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Inquiry into Educational Opportunities for Aboriginal and Torres Strait Islander students

March 2017

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NT COGSO Submission to the House of Representatives Standing Committee on Indigenous Affairs.

Reference: Inquiry into educational opportunities for Aboriginal and Torres Strait Islander students.

The Northern Territory Council of Government Schools Organisation (NT COGSO) welcomes the Inquiry into educational opportunities for Aboriginal and Torres Strait Islander students.

We make this submission as the peak organisation that advocates for the parents of children attending public schools throughout the Northern Territory.

We submit that without practical communication tools being provided in our schools and an interdepartmental collaborative approach between Health and Education our Aboriginal students will continue to be set up to fail as a result of a "pandemic" of Otitis Media (middle ear infection) which means many literally can't hear their teacher. How do we expect them to learn when they can't hear their teacher?

To make a genuine improvement in the lives and wellbeing of our children much needs to be done to address the effects of Otitis Media (middle ear infection) which causes the prevalence of conductive hearing loss in Aboriginal and Torres Strait Islander children.

Evidence-based research shows that to improve our hearing loss children's ability to learn we need:

- **classrooms with improved acoustics**
- **sound field amplification systems in classrooms with predominantly Indigenous students**
- **individual amplification devices for one-on-one learning and group learning**
- **community members employed in the classroom fluent in the local language and cognisant of local sign languages**
- **audiology assessments**
- **education and awareness of parents, teachers and staff of conductive hearing loss**
- **referral to audiology services of students with suspected hearing loss**
- **access to audiology services**

Imagine sitting at school as a student with hearing loss and English as your second language, lost in your own world because the classroom acoustics simply don't enable you to hear your teacher.

Sadly, that is the case for almost half of our Aboriginal students at any given time. Yet as a society we wonder why these children aren't learning. As a government, you wonder why the gap isn't closing. We would ask; how do you learn when you can't hear the teacher?

Middle ear infection (Otitis Media) is the predominant cause of hearing loss and of the 4,371 Aboriginal and Torres Strait Islander (ATSI) children and young people who received audiology services from July 2012 to June 2015 some 45% suffered hearing loss.

Assessments of children in remote communities show that up to 90% of children suffer hearing loss.

The current Royal Commission into the Protection and Detention of Children in the Northern Territory has heard submissions that many of these children go on to dominate our child protection system and then into juvenile detention. It also heard that many of them then go on to adult prison.

Studies show that of our adult Aboriginal inmates in Alice Springs and Darwin correction systems (more than 80% of the prison cohort), some 90% have suffered hearing loss.

"In remote communities it is common for as many as 90 per cent of the children to have abnormal middle ears; that is, they have current middle ear infection or perforation or scarring of the eardrum related to past infections (Couzos et al., 2001). In urban classrooms it is typical for up to 50 per cent of the Indigenous children to experience conductive hearing loss at any point in time (Quinn, 1988). (Ref: Conductive Hearing Loss and Behaviour Problems Amongst Urban Indigenous Students, Damien Howard 2006).

The prevalence of middle ear infection (Otitis Media) has been studied for the past two decades and is common among Aboriginal people with increasing recognition of the need for health resources to be drawn to tackling this disease of poverty.

The significant gap is a systemic failure to understand that in education, resources need to be provided in our schools to ensure hearing loss students are equipped with the communication tools they need to learn.

This Inquiry's Terms of Reference: access to, participation in and outcomes of pre-schooling is best addressed comprehensively in a September 2012 literature review *A Hearing Loss Literature Review of the Families as First Teachers (FaFT) pre-schooling program in remote Aboriginal communities*. For your reference it is **Attachment 1**.

The literature review, written by Dr Damien Howard was prepared as part of the Cross Agency Prevention of Conductive Hearing Loss Strategy Project, a partnership between Batchelor Institute of Indigenous Tertiary Education and Phoenix Consulting.

The Northern Territory Department of Education and Training (DET), now the Department of Education (DoE), provided funding for this project.

The FaFT Literature Review found that:

"Children with communication problems, as well as children who have experienced neglect or been traumatised, are likely to experience greater adverse outcomes from hearing loss. Research in Western Australia with Aboriginal children found children with speech and language problems experienced more adverse social and emotional outcomes than other children (Zubrick et al, 2006).

While the survey methodology used could not determine the cause of the expressive communication problems speech problems are often associated with conductive hearing loss. Difficulty in understanding young Aboriginal children's speech has been found to be a useful indicator of a child at risk of current middle ear disease and hearing loss (Hogan et al, 2012).

"When hearing loss has been chronic and persistent enough to impact on speech and language development as well as auditory processing capacities, a child has a compounded communication difficulty. Not only will such children with hearing loss have problems in understanding what others say to them, they will also often have difficulties in making themselves understood by others. Because they experience difficulty in having their needs known and met, they also experience high levels of frustration and distress. Those trying to understand and interact with them will also experience frustration and distress, especially when they are not aware of the influence of hearing loss and other factors and how to address these. The following description by the mother of a four-year-old girl illustrates this.

> *"She gets upset when we can't understand her. When she's not feeling well or she's trying to express that she wants something, she can't say it. So she'll either throw a tantrum, get upset because we're not understanding, get upset because she's trying to tell us something. As well she is obviously getting frustrated with herself because she can't communicate properly with us and [get] what she actually wants."* (Personal communication, Mother)
>
> *"We keep continuously asking her 'What do you want? What do you want?' and she's trying so hard to say it. And then of course it leads to me getting frustrated because she's crying. And it's always the continuous repetition with her that makes it hard, she'll ask a question and when you answer her, I don't know if she's understanding it or if she's just not hearing it properly. Because she's always like 'Uh?'. When she talks to you she grabs your face and you look at her and you can tell she's trying to say something to you and you're talking to her and if you look away she'll grab your face and bring it back so she's looking at you. If she thinks you're not listening to her or she can't hear you, she'll turn your face around. It gets so just draining because she has to have your attention all the time.*
>
> *If she's not feeling well or if she's going down with an ear infection or anything, she won't let me do anything. She just wants Mum to hold her and just playing with Isaiah or doing any of the general housework what not. Getting to work can be hard."* (Personal communication, Mother)

"This mother's experiences highlights not only the compounded impact of conductive hearing loss and speech and language problems but also how the greater demands on carers that children with hearing loss make, especially when persistent hearing loss has contributed to expressive communication problems.

"It has been found that when a significant proportion of a class group of school aged children have a hearing loss, the high level of demands of children with hearing loss impacts on the quality of support

for all children in the group (Howard, 1994). Conversely, the quality of childcare – caregiver to child ratios (Feagans, Kipp & Blood, 1994) has been found to influences the impact that conductive hearing loss has on non-Indigenous children (Feagans et al, 1994). Children with OM are less attentive in larger groups and lower quality care-giving environments, typified by factors such as less frequent interactions and less 'scaffolding' by adults to provide the support structures that help children learn to communicate, are also associated with lower scores on language and cognitive outcomes (Rach, Zielhuis & van de Broek, 1988; Phillips, McCartney & Scarr, 1987) This is especially so when the language or dialect spoken in the care environment is not the same as the one children are familiar with in their home environment. The high prevalence of ear disease and its impact on Indigenous children (in both more individual children being affected as well as the exacerbated impact that can result when many children in a group have hearing loss) provides a strong argument for well-resourced and hearing loss informed early intervention programs. FaFT in the NT is one important step in this direction.

"The importance of children with hearing loss being immersed in rich communication and social environments was highlighted by Lowell (1994). She carried out research on the impact of hearing loss on Indigenous children's communication in a bilingual school environment. She noted that Yolngu (Indigenous people from East Arnhem Land) teachers in a bilingual school often used Yolngu sign language in parallel with verbal communication. The shared experiential, cultural, linguistic, and non-verbal understandings that prevailed in the school were factors that helped to minimise the impact of hearing loss. Conversely when carers come from a different culture than the children they care for, hearing loss is liable to compound the influence of cultural differences (Howard, 2007).

"Lowell's work suggests that the adverse effects of conductive hearing loss can be minimised in group contexts when:

- the language spoken is the one with which children have greatest familiarity;
- the adults who engage children are from the same cultural and linguistic background as the children;
- children engage with other children from the same cultural and linguistic background and with whom they have long-standing and deep relationships; and
- non-verbal communication strategies are employed to supplement verbal communication.

"The findings of Jacobs (1986), Lowell (1994) and Howard (2004 and 2007) suggest that cultural familiarity is an important factor in minimising adverse communication outcomes from hearing loss. When communicating with familiar people from their own culture, culturally derived communication strategies can help children to compensate for the communication disadvantages related to their hearing loss.

"People with hearing loss are best able to use what hearing they do have to perceive speech when there is minimal background noise. This means the acoustic environment is another important factor to consider in relation to the support needs of young children with hearing loss. Optimising the listening environment can support children with hearing loss to develop and learn.

“Sound is measured in decibels (dB), and the quality of the verbal communication available to a listener is measured by the signal-to-noise ratio. This describes the difference between the level of the sound someone is listening to (the signal) and the level of the background noise (noise). The greater the difference between the signal and the background noise, the easier the signal is to ‘hear’. A signal-to-noise ratio of at least 15 dB is recommended for classrooms and other environments where children interact as a group. That is, the acoustic signal is 15 dB greater than the background noise. However, this ideal is rarely achieved (Crandell, Smaldino & Flexer, 1995).

“A number of features contribute to the level of background noise in schools and other environments where children are gathered together. Firstly, there is the sound generated by the equipment in the room and noise intrusion from outside the room. Secondly, there are the acoustic properties of the area. Lastly, there is the amount of noise generated by the talk of children and carers. Background chatter has been found to more disrupt school performance (Jones, 1989), and children’s talk has been found to interfere with or mask speech perception more than any other sources of noise (Crandell et al, 1995). The degree that furnishings absorb or reflect sound in an area also influences the acoustics in an environment.

“The impact of poor listening environments will be greatest on younger as compared to older children with hearing loss and/or auditory processing problems because the presence of background noise tends to have a greater effect when the exposed individual has had less experience with language. Even before children speak and understand language prelingual hearing loss can impact on the development of auditory skills. These effects are compounded when they come from an English as a second language background that requires more listening in order to understand. For instance, younger children were found to experience more difficulty in hearing word lists when background noise levels are high (Smyth, 1979; Crandell et al, 1995).

“In supporting young Aboriginal children, early childhood programs need to consider the acoustic environment in terms of both the physical layout and the personal communication strategies they will need to adopt in order to maximise children’s hearing. Things to consider include:

- avoiding arrangements that require too many children to share a confined space resulting in the generation of high levels of background noise;
- avoiding noisy play occurring too close to quiet activities, such as reading stories, that require children to listen;
- being aware of and scheduling quiet activities around noise intrusion from outside;
- gaining children’s attention first before speaking;
- using visual aids such as toys or puppets to focus children’s attention in group discussions and as signals for changes in activity, rather than relying on verbal communication alone;
- using repetitive routines that make it easier for children to attend;
- getting close to children when speaking, especially if they demonstrate listening difficulties;
- speaking with tonal variation and facial animation to engage and maintain children’s interest; and
- using accompanying body language to help ‘illustrate’ speech as an aid to children’s understanding of what is said.

"Early childhood is the period when children have most ear disease and when most benefits can result in prevention of middle ear disease as well as from an improved awareness of communication strategies that can assist to reduce the potential lifelong impacts of listening problems. This literature review has been developed as part of a sequence of resources to equip FaFT workers to address ear disease within FaFT programs. This document should be read in conjunction with other documents, including the 'strategy' and 'the facilitators' guide.

The FaFT Literature Review created documents for use in pre-schooling. They are detailed within the Review and NT COGSO strongly recommends that these are implemented across all pre-schooling programs as this has been an evidence-based approach to providing early learning to Aboriginal children supported by their families and educators.

The FaFT Literature Review outlined a "program to address ear disease guided by the following principles:

- *a **holistic focus** that targets the whole community for education and awareness raising to tackle hearing loss problems in young children. It engages families, children, professional workers, agency representatives and other stakeholders in contributing what they can to the prevention of ear disease and to mitigating its impact on children's learning and development;*
- *a **strengths' based approach** that positions Indigenous community members, families and children as having extensive knowledge, expertise and experience of hearing loss and its consequences on their lives that is acknowledged as the starting point for solving the problem;*
- *a culturally informed **communication approach** that recognises the different communication needs of people (adults and children) depending on a variety of factors including the fact of extensive adult hearing loss in remote communities;*
- *an **action oriented approach** that highlights practical action for prevention of conductive hearing loss and minimisation of the impacts of conductive hearing loss through family and agency engagement with FaFT; and*
- *a **locally responsive approach** that supports communities to customise their responses to hearing loss by drawing on their own ways of thinking and speaking about hearing loss."*

Further, research has been carried out in the NT that points to excessive noise in some crowded Aboriginal households as contributing to a new wave of preventable noise induced hearing loss. This work points to exposure of excessive noises that occur when people live in crowded houses, where many residents have existing conductive hearing loss from childhood ear disease and listen to increasingly accessible electronic equipment at a loud level for long periods. This is a new and concerning cause of increased hearing loss in a population group who already have the highest incidence of hearing loss in Australia. (**Attachment 2**. Dangerous Noise Article).

Professor Amanda Leach, leader of the Ear Health Research Program, Child Health Division at the Menzies School of Health Research, provided a Presentation to the Ear Disease Roundtable, AMA, in

Canberra in November last year and has kindly agreed for her Presentation paper to be referred to in this submission and for it to be included as an Attachment.

The Presentation "NT Prevalence update & What Works" is crucial reading for this Parliamentary Inquiry. (**Attachment 3**).

Professor Leach's presentation shows the evidence-based research on;

the causes of Otitis Media (middle ear infection); the prevalence among Aboriginal children living remotely in the NT from 2001 to 2013, the diagnoses by age (months) in a birth cohort of Aboriginal infants living in remote communities in the NT and WA (2012 to 2016); the risk factors for Suppurative Otitis Media in Aboriginal children; the effects of various strategies for prevention; and, antibiotic and surgery trials and health gains from intervention.

What Works shows the lengthy waiting times for babies eligible for a hearing test. Within the cohort, some 54% have had no hearing to test to date, and of those, 68% had waited more than 12 months.

What Works also shows the prevalence of Otitis Media (middle ear infection) as a health crisis which the Australian Medical Association describes as a pandemic. We refer to the AMA submission to the House of Representatives Standing Committee on Health, Aged Care and Sport in its *Inquiry into the Hearing Health and Wellbeing of Australia.*

NT COGSO submits that it is a health crisis that leads to an education failure that leads to an overburdened justice system resulting from these societal failures.

"In many remote communities with a high level of middle ear disease only 10 per cent of the children have normal hearing in both ears (Couzos et al., 2001). Indigenous children also experience their first episodes of middle ear disease at an early age. In a prospective study of otitis media and conductive hearing loss in Indigenous children, otitis media was observed in Indigenous infants as young as eight days old; by four months of age almost all had experienced episodes of otitis media. (Ref: Conductive Hearing Loss and Behaviour Problems Amongst Urban Indigenous Students, Damien Howard 2006).

Included in this submission is an Excerpt from the Audiology Australia (NT Chapter) Submission to the Review of Indigenous Education in Northern Territory, which is contained it the Northern Territory's Bruce Wilson Indigenous Education Review draft Report of February 2014.

"Audiology Australia wishes to reiterate important points about otitis media (ear infections), hearing loss and its potential consequences related to educational outcomes [1]. It is important that education policy-makers, funders, service providers and personnel at all levels have a good understanding of this in order to address educational needs and improve outcomes for students with hearing loss.

[1] Audiology Australia. *Chronic Otitis Media and Hearing Loss Practice (COMHeLP), A Manual for Audiology Practice with Aboriginal and Torres Strait Islander Australians*, 2012. http://www.audiology.asn.au/

"Otitis media and ear disease are significant health issues for Aboriginal communities within Australia. Periodic and occasional ear infections in one or both ears are typical for young children in the Australian community generally. However, the incidence of recurrent or chronic ear infections is higher amongst Aboriginal and Torres Strait Islander communities. The infections also often recur for a longer period of time.

