *Noise and Health 16*, 285–291.

Gilles, A., & Van de Heyning, P. (2014). Effectiveness of a preventive campaign for noise-induced hearing damage in adolescents. *International Journal of Pediatric Otorhinolaryngology, 78*, 604-609.

Gilliver, M., & Hickson, L. (2011). Medical practitioners' attitudes to hearing rehabilitation for older adults. *International Journal of Audiology, 50*(12), 850–856.

Gilliver, M., Carter, L., Macoun, D., Rosen, J., & Williams, W. (2012). Music to whose ears? The effect of social norms on young people's risk perceptions of hearing damage resulting from their music listening behavior. *Noise and Health, 14*(57), 47-51.

Gilliver, M., Beach, E. F., & Williams, W. (2013). Noise with attitude: Influences on young people's decisions to protect their hearing. *International Journal of Audiology, 52*, S26-S32.

Gilliver, M., Williams, W., & Beach, E. F. (2014). Noise exposure in the balance: Managing occupational and leisure risks to hearing health. *Journal of Health, Safety and Environment, 30*(1), 203-208.

Gilliver, M., Beach, E. F., & Williams, W. (2015). Changing beliefs about leisure noise: Using health promotion models to investigate young people's engagement with, and attitudes towards, hearing health. *International Journal of Audiology, 54*, 211–219.

Gilliver, M., Nguyen, J., Beach, E. F., & Barr, C. (2017). Personal listening devices in Australia: Patterns of use and levels of risk. *Seminars in Hearing, 38*(4), 282-297.

Gilliver and Beach (in preparation). 'Know Your Noise' helps young people understand risks associated with recreational noise exposure and take action to prevent hearing damage.

Granberg, S., Pronk, M., Swanepoel, D. W., Kramer, S. E., Hagsten, H., Hjaldahl, J., . . . Danermark, B. (2014). The ICF core sets for hearing loss project: Functioning and disability from the patient perspective. *International Journal of Audiology, 53*(11), 777-786.

Griest, S. E., Folmer, R. L., & Martin, W. H. (2007). Effectiveness of Dangerous Decibels: A school-based hearing loss prevention program. *American Journal of Audiology, 16*, S165–S181.

Goderis, J., De Leenheer, E., Smets, K., Van Hoecke, H., Keymeulen, A., & Dhooge, I. (2014). Hearing loss and congenital CMV infection: A systematic review. *Pediatrics, 134*(5), 972-982.

Goggin, L. S., Eikelboom, R. H., Edwards, G. S., Maric, V., Anderson, J., Sander, P., . . . Atlas, M. D. (2008). Noise levels, hearing disturbances, and use of hearing protection at entertainment venues. *Australian and New Zealand Journal of Audiology, 30*(1), 50-58.

Halfon, N., Forrest, C. B., Lerner, R. M., Faustman, E. M., Tullis, E., & Son, J. (2018). Life course research agenda (LCRA), version 1.0. In N. Halfon, C.B. Forrest, R.M. Lerner & M. Faustman (Eds.), *Handbook of Life Course Health Development* (pp. 623-645). Cham: Springer.

Hallberg, L. R. M., & Carlsson, S. G. (1991). A qualitative study of strategies for managing a hearing impairment. *British Journal of Audiology, 25*(3), 201-211.

Hartley, D., Rochtchina, E., Newall, P., Golding, M., & Mitchell, P. (2010). Use of hearing aids and assistive listening devices in an older Australian population. *Journal of the American Academy of Audiology, 21*(10), 642-53.

Haynes, L., Service, O., Goldacre, B., Torgerson, D. (2012). *Test, learn, adapt: Developing public policy with randomised controlled trials*. Cabinet Office Behavioural Insights Team, UK. Retrieved from https://researchonline.lshtm.ac.uk/id/eprint/201256

Hearing Health Sector Committee. (2019). *Roadmap for hearing health*. Canberra: Commonwealth of Australia. Retrieved from https://www1.health.gov.au/internet/main/publishing.nsf/Content/roadmap-for-hearing-health

Hearing Care Industry Assocation (HCIA). (2020). *Hearing for Life: The value of hearing services for vulnerable Australians*. Report prepared with assistance from Deloitte Access Economics, Canberra. Retrieved from https://www.hcia.com.au/hcia-wp/wp-content/uploads/2020/02/Hearing_for_Life.pdf

Hearing Impaired & Deaf Kindred Organisation Network (2009). Submission no. 41 to the Senate Community Affairs References Committee Inquiry into hearing health in Australia. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Completed_inquiries/2008-10/hearing_health/submissions/sublist

Heffernan, E., Habib, A. & Ferguson, M. (2019). Evaluation of the psychometric properties of the social isolation measure (SIM) in adults with hearing loss. *International Journal of Audiology, 58*(1), 45-52.