"The effects of ear disease and otitis media will result in hearing loss. Hearing loss associated with otitis media may range from mild-moderate conductive hearing loss which may fluctuate or be long-term in nature. Chronic ear disease and its complications may result in more permanent hearing loss of varying degree – mild, moderate or severe.

"For young children, hearing loss will impact on speech and language development.

"For students with hearing loss, listening in the classroom environment and in group activities becomes harder and so a group learning environment becomes more challenging. This would have some impact on behaviour and learning outcomes. Persistent and ongoing hearing loss in children can impact on literacy, learning, education, behaviour, communication skills, inter-personal relationships, well being and later employment options [2].

"The impacts of hearing loss on young children and students with hearing loss who do not have English as their first language are more significant when in a classroom and when trying to learn English.

"The financial costs of hearing loss in Australia are considerable and results in net costs of lost wellbeing. Access Economics had prepared a report on the financial cost of hearing loss in Australia which reported that, "In 2005, the real financial cost of hearing loss was $11.75 billion or 1.4% of GDP'.

"Access Economics also estimated the incidence, financial impact and burden of disease from otitis media in Australia for 2008 [3]. In one approach to analysis, the costs of otitis media cases occurring for all Australians in the year 2008, the burden of cases was 3,974 - 9,758 disability adjusted life years (DALYs) (887 - 2,178 DALYs among Indigenous Australians). The net cost of lost wellbeing was estimated to be $1.05 billion to $2.6 billion.

"Strategies to help support schools with high numbers of Aboriginal or Torres Strait Islander children with hearing loss are important to help these students reach their potential and for better educational outcomes. This then better enables further education and training opportunities and potential for employment.

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[2] Access Economics, 2006, *Listen Hear! The economic impact and cost of hearing loss in Australia* www.hearingcrc.org/crc-corporate-publications/listen-hear

[3] Access Economics, 2009, *The cost burden of otitis media in Australia* www.deloitteaccesseconomics.com.au/publications+and+reports/browse+reports

"Audiology Australia recommends that for Aboriginal communities where the prevalence of conductive hearing loss is significant, it is important from an audiological and educational perspective for educational personnel and schools to [4]:

- Improve their awareness and understanding of
    - otitis media (ear infections), ear disease and associated hearing loss.
    - the prevalence of otitis media and its underlying reasons within communities.
    - the importance of ear and hearing health for listening, communication, language development, education and employment.
    - the nature of conductive hearing loss associated with otitis media and that hearing can fluctuate.
- Recognise behaviour indicative of hearing loss in children and young adults.
- Recognise the signs and symptoms of middle ear disease.
- Understand and support key primary prevention messages.
- Conduct preventive health and education programs in the classroom/community.
- Understand the role of the audiologist in the identification and management of ear disease and hearing loss.
- Understand the objectives of ear and hearing health programs, the roles and responsibilities of relative agencies and how educational facilities can support these.
- Improve school enrolment processes to seek or record information from families, local primary health services and hearing services (with appropriate provisions for patient privacy) so that children who already have a significant history of otitis media and hearing loss are readily identified at the point of school entry. Hearing services are trying to improve the surveillance of ear and hearing health from a young age and so improve the detection and management of hearing loss for children well before they reach school age. It would be helpful for schools to know this hearing health history from the outset of school entry so appropriate strategies are ready in place.
- Improve skills and knowledge of teaching staff to better assist them to identify the warning signs of fluctuating or long-term hearing loss and how to manage this effectively in their communication, classroom and teaching methods.
- Improve skills and knowledge of schools to understand how they can access, engage with and refer to local primary health services and appropriate hearing services according to individual

[4] Audiology Australia. *Chronic Otitis Media and Hearing Loss Practice (COMHeLP), A Manual for Audiology Practice with Aboriginal and Torres Strait Islander Australians*, 2012. http://www.audiology.asn.au/

students' hearing health needs.

- Improve classroom design and acoustics so that noisy and reverberant acoustic environments do not impact on a student's listening even further.
- Use soundfield amplification in classrooms to provide a more consistent level of a teacher's voice evenly transmitted around the room and above any background noise (signal-to-noise ratio) and to optimise listening for all students. (See discussion of *Soundfield amplification* below.)
- Improve training of school staff so that they have the appropriate skills and knowledge to understand the benefits of soundfield amplification and to understand the use and maintenance of particular systems.

"Australian Hearing has the responsibility to manage permanent or long term hearing loss in children as part of its Community Service Obligations. During the 2012 calendar year, Australian Hearing fitted a total of 559 Aboriginal children in the whole of NT with hearing devices. Many of these children live remotely across NT and with hearing loss arising from chronic otitis media [5].

"However, children with milder degrees or fluctuating hearing loss may not always be recommended for a personal hearing device based on clinical decisions such as the extent of the problem, likely benefit of amplification and individual circumstances. Rather, classroom communication strategies and/or the use of soundfield amplification may be advised [6].

"Soundfield amplification (or *soundfield distribution* as it is beginning to be known) refers to the use of speakers to more evenly distribute sound in an area such as a classroom. The teacher speaks into a microphone, which makes it much easier for children with mild hearing loss to hear and engage in the classroom.

"The benefit of a soundfield amplification system in a highly reverberant room or one with poor acoustics can be compromised or negated. Room acoustics therefore require carefully considered management in conjunction with the use of soundfield systems.

Soundfield amplification systems are not funded by Australian Hearing and are not funded across Australia in a systematic or consistent way. Schools often have to source their own funding, apply from sporadic funding programs when available or some have been fortunate to have funds provided by local service groups."

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[5] Australian Hearing Annual Report 2012/12. http://www.hearing.com.au/wp-content/uploads/2013/09/Australian-Hearing-Annual-Report-2012_13.pdf

[6] Australian Hearing, http://www.hearing.com.au/supporting-aboriginal-torres-strait-islander-children-classroom/

In regard to the Terms of Reference; *engagement and achievement of students in remote areas* this cannot be truly addressed with implementing communication tools.

The Article: *Soundfield amplification: Enhancing the Classroom Listening Environment for Aboriginal and Torres Strait Islander Children*, published in the Australian Journal of Indigenous Education, Volume 33, 2004, **(Attachment 4)** comprehensively explains the importance of acoustics, sound field amplification systems and the employment of local teacher aides.

"Sound field amplification is an educational tool that allows control of the acoustic environment in a classroom. Teachers wear small microphones that transmit sound to a receiver system attached to loudspeakers around the classroom. The goal of sound field amplification is to amplify the teacher's voice by a few decibels, and to provide uniform amplification throughout the classroom without making speech too loud for normal hearing children".

An 8-week field trial of sound field amplification was carried out in four classrooms, two in each of the rural Queensland communities of Cherbourg and Yarrabah. The research undertaken by Robyn Massie et al., showed an increase in the total number of communicative interactions; an increase in child, teacher and peer verbal communication and an increase in the number of interactions initiated by the children.

The study "investigated the effects of sound field amplification on the communication naturally occurring in the classrooms of Aboriginal and Torres Strait Islander children.

"The results confirmed the extremely noisy and reverberant conditions in which teachers and children are operating on a daily basis.

"The findings indicated that sound filed amplification intervention encouraged the children to interact with teachers and peers in a proactive way. Teachers identified voice-relate3d factors to be a major personal benefit of the systems."

NT COGSO submits that the prevalence of Otitis Media (middle ear infection) is significant across all remote Indigenous communities and affects Australians in Queensland, Western Australia, and South Australia to a large extent and Aboriginal Australians across the urban centres of all States and Territories, yet there is no Federal-State-Territory national partnership agreement to address this significant health and education issue that has dramatic disadvantage consequences flooding into our child protection and justice systems.

In the Northern Territory, NT COGSO has worked with the Aboriginal Medical Services Alliance of the Northern Territory (AMSANT) to advocate for the creation of an Interdepartmental Working Party between Education and Health with AMSANT and NT COGSO representatives.

It is through this Working Party that we hope to strengthen the innovative policy implementation efforts of the NT Department of Education with *Hear Now* and the NT Department of Health with *iHearing*.

However, the reality is, that without Federal Government support through a National Partnership funding agreement, the Northern Territory's budget constraints will mean it will take decades to address the overwhelming need for access to assessments, specialist audiological support, the roll-out of sound field amplification systems and individual amplification tools as well as acoustic upgrades to classrooms and also crucially, the employment of local Indigenous adults in classrooms as teacher aides to assist with local "sign language" communication.

It has been proven through Queensland and Northern Territory studies that, the employment of local Aboriginal people as teacher aides and teachers in the classrooms is incredibly effective because they understand the local sign language and use it as an effective communication tool.

The reality is that Auslan is not delivered as a language across remote schools for conductive hearing loss students (about 90% of the school cohort) and is only provided as a communication language for sensory/neural hearing loss deaf children. Recent funding cuts to Deaf Children NT has dramatically reduced the Auslan teacher service. As a consequence, access to Auslan is getting worse, rather than improving it.

Further, it is known that Aboriginal communities have their own sign languages as well as develop family-based signing systems for individuals. In her submission to the Royal Commission into the Protection and Detention of Children in the Northern Territory, Jody Barney – a Deaf Indigenous Community Consultant and Deaf Cultural Broker, who has more than 25 years professional experience working in the field and is also an Indigenous Deaf person – said she is fluent in eight (8) different Aboriginal and Torres Strait Islander sign languages and systems, and has knowledge of over 55 separate signing systems used in Indigenous communities across Australia.

Ms Barney submits to the Royal Commission that: "In many Indigenous communities, hearing loss is an unidentified, undiagnosed and therefore unaddressed concern. If many in a community have a hearing impairment of some level, there may be no self-awareness of loss because the hearing loss has been normalised."

"This is particularly important when people are asked to self-identify that they have a hearing loss. It also means Indigenous people often don't have the capacity to advocate for themselves for treatment and services."

"As a result, in both Indigenous communities and more broadly, Indigenous people with hearing loss may often be wrongly identified as having some other medical or more commonly cognitive impairment."

There needs to be a significantly increased investment in audiological assessment and support interventions for our children. Today in the Northern Territory, more than 2,000 children are on a referral waiting list for assessment.

Moreover, there needs to be strategies in place that support the referral of appropriate Aboriginal children with hearing loss for audiological assessment. There are cultural factors, that have been identified through research carried out in the Northern Territory, that obstruct children who have

hearing loss being perceived by teachers and child care workers as needing an audiological assessment. (**Attachment 5**: Classroom Case Study: Cross Cultural Obstacles to the Referral of Aboriginal Children for Hearing Tests, Dr Damien Howard, The Australian and New Zealand Journal of Audiology, Vol 28 May 2006). This means that there is a need for school-based screening programs and family educational programs to help prompt appropriate audiological referrals.

Hearing Australia receives Federal Government funding for the assessment of remote Indigenous children. We suggest that a service delivery model that has specialist audiologists working with the Aboriginal Medical Services who operate remote health clinics is an additional or alternative service well worth investigating if Australia is to achieve a sustainable service delivery that addresses the existing backlog and is capable of working with preventative researchers such as Menzies School of Health.

One of the significant problems has been a lack of structural changes to our schools to enable our children to hear during the periods of hearing loss. If you've ever had a middle ear infection you'd know what it's like trying to hear through a fog – the sound is muffled, words become indistinct. Add the dynamic that it's a second language you're trying to hear, and learn, in a noisy classroom and it becomes all the more challenging.

This has an impact on behaviour and learning outcomes. Persistent and ongoing hearing loss in children impacts on literacy, learning, behaviour and communication skills.

It is vitally important that this Inquiry recommend the upgrade to acoustics in remote schools.

As NT COGSO President, I recently presented a paper to the Australian Council of State School Organisations (ACSSO) recommending a multi-jurisdictional approach to addressing the impact of conductive hearing loss and its significant service delivery deficits.

To be truly effective in systemic change to close the gap of disadvantage, all tiers of Government – Territory, State and Federal – need to work in a National Partnership as this is an issue that affects children across state and territory borders.

Our advocacy to deliver acoustic upgrades and sound field amplification systems into our schools has become known as **Hearing in Education for Learning Project (HELP**) and we've been thrilled with the support of AMSANT, Deaf Children Australia and experts such as Dr Damien Howard who completed his PhD in the faculty of Education on Conductive Hearing Loss and Behaviour Problems Amongst Urban Indigenous Students in 2006.

NT COGSO respectfully submits that the Indigenous Affairs Standing Committee recommends:

- reducing Otitis Media (conductive hearing loss) be added as a Closing the Gap target
- a national classroom acoustics upgrade program that prioritises schools with predominantly Aboriginal students
- establishing Education protocols and procedures for the use of Sound field amplification systems in classrooms and individual hand-held amplification devices (also useful in groups)

- the provision of sound-field amplification and individual hand-held devices
- community members employed as teacher aides in classrooms who are cognisant of local sign languages
- education and awareness materials for parents, teachers and staff of conductive hearing loss
- referral of students with suspected conductive hearing loss to audiology services
- increased access to audiology services.

We submit that an effective tool for the delivery of these recommendations would be a National Federal-State-Territory Funding Partnership.

Sometimes, from little things, big things grow.

Imagine a child sitting at school in a classroom with acoustics that reduce noise and with a sound system amplifying the teacher so that they have no difficulty hearing and learning. Imagine that child with the support of a local Aboriginal adult competent in the local sign language. The world of learning will finally open up to them instead of being a student with hearing loss destined for our child protection, juvenile detention and ultimately adult prison systems. Who knows, we may actually succeed in 'Closing the Gap'.

"Education is the most powerful weapon we can use to change the world." – Nelson Mandela.

Tabby Fudge
President
NT Council of Government School Organisations

Families as First Teachers (FaFT)
Hearing Loss Literature Review

September 2012

Dr. Damien Howard
Phoenix Consulting

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Background

This literature review was commissioned as part of a larger project. This component was to:

> conduct a review of current and previous literature, inclusive of the relationship between otitis media types and predicted hearing loss and consequences. The review should include specific risks and potential consequences to language, learning, auditory development/processing, socialisation, oral language and ESL consequences of early childhood otitis media as experienced by remote NT children 0-4 years.

The principle purpose for the literature review is to provide the underpinning knowledge for informing the development of a parent education tool for use in non-clinical, informal early childhood contexts such as playgroup and other early childhood services in remote Indigenous communities. These playgroups are led by practitioners who are, for the most part, early childhood teachers and parents.

The Families as First Teachers (FaFT) program is an early learning and family support program for remote Indigenous families with children prior to school entry (0-3 years). The program aims to develop play-based programs to engage families and communities in giving their children the best start in life.

The FaFT program is holistic, acknowledging the important role families have as the first teachers of their children in fostering the child's development and learning within the family unit; helping to build family knowledge of child development and providing active engagement in quality early childhood education and family support strategies. Parental knowledge of early childhood learning and development, parenting skills, health, hygiene, nutrition and family functioning, are enhanced.

The program is based on five key messages:

- Families who understand how their children learn and develop are able to support them now and in the future.
- Healthy children have a better chance to grow up strong and succeed in life.
- Early learning experiences impact on life outcomes.
- Building on community strengths will empower families and support them to give their children the best start in life.
- Parental literacy and numeracy skills help to support their children's success at school.

Schools line-manage the FaFT program positions, provide administrative and collegial support and oversee the implementation of the program on a day to day basis. The program team provides pedagogical leadership, site support, professional development and training for all employees in the program.

This literature review focuses on key information from the available literature to inform the development of teaching and learning tools for early childhood workers, particularly FaFT workers, of issues around Aboriginal ear disease and hearing loss. As such it focuses on impacts of hearing loss on Indigenous children's development and learning in the age group 0-4 years. It provides information relevant to the development of learning activities and resources that will support parents and workers to take action to prevent and alleviate the impacts of hearing loss. With this audience and purpose in mind, the review does not have a strongly medical focus on issues around ear health.

As a multidisciplinary issue, the hearing loss literature referred to is derived from a number of perspectives. These include: health, education, childcare, speech pathology and psychology, to mention some. However, these are areas that, outside the health sector, have been little researched in the past. Most notably there have been few studies of non-health related issues of ear disease and hearing loss among pre-school aged Aboriginal children. When examining issues in areas where there has been little formal research, the best information is often found in non-published reports and the firsthand accounts of families and practitioners who have direct experience with the issues.