Hétu, R., Riverin, L., Lalande, N., Getty, L., & St-Cyr, C. (1988). Qualitative analysis of the handicap associated with occupational hearing loss. *British Journal of Audiology, 22*(4), 251-264.

Hogan, A., Phillips, R. L., Brumby, S. A., Williams, W., & Mercer-Grant, C. (2015). Higher social distress and lower psycho-social wellbeing: Examining the coping capacity and health of people with hearing impairment. *Disability and Rehabilitation, 37*(22), 2070-2075.

House of Representatives Standing Committee on Health, Aged Care and Sport (2017). *Still waiting to be heard…Report on the Inquiry into the Hearing Health and Wellbeing of Australia*. Canberra: Commonwealth of Australia. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/HearingHealth/Report_1

Hunn, N. (2016). The Market for Hearable Devices 2016-2020. WiFore Wireless Consulting. Retrieved from http://www.nickhunn.com/wp-content/uploads/downloads/2016/11/The-Market-for-Hearable-Devices-2016-2020.pdf

Hunter, A. (2018). "There are more important things to worry about": Attitudes and behaviours towards leisure noise and use of hearing protection in young adults. *International Journal of Audiology, 57*(6), 449-456.

Israelite, N., Ower, J., & Goldstein, G. (2002). Hard-of-hearing adolescents and identity construction: Influences of school experiences, peers, and teachers. *Journal of Deaf Studies and Deaf Education, 7*(2), 134-148.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly, 11*(1), 1-47.

Jervis-Bardy, J., Sanchez, L., & Carney, A. S. (2014). Otitis media in Indigenous Australian children: Review of epidemiology and risk factors. *The Journal of Laryngology and Otology, 128*(S1), S16-S27.

Keith, S. E., Michaud, D. S., & Chiu, V. (2008). Evaluating the maximum playback sound levels from portable digital audio players. *The Journal of the Acoustical Society of America, 123*(6), 4227-4237.

Keppler, H., Dhooge, I., Maes, L., D'haenens, W., Bockstael, A., Philips, B., . . . Vinck, B. (2010). Short-term auditory effects of listening to an MP3 player. *Archives of Otolaryngology: Head and Neck Surgery, 136*(6), 538-548.

Knox, C. A. H. (2009). *The effect of visual feedback of sound intensity on preferred iPod listening levels*. Doctoral dissertation, James Madison University.

Kochkin, S. (2000). MarkeTrak V: "Why my hearing aids are in the drawer": The consumers' perspective. *The Hearing Journal, 53*(2), 34–41.

Kong, K., & Coates, H. L. (2009). Natural history, definitions, risk factors and burden of otitis media. *Medical Journal of Australia, 191*(S9), S39-S43.

Kreuzer, P. M., Landgrebe, M., Schecklmann, M., Staudinger, S., Langguth, B., & TRI Database Study Group. (2012). Trauma-associated tinnitus: Audiological, demographic and clinical characteristics. *PLoS One, 7*(9).

Kujawa, S. G., & Liberman, M. C. (2009). Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss. *Journal of Neuroscience, 29*(45), 14077-14085.

Kumar, P., Upadhyay, P., Kumar, A., Kumar, S., & Singh, G. B. (2017). Extended high frequency audiometry in users of personal listening devices. *American Journal of Otolaryngology, 38*(2), 163-167.

Lewkowski, K., Heyworth, J. S., Li, I. W., Williams, W., Mccausland, K., Gray, C., … Fritschi, L. (2019). Exposure to noise and ototoxic chemicals in the Australian workforce. *Occupational and Environmental Medicine, 76*(5), 341–348.

Lin, F. R., Metter, E. J., O'Brien, R. J., Resnick, S. M., Zonderman, A. B., Ferrucci, L. (2011). Hearing loss and incident dementia. *Archives of Neurology, 68*(2), 214-20.