There has been considerable research into non-Indigenous children's ear disease, mainly to determine if otitis media (OM) [1] experienced in early childhood causes long-term educational, social or cognitive outcomes. The overriding concern of this research has been to answer a medical question, namely, 'Should early childhood ear disease be treated more aggressively to prevent possible long-term adverse outcomes?' The research findings around these kinds of questions have been inconsistent, leading to conclusions that the ear disease experienced by non-Indigenous children could not be demonstrated to have long-term adverse outcomes. Unfortunately, these findings have influenced policy makers in Indigenous education to not consider otitis media a serious issue.

There are problems for Indigenous children with the conclusions drawn from this research. Firstly, the research methodologies used amongst non-Indigenous children often involved important interventions that tended to minimise the impact of hearing loss; the children who were involved in the research had their ear disease identified and treated, which reduced the usual real life outcomes of their ear disease. Secondly, participation in research meant families became aware that their child had ear disease as well as likely hearing loss and so had information that helped them to understand why their child may have had communication problems. This knowledge was likely to have facilitated their use of more compensatory communication strategies. Thirdly, the non-Indigenous children involved in the research usually had a quite different, milder

[1] OM is an inflammation, infection or fluid accumulation in the middle ear that most often presents in Aboriginal children of the NT in a natural sequel of reoccurring, chronic or deteriorating disease states. It is caused by bacterial or viral infections and is often the result of another illness, such as a cold.

profile of ear disease than that experienced by most Indigenous children. Nor did the non-Indigenous children participating in the research experience the types of extreme disadvantage so often experienced by Indigenous children and which are known to exacerbate the impact of hearing loss. This body of research involving non-Indigenous children has questionable applicability to Aboriginal children in the Northern Territory and appears to have less influence these days among those considering Aboriginal ear disease. A growing awareness of the quite different profile of Aboriginal ear disease appears to have limited ongoing reference to misleading 'evidence' from non-Indigenous populations. Therefore, this research is referred to only very briefly and selectively in this document.

The bulk of formal research about Aboriginal children's ear disease and hearing loss that has been conducted has been undertaken in the health and education sectors. Two relatively recent reviews - one in health (Australian Indigenous Health*InfoNet*, 2004) and one in education (Burrow, Galloway & Weissofner, 2009) – have been produced. We wish to acknowledge our reliance on the work carried out by these two reviews in this review.

While relevant and needed, formal research into long-term impacts of Indigenous ear disease, and how to minimise these impacts, has not yet been undertaken. In areas where there has been little, if any, formal research we have relied on extrapolations from work carried out with older Aboriginal children or the expertise and experience of Indigenous families and professionals working with young Indigenous children. In doing so we follow the lead of the recent Senate Community Affairs report *Hear Us: Inquiry into Hearing Health in Australia* (2010). The writers of that report solved the problem of the little available published research literature by gathering evidence directly from practitioners and families to create a document that is currently the best overall review of Indigenous ear disease and hearing loss and their impact. This 'grass roots evidence' approach is needed when there is an absence of formal research and/or formal evidence available is mostly from other populations and contexts whose findings have limited relevance for Aboriginal children in the NT.

Introduction

This review discusses the specific risks and potential consequences otitis media and associated hearing loss has on children's oral language development, learning, auditory development and processing, development of social skills and English as a Second Language (ESL) as experienced by Indigenous children aged 0-4 years living in remote communities of the Northern Territory.

Middle ear disease (otitis media) and subsequent hearing loss are a significant although often little considered problem among many Indigenous populations in developed countries, as well as disadvantaged groups in developing countries. High levels of ear disease are associated with poverty and disadvantage. It has been estimated that one third of the people in developing countries are significantly affected by middle ear

disease (Berman 1995)[2]. Indigenous Australians are reported as having the highest prevalence of ear disease in the world (Couzos, Metcalf & Murray, 2003).

Exceptionally high rates of ear disease and hearing loss have been reported in many Indigenous Australian communities, particularly in remote areas and among children (Couzos et al, 2003). The twenty growth townships in the Northern Territory selected as centres of NT Government service provision are amongst those that have the highest prevalence of ear disease and associated hearing loss (Currie, 2012).

Ear disease usually starts very early in young children's lives and can have a double impact. Firstly, ear disease can affect critical periods of development in children's auditory, cognitive and psychosocial competencies, and, secondly, it may result in some degree of permanent hearing loss that has an ongoing impact on communication and learning. There is evidence that hearing loss resulting from extensive ear disease among disadvantaged groups contributes to a self-perpetuating cycle of disadvantage (Senate Community Affairs Secretariat 2010).

Children experience the greatest prevalence of ear disease between the ages one to five (Couzos, Metcalf & Murray, 1999). This means it is critical that families and carers of young children become aware of ear disease, how to prevent it, the importance of early and sustained treatment, as well as effective compensatory communication strategies that can help to minimise the potential long term adverse impacts.

Increasing awareness among Indigenous families of the high risk of ear disease in young children, as well as its common communication and other consequences, has the potential to reduce the many potential adverse impacts of hearing loss from middle ear disease. Greater awareness of ear disease can promote family instigated ear disease prevention activities, as well as foster early treatment of ear disease and promote use of compensatory communication strategies by families.

Otitis Media

Middle ear disease, generally referred to as otitis media (OM), is one of the most common childhood illnesses. It is also the major cause of hearing loss among Indigenous Australians (Access Economics, 2006). OM is an inflammation, infection or fluid

[2] In developing countries the paucity of audiological resources, even for those with moderate to severe hearing loss, means that issues for people with mild to moderate hearing loss or auditory processing problems as a result of ear disease are not visible, nor a viable priority. However, while addressing individual health issues is not viable, there is much that could be done to address the 'population' level communication, educational, wellbeing and employment issues associated with ear disease. In the same way that 'population health' approaches were needed to make the leap forward in many of the widespread health problems that beset the Western world last century, 'population wellbeing' approaches may be able to make substantial inroads into the adverse outcomes associated with widespread ear disease in disadvantaged populations worldwide – including among Indigenous Australians.

accumulation in the middle ear that most often presents in Aboriginal children of the NT in a natural sequel of reoccurring, chronic or deteriorating disease states. It is caused by bacterial or viral infections and is often the result of another illness, such as a cold (Morris, 1998a; Access Economics, 2006). OM typically leads to conductive hearing loss that is mild to moderate in degree, and may be intermittent or persistent according to the form of OM. Evidence suggests that some forms of OM may also lead to sensorineural hearing loss (Morris, 1998a). This occurs when damage to the middle ear removes protective barriers and exposes the inner ear to ototoxic or mechanical damage.

Without effective identification, treatment and follow-up, OM may become severe and chronic, increasing the risk of permanent conductive hearing loss (Morris, 1998a; Access Economics, 2006). While non-Indigenous children frequently present to health practitioners with acute otitis media (AOM), this form of the disease (involving inflammation of the middle ear and symptoms of earache, fever and irritability, but without perforation of the tympanic membrane) is not characteristic of Indigenous children's ear disease (Bear, 1992; Willis, 1992). Acute, suppurative otitis media (ASOM), characterised by a rapid and apparently painless perforation of the eardrum, and discharge of pus (runny ears), is usually the first stage of the disease among Indigenous infants (Willis, 1985; Clements, 1968). If OM in non-Indigenous children does become chronic, it is not generally characterised by perforation. OM in non-Indigenous children is often self-limiting, typically resolves with age, and is seldom seen among children older than 8 years (Boswell, 1997; McPherson & Knox, 1992). Chronic suppurative otitis media (CSOM) occurs rarely among non-Indigenous Australians, who typically benefit from good living conditions and access to adequate health care, but high rates are common among Indigenous children.

Children presenting with perforated eardrums, particularly those with bilateral CSOM, experience significantly worse hearing loss than those with otitis media with effusion[3] (Couzos et al, 1999; Nienhuys, Boswell & McConnel, 1994). Half of those children with bilateral CSOM experience hearing loss of greater than 35 dB and very few escape without some residual loss (Morris, 1998b). It is not uncommon for some Indigenous people to continue to suffer from CSOM throughout adolescence (McPherson & Knox, 1992) and into adulthood.

The World Health Organization (WHO) is particularly concerned about CSOM, which it considers to be a massive public health problem requiring urgent attention if it occurs in more than four per cent of the population (Dawson et al, 1985). The level of CSOM among Indigenous infants, children, adolescents and even adults in many communities in the NT is far greater than this, with prevalence rates of up to 40 per cent reported for some communities (McPherson & Knox, 1992).

[3] Otitis media with effusion (OME) is when there is thick or sticky fluid behind the eardrum in the middle ear.

Since pain or obvious symptoms is often absent with Indigenous children's OM, treatment is often not sought or is delayed. The persistent bacterial colonisation experienced by many Indigenous children has been attributed to cross-infection stemming from overcrowded living conditions, poor hygiene, high carriage rates of bacterial pathogens and the prevalence of multiple bacterial strains (Leach, Boswell, Asche, Nienhuys & Mathews, 1994; Mathews, et al, 1992; Foreman, Boswell & Mathews, 1992). Many rural and remote Indigenous communities have poor housing with inadequate access to water, sewerage systems, and waste removal (Australian Bureau of Statistics, 2000), increasing the risk of infectious ear disease (Kelly & Weeks, 1991). Otoscopic signs of AOM (such as a bulging tympanic membrane) are relatively common in the first two years of life, and symptoms are usually lacking, atypical, or so short-lived that they are rarely recognised by health staff. Given that few symptoms of otitis media are apparent to the family, combined with the difficulty of health practitioners in identifying and diagnosing otitis media, early identification and treatment of ear disease is confounded for many Indigenous children.

Hearing loss and auditory processing problems as an outcome of ear disease

Persistent otitis media often damages middle ear structures causing some degree of permanent hearing loss. Methodological limitations of the different studies in this area make meaningful comparison of results between hearing tests difficult. For example, some research uses parental or self-reporting of hearing loss as a measure. However, since the symptoms of ear disease and hearing loss are often non obvious and people may not be aware they have a hearing loss, such research generally underestimates the prevalence of hearing loss.

The majority of childhood hearing impairment ranges from mild to moderate loss (Poltl, 1993). Studies of Indigenous students at urban schools revealed varying levels of hearing loss, but not the very high prevalence rates found in rural and remote Aboriginal communities (McPherson & Knox, 1992; Nienhuys, Sherwood & Bush, 1990; Howard, 2004a). Some studies have reported that many Indigenous adults studying or working in urban areas suffer from slight or mild hearing loss (Nienhuys, Boswell & Lay, 1992; Ward, McPherson & Thomason, 1994).

It is evident that the proportion of Indigenous adults with hearing loss varies in different communities. The best evidence currently available in the Northern Territory is that between 30 and 70 per cent of the general population in remote townships have a significant degree of permanent hearing loss (Poltl, 1993; Nienhuys et al, 1992; Ward, McPherson & Thomason, 1994; Vanderpoll & Howard, 2012). It is rare that whole community hearing tests are carried out in remote communities. It is more common, although still relatively rare, that hearing testing is sometimes carried out among Indigenous people from regional and remote areas who have come to an urban area for

one reason or another. For example, it was found that 20 per cent of students engaged in tertiary education at Batchelor College had a significant hearing loss[4] (Nienhuys et al, 1992). While these studies occurred up to 20 years ago, a very recent study illustrates the continued significance of the problem. Of the Indigenous inmates in Darwin and Alice Springs prisons, 93 per cent were found to have a significant level of hearing loss (Vanderpoll & Howard, 2012). The vastly different prevalence of hearing loss between Indigenous adult participants in the tertiary education and among prison inmates, suggests the adverse impacts of hearing loss in obstructing involvement in education and fostering involvement in the criminal justice system.

Hearing deprivation associated with fluctuating or persistent hearing loss during the first years of life (especially the first 12 months) as this impacts on auditory processing skills development – such as being able to detect very subtle differences in speech (voiced and unvoiced consonants, having figure-ground skills (ability to sort speech from noise) and auditory memory development. Much of this auditory processing skill development happens in first 12 months (Burrow et al, 2009).

Factors contributing to ear disease and hearing loss among Indigenous people

A number of factors are known to contribute to OM and increase the risk of conductive hearing loss – hearing loss related to the mechanical 'conduction' of sound through the middle ear which is common with ear disease. These factors include: premature birth, being male, not being breastfed, exposure to smoke from cigarettes or wood fires, poor nutrition, poor hygiene, lack of access to clean water, lack of access to medical services, overcrowded living conditions, and generally poor environmental conditions (Howard, 2004a; Australian Bureau of Statistics, 2000; Leach et al, 1994).

Environmental conditions are important determinants of levels of OM and subsequent hearing loss in Indigenous communities. Many rural and remote communities have poor housing with inadequate access to water, sewerage systems, and waste removal (Tait, 1992). These living conditions and overcrowding contribute to poor hygiene, increase the risk of infectious ear disease (Morris, 1998a; Mathews et al, 1992) and contribute to the early onset of chronic or recurrent OM, placing Indigenous infants at increased risk of early conductive hearing loss (Boswell, 1995). The risk of hearing loss is heightened by the fact, mentioned above, that symptoms of OM are often lacking, atypical, or so short-lived in Indigenous infants that they are commonly not recognised and or identified by health staff (Mathews et al, 1992).

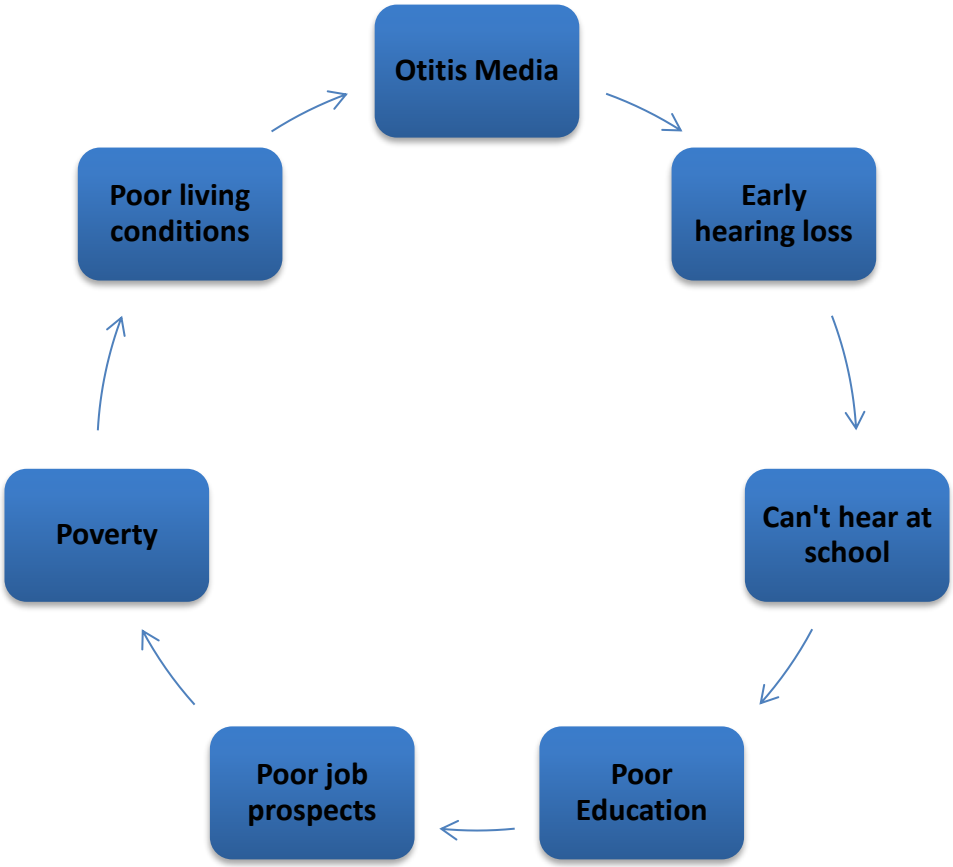
[4] At least a mild level of hearing loss (greater than 25 dB in the better ear). However, 50% of tertiary students were found to have at least a slight level of hearing loss and most probably also experienced some degree of auditory processing problems from a childhood history of ear disease. The impact of childhood middle ear disease on Indigenous students' participation in tertiary education is also currently an important but neglected issue.