Lin, F. R., Yaffe, K., Xia, J., Xue, Q. L., Harris, T. B., Purchase-Helzner, E., Satterfield, S., Ayonayon, H.N., Ferrucci, L., Simonsick, E.M. & Health ABC Study Group, F. (2013). Hearing loss and cognitive decline in older adults. *JAMA Internal Medicine, 173*(4), 293-299.

Lin, F., Hazzard, W., & Blazer, D. (2016). Priorities for improving hearing health care for adults: A report from the National Academies of Sciences, Engineering, and Medicine. *JAMA, 316*(8), 819-820.

Livingston, G., Sommerlad, A., Orgeta, V., Costafreda, S. G., Huntley, J., Ames, D., Ballard, C., Banerjee, S., Burns, A., Cohen-Mansfield, J. & Cooper, C. (2017). Dementia prevention, intervention, and care. *The Lancet, 390*(10113), 2673-2734.

Lower, T., Fragar, L., Depcynzksi, J., Challinor, K., Mills, J. & Williams, W. (2010) Improving hearing health for farming families. *Rural and Remote Health, 10*, 1350.

Lusk, S. L., & Kelemen, M. J. (1993). Predicting use of hearing protection: A preliminary study. *Public Health Nursing, 10*(3), 189-196.

Manchaiah, V. K., & Stephens, D. (2013). Perspectives on defining 'hearing loss' and its consequences. *Hearing, Balance and Communication, 11*(1), 6-16.

Melamed, S., Rabinowitz, S., Feiner, M., Weisberg, E., & Ribak, J. (1996). Usefulness of the protection motivation theory in explaining hearing protection device use among male industrial workers. *Health Psychology, 15*(3), 209-215.

Mener, D. J., Betz, J., Genther, D. J., Chen, D., Lin, F. R. (2013). Hearing loss and depression in older adults. *Journal of the American Geriatrics Society, 61*(9), 1627-1629.

Meyer, C., Grenness, C., Scarinci, N., & Hickson, L. (2016). What is the International Classification of Functioning, Disability and Health and why is it relevant to Audiology? *Seminars in Hearing, 37*(3), 163–186.

Michie, S., Atkins, L., & West, R. (2014). *The behaviour change wheel: A guide to designing interventions*. Great Britain: Silverback Publishing.

Moeller, M. P. (2007). Current state of knowledge: psychosocial development in children with hearing impairment. *Ear and Hearing, 28*(6), 729-739.

Moore, D. R., Zobay, O., Mackinnon, R. C., Whitmer, W. M., & Akeroyd, M. A. (2017). Lifetime leisure music exposure associated with increased frequency of tinnitus. *Hearing Research, 347*, 18-27.

Morata, T. C., Fiorini, A. C., Fischer, F. M., Krieg, E. F., Gozzoli, L., & Colacioppo, S. (2001). Factors affecting the use of hearing protectors in a population of printing workers. *Noise and Health, 4*(13), 25.

National Acoustic Laboratories (NAL) (2012). Hear4Tomorrow. Retrieved from https://hear4tomorrow.nal.gov.au/

National Rural Health Alliance. (2014). *Hearing loss in rural Australia*. Retrieved from https://www.ruralhealth.org.au/factsheets/thumbs

Nielsen, L. B., Beach, E. F., & Gilliver, M. (2014). Clubbers' attitude toward earplugs: Better with use. *The Hearing Journal, 67*(4), 6-11.

O'Connor, T. E., Perry, C. F., & Lannigan, F. J. (2009). Complications of otitis media in Indigenous and non-Indigenous children. *Medical Journal of Australia, 191*(S9), S60-S64.

Pacala, J. T., & Yueh, B. (2012). Hearing deficits in the older patient:"I didn't notice anything". *JAMA, 307*(11), 1185-1194.

Page, A. & Fragar, L. (2002). Suicide in Australian farming: 1988– 1997. *Australian and New Zealand Journal of Psychiatry 36*, 81–85.

Picard, M., Girard, S. A., Simard, M., Larocque, R., Leroux, T., & Turcotte, F. (2008). Association of work-related accidents with noise exposure in the workplace and noise-induced hearing loss based on the experience of some 240,000 person-years of observation. *Accident Analysis & Prevention, 40*(5), 1644-1652

Portnuff, C. D., Fligor, B. J., & Arehart, K. H. (2011). Teenage use of portable listening devices: a hazard to hearing? *Journal of the American Academy of Audiology, 22*(10), 663-677.