Environmental risk factors, coupled with inadequate health-related infrastructure and health services (Access Economics, 2008), ineffective treatment (Menzies School of Health Research, 2001) and poor nutrition and exposure to passive smoking (Burrow & Thomson, 2003; Mathews et al, 1992; Access Economics, 2008; Lehmann et al, 2003), reflect the profound socioeconomic disadvantages faced by many Indigenous communities. Like many health problems, the prevention and management of OM and hearing loss in Indigenous communities requires a comprehensive holistic approach that combines medical, social and economic interventions, including family awareness as well as programs and strategies to combat OM-related hearing loss and its lifelong consequences for Indigenous peoples.

Impact of hearing loss/auditory processing problems

In recent decades there has been growing recognition of the prevalence of Indigenous ear disease with medical aspects receiving significant attention from researchers, practitioners and policy makers. However, recognition of the lifelong impacts of hearing loss that results from ear disease in early childhood has been more limited. Most of the attention and activity about the impact of Aboriginal hearing loss has occurred within the primary education sector although at a minimal level.

There is little information publically available, despite considerable experience among some practitioners and families, on how best to address the lifelong impacts of Indigenous hearing loss. For example, there is minimal information publically available on the impact of hearing loss, and how to address it, in the areas of secondary and tertiary education, adult training and employment. There is also little information in the public domain on how hearing loss acts as a barrier to access to mainstream services or Indigenous people's over involvement in the criminal justice system. The diagram below, developed by a group concerned about Indigenous hearing loss (ACHE working group), describes the intergenerational cycle of disadvantage associated with otitis media as observed by participants in this group.



The diagram describes the major elements in this cycle. Behind these major identified areas of impact are many subtle, not easily identifiable processes and interactions. For example, there are long term developmental consequences of hearing loss on children's auditory skills, speech and language and social competencies that contribute to these impacts. There are also magnified adverse outcomes when many children and adults in the same group have listening problems. There are also complex and as yet poorly understood interactions between listening problems and other forms of disadvantage experienced by Aboriginal people in Australia. These issues are briefly discussed later in the review.

The consequences of different degrees of early, often fluctuating, hearing loss on subsequent childhood and adult development are not well understood, but current evidence suggests that the early onset of chronic or recurrent OM, particularly in the first two years of life, leads to hearing loss at a critical period in children's development (Morris, 1998a). Hearing loss in early childhood affects speech and language development and learning. It may have serious and ongoing developmental and educational effects (Morris, 1998a; Kelly & Weeks, 1991; Howard, 2004a). Educational consequences of hearing loss include delays in language comprehension and production, poor listening skills, problems with attention, distraction and memory, reduced mathematical skills and reduced scores on intelligence tests (Partington & Galloway, 2005; Wallace & Hooper, 1997; Yonowitz, Yonowitz, Nienhuys & Boswell,

1995; Howard, 2004b).

Hearing loss also contributes to poor social and emotional wellbeing, behavioural problems, and poor social skills (Nienhuys et al, 1994; Yonowitz et al, 1995) and can have long-term, negative social impacts including: limited employment options, increased risk of anti-social behaviour (Howard, 2005; Nienhuys & Burnip, 1988; Lowell, 1994), drug use (Howard, Quinn, Blockland & Flynn, 1994) and contact with the criminal justice system (Morris, 1998a; Preston, 1994; Morris et al, 2005).

The degree and impact of hearing loss associated with OM varies according to the severity and frequency of episodes of OM, but research suggests that three or more episodes of OM before the age of three years may seriously affect language development (Walker & Wigglesworth, 2001). The conductive hearing loss experienced by children because of OM may frequently fluctuate: as a result, they may hear normally at times, but not at others. Under these conditions, they receive variable language input (Galloway, 2008), hearing different forms of the same word at different times, for example. This poses difficulties for children as they try to develop language-learning strategies, leading to fatigue, frustration and frequent withdrawal from interaction (Lowell, 1993).

It is generally accepted that children who experience multiple episodes of OM-related hearing loss prior to going to school experience difficulties with the development of auditory discrimination and processing skills, phonological awareness, short-term auditory memory skills, and auditory sequential memory skills (Lowell, 1994; New South Wales Health Dept., 1996; Holte, 2003). Ultimately, this affects a child's ability to learn to communicate and read and write, and contributes to poor educational outcomes (Lowell, 1993; Couzos, Lea, Mueller, Murray & Culbong, 2003).

Impact of hearing loss on education

Western schooling is highly focused on learning though listening and talking as central learning and teaching strategies. Learning within the Western school environment greatly relies on language and communication skills, and children who have experienced hearing loss in early life are likely to struggle with most aspects of learning at school (Burrow et al, 2009) as well as demonstrate behavior problems at school (Howard, 2006). Children who have difficulty in performing tasks that require literacy and numeracy skills, due to present or developmental effects of previous hearing loss, may become disinterested in learning and attend school less regularly. Consequently, they are less familiar with classroom routines and less able to interpret and participate in classroom activities when they do attend school. Ultimately, hearing loss may contribute to school failure, absenteeism, early school dropout and reduced employment opportunities (Wallace & Hooper, 1997; Howard, 2011). Research conducted by NACCHO (the National Aboriginal Community Controlled Health Organisation) has shown that Indigenous children with CSOM attend school less frequently than other children (Burrow et al, 2009).

The negative effect of hearing loss on language acquisition, and subsequent reading, writing and learning is likely to be magnified by a range of issues that impact on the educational experiences and outcomes of Indigenous students. Many Indigenous students have difficulties adjusting to a classroom where the language and environment differ from that of their home environment (Morris, 1998a; Wallace & Hooper, 1997; Aithal, Yonovitz & Aithal, 2008), especially a home environment where the use of non-verbal communication has been significantly increased as a compensatory communication strategy because of hearing loss (Lowell, 1993).

Many Indigenous students in the NT speak a language other than English at home, or they speak a dialect of English (Aboriginal English). Approximately 59% of Indigenous Territorians reported speaking an Indigenous language at home suggesting that significant proportion of Indigenous children come to school from multilingual home environments (ABS, 2005). As a result, they may not be familiar with the sounds and structures of Standard Australian English (SAE) spoken at school (Yonovitz & Yonovitz, 2000; Howard, 1992). Language, literacy and learning difficulties may be compounded by poor school attendance associated with cultural events and family commitments, such as ceremonies and funerals. In addition, literacy-learning resources (books, magazines and word games) are frequently lacking in Indigenous families (Wallace & Hooper, 1997), and there are often issues of power and identity associated with language use (Lowell, 1994). Issues of racism, oppression, alienation, and poverty also influence the learning of Indigenous students (Mellor & Corrigan, 2004).

While the factors referred to above may compound the poor educational performance associated with hearing loss, they, and various cultural differences (Howard, 1994; Higgins, 1997; Howard, 2011), may also 'mask' as well as compound hearing loss as a cause of poor educational performance. Hearing loss may also be overlooked as an underlying cause of poor educational performance in children who are quiet and introverted or who, alternatively, exhibit disruptive behaviours (Mellor & Corrigan, 2004; Moore, 1999; WHO/CIBA, 2000; Howard, 2006).

Impact of hearing loss on psychosocial development

Hearing loss affects not only educational performance but also social and emotional development and can lead to behavioural problems such as irritability, disobedience, distractibility, and over activity. This can, in turn, lead to social isolation (New South Wales Health Dept., 1996) and further behavior problems (Howard 2004, 2006). At school, children may be ostracised by their peers, and the educational and social problems they experience may lead them to leave school early (Wallace & Hooper, 1997).

Many Indigenous children with hearing loss will also have behaviour problems at home that may diminish both the child's and the carer's social and emotional wellbeing, disrupt family life and impact on community functioning (Nienhuys et all, 1994; Howard & Hampton, 2006).

Prevention of ear disease/hearing loss

There are known predisposing factors of ear disease, and therefore, prevention of ear disease is assisted by addressing these. Prevention strategies include keeping children away from cigarette smoke, washing hands and face regularly, breast feeding (especially early sustained breast feeding), encouraging swimming in clean or chlorinated water, having health practitioners check ears regularly (Kelly & Weeks, 1991; Couzos, Metcalf & Murray, 2001; Scott, 2001) and improving nutrition (Jones, 2012).

Early identification of ear disease also enables early treatment that can limit early chronic ear disease from becoming a persistent condition (Gibney et al, 2005). In the NT routine health checks (including well baby checks, Healthy Under 5 Kids surveillance programs and developmental assessments) are Health Department based programs that create opportunities to identify active ear disease and provide anticipatory advice (personal communication Kathy Currie). Early identification of middle ear disease has the potential to not only treat ear disease but to prevent adverse social, emotional and educational outcomes of ear disease as well. Families who are not aware that children have hearing loss have been reported to punish children for ignoring directions or other hearing related behaviours (Howard & Hampton, 2006). There is also increasing evidence emerging on adverse social and emotional outcomes associated with ear disease among both Indigenous (Zubrick et al, 2006) and non-Indigenous children (Hogan, Howard & Yiengprugsawan, 2012) as well as a high proportion of imprisoned Indigenous adults having a significant hearing loss.

There are other prevention strategies that are not within the control of individuals and families. Foremost among these is poor housing and overcrowding in homes.

Ear disease and Early Childhood workers

Early childhood services in Australia provide care and education for children from birth to 12 years across a range of different service types including long day care, occasional care, play groups, preschool and out of school hours care as well as parent education and home visiting programs. Through the Council of Australian Governments (COAG) partnership agreements with states and territories, Indigenous early childhood is targeted as a key site for intervening to ‘close the gap’ in Indigenous disadvantage (Sims, 2011).

There has been a rapid growth of early childhood services in remote NT Indigenous communities. There is a greater risk of ear disease when children participate in child care, especially in larger childcare centres (Uhari, Mantysaari and Niemela, 2008). However it has been suggested this may not be the case for Indigenous children. Jacoby et al (2008) suggested that attending childcare outside of the home may help decrease the risk of exposure to environmental smoke – which increases risk of ear disease. Further, childcare facilities may provide more hygienic environments for children when

homes are chronically overcrowded and where toilet and washing facilities are regularly and persistently overwhelmed.

The growth in early childhood services has not been matched by similar growth in training programs for local Indigenous employees (Elliott, Fasoli & Nutton, 2009). Most Indigenous staff working in remote communities do not have formal training or qualifications in early childhood. Where possible, non-Indigenous staff from outside the communities are hired to support unqualified local staff (Productivity Commission, 2011).

Most early childhood services located in remote Indigenous communities are known as 'non-mainstream' services and are funded and regulated through a different system to that used in town or regionally based early childhood services. Financial support is provided through 'budget based funding' (BBF) because these services exist 'where the market would otherwise fail to deliver these services' (DEEWR, 2011). They also fall outside the new National Quality Framework (NQF) for early childhood education and care. The NQF describes the quality indicators for high quality service provision as well as the minimum levels of qualification (Certificate III) for staff working in an early childhood service. While remote BBF early childhood services will not be required to meet new quality standards immediately, they are being funded to work towards these standards.

Few of these staff have access to early childhood training courses (Productivity Commission, 2011). Where such courses are available, there is minimal attention given to the prevalence, prevention, impact and strategies for addressing hearing loss for Indigenous children. Apart from primary school teachers who have undertaken professional development on otitis media, there is limited awareness of the presence and impact of otitis media and hearing loss among Indigenous children. Moreover, and surprisingly, there has been little focus on ear disease and hearing loss among those involved in early childhood services, despite the peak prevalence of ear disease being among preschool (0-5) aged children.

The incidence of otitis media and its effects are a significant problem for Indigenous children in the Northern Territory because of the proportionally high Indigenous population, the location of most of that population in regional, remote and very remote communities and the unique characteristics of the early childhood field in the Northern Territory. In the NT approximately 80% of the NT Indigenous population lives in a remote community (NTER 2011, p. iii). There are 641 discrete Aboriginal communities in the NT, 9 of which have 1000-2000 people, 50 from 200 –999 people and 570 with less than 200 people (NT Dept of Planning and Infrastructure, 2012). This means that most Indigenous children in the NT are growing up remote from the hearing loss and health information services that urban populations take for granted.

A speech pathologist, Anne Jacobs, has conducted the only research that has examined

the impact of ear disease specifically on young Aboriginal children. Working with a group of Western Desert families, Jacobs (1986) described a sequence of language and social development that was different, and generally more advanced, than that found among non-Indigenous infants. For example, responsive smiling, the imitation of facial patterns and the localisation of the mother's voice occurred at a younger age than they do among non-Indigenous children. The patterns of verbal and non-verbal communication were also different from those found among non-Indigenous children, and they developed at an earlier age.

The closer physical contact with family members and strong social and communicative responsiveness towards children by members of the extended family (Jacobs, 1986) may have contributed to this accelerated linguistic and social development. Jacobs noted, however, that there were comparative delays in the social and linguistic development of Western Desert infants who experienced chronic conductive hearing loss. This suggests that traditional childrearing practices that involve children's intense contact with an extended family may create an enriched communication environment that can reduce some of the impact of early hearing loss.

Hearing loss and Indigenous Communication Strategies

While Jacob's findings that chronic hearing loss nevertheless had an adverse impact on the accelerated normal development, despite the enriched extended family environment, it also seems likely that the maintenance of an enriched extended family engagement helps to compensate for the deprivation of auditory input because of hearing loss. The use of community signing systems and more intense communicative engagement with extended family and Aboriginal staff has been found to minimise communicative disadvantage. Lowell (1994) found that Yolngu (Indigenous people from East Arnhem Land) teachers often used Yolngu sign language in parallel with verbal communication. The shared experiential, cultural, linguistic, and non-verbal understandings that prevailed in bilingual schools were potentially powerful compensating factors that could combine to offset the effects of both hearing loss and the problems created by background noise.

Howard and Hampton (2006) also noted that Aboriginal children with hearing loss are often very demanding of and reliant on family members for communicative as well as social and emotional support. The degree of support that is available to children can mediate the level of communication and social and emotional disadvantage.

There are also risks that the higher demands of children and non-compliance with adult requests can adversely impact on family relationships. Howard and Hampton (2006) reported on family problems that may correlate to heavy demands made by children with hearing loss. The following quotes from this article illustrate the impact of hearing loss on families.

> *"They are cheeky ... you see a kid (who has middle ear disease) throwing rocks at Mum and swearing and demanding something, and usually most times they will give it to them to shut them up."* (Aboriginal Health Worker)

> *"I have noticed that it is the kids with chronic ear problems who are the ones you sometimes see hitting their family when they are in the waiting room."* (Remote Area Nurse)

Some Aboriginal parents' reactions when they felt children were ignoring them.

> *"Half the kids get floggings because they (the parents) think they're (the children) ignoring them. I see parents giving kids with hearing loss a flogging when they (the children) have not understood; I see that all the time, everywhere ... I think half the kids (with hearing loss) get hidings sometimes."* (Aboriginal Health Worker)

This suggests a child's hearing related social problems may lead to negative impacts on parents which rebound onto relationships with children.

> *"I (earlier) felt depressed and frustrated because I didn't know what was going on. I was blaming myself. I thought it was my fault and I was a bad mother. I felt like I was letting her down. I was trying to figure out what to do. The behaviour problem came at school. They never suggested anything and it was depressing not knowing what to do ... but it was getting me down and it was the stress levels. I was growling at her and yelling. I was pushing her away because I didn't know how to deal with it. It made us grow apart. I did not want to be around her."* (Mother)

The process whereby her child's hearing related social problems led to this parent blaming herself and withdrawing from her child appears to have exacerbated the impacts of hearing loss. It is likely that some Aboriginal families are caught in a cycle involving increasing social problems among children and decreasing social and emotional wellbeing among their carers, and that breaking this cycle could include identifying children's hearing loss and informing families of the predictable social outcomes of hearing loss and how they can be best managed.

The demands of many children in a family with hearing loss can strain the capacity of family members to provide the optimal support needed for children's normal development. A high proportion of children with hearing loss could even contribute to the breakdown in extended family support systems. This in turn may create an environment where hearing loss has a magnified impact on individual children because of a high proportion of children in a family have hearing loss. It has been suggested in some situations hearing loss may contribute to child protection issues (Howard and Saxton Barney 2010).

There are many factors that contribute to child protection issues for Aboriginal children. Widespread hearing loss among children and adults has not been generally considered as an important child protection issue. However the above discussion suggests that the impact of hearing loss on family relationships is an important issue to be considered in Aboriginal child protection. Children's hearing loss can make high demands on family support and many families may not have adequate family support capacity to cope. In an impoverished family support environment, where there are few adults or older siblings available to provide the intense engagement with children there may not be the capacity to provide optimal exposure to social and communication experiences necessary for normal child development. In impoverished social contexts children with hearing loss could experience more frustration as well as social exclusion. As a result, they may be more likely to have difficulties in developing social skills and to resort to physical coercion or aggression. In childcare settings, children for whom staff had concerns about biting, toileting accidents, fighting and social immaturity often had a history of ear disease and associated hearing loss (Hogan et al, 2012). As noted above, families who are challenged to adequately meet the needs of children (needs that are greater because of one or more children in the family having hearing loss) may precipitate contact with the child protection system (Howard and Saxton-Barney, 2010).

Fostering an understanding of the impact of hearing loss and promoting the use of compensatory communication strategies can help children experience the types of social engagement needed for normal psychosocial development, despite their hearing loss. In addition amplification would be usually recommended for children with moderate, severe or profound bilateral hearing loss. In most situations a bone conductor hearing aid is seen as the most appropriate device to use with young children with conductive hearing loss related to ear disease. This type of device sits on the bone just behind the ear. The amplified sound is 'conducted' though bones in the skull past the middle ear. By not being in the ear this device also keeps the ear canal clear of anything that could potentially block or spread any infection if there is a discharging ear, as well as providing a more 'normal' sound quality, as it delivers the sound direct to the inner ear.

Sound field systems (which operate like a PA system with a microphone used to amplify sound to everyone occupying a shared space[5]) are likely to have utility in the provision of early childhood services. However, the variety of often-small group communication contexts in early childhood settings need to be explored and systems evaluated. It is possible 'belt based' amplification devices or hand held devices may also prove useful.

[5] There is ample evidence of the benefits of sound field systems in schools (Massie, 1999).

Optimal development for children with hearing loss and auditory processing problems

To maximise developmental opportunities, children with hearing loss need not only to have an environment that is responsive to them but they also need to be highly responsive to their environment. Hearing is the sense that most structures our social engagement. When young children have a hearing impairment they need to be more attentive and responsive than children with normal hearing in order to make the best use of both available auditory input, as well as of available visual and history of past experience. Anything that tends to distract children's capacity to attend, such as limited experience of listening because of past hearing loss or living in noisy environments or the cognitive impacts of trauma, can contribute to impoverished communication outcomes. One area that has been examined is exposure of children with hearing loss to trauma, which is unfortunately an all too common occurrence for many Indigenous children. It has been suggested the combined effects of hearing loss and trauma can contribute to diminished access to social and communication experiences needed for optimal development (Howard and Saxton Barney, 2010).

It is also likely that there will be impacts on communication when children with hearing loss have other more minor emotional distress, or distress and pain related to some physical illness. The effect that these experiences have on distracting children from fully focusing their attention means that, at these times, children with hearing loss will be even less able to effectively listen and engage with others.

There are internal factors, such as tiredness, hunger, limited experience in attending to speech or trauma and external factors, such as noisy or visually distracting environments that affect children with hearing loss. When children with hearing loss experience either or both internal and external factors they are more likely to engage less, or engage in a dysfunctional manner with others. Therefore, an understanding of how hearing loss interacts with internal and external factors to influence communication is important information for early childhood workers. This knowledge would assist them in providing a more optimal developmental experience for children with current and/or past conductive hearing loss and auditory processing problems.

Table 1: Influence on communication of social and emotional environments

Social and emotional environments	Factors influencing social and emotional environment	Actions to influence social and emotional environments
	-Children have adequate social and emotional support from carers	-Issues of neglect or trauma addressed through informed family support services. -For example ensuring communication support

		and information to families by professionals working with them in such things as providing structure and routines that help to minimize listening demands.
	-Children have access to familiar culturally based communication and social supports.	-Support workers have culturally informed and hearing loss sensitive communication skills

Hearing loss and speech and language problems

Children with communication problems, as well as children who have experienced neglect or been traumatised, are likely to experience greater adverse outcomes from hearing loss. Research in Western Australia with Aboriginal children found children with speech and language problems experienced more adverse social and emotional outcomes than other children (Zubrick et al, 2006). While the survey methodology used could not determine the cause of the expressive communication problems speech problems are often associated with conductive hearing loss. Difficulty in understanding young Aboriginal children's speech has been found to be a useful indicator of a child at risk of current middle ear disease and hearing loss (Hogan et al, 2012).

When hearing loss has been chronic and persistent enough to impact on speech and language development as well as auditory processing capacities, a child has a compounded communication difficulty. Not only will such children with hearing loss have problems in understanding what others say to them, they will also often have difficulties in making themselves understood by others. Because they experience difficulty in having their needs known and met, they also experience high levels of frustration and distress. Those trying to understand and interact with them will also experience frustration and distress, especially when they are not aware of the influence of hearing loss and other factors and how to address these. The following description by the mother of a four-year-old girl illustrates this.

> *"She gets upset when we can't understand her. When she's not feeling well or she's trying to express that she wants something, she can't say it. So she'll either throw a tantrum, get upset because we're not understanding, get upset because she's trying to tell us something. As well she is obviously getting frustrated with herself because she can't communicate properly with us and [get] what she actually wants."* (Personal communication, Mother)

These communication difficulties impact on children's relations with other family members.

> *"We keep continuously asking her 'What do you want? What do you want?' and she's trying so hard to say it. And then of course it leads to me getting frustrated because she's crying. And it's always the continuous repetition with her that makes it hard, she'll ask a question and when you answer her, I don't know if she's understanding it or if she's just not hearing it properly. Because she's always like 'Uh?'. When she talks to you she grabs your face and you look at her and you can tell she's trying to say something to you and you're talking to her and if you look away she'll grab your face and bring it back so she's looking at you. If she thinks you're not listening to her or she can't hear you, she'll turn your face around. It gets so just draining because she has to have your attention all the time.*
>
> *If she's not feeling well or if she's going down with an ear infection or anything, she won't let me do anything. She just wants Mum to hold her and just playing with Isaiah or doing any of the general housework what not. Getting to work can be hard."* (Personal communication, Mother)

This mother's experiences highlights not only the compounded impact of conductive hearing loss and speech and language problems but also how the greater demands on carers that children with hearing loss make, especially when persistent hearing loss has contributed to expressive communication problems.

Greater support needs of children with hearing loss

Children with hearing loss are likely to have increased care and support needs and are more likely to demand adult attention than children with normal hearing. If a high proportion of children in a family or other group setting have hearing loss there are greater demands on adult care. The availability of adequate resources to meet these demands will likely influence the developmental opportunities of all children in groups where there are a high proportion of children with hearing loss.

It has been found that when a significant proportion of a class group of school aged children have a hearing loss, the high level of demands of children with hearing loss impacts on the quality of support for all children in the group (Howard, 1994). Conversely, the quality of childcare – caregiver to child ratios (Feagans, Kipp & Blood, 1994) has been found to influences the impact that conductive hearing loss has on non-Indigenous children (Feagans et al, 1994). Children with OM are less attentive in larger groups and lower quality care-giving environments, typified by factors such as less frequent interactions and less 'scaffolding' by adults to provide the support structures that help children learn to communicate, are also associated with lower scores on language and cognitive outcomes (Rach, Zielhuis & van de Broek, 1988; Phillips, McCartney & Scarr, 1987) This is especially so when the language or dialect spoken in the care environment is not the same as the one children are familiar with in their home environment. The high prevalence of ear disease and its impact on Indigenous children (in both more individual children being affected as well as the exacerbated impact that can result when many children in a group have hearing loss) provides a strong argument

for well-resourced and hearing loss informed early intervention programs. FaFT in the NT is one important step in this direction.

In populations where there is a known high prevalence of ear disease there will be a greater need for high quality support for young children. This includes smaller groups of children being supported by more adults, with a preference for adult carers coming from the same cultural background as the children or having training in culturally based communications strategies (Howard, 2004).

Culturally supportive communication environments

The importance of children with hearing loss being immersed in rich communication and social environments was highlighted by Lowell (1994). She carried out research on the impact of hearing loss on Indigenous children's communication in a bilingual school environment. She noted that Yolngu (Indigenous people from East Arnhem Land) teachers in a bilingual school often used Yolngu sign language in parallel with verbal communication. The shared experiential, cultural, linguistic, and non-verbal understandings that prevailed in the school were factors that helped to minimise the impact of hearing loss. Conversely when carers come from a different culture than the children they care for, hearing loss is liable to compound the influence of cultural differences (Howard, 2007).

Lowell's work suggests that the adverse effects of conductive hearing loss can be minimised in group contexts when:

- the language spoken is the one with which children have greatest familiarity;
- the adults who engage children are from the same cultural and linguistic background as the children;
- children engage with other children from the same cultural and linguistic background and with whom they have long-standing and deep relationships; and
- non‑verbal communication strategies are employed to supplement verbal communication.

The findings of Jacobs (1986), Lowell (1994) and Howard (2004 and 2007) suggest that cultural familiarity is an important factor in minimising adverse communication outcomes from hearing loss. When communicating with familiar people from their own culture, culturally derived communication strategies can help children to compensate for the communication disadvantages related to their hearing loss.

Table 2: Influence on communication of physical, social emotional and cultural factors

Physical, Social, emotional and cultural Environment	Factors influencing environment	Actions to influence environment
	-Nutritional status of child	-Address any immediate nutritional needs
	-General physical health of child	-Address any immediate physical health needs
	-Emotional state of child	-Calm or support if distressed
	-Cultural context	-Awareness of the interaction between culture and hearing loss. -Support provided by known Aboriginal staff or non-Aboriginal staff provided with culturally informed communication strategies
	-Social context	-As much as is possible children are in stable familiar social groups with known carers

Hearing Loss, background noise and amplification

People with hearing loss are best able to use what hearing they do have to perceive speech when there is minimal background noise. This means the acoustic environment is another important factor to consider in relation to the support needs of young children with hearing loss. Optimising the listening environment can support children with hearing loss to develop and learn.

Sound is measured in decibels (dB), and the quality of the verbal communication available to a listener is measured by the signal-to-noise ratio. This describes the difference between the level of the sound someone is listening to (the signal) and the level of the background noise (noise). The greater the difference between the signal and the background noise, the easier the signal is to 'hear'. A signal-to-noise ratio of at least 15 dB is recommended for classrooms and other environments where children interact as a group. That is, the acoustic signal is 15 dB greater than the background noise. However, this ideal is rarely achieved (Crandell, Smaldino & Flexer, 1995).

A number of features contribute to the level of background noise in schools and other environments where children are gathered together. Firstly, there is the sound generated by the equipment in the room and noise intrusion from outside the room. Secondly, there are the acoustic properties of the area. Lastly, there is the amount of

noise generated by the talk of children and carers. Background chatter has been found to more disrupt school performance (Jones, 1989), and children's talk has been found to interfere with or mask speech perception more than any other sources of noise (Crandell et al, 1995). The degree that furnishings absorb or reflect sound in an area also influences the acoustics in an environment.

The impact of poor listening environments will be greatest on younger as compared to older children with hearing loss and/or auditory processing problems because the presence of background noise tends to have a greater effect when the exposed individual has had less experience with language. Even before children speak and understand language prelingual hearing loss can impact on the development of auditory skills. These effects are compounded when they come from an English as a second language background that requires more listening in order to understand. For instance, younger children were found to experience more difficulty in hearing word lists when background noise levels are high (Smyth, 1979; Crandell et al, 1995).

Elliot and Powers (1992) found that for normal-hearing English-speaking children, words had to be voiced at higher dB levels than was necessary for adults: up to 25 dB higher than was necessary for normal-hearing English-speaking adults if they were to score 100 per cent in the tests. This means children may find it very difficult to hear in situations where the noise levels do not interfere with speech reception for adults (Plant, 1995). This is especially so for children for whom English is a second language (Crandell et al, 1995), especially if they have impaired hearing. Children with some degree of hearing loss perform worse than children with normal hearing in their ability to hear words against background noise (Finitzo-Hieber & Tillman, 1978).

Research with Aboriginal children has also identified the compounded impact that hearing loss and high background noise levels can have on social functioning and educational opportunities for Indigenous children. Indigenous children with hearing loss displayed more behavior problems and were less engaged in learning as noise levels increased in classrooms (Howard, 2006).

It is not only noise in the immediate communication environment that is important to consider. Research shows that auditory discrimination and reading achievement can be adversely affected when children live in noisy situations, even though their schools may be no noisier than average (Cohen and Weinstein, 1981). Very recent research has identified that Aboriginal homes are often very noisy because of overcrowding and the presence of many individuals with hearing loss from childhood ear disease. Such individuals tend to talk loudly and listen to loud music and TV (Howard et al, 2011). This research suggests that some noisy Indigenous home environments can create risks for excessive noise; that is exceeding a daily average exposure of >85 dB for at least eight hours a day, which is the accepted standard for workers in an occupational context. However, people spend longer than the standard eight hours five days a week in home environments. Also young children, not just adults of working age, are being exposed to

extended periods of loud noise. The exposure to excessive noise at a younger age means that the hearing loss that results from the cumulative effects of exposure to excessive noise commences at a younger age.

This exposure to loud noise can contribute not only to noise induced hearing loss. When very young children, especially those with conductive hearing loss and/or auditory processing problems from current or past ear disease, spend extended periods in noisy environments the development of the auditory skills important in acquiring oral language and literacy are likely to be at a greater risk of being compromised.

It is not known what are the implications for children growing up in noisy households for their participation in early childhood programs childcare. There is research among school age children that living in noisy households is associated with diminished acquisition of literacy skills (Howard, 2006). It would seem likely that children living in noisy households, especially those with hearing loss and/or auditory processing problems may 'learn not to listen' as well as having compromised auditory skills. If so early childhood programs may need to provide as enriched listening environments as possible to compensate for lower quality home listening environments. For children with hearing loss/auditory processing problems this would sometimes includes access to amplified speech as well as optimal acoustics. This suggests that programs that seek to provide early support for Aboriginal children's learning ideally should seek to create optimal acoustic environments in order to provide children with best access to adequate auditory experiences. Further, they should consider acting to inform families of the dangers of 'too noisy' home environments.

In supporting young Aboriginal children, early childhood programs need to consider the acoustic environment in terms of both the physical layout and the personal communication strategies they will need to adopt in order to maximise children's hearing. Things to consider include:

- avoiding arrangements that require too many children to share a confined space resulting in the generation of high levels of background noise;
- avoiding noisy play occurring too close to quiet activities, such as reading stories, that require children to listen;
- being aware of and scheduling quiet activities around noise intrusion from outside;
- gaining children's attention first before speaking;
- using visual aids such as toys or puppets to focus children's attention in group discussions and as signals for changes in activity, rather than relying on verbal communication alone;
- using repetitive routines that make it easier for children to attend;
- getting close to children when speaking, especially if they demonstrate listening difficulties;
- speaking with tonal variation and facial animation to engage and maintain

children's interest; and
- using accompanying body language to help 'illustrate' speech as an aid to children's understanding of what is said.

Another potential strategy to give best auditory input despite background noise is to strategically use amplification in programs with young Indigenous children – see earlier discussion of amplification in early childhood settings. Bone conductors and sound field systems are commonly used devices in school settings. Hand held amplification devices may also be useful. When literacy workers providing support to young children in often noisy classrooms used hand held devices, the results were very positive. Workers commented that one noticeable outcome when these devices were used to amplify the workers' voices when reading to children was that children stopped constantly watching workers' faces while they read and instead looked at the text of the book being read; a definite positive for a literacy program.