Portnuff, C. D. (2016). Reducing the risk of music-induced hearing loss from overuse of portable listening devices: Understanding the problems and establishing strategies for improving awareness in adolescents. *Adolescent Health, Medicine and Therapeutics, 7*, 27.

Prochaska J.O. & Velicer W. (1997) The transtheoretical model of health behaviour change. *American Journal Health Promotion*, 12, 38-48.

Pronk, M., Deeg, D. J., Smits, C., van Tilburg, T. G., Kuik, D. J., Festen, J. M., et al. (2011). Prospective effects of hearing status on loneliness and depression in older persons: Identification of subgroups. *International Journal of Audiology, 50*(12), 887-96.

PWC. (2017). *Review of services and technology supply in the Hearing Services Program*. Retrieved from http://www.hearingservices.gov.au/wps/portal/hso/site/about/whoarewe/publications

Reed, N. S., Altan, A., Deal, J. A., Yeh, C., Kravetz, A. D., Wallhagen, M., & Lin, F. R. (2019). Trends in health care costs and utilization associated with untreated hearing loss over 10 years. *JAMA Otolaryngology: Head & Neck Surgery, 145*(1), 27-34.

Rosenstock, I. M. (1974). The health belief model and preventive health behaviour. *Health Education Monographs, 2*(4), 354-386.

Russ, S. A., Tremblay, K., Halfon, N., & Davis, A. (2018). A life course approach to hearing health. In N. Halfon, C.B. Forrest, R.M. Lerner & M. Faustman (Eds.), *Handbook of Life Course Health Development* (pp. 349-373). Cham: Springer.

Safe Work Australia (2010). *Occupational noise-induced hearing loss in Australia*. Retrieved from https://www.safeworkaustralia.gov.au/doc/occupational-noise-induced-hearing-loss-australia

Safe Work Australia (2014). *Occupational disease indicators*. Retrieved from https://www.safeworkaustralia.gov.au/system/files/documents/1702/occupational-disease-indicators-2014.pdf

Safe Work Australia (2019). *Model Work Health and Safety Regulations*.Canberra: Parliamentary Counsel's Committee. Retrieved from https://www.safeworkaustralia.gov.au/system/files/documents/2003/model-whs-regulations-dec2020.pdf

Scarinci, N., Worrall, L., & Hickson, L. (2008). The effect of hearing impairment in older people on the spouse. *International Journal of Audiology, 47*(3), 141-151.

SCENIHR. (2008). *Potential health risks of exposure to noise from personal music players and mobile phones including a music playing function*. European Commission. Retrieved from https://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_018.pdf

Schaal, N. C., Slagley, J. M., Richburg, C. M., Zreiqat, M. M., & Paschold, H. W. (2018). Chemical-induced hearing loss in shipyard workers. *Journal of Occupational and Environmental Medicine, 60*(1), e55-e62.

Senate Community Affairs References Committee (2010). *Hear us: Inquiry into hearing health in Australia*. Canberra: Commonwealth of Australia. Retrieved from https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Community_Affairs/Completed_inquiries/2008-10/hearing_health/report/index

Serpanos, Y. C., Berg, A. L., & Renne, B. (2016). Influence of hearing risk information on the motivation and modification of personal listening device use. *American Journal of Audiology, 25*(4), 332-343.

Sharot, T. (2011). The optimism bias. *Current Biology, 21*(23), R941-R945.

Simpson, A. N., Matthews, L.J., Cassarly, C., Dubno, J.R. (2019). Time from hearing aid candidacy to hearing aid adoption: A longitudinal cohort study. *Ear and Hearing, 40*(3), 468-76.

Smith, P., Davis, A., Ferguson, M., & Lutman, M. (2000). The prevalence and type of social noise exposure in young adults. *Noise and Health, 2*(6), 41-56.

Standards Australia. (2005). *Australian/New Zealand Standard AS/NZS 1269.1: 2005 Occupational noise management Part 1: Measurement and assessment of noise immission and exposure*. Sydney: Standards Australia.

Sulaiman, A. H., Husain, R., & Seluakumaran, K. (2014). Evaluation of early hearing damage in personal listening device users using extended high-frequency audiometry and otoacoustic emissions. *European Archives of Oto-Rhino-Laryngology, 271*(6), 1463-1470.