As part of a research program, a family of a four-year-old girl with conductive hearing loss was provided with an inexpensive hand held amplification device. Two weeks after the device had been used by the mother, she was asked about the outcomes of using this device with her daughter.

> *"(Before using the amplifier) she used to cry, always screaming. She was constantly crying because she didn't know what to say or how to ask for things and cry and she would just point to what she wanted and there is not much of that now; in fact, not any of that now actually.*
>
> *Usually when I have the afternoon time with her, when she goes and has her afternoon sleep, I usually tell her a story. Now she's not jumping around and not wanting to not listen to the story because she couldn't hear it. But she's actually lying there now and listening to the story and looking at the book and she's going to sleep. That's the same in the evening. When I put it on her she just lies there and listens to the story instead of bouncing all around on the bed.*
>
> *When she's watching TV I'll have it on lower and she's not that close to the TV but it's just to the side of her while she's on the couch and she's sitting down watching the TV. She (usually) doesn't watch TV very much. But she ended up watching a whole movie, sitting down there watching a whole movie on Saturday. So she was really rapt with that.*
>
> *She's having a lot of conversation with her grandparents, when she goes up to her grandparents. When I went home and my mum was really curious to, you know, she was excited because she wanted her granddaughter to hear her voice clearly. I just set up (the amplifier) and my mum nearly burst into tears because she was like, 'My goodness'. She was just sitting there and just talking to each other - having conversation. She goes up there for a couple of hours so they sit*

down and talk with her.

It's been really good with the guitar. My mom's been singing to her. So just having it (the amplifier) down there next to her made a big difference. Usually when she visits her grandparents she just goes and does her own thing or just plays by herself. And now she's talking more to her grandparents and they're doing things like playing music with her. With her brother too, she sits down and has a conversation with her brother. If he wants to talk to her he'll go and grab it and say, 'Can I talk to you?' he'll show it to her and she'll put it in her ears and they'll sit there and have this little conversation with each other. And it's really good for him because now that he understands why she was the way she was. Which is good for them because it's improving their relationship. With her father too, he works away and she only sees him on weekends. She used to hardly talk to him, but now she is looking for him to talk to (using the amplifier). He is so happy that she is doing that.

She's just doing so well with it. When she wants to say something now she'll, because I leave it on a special place on the table, she knows to go and get it and she wants to say something she'll go and grab it to talk to you; if she wants to have a conversation she'll go and grab it.

Lately it's, I've been just getting so much hugs and kisses and 'I love you, mum', which is good because before that it was even hard to get sort of any affections or any emotions from her besides the crying and whatnot, you know. Prior to that she didn't want to, you know, to come over and give you a kiss and give you a hug or for her to be wanting to be sitting on your lap or just anything that you were wanting her to do. She'd just look at us with a blank look and just go about doing her own thing, like if she was playing.

Now she's showing a lot of affection she's showing which is really good. I'm sort of not used to it (from her) but now it's getting to the point where I'm used to it now. And she's just with me all the time now. It's just like, she just lies down next to me and sit next to me, not in the sense where she was getting frustrated because she wanted something (from me), now she is just enjoying being with me, she's interacting so much more.

In regards to the phonics, the words, the correct sounding words, it (the amplifier) has really made that improvement with her. I usually sing 'Twinkle, twinkle' with her at night and she wasn't saying 'twinkle' itself the 'tw' sound. And now when she sings it it's actually saying the 'tw' sound in it. The pronunciation of all the words is better you know, she's speaking more clearly. There will be times where she doesn't have it (the amplifier) on, but because she's already heard the sound, she's able to repeat that sound correctly."

These comments indicate the benefits that early amplification can have on young children's social and emotional wellbeing as well as speech and language development. The selective use of amplification in some setting with young children, especially those with hearing loss, may provide valuable auditory experiences that can help to compensate for children's otherwise limited auditory experiences.

Table 3: Influence on communication of acoustic factors

Acoustic Environment	Factors influencing environment	Actions to influence environment
-Acoustic signal able to be consistently heard by children	-Signal is loud enough	-Optimal child:carer ratios -Communications training for carers -Selective use of amplification
	-Background noise is minimal	-Low numbers in group activities -Adequate space available for activities -Management of noise intrusion from outside
	-Children's home environment has acceptable levels of background noise	-Information provided to families on dangers of excessive noise and how to minimise noise in home environment. -Language stimulation – compensatory programs for auditory processing skills development

Visual environment

It is not only the auditory environment that needs greater consideration because of the high prevalence of ear disease and associated hearing loss among Aboriginal children. Children with a history of ear disease commonly develop compensatory visual monitoring strategies. For example, young children with hearing loss have been found to visually monitor their school environment to a greater extent than children with normal hearing (Howard, 2006). Some children with hearing loss were found to visually scan their environment significantly more than students without hearing loss. At times this watching was directed towards watching what others did in order to know what they were expected to do. Often visual scanning was used to monitor what was going on around them socially (Howard, 2006).

Children with conductive hearing loss in the mild to moderate range can hear something is happening in their environment, but not hear well enough to be able to fully monitor what is happening only through listening. Children with normal hearing may look up from what they are engaged in to initially observe some new event, such as someone entering the room. However, they then return to their work, only looking up to again observe events if they hear something different has happened.

On the other hand, children with hearing loss look to observe new events and on keep visually observing what is happening for a much longer time than other children and so spend less time engaged learning activities (Howard, 2006). This means that being in an event filled environment is likely to be more distracting to children with hearing loss than to children with normal hearing. This has a double impact on engagement in planned learning activities. Firstly, children spend less time engaged in the learning activities while they monitor other events. Secondly, because children with hearing loss need to be fully focused, both by listening and watching, to keep engaged with the activity they lose track more easily if distracted. A child with normal hearing may look away from a planned activity they are engaged in, but still monitor what is happening in the planned activity by listening to an extent that children with hearing loss will have more difficulty in being able to achieve. Children with hearing loss need to make best use of both auditory and visual information to be able to best understand what is happening in an event.

Learning and stimulating activities for children with hearing loss need to be rich in both visual and auditory information and the surrounding environment to have few distractions for best development and learning outcomes.

Table 4: Influence on communication of visual factors

Visual Environment	**Factors influencing environment**	**Actions to influence environment**
-Optimal visual environment	-Visual information available to support understanding of available auditory input	-Optimal child:carer ratios -Aboriginal carers from same cultural group employers as carers -Visual communications training for carers
	-Visual environment not excessively distracting	-Low numbers in group activities -Enough space and/or visual barriers between group activities -Management of external visual and auditory intrusion from outside

Normalisation of ear disease and hearing loss

Early identification, diagnosis and treatment of ear disease can help prevent persistent, chronic disease developing (Gibney et al, 2005). However, ear disease and hearing loss amongst Indigenous people is so widespread in many communities that it is seen as normal (Senate Community Affairs Committee Secretariat, 2010). Challenging this 'normalisation' of ear disease and hearing loss is important in raising awareness about ear disease. Indigenous ear disease is often asymptomatic (Gibney et al, 2005). It has been suggested (Senate Community Affairs Secretariat, 2010) that the early recurrent infections that Indigenous children experience may contribute to nerve connections being desensitised so that children experience less pain on subsequent infections. It is also known that Indigenous childrearing practices encourage an uncomplaining tolerance to physical pain (Malin, 1990).

Whatever the origin of Indigenous children being less likely to report distress and pain from ear disease, the outcome is that Indigenous children's ear disease is less likely to become apparent to families because of children's distress being observed by parents. Without physical signs (except for pus coming out of ears) and little overt distress apparent, families are often unaware that a child is affected by ear disease.

Since there are few indicators to prompt immediate concern about ear disease, it is awareness of the BIG picture (long-term impacts of hearing loss) of ear disease that can motivate action about early childhood ear disease. Social outcomes of ear disease are not only observable by Indigenous families but are also matters of intense interest to them. Collective societies place a particular priority on social relationships and interactions, so that social functioning is closely observed. The bedrock of family strength is built on deeply felt reciprocal social obligations as a core component of cultural identity (Schwab, 1995). As a culturally mediated strength, social competencies generally develop among Indigenous children earlier than non-Indigenous children, but are adversely influenced by OM (Jacobs, 1986). Highlighting the social outcomes of ear disease can help prompt family action about ear disease in the areas of prevention, treatment and communication compensations.

Often older family members, those who have sufficient life experience of many children growing up, have the best capacity to observe and understand the potential impact of children's early ear disease in later life. Their observation of the lives of many children, who have had indications of hearing loss (when these are explained), provide them with an in depth understanding of social, educational, occupational and other outcomes of hearing loss from ear disease. This suggests an important strategy in raising awareness about the importance of ear disease is engagement of grandmothers/ grandfathers and aunties/uncles in programs to raise awareness of ear disease and hearing loss among direct carers.

Building awareness of links between ear disease and hearing loss

A key factor in building motivation to address children's ear disease is strengthening the link between ear disease and adult family members' understanding of hearing loss and auditory processing problems.

One important tool that can help to address the 'invisibility' of ear disease for families is video otoscopy. An otoscope – a device that is used by health practitioners to examine inside the ear canal - is attached to a video which enables families to see the condition of the ear drum and ear canal.

The experience of amplification can also help prompt awareness of the importance of preventing ear disease. With early onset conductive hearing loss, people experience compromised hearing for so long that they come to believe their hearing is normal (Senate Community Affairs Committee Secretariat 2010). The experience of amplification can challenge the 'normalisation' of hearing loss. For example, when an Aboriginal Health Worker was loaned a hand-held amplification device she took it to a day care setting where mothers congregated. As a result of passing the device around, six other mothers identified that they benefited from amplification and made appointments to see the audiologist when they next visited.

Another important strategy for raising the awareness of the link between childhood middle ear disease and hearing loss is to raise awareness of adult hearing loss and its consequences. Experience of those working with family members around ear disease and hearing loss is that when family become aware of the consequences of children and adult hearing loss, families become interested to find ways to ensure their children do not experience the same kind of long-term hearing loss.

There is also a potential important role of 'intermediaries' acting to help families to be aware of ear disease. This was highlighted in research to develop a social marketing campaign to increase awareness of ear disease among Indigenous families. However, the information provided to families by intermediaries needs to engage the interest of Indigenous families. Health information alone on ear disease usually does not do that (Submission to the Senate Community Affairs Committee, 2010). As an obscure health condition without observable physical indicators or immediate physical outcomes, the importance of addressing ear disease is difficult to communicate.

It is also common for health and education professionals to not alert parents that ear disease can cause hearing loss and it is almost universal[6] that health and education

[6] The NT five year old health check (HKU5) has some anticipatory advice for families relevant to risks for ear disease and communication at different age stages.

practitioners do not inform parents of common observable communication and social outcomes of hearing loss, as they themselves are mostly unaware of them.

> *"Doctors and health workers I have seen over the years told me about ear disease but have never mentioned the kinds of communication and social problems that kids with ear disease can have... I found information about this on the ear troubles website... we just did not get it from the health professionals we had contact with again and again."* (Indigenous parent)

Greater awareness of the long-term outcomes of hearing loss among health and education workers, as well other intermediaries, is important to raise awareness of ear disease among Indigenous families. The collaboration between families and practitioners is crucial in clinical care of otitis media. Early childhood workers, who have more regular contact with children and families, can assist foster this collaboration.

Behavioural indicators of hearing loss

As well 'the BIG picture' of long-term outcomes being important in creating family motivation to address ear disease, the immediate outcomes of ear disease that are observable in social contexts also have potential as an indicator of ear disease given the absence of physical indicators.

Difficulties in identifying ear disease and hearing loss among young children prompted commonwealth funded research into innovative ways of identifying ear disease and hearing loss among young children. Earlier research findings that behavioral indicators were the best indicator of hearing loss among school-aged Indigenous children in NSW (McPherson, 1995) prompted consideration of behavioral responses associated with ear disease and hearing loss among young Indigenous children in childcare. This as yet unpublished research found that the six best indicators of ear disease/hearing loss among Indigenous children in childcare were:

- not talking much
- using actions or pointing more
- taking longer to tell things
- needing people to call out loud to get their attention
- liking to do things their own way
- sitting close to music or TV

These indicators are responses that are easily observable by carers and that have been found to be associated with ear disease and hearing loss. The indicators relate to the impact of hearing loss on expressive communication (not talking much, taking longer to tell things, using more non-verbal responses) and receptive communication (needing people to call out to get their attention and sitting close to music or TV to be able to hear better). The last indicator of children 'liking to do things their own way' appears to

relate to likely problems in expressive and receptive communication leading to a disengagement between children and carers. Carers are liable to interpret these responses as being that children are being excessively independent. These behavioural indicators of hearing loss are observable by carers and are likely to help address the difficulty of there being few physical indicators of hearing loss. Once hearing loss has been identified, the next task involves explaining ear disease to families so they can respond appropriately.

During workshops that were part of the larger FaFT project that this literature review is part of, FaFT workers expressed the need for more specific age-based identification resources. These were developed after a review of existing resources and consultations with Indigenous family members. The text of these resources are attached as Appendix A.

These behavioural indicators of ear disease can supplement family awareness derived from their knowledge of children's history of ear disease, ear discharge, persistent nasal discharge and current treatment or active ear disease and when children have had access to treatment in the past. If children have had ear disease in the past there is greater likelihood of them having listening problems now either from damage caused by past ear disease and/or auditory processing problems. Also children with a history of ear disease are likely to continue to have future problems with ear disease that may or may not be symptomatic or observable.

Ways of explaining about ear disease to Indigenous families

As an often asymptomatic, obscure condition without easily observable immediate outcomes ear disease/hearing loss is an issue that is difficult to engage carers' interest in. Further, it is likely that many carers themselves have low literacy and limited oral English partly as a consequence of their own hearing loss from ear disease. The operation of a trans-generational cycle of disadvantage means that children of parents who have hearing loss as a result of persistent childhood ear disease are more likely than other Aboriginal children to experience the same condition (Howard, 2010). This means communication with families about hearing loss and ear disease needs to consider hearing loss among adult family members.

Certain communication strategies have been found to facilitate easy understanding among those with hearing loss. These include having strong visual elements, plain English or Indigenous language and/or audio resources, since many Indigenous adults do not speak or read English well. Indirect communication where those in the family with best hearing and best literacy 'translate' to other family members is also important. These components are especially needed in any program seeking to communicate with families about ear disease; families where ear disease among children is prevalent is likely to have many adults with hearing loss One consideration in communicating with

adults with hearing loss is that they often have sensitivities about being seen to fail to understand what is said (Howard, 2011). This is a result of often being shamed through hearing related communication problems throughout childhood. The combination of hearing loss and avoidance is a common coping strategy, often used when cross-cultural communication difficulties obstruct development of English language/literacy skills. This means that it is important that resources created involve failure-free listening through, for example, DVDs, talking books and information being conveyed by known Indigenous people.

Conclusion

Middle ear disease is an all too common health issue among Aboriginal children in the Northern Territory. It results in many children experiencing fluctuating hearing loss for long periods of their childhood and some degree of life long permanent hearing loss and/or auditory processing problems. Persistent ear disease can impact on speech and language, auditory processing and psychosocial development. These, together with ongoing hearing loss and auditory processing problems, can impact on children's educational engagement and achievement, family functioning, employment outcomes and propensity to be involved in the criminal justice system.

Early childhood is the period when children have most ear disease and when most benefits can result in prevention of middle ear disease as well as from an improved awareness of communication strategies that can assist to reduce the potential lifelong impacts of listening problems. This literature review has been developed as part of a sequence of resources to equip FaFT workers to address ear disease within FaFT programs. This document should be read in conjunction with other documents, including the 'strategy' and 'the facilitators' guide.

These documents outline a program to address ear disease guided by the following principles:

- a **holistic focus** that targets the whole community for education and awareness raising to tackle hearing loss problems in young children. It engages families, children, professional workers, agency representatives and other stakeholders in contributing what they can to the prevention of ear disease and to mitigating its impact on children's learning and development;
- a **strengths' based approach** that positions Indigenous community members, families and children as having extensive knowledge, expertise and experience of hearing loss and its consequences on their lives that is acknowledged as the starting point for solving the problem;
- a culturally informed **communication approach** that recognises the different communication needs of people (adults and children) depending on a variety of factors including the fact of extensive adult hearing loss in remote communities;

- an **action oriented approach** that highlights practical action for prevention of conductive hearing loss and minimisation of the impacts of conductive hearing loss through family and agency engagement with FaFT; and
- a **locally responsive approach** that supports communities to customise their responses to hearing loss by drawing on their own ways of thinking and speaking about hearing loss.

References

Access Economics (2006) *Listen hear: the economic impact and cost of hearing loss in Australia*. Melbourne: CRC Hear and the Victorian Deaf Society. Available online at: http://www.audiology.asn.au/pdf/ListenHearFinal.pdf

Access Economics, Coates H, Del Mar C, Marks M, Skull S (2008) *The cost burden of otitis media in Australia*. Canberra: Access Economics Pty Ltd.

Aithal S, Yonovitz A, Aithal V (2008) Perceptual consequences of conductive hearing loss: speech perception in Indigenous students learning English as a 'school' language. *Australian and New Zealand Journal of Audiology*; 30(1): 1-18.

Australian Bureau of Statistics (2000) *Housing and infrastructure in Aboriginal and Torres Strait Islander communities, Australia 1999*. Canberra: Australian Bureau of Statistics.

Australian Bureau of Statistics, Australian Institute of Health and Welfare (2005) *The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples*. Canberra: Australian Institute of Health and Welfare and the Australian Bureau of Statistics.

Australian Indigenous Health*InfoNet* (2004) *Review of ear health and hearing among Indigenous peoples*. Retrieved [access date] from http://www.healthinfonet.ecu.edu.au/other-health-conditions/ear/reviews/our-review

Bear V (1992) *An ENT perspective of otitis media in Aboriginal Australians*. Paper presented at the Medical Options for Prevention and Treatment of Otitis Media in Australian Aboriginal Infants Conference. 16-18 February 1992, Darwin, Northern Territory.

Berman, S. (1995). Otitis Media in Developing Countries. *Pediatrics,* 96(1), 126-131.

Boswell J (1995) Auditory brainstem response and conductive hearing loss in infants. *Australian Journal of Audiology*; 17(2): 101-106.

Boswell J (1997) Presentation of early otitis media in 'Top End' Aboriginal infants.

Australian and New Zealand Journal of Public Health; 21(1): 100-102.

Burrow S, Galloway A, Weissofner N (2009) *Review of educational and other approaches to hearing loss among Indigenous people*. Retrieved [access date] from http://www.healthinfonet.ecu.edu.au/other-health-conditions/ear/reviews/our-review-education

Burrow S, Thomson N (2003) Ear disease and hearing loss. In: Thomson N, ed. *The health of Indigenous Australians.* South Melbourne: Oxford University Press: 247-272.

Clements DA (1968) Otitis media and hearing loss in a small Aboriginal community. *Medical Journal of Australia*; 1(16): 665-667.

Couzos S, Metcalf S, Murray RB (1999) Ear health. In: Couzos S, Murray R, eds. *Aboriginal primary health care: an evidence-based approach*. South Melbourne: Oxford University Press: 240-320.

Couzos S, Metcalf S, Murray RB (2001) *Systematic review of existing evidence and primary care guidelines on the management of otitis media in Aboriginal and Torres Strait Islander populations*. Canberra: National Aboriginal Community Controlled Health Organisation and Commonwealth Department of Health and Aged Care.

Couzos S, Metcalf S, Murray R (2003) Ear health. In: Couzos S, Murray R, eds. *Aboriginal primary health care: an evidence-based approach*. 2nd ed. South Melbourne: Oxford University Press: 193-250.

Couzos S, Lea T, Mueller R, Murray R, Culbong M (2003) *NACCHO ear trial and school attendance project*. Deakin, ACT: National Aboriginal Community Controlled Health Organisation.

Crandell, C., Smaldino, J., & Flexer, C. (1995). *Sound Field FM Amplification: Theory and Practical Applications*. Singular Press: Los Angeles, CA.

Currie 2012, K. (2012) Report on Ear Health in 20 growth townships in the NT.

Dawson VM, Coelen RJ, Murphy S, Graham D, Dyer H, Sunderman J (1985) Microbiology of chronic otitis media with effusion among Australian Aboriginal children: the role of chlamydia trachomatis. *Australian Journal of Experimental Biology and Medical Science*; 63(pt1): 99-107.

Gibney KG, Morris PS, Carapetis JR, Skull SA, Smith-Vaughan HC, Stubbs E, Leach AJ (2005) *The clinical course of acute otitis media in high-risk Australian Aboriginal children: a longitudinal study*.
BMC Pediatrics; 5

Retrieved from http://www.biomedcentral.com/1471-2431/5/16
DEEWR (2011). Fact Sheet – Raising the Quality of Budget Based Funded Services. Available online at: http://www.deewr.gov.au/Earlychildhood/Programs/ChildCareforServices/Documents/BBFQMFactSheet.pdf

Elphinstone JJ (1971) *Personal communication*.

Elliott A, Fasoli L. & Nutto, G (2009) Early Childhood Services Audit Report. Darwin, Department of Education and Training.

Foreman A, Boswell J, Mathews J (1992) *Prevalence of otitis media in Aboriginal children of pre-school age in three Northern Territory rural communities*. Paper presented at the Medical Options for Prevention and Treatment of Otitis Media in Australian Aboriginal Infants Conference. 16-18 February 1992, Darwin, Northern Territory.

Galloway A (2008) Indigenous children and conductive hearing loss. In: Simpson J, Wigglesworth G, eds. *Children's language and multilingualism: Indigenous language use at home and school*. London: Continuum International Publishing Group: 216-234.

Higgins H (1997) *Addressing the health and educational consequences of otitis media among young rural school-aged children*. Townsville: Australian Rural Education Research Association.

Hogan, A., Howard, D. and Yiengprugsawan, V. (2012) The Wellbeing of Children with Ear Infection – A Cross Sectional Study. OMOZ Conference Perth May 2012
Holte L (2003) Early childhood hearing loss: a frequently overlooked cause of speech and language delay. *Pediatric Annals*; 32(7): 461-465.

Howard D (1992) Knowing who may have a hearing loss: a simple speech reception game for use by teachers and parents. *The Aboriginal Child at School*; 20(4): 37-47.

Howard D (1994) Culturally responsive classrooms: a way to assist Aboriginal students with hearing loss in urban schools. In: Harris S, Malin M, eds. *Aboriginal kids in urban classrooms*. Wentworth Falls: Social Science Press: 37-50.

Howard D (2004) Why we need more Aboriginal adults working with Aboriginal students. *The Australian Journal of Teacher Education*; 29(1): 14-22.

Howard D (2005) *Scoping project: Indigenous new apprentices' hearing impairment and its impact on their participation and retention in new apprenticeships*. Darwin: Phoenix Consulting.

Howard D (2006) *Conductive hearing loss and behaviour problems amongst urban*

Indigenous students. Unpublished PhD thesis. Charles Darwin University: Darwin, Northern Territory.

Howard D (2007) Intercultural Communication and Conductive Hearing Loss. First Peoples Child and Family Review; 3 (1): 96-105.

Howard D (2010) *Submission to the Senate Community Affairs Committee inquiry on the hearing health in Australia*. Available online at: http://www.aph.gov.au/senate/committee/clac_ctte/hearing_health/submissions/sub112.pdf

Howard D (2011) *Listening, learning and work: Improving outcomes in Indigenous training and employment.* Darwin: Phoenix Consulting.

Howard D, Hampton D (2006) Ear disease and Aboriginal families. *Aboriginal and Islander Health Worker Journal*; 30(4): 9-11.

Howard D, Quinn S, Blockland J, Flynn M (1994) Aboriginal hearing loss and the criminal justice system. *Aboriginal and Islander Health Worker*; 18(6): 9-11.

Jacobs A (1986) *A descriptive study of the bilingual language development of Aboriginal children in the eastern goldfields region of Western Australia.* Perth: Health Department of Western Australia.

Jacoby, P., Coates, H., Arumugaswamy, A., Elsbury, D. et al. (2008). The effect of passive smoking on the risk of otitis media in Aboriginal and non-Aboriginal children in the Kalgoorlie-Boulder region of Western Australia. Medical Journal of Australia, 188(10),599–603.

Jones, R. (2012) Fighting disease with Fruit OMOZ conference Perth

Kelly HA, Weeks SA (1991) Ear disease in three Aboriginal communities in Western Australia. *Medical Journal of Australia*; 154(Feb 18): 240-245.

Leach AJ, Boswell JB, Asche V, Nienhuys TG, Mathews JD (1994) Bacterial colonization of the nasopharynx predicts very early onset and persistence of otitis media in Australian Aboriginal infants. *Pediatric Infectious Disease Journal*; 13(11): 983-9.

Lehmann L, Tennant M, Silva D, McAullay D, Lannigan F, Coates H, Stanley F (2003) Benefits of swimming pools in two remote Aboriginal communities in Western Australia: intervention study. *British Medical Journal*; 327(7412): 415-419.

Lowell A (1993) Otitis media and Australian Aboriginal children: the influence of conductive hearing loss in the classroom. *Ngoonjook: A Journal of Australian Indigenous*

Issues; (8): 21-32.

Lowell A (1994) *Communication and learning in an Aboriginal school: the influence of conductive hearing loss*. Unpublished PhD thesis. University of Sydney: Sydney, New South Wales.

Malin, M. (1990). Why is life so hard for Aboriginal students in urban classrooms? *The Aboriginal Child at School*, 18(1), 9-29.

Massie R (1999) *The effects of sound field classroom amplification on the communicative interactions of Aboriginal and Torres Strait Islander children*. Unpublished PhD Thesis, University of Queensland: Brisbane, Queensland.

Mathews J, Leach A, Douglas F, Boswell J, Foreman A, Nienhuys T (1992) *Otitis media in Aboriginal populations*. Paper presented at the Medical Options for Prevention and Treatment of Otitis Media in Australian Aboriginal Infants Conference. 16-18 February 1992, Darwin, Northern Territory.

McPherson B, Knox E (1992) Hearing loss in urban Aboriginal and Torres Strait Islander schoolchildren. *Australian Aboriginal Studies*; 2: 60-70.

McPherson, D. B. (1995). *Identification of hearing loss in urban Indigenous school children.* Unpublished PhD Thesis, University of Queensland, Brisbane.

Mellor D, Corrigan M (2004) *The case for change: a review of contemporary research in Indigenous education outcomes*. Melbourne: Australian Council for Educational Research.

Menzies School of Health Research (2001) *Recommendations for clinical care guidelines on the management of otitis media in Aboriginal and Torres Strait Islander populations*. Canberra: Commonwealth Department of Health and Aged Care.

Moore JA (1999) Comparison of risk of conductive hearing loss among three ethnic groups of Arctic audiology patients. *Journal of Speech, Language, and Hearing Research*; 42(6): 1311-1322.

Morris P (1998a) A systematic review of clinical research addressing the prevalence, aetiology, diagnosis, prognosis and therapy of otitis media in Australian Aboriginal children. *Journal of Paediatrics and Child Health*; 34(6): 487-497.

Morris PS (1998b) Management of otitis media in a high risk population. *Australian Family Physician*; 27(11): 1021-1029.

Morris PS, Leach AJ, Silberberg P, Mellon G, Wilson C, Hamilton E, Beissbarth J (2005) Otitis media in young Aboriginal children from remote communities in Northern and Central Australia: a cross-sectional survey. *BMC Pediatrics*; 5(1): 1-10.

New South Wales Health Department Working Party on Ear Disease in Aboriginal Children (1996) Guidelines on the prevention and control of otitis media and its sequelae in Aboriginal children. *Medical Journal of Australia*; 164(Supplement): S1-S17.

Nienhuys TG, Boswell JB, Lay KJ (1992) Middle ear condition and hearing deficit in a sample of Aboriginal adults. *Australian Journal of Otolaryngology*; 1(2): 137-145.

Nienhuys T, Boswell J, McConnel F (1994) Middle ear measures as predictors of hearing loss in Australian Aboriginal schoolchildren. *International Journal of Pediatric Otorhinolaryngology*; 30(1): 15-27.

Nienhuys T, Burnip L (1988) Conductive hearing loss and the Aboriginal child at school. *Australian Teacher of the Deaf*; 29: 4-17.

Nienhuys T, Sherwood J, Bush J (1990) Hearing loss in a sample of central Sydney Aboriginal schoolchildren. *Australian Journal of Audiology*; 13(1): 13-19.

Northern Territory Emergency Response (NTER) (2011) *Northern Territory Emergency Response Evaluation Report 2011.* Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA)**.** Australian Government, Canberra. Retrieved from http://www.fahcsia.gov.au/sa/indigenous/pubs/nter_reports/Documents/nter_evaluation_report_2011.PDF, January 12, 2012.

Partington G (2003) *Receptivity of teachers to implementing new strategies for literacy teaching*. Paper presented at the Annual conference of the Australian Association for Research in Education and New Zealand Association for Research in Education. 29 November - 2 December 2003, Auckland, NZ.

Partington G, Galloway A (2005) Effective practices in teaching Indigenous students with conductive hearing loss. *Childhood Education*; Winter 2005/2006: 101-106.

Poltl SM (1993) *Hearing loss and ear disease in Aboriginal school children in remote communities*. Paper presented at the Otitis Media in Childhood: issues, consequences and management conference. Western Australia.

Preston G (1994) Hearing health needs for Aboriginal and Torres Strait Islander people. *Australian Family Physician*; 23(1): 51-53.

Productivity Commission. (2011) *Early Childhood Development Workforce*, Research

Report. Melbourne: Productivity Commission. Available online at: http://www.pc.gov.au/__data/assets/pdf_file/0003/113907/early-childhood-report.pdf

Royal Australian College of Ophthalmologists (1980) *The national trachoma and eye health program of the Royal Australian College of Ophthalmologists*. Sydney: Royal Australian College of Ophthalmologists.

Schwab RG (1995) The calculus of reciprocity: Principles and implications of Aboriginal sharing, CAEPR Discussion Paper No. 100, Centre for Aboriginal Economic Policy Research, The Australian National University: Canberra. Available online at: *http://caepr.anu.edu.au/sites/default/files/Publications/DP/1995_DP100.pdf*

Scott J (2001) *Aboriginal, rural and remote audiological services*. Paper presented at the National seminar on the recommendations for clinical care guidelines for the management of otitis media (middle ear infection) in Aboriginal and Torres Strait Islander populations. 23 August 2001, Sydney, New South Wales.

Senate Community Affairs Committee Secretariat (2010). *Hear us: Inquiry into hearing health in Australia.* Canberra: Senate Printing Unit. Available online at: http://www.aph.gov.au/senate/committee/clac_ctte/hearing_health/report/report.pdf

Sims M (2011) *Early childhood and education services for Indigenous children prior to starting school: Resource sheet no. 7*. Produced for the Closing the Gap Clearinghouse. Canberra: Australian Institute of Health and Welfare and Melbourne: Australian Institute of Family Studies. Available online at: http://www.aihw.gov.au/closingthegap/documents/resource_sheets/ctgc-rs07-updated.pdf

Tait P (1992) *Otitis media: the central Australian experience*. Paper presented at the Medical Options for Prevention and Treatment of Otitis Media in Australian Aboriginal Infants Conference. 16-18 February 1992, Darwin, Northern Territory.

Uhari M, Mantysaari K, Niemela M. (1996). A meta-analytic review of risk factors for acute otitis media. Clinical Infectious Diseases, 22: 1079–83.

Vanderpoll, T. and Howard, D. (2012) Massive prevalence of hearing loss among Aboriginal inmates in the Northern Territory. 2012 Indigenous Law Bulletin Jan/Feb; 7 (21), 3-11

Walker N, Wigglesworth G (2001) The effect of conductive hearing loss on phonological awareness, reading and spelling of urban Aboriginal students. *Australian and New Zealand Journal of Audiology*; 23(1): 37-51.