Swan, M. (2012). Sensor mania! The internet of things, wearable computing, objective metrics, and the quantified self 2.0. *Journal of Sensor and Actuator networks, 1*(3), 217-253.

Sliwinska-Kowalska, M., Zamyslowska-Szmytke, E., Szymczak, W., Kotylo, P., Fiszer, M., Wesolowski, W., & Pawlaczyk-Luszczynska, M. (2005). Exacerbation of noise-induced hearing loss by co-exposure to workplace chemicals. *Environmental Toxicology and Pharmacology, 19*(3), 547-553.

Taylor, B., & Mueller, H. G. (2011). *Fitting and dispensing hearing aids*. California: Plural Publishing.

Venekamp, R. P., Mick, P., Schilder, A. G., & Nunez, D. A. (2018). Grommets (ventilation tubes) for recurrent acute otitis media in children. *Cochrane Database of Systematic Reviews, 5*.

Viljanen, A., Kaprio, J., Pyykkö, I,, Sorri. M., Pajala. S., Kauppinen, M. et al. (2009). Hearing as a predictor of falls and postural balance in older female twins. *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences, 64*(2), 312-7.

Vos, T., Allen, C., Arora, M., Barber, R. M., Bhutta, Z. A., Brown, A., ... & Coggeshall, M. (2016). 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. *The Lancet, 388*(10053), 1545-1602.

Weichbold, V., & Zorowka, P. (2007). Can a hearing education campaign for adolescents change their music listening behavior? *International Journal of Audiology, 46*(3), 128-133.

Weinstein, B. (2015). Hearing loss in the elderly: A new look at an old problem. In J. Katz (Ed.), *Handbook of Clinical Audiology* (7th ed., pp. 459-475) Philadelphia: Wolters Kluwer.

Weinstein, B. E., Sirow, L. W., & Moser, S. (2016). Relating hearing aid use to social and emotional loneliness in older adults. *American Journal of Audiology, 25*(1), 54-61.

Widén, S. E., Holmes, A. E., Johnson, T., Bohlin, M. C., & Erlandsson, S. I. (2009). Hearing, use of hearing protection, and attitudes towards noise among young American adults. *International Journal of Audiology, 48*(8), 537-545.

Williams, W., Forby-Atkinson, L., Purdy, S., & Gartshore, G. (2002). Hearing loss and the farming community. *Journal of Occupational Health and Safety-Australia and New Zealand, 18*(2), 181-186.

Williams, W., Purdy, S. C., Murray, N., Dillon, H., LePage, E., Challinor, K. & Storey, L. (2004). Does the presentation of audiometric test data have a positive effect on the perception of workplace noise and noise exposure avoidance? *Noise and Health, 6*(24), 75-84.

Williams, W. (2009). Trends in listening to personal stereos. *International Journal of Audiology, 48*(11), 784-788.

Williams, W., & Purnell, J. (2010). The statistical distribution of expected noise level output from commonly available personal stereo players. *Acoustics Australia, 38*(3), 119-122.

Williams, W., Brumby, S., Calvano, A., Hatherell, T., Mason, H., Mercer-Grant, C., & Hogan, A. (2015). Farmers' work-day noise exposure. *Australian Journal of Rural Health, 23*(2), 67-73

Williams, W., & Carter, L. (2017). Tinnitus and leisure noise. *International Journal of Audiology, 56*(4), 1-7.

Williams, W., Zhou, D., Stewart, G., & Knott, P. (2017). Facilitating occupational noise management: The use of a smartphone app as a noise exposure, risk management tool. *Journal of and Health and Safety Research and Practice, 9*(1), 3-9.

Wong, C. L., Ching, T. Y., Leigh, G., Cupples, L., Button, L., Marnane, V., ... & Martin, L. (2018). Psychosocial development of 5-year-old children with hearing loss: Risks and protective factors. *International Journal of Audiology, 57*(sup2), S81-S92.

World Health Organization (WHO). (2019). *WHO-ITU global standard for safe listening devices and systems*. Geneva: World Health Organization.

Yoshinaga-Itano, C., Sedey, A. L., Coulter, D. K., & Mehl, A. L. (1998). Language of early-and later-identified children with hearing loss. *Pediatrics, 102*(5), 1161-1171.

Appendix

Appendix A. Costs of hearing assessments

Table A1: Costs of hearing assessments by clinic as at April 2020.

		Fees	
Clinic	**Location**	**Adults**	**Children**
Hearing Australia	Australia-wide	$110 for 30 mins.	$110 for 30 mins.
Specsavers	Australia-wide	Fully covered by Medicare, or $49 for adults without Medicare.	
National Hearing Care	Australia-wide	Free 20 min hearing screen, then $50 for follow-up appointment if needed.	
Attune	Australia-wide	$165	$165 for children over 4 years.
Connect Hearing	Australia-wide	$65-$110	$90
Bay Audio	Australia-wide	$88	
ihear	Australia-wide	Free 15 min screen. $115 for full assessment plus $65 for report.	Free 15 min screen. $115 for full assessment plus $65 for report.
Audika	Australia-wide	$70 for 30 mins, $140 for 60 mins, plus $35 for report.	$70 for 30 mins plus $35 for report.
Total Care Hearing	Sydney-wide	$160 for 30-60 mins.	$160 for 30-60 mins.
Northside Audiology	Sydney-wide	$175	$175
Edgecliff Hearing	Sydney-wide	$145	$145
MQ Health Speech and Hearing Clinic	Sydney	$150 for 60 mins, $112.50 for 45 mins.	$112.50 for 45 mins.
Acute Hearing	Sydney (Drummoyne, West Pennant Hills)	$129	$129
Melbourne Audiology Centre	Melbourne-wide	$175	$145
Canberra Audiology	Canberra	$185 for 1 hour	$110
Hear and Say	Queensland-wide	$150	$175 for children over 4.5 years

		Fees	
Clinic	**Location**	**Adults**	**Children**
Tasmanian Hearing Centre	Hobart	$190-250	$120-$150
Adelaide Audiology	Adelaide	$90-110	
Arafura Audiology	Darwin, Alice Springs, Cullen Bay, NT	$80	$80
Hearing and Audiology	Perth, Duncraig, Geraldton	$135	$160

Appendix B. Medicare rebates for audiology services

Tables B1-B3 show the Medicare rebates available to if the service is delivered by or on behalf of a medical practitioner (Table B1), a registered audiologist (Table B2), and for people from special populations (Table B3). These details are current as at January 2020.

Medical Practitioners

Table B1 shows the fees and benefits of otolaryngology items for services delivered by, or on behalf of medical practitioners. Benefits are paid at 75% for services provided in a private hospital or 85% for services provided out of hospital and range from $20.05-$52.45 depending on the tests conducted.

Table B1: Fees and benefits for otolaryngology services delivered by, or on behalf of medical practitioners.

Item number	Test	Fee	Benefit
11309	Audiogram, air conduction	$26.70	75% = $20.05
11312	Audiogram, air and bone conduction or air conduction and speech discrimination	$37.75	75% = $28.35
11315	Audiogram, air and bone conduction and speech	$50.00	75% = $37.50
11318	Audiogram, air and bone conduction and speech, with other Cochlear tests	$61.70	75% = $46.30

Diagnostic Audiology

Table B2 shows the fees and benefits of diagnostic audiology services provided by an eligible audiologist who is registered with the Department of Human Services. Benefits are paid at 85% of the scheduled fee and range from $13.65-$132.95 depending on the tests conducted.

Table B2: Fees and benefits for diagnostic audiology services.

Item number	Test	Fee	Benefit (85%)
82300[1]	Brain stem evoked response audiometry	$156.40	$132.95
82306[1]	Non-determinate audiometry	$17.80	$15.15
82309[2]	Air conduction audiogram	$21.40	$18.20
82312[2]	Air and bone conduction audiogram or air conduction and speech discrimination audiogram	$30.20	$25.70
82315[2]	Air and bone conduction and speech discrimination audiogram	$40.00	$34.00
82318[2]	Air and bone conduction and speech discrimination audiogram with other cochlear tests	$49.40	$42.00
82324[2]	Impedance audiogram involving tympanometry and measurement of static compliance and acoustic reflex	$26.70	$22.70
82327[2]	Impedance audiogram involving tympanometry and measurement of static compliance and acoustic reflex	$16.05	$13.65
82332[2]	Oto-acoustic emission audiometry for the detection of permanent congenital hearing impairment in an infant or child	$47.60	$40.50

1 Medicare benefits are only payable if a written request is made by an eligible specialist in otolaryngology head and neck surgery.

2 Medicare benefits are only payable if a written request is made by an eligible specialist in otolaryngology head and neck surgery, or an eligible neurology specialist or consultant physician in neurology.

Special Populations

Table B3 shows the other audiology service item numbers for patients from special populations. Benefits are paid at 85% of the scheduled fee and range from $53.80-$75.95 depending on the tests conducted.

Table B3: Fees and benefits for other audiology services for patients from special populations.

Item number	Patient type	Fee	Benefit (85%)
10952	People with a chronic or terminal medical condition and complex care needs	$63.25	$53.80
81310	Aboriginal or Torres Strait Islander Australians who have had a health assessment	$63.25	$53.80
82030	Children with autism, pervasive development disorder or an eligible disability for assessment services	$89.35	$75.95
82035	Children with autism, pervasive development disorder or an eligible disability for treatment services	$89.35	$75.95

Source: MBS online (Medicare Benefits Schedule, 2020) http://www.mbsonline.gov.au/internet/mbsonline/publishing.nsf/Content/Home

Appendix C. Benefits provided by private health funds

Table C1: Benefits provided by private health funds as of January 2020.

Health cover	Consultation benefits	Hearing aid benefits	Other benefits	Waiting period
ACA Health **Complete Ancillary**		Hearing aids, repairs and maintenance 80% of cost, 3 year limit of $1,500	Hearing aid (HA) and cochlear implant batteries 80% of cost, 1 year limit of $200	12 months for HAs
AHM **Super Extras**	Annual limit $300	3 year limit of $1,600		12 months for HAs
APIA Health **Premium Extras**		Hearing aids and speech processors limit $1,200		36 months
Australian Unity **Comprehensive Extras**		Annual limit of $550		12 months
Bupa **Top Extras 60**		Annual limit of $800		12 months
Top Extras 75		Annual limit of $1,000		12 months
Top Extras 90		Annual limit of $1,200		12 months
CBHS **Top Extras**	70% of cost up to $60, annual limit $360	70% of cost, 3 year limit of $1,600		2 months for consultation, 12 months for HAs
CUA **Classic Extras**		Annual limit of $600	Repairs: 60% up to $100	12 months
Total Extras		Annual limit of $800	Repairs: 80% up to $150	12 months

Health cover	Consultation benefits	Hearing aid benefits	Other benefits	Waiting period
Defence Health **Top Extras**	$40 initial consultation, $30 subsequent consultation, annual limit $200	Annual limit of $1,000		2 months for consultation, 36 months for HAs
GMHBA **Mid Extras Set Benefits**	$35 initial consultation, $27 subsequent consultation, annual limit $400	100% of cost up to a limit of $744 per appliance, up to a limit of $1,200 per person, every three years		
Mid Extras 65%	Annual limit $400	65% of cost up to a limit of $1,200 per person, every three years		
HBF **Standard Extras**		3 year limit of $500		12 months
Flexi Extras		3 year limit of $800		12 months
Top Extras		3 year limit of $900		12 months
HCF **Vital Extras**	$60, annual limit $200	Annual limit of $600		
Top Extras	$70, annual limit $250	Annual limit of $800 Benefits accrue and renew every 3 years		
HCI **Healthy Extras and Premier Extras**	$33 initial consultation, $30 subsequent consultation, annual limit $200	90% of cost up to a limit of $800 for a single hearing aid, and $1,600 for bilateral aids, 3 year limit	Repairs: 90% up to $120	

Health cover	Consultation benefits	Hearing aid benefits	Other benefits	Waiting period
Health Partners				
Top Extras		85% of cost up to $500 if membership < 2 yrs, $750 if membership 2-5 years, $1,000 if membership 5+ years, 5 year limit		
HIF				
Super Options		$550 for one device if membership < 5yrs, $550 per ear if membership 5+ yrs		36 months
Premium Options		$550 for one device if membership < 5yrs, $600 per ear if membership 5-10 yrs, $700 per ear if membership 10+ yrs		36 months
Latrobe				
Standard Extras, Advantage Family Care Extras, and Advantage Extras	$17, annual limit $300	5 year limit of $500		
Top Extras	$25, annual limit $300	5 year limit of $650		
Premier Family Care Extras and Premier Extras	$65, annual limit $1,000	5 year limit of $1,000		
Medibank				
Top Extras 55		55% of cost, annual limit $400		36 months
Top Extras 70		70% of cost, annual limit $800		
Top Extras 85		85% of cost, annual limit $1,200		

Health cover	Consultation benefits	Hearing aid benefits	Other benefits	Waiting period
Navy Health **Healthy Living Extras**	$60 initial consultation, $40 subsequent consultation, annual limit $300	3 year limit of $900	Repairs up to $150	2 months for consultation, 12 months for HAs
Premium Extras	$70 initial consultation, $65 subsequent consultation, annual limit $500	3 year limit of $1,300	Repairs up to $150	2 months for consultation, 12 months for HAs
NIB **Top Extras**		Annual limit of $1,200		36 months
People Care **High Extras**		70% of cost, limit $1,000 for 5 years		24 months
Premium Extras		80% of cost, limit $1,500 for 5 years		24 months
Phoenix Health Fund **Top Extras**		$900 first aid, $800 second aid, 2 aids per 5 years	Repairs up to $100	
Queensland Country Health **Essential Extras**	$35 consultation, $42 report, annual limit $900			2 months
Premium Extras	$50 consultation, $60 report, annual limit $1,400			
RTHealth **Smart Extras**	$60, annual limit $120	100% of the cost up to $450 per hearing aid every 3 years		2 months for consultation, 24 months for HAs
Premium Extras	$80, annual limit $160	100% of the cost up to $600 per hearing aid every 3 years		2 months for consultation, 24 months for HAs

Health cover	Consultation benefits	Hearing aid benefits	Other benefits	Waiting period
Teacher Health **Top Extras**		Single aid $600 if membership 1-5 yrs $900 if membership 5+ yrs Pair $1,200 if membership 1-5 yrs $1,800 if membership 5+ yrs 1 pair per 3 years		
Transport Health **Top Extras**	$32 initial consultation, $22 subsequent consultation, annual limit $1,000	100% up to $1,000, 3 year limit		2 months for consultation, 24 months for HAs
St Lukes Health **Extras Benefits**	$40, limit 2 per year			
Westfund **Advantage Pro Extras and Esteem Extras**		HAs and FMs $1,400, 3 year limit		
Ultimate Extras		HAs and FMs $2,000, 3 year limit		

Appendix D. Costs of hearing devices

Hearing Aids

According to the Australian Competition and Consumer Commission (2017), the price of hearing aids ranges from around $1,500 to $15,000 per pair. Choice has published a guide of the prices of popular hearing aid brands by level (see table below).

Table D1: Costs of popular hearing aids, adapted from Choice.

Hearing aid levels	Lifestyle aspects	Examples	Price range per aid
Entry level	Amplification in the home, on the phone and quiet places.	Oticon Ria 2, Phonak Audeo B30, Siemens Signia Orion 2, Starkey Muse i1000, Unitron Moxi Tempus 500	$900-1,700
Basic	Small groups, mixing with friends and family.	Oticon Ria 2 Pro, Phonak Audeo B30, Siemens Signia Orion 2, Starkey Muse i1200, Unitron Moxi Tempus 600, Widex Beyond 110	$1,000-2,000
Standard or Intermediate	Outdoors, shopping, small meetings, theatre, small social gatherings.	Oticon Opn3, Phonak Audeo B50, ReSound LiNX 3D 5, Sivantos Signia Primax 3/ 3Nx, Starkey Muse i1600, Unitron Moxi Tempus 700, Widex Beyond 220	$1,400-2,600
Advanced	Meetings at work, restaurants, larger social gatherings.	Oticon Opn2, Phonak Audeo B70, ReSound LiNX 3D 7, Sivantos Signia Primax 5/ 5Nx, Starkey Muse i2000, Unitron Moxi Tempus 800, Widex Beyond 330	$2,300-3,300
Premium	Large social events, concerts, parties, large crowds.	Oticon Opn1, Phonak Audeo B90, ReSound LiNX 3D 9, Sivantos Signia Primax 7/ 7Nx, Starkey Muse i2400, Unitron Moxi Tempus pro, Widex Beyond 440	$3,000-4,200+

Source: https://www.choice.com.au/health-and-body/optical-and-hearing/hearing/buying-guides/hearing-aids-buying-guide

www.nal.gov.au