Wallace IF, Hooper SR (1997) Otitis media and its impact on cognitive, academic and

behavioral outcomes. In: Roberts JE, Wallace IF, Henderson FW, eds. *Otitis Media in Young Children*. Baltimore: Paul Brookes Publishing.

Ward BR, McPherson B, Thomason JEM (1994) Hearing screening in Australian Aboriginal university students. *Public Health*; 108: 43-48.

WHO/CIBA (2000) *Prevention of hearing impairment from chronic otitis media*. Geneva: WHO.

Willis R (1985) Otitis media and the Australian Aboriginal. *American Journal of Otology*; 6(4): 316-22.

Willis R (1992) *Infant otitis media in Aboriginal communities what pathologic process are we dealing with?* Paper presented at the Medical Options for Prevention and Treatment of Otitis Media in Australian Aboriginal Infants Conference. 16-18 February 1992, Darwin, Northern Territory.

Yonovitz L, Yonovitz, A (2000) PA-EL: A phonological awareness program for Indigenous EFL students with hearing disabilities. Teaching English as a Second or Foreign Language, 4(4). Retrieved April 20, 2003 from http://wwwwriting.berkeley.edu/TESl-EJ/ej16/cf1.html

Yonowitz L, Yonowitz A, Nienhuys T, Boswell J (1995) MLD evidence of auditory processing factors as a possible barrier to literacy for Australian Aboriginal children. *The Australian Journal of Education of the Deaf*; 1(1): 34-41.

Zubrick, S. R., Silburn, S. R., De Maio, J. A., Shepherd, C., Griffin, J. A., Dalby, R. B., et al. (2006). *The Western Australian Aboriginal child health survey. Volume 3: Improving the educational experiences of Aboriginal children and young people.* Perth: Curtin University of Technology and Telethon Institute for Child Health Research.

Dangerous Listening: The Exposure of Indigenous People to Excessive Noise

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Introduction

Health professionals working with Indigenous people are generally well aware of the widespread conductive hearing loss that occurs, especially among children, because of middle ear disease. Regular exposure to loud noise can also cause hearing loss. Noise-induced hearing loss is commonly found among people who work in noisy industries and environments. About 20% of non-Indigenous Australians are hard-of-hearing. Most of these are over 50 and were exposed to loud noise through work[1]. Noise-induced hearing loss is occurring increasingly among children. Research shows there have been significant increases in the number of children in the USA who show signs of noise-induced hearing loss most likely caused by the exposure to loud noise which is now a normal part of their modern lifestyles[2,3]. Regularly listening to music on iPods and other MP3 players on high volume for a long time can damage hearing.

This article reports the preliminary results of a project[i] that seeks to better understand the noise exposure risks in many Indigenous lifestyles. Information on exposure to loud noise was gathered in two ways. Firstly, noise exposure surveys were carried out with Indigenous people, mostly in the Northern Territory but with some respondents from other states included. Secondly, people's actual exposure to loud noise was measured using noise dosimeters in a variety of homes.

An occupational sound exposure level of no more than 85 decibels (dB) averaged over an 8 hour working day (L_{Aeq} 8h < 85 dB) or equivalent is the international criteria adopted by many countries including Australia and New Zealand. This is termed 100% dose[ii] and can be described as the level of acoustic energy received by the person which should not be exceeded. This has been called the **'allowable daily exposure' (ADE)**. There is considered to be a significant risk of noise-induced hearing loss in the majority of persons exposed to levels which exceed this criterion on a long term basis[A]. The table below, used in occupational noise assessment, clearly defines the time average levels and corresponding time exposures, all of which are of equivalent acoustic energy (i.e. 100% dose)[iii]. If the time average sound pressure levels are in excess of 85 db over an 8 hour day then the time exposed must be correspondingly reduced so that exposure does not exceed the 100% dose. For each additional 3 dB the allowable time exposure to the noise level is halved.

These are considered safe noise exposure times for different noise levels for adults in occupational settings over an 8 hour period[iv]. It is unclear what the 'safe' level of noise exposure is for children but is widely thought that children's hearing is more vulnerable to damage

Time average level $L_{A\,eq}$	Time exposed hours	Types of activities[B]
85 dB	8	Sitting close (within one metre) to TV on moderately high volume or mobile phone on speaker held in front of face.
88 dB	4	Listening to music on CD/DVD through TV on high volume sitting close.
91 dB	2	Someone shouting close to you, sitting close to stereo on moderate volume, listening to music on mobile phone on speaker function held close to an ear.
94 dB	1	Being 3 metres away from stereo on high volume or listening to music on personal listening device (mobile phone) through headphones volume on high.
97 dB	0.5 (30 mins)	Sitting close to stereo on moderately high volume,
100 dB	0.25 (15 mins)	Being 2 metres away from stereo on maximum volume, being at disco, people screaming close to you, listening to music on some personal listening devices using earbud headphones on maximum volume.

A It should be remembered that this is based on a five day 8 hour working day. However, people spend longer in home environments. Those who are unemployed or attend school irregularly spend even longer than others at home or in others' homes.

B Note these are general indications only and there can be variation of noise exposure depending, for example, on type of equipment and settings. Also some activities in the 100 dB section often involve louder noise levels than 100 dB, as outlined later in article.

from excessive noise. The World Health Organization[4] outlines studies of laboratory animals which support this[v].

Damage to hearing through noise exposure generally happens over time. The "accumulated effect of hours, days and years of exposure all contribute to an individual's hearing damage and subsequent hearing loss"[5]. This means exposure to loud noise regularly, early in life is of special concern. Some excessively noisy toys have created concern such as toy guns, juke boxes, whistles, clackers and rattles[6]. Likewise the extensive use of personal listening devices such as iPods and MP3 players has raised cause for serious concern[7]. It is not only the volume that is used but the length of time users can now listen. The earlier generation of personal listening devices such as the walkman or disc man could not be so easily used continuously for many hours as can the modern devices because they had less battery and storage capacity.

Noise Exposure in Indigenous Lifestyles

There are consistent trends emerging from the early results of this present investigation into the exposure of Indigenous people to loud noise. The trends suggest that for many Indigenous people, including young children, the level of persistent exposure to loud noise, especially in some home environments, creates significant risks of eventual sensori-neural hearing loss related to excessive noise exposure.

There are multiple factors contributing to excessive noise exposure among Indigenous people. They have greater access now to potentially louder TVs, amplifiers, personal listening devices and electronic games. The availability of these items in Australia has increased in the last ten years. The potential volume of noise from increasingly less expensive electronic goods, in combination with the increased use of mobile phones as personal listening devices, has dramatically altered the noise exposure profile in a majority of Indigenous households.

Crowded housing is another important consideration. Noise levels can be chronically high in crowded housing and especially so in households where many of the residents have existing hearing loss from childhood middle ear disease. People with hearing loss often behave in ways which generate loud noise. They tend to turn up the volume of electronic devices to higher levels than those with normal hearing. The result is a significant increase in non-occupational noise exposure for Indigenous families in recent years.

The results indicate that there is an urgent need for the development and implementation of hearing conservation health promotion programs for Indigenous people.

Listening 'Loud'

Attendance at 'discos' and concerts constitutes the greatest risk of excessive noise exposure in non-occupational settings for young people living 'mainstream' Australian lifestyles[5]. In urban, regional and remote areas Indigenous youth attend discos or regular locally organised concerts. In many Indigenous communities there are also twice weekly or fortnightly house parties where the noise exposure level can be similar to, or even greater than, that found in discos.

At some house parties noise was recorded at decibel levels equating to those in discos (for example, at one party the recorded average noise exposure was 105 decibels; the same as for a person at an urban disco). However, while people generally stay at a disco for only two to three hours, house parties often go on for up to five hours, or longer. Young people choose to attend discos, but household parties take place where families live. Whole families, including young children can be exposed to loud noise for long periods. A child exposed to an average noise level of 105 dB for five hours would receive more than 40 times the ADE (allowable daily exposure) for an adult in an occupational setting. Long distance car trips are another family activity, common in some areas, where loud music may be played for many hours – with people frequently shouting over the music to communicate.

This project has found that for Indigenous people there is not only greater risk of excessive exposure to loud noise from music than there is in 'mainstream' communities, but also that fewer people know that excessive exposure to loud noise can damage hearing.

The results indicate that there is an urgent need for health promotion programs which alert Indigenous communities to the risks of excessive noise exposure and extended periods of listening to loud music.

Noisy Electronic Childcare

The greater availability of loud electronic devices has dramatically altered the noise exposure profile for Indigenous children. There has also been increased 'viewer choice' in television (cable, DVD and more free-to-air channels). As a result, there is now more TV content that is of high interest to children. Cheaper TVs have meant that TVs are often now in bedrooms, and used only by children in situations where there is minimal adult control over volume. Children's greater access to, and control of, the volume of electronic noise, when combined with the presence in crowded households of many children with conductive hearing loss who like to 'listen loud', has helped contribute to what can be described as recurrent 'noise-storms' in many households where electronic equipment and devices have often become an element of usual childcare arrangements. The result is that some children are often exposed to noise that exceeds ADE limits.

Some respondents spoke of urbanisation and loss of contact with extended family as a factor which can exacerbate noise levels and noise exposure in some families. Childcare in extended family settings is usually shared. The sharing of childcare responsibilities gives people more flexibility to manage work or other responsibilities. Where extended family support is not available, some of those surveyed spoke of greater use of electronic entertainment equipment as part of their childcare arrangements. Their children spent more time in front of television screens or listening to music than they would otherwise have done.

One family had two children who were born and spent their early years in a remote community. The family then moved to an urban area, where three more children were born. The older children had far less noise exposure in their early years than all the children experience now. In the remote community there was no TV coverage when the children were small. People there may have watched a DVD once or twice a week. After school and at weekends children were most often out of the home and free to play with same-age relations over a wide area in what was seen as a safe environment. Extended family members were readily available to help with child care when needed.

The family now lives in an urban environment. After school and at the weekend the children are most often at home, indoors, watching TV. They spend up to 12 hours a day on weekends and up to six hours a day on school days watching either cable TV on a flat screen TV in a small enclosed bedroom or a mixture of cable and free-to-air on an older TV in the lounge room. Two younger children with a history of ear disease set the volume on maximum when they control what is watched, and sit within a meter of the TV. The older children generally have the TV at a lower volume and sit further back. Communication between family members is often in the form of screaming over the noise of the TV – to express sibling irritation or some desire

they may have. The disputes are often over whose turn it is to use two small hand held games while watching TV. Sound level measurements and noise survey information indicate that the children, especially the younger children, are frequently exposed to more than the safe daily 'adult' occupational noise exposure limits, in their home environment.

Mobile Phones as Personal Listening Devices

The use of personal listening devices, especially by young people, is another reason for the increasing concern about the risks of noise-induced hearing loss in Australia and elsewhere[8]. Use of iPods and other 'music only' listening devices were not common for most of the Indigenous people interviewed during this study. However, the use of mobile phones as personal listening devices[C] was widespread. Mobile phones are an increasing presence in the lives of the people who were interviewed. They help with regular communication between family and friends; when people run out of credit on the prepaid services they often use they can still use the phone to play music.

Adults' mobile phones were commonly passed around children in the family, and were a favorite 'toy' for some toddlers. Large families often had many phones – one home with twenty-two residents, including twelve children, had eight mobile phones in use among family members[D]. One elder said the mobile phones helped 'keep children safe' – by entertaining them so they are happy to stay at home, rather than going out to places where they may be at risk of physical or emotional harm. While indirectly protecting the children from physical harm this method of doing so may contribute to an increased long-term risk of hearing loss; a risk that family members were not aware of.

The survey participants often said that mobile phones are used as a form of 'pacifier' (a 'noise dummy') for young children. Toddlers are given a mobile phone playing music to distract and placate them, especially if distressed. Some parents commented that children whose behaviour was hard to manage were often 'quieted' by giving them a phone playing music. It was common for young children to go to sleep with a mobile phone next to them and the speaker function turned on.

Some young children listen to music with the phone speaker function switched to the maximum volume, mostly holding the phone 15–20 cm from their face but sometimes holding it directly against an ear (the high background noise levels in homes and use of these phones as group listening devices meant that the volume was often on maximum when passed to the children). In one example, a mobile phone on maximum volume held in front of the face and about 15–20 cm from an ear produced sound at a level of 75–84 dB. This level of noise exposure is equivalent to standing near industrial machinery or a truck. The same phone held close to the ear produced a sound level of 86–92 dB (the noise level near a motorbike engine). Those interviewed said young children would often listen to music on mobile phones for many hours during a day ("*they listen 'til the battery run down*" – around three hours if fully charged) and would often go to sleep with the phone next to their head.

Older children would listen to mobile phones using the speaker function if in a group, but commonly also used headphones – often for many hours. Listening to music through headphones with the volume at, or near, maximum level was described as a useful way to block out other noise in and around noisy households. Listening to music on personal listening devices on maximum volume using 'ear buds' for more than 15 minutes a day can damage hearing[9] over a long period of time. Using the above occupational criteria as a guide, listening to a personal listening device delivering music to the ear at 94 dB it would only take one hour before the 100% dose level was reached. If the device delivers music at 97 dB that threshold is reached in only 30 minutes. As these devices are capable of delivering such sound levels to the ear it is clear that very real damage is possible. This does not take into account the more sensitive nature of young ears to those of an adult.

The loud background noise levels common in crowded Indigenous households are an important influence on the volume at which music is played on personal listening devices. When it was noisier, the volume on mobile phones with headphones was turned up, or if the sound was already set on the maximum volume, the phone was held closer to the ear. Either action will increase the noise exposure level. When the noise source was close to the ear, individuals were exposed to loud noise in a way that was mostly unnoticed and unobtrusive for other family members. Listening devices were also sometimes used by parents to help manage unruly children; children whose behaviour was hard to manage being 'quieted' by giving them a phone to listen to music on.

These results suggest that the way personal listening devices are used in often crowded, noisy home environments places many Indigenous people at greater risk of excessive noise exposure and resultant noise-induced hearing loss than is the case for non-Indigenous people in Australia.

Crowded Housing

Crowded housing is a feature of many Indigenous lifestyles[10]. It often results in noisy home environments. The predisposing factors for crowding in Indigenous households were described by those surveyed as follows:

- Limited available housing was the major factor for people in houses which commonly accommodate twenty to thirty people.
- Cultural preferences for 'connectedness' mean that people often seek to spend time together and visit others during the day.
- Family visits by relatives can often double or treble the number of people occupying a house, for weeks or months during the year[E].
- People tend to congregate in the houses with desirable items or activities: hi-fi equipment, cable TV, card games.
- The youthful demographic profile of Indigenous families means they have more young children than most non-Indigenous families.
- High levels of alcohol consumption by some community members results in children being cared for by other family or community members; some households care for many children.
- Concerns for the safety of children mean that families may keep children at home or allow them to play at only a few 'safe houses' – where drinking is not a problem and/or there is known to be responsible supervision of children.
- There are certain houses where people gather to drink alcohol, or where they go when drunk. There is more likely to be excessive noise from loud music and shouting in these houses.

C Unlike most other personal listening devices mobile phones do not require links to computers and broadband to load and play music. Many disadvantaged Indigenous households do not have access to computers.

D This example is from a community with mobile phone coverage. In communities without this coverage mobile phones were understandably rare.

E These visits, which regularly contribute to excessive overcrowding, are influenced by limited housing availability, cultural responsibilities to provide hospitality and the desire to maintain family connections.

Mutual Noise Exposure

When a number of adults and children are in close proximity there tends to be greater exposure of adults to noise from children's activities and greater exposure of children to noise from adult activity.

In Indigenous families, children and adults are often in the same place or space but engaged in separate activities. Groups of children will play after school and at weekends in 'safe houses' – running around and through the house (often shouting and screaming as they do this). The noise survey results indicate that the shouting and screaming of children is one of the most common 'noisy' activities in the surveyed Indigenous households. Shouting was recorded at around 90 dB when standing close to the person who was shouting. Screams were recorded at between 90 and 127 dB, both for someone close to the person screaming and for the 'screamer'. Analysis of the results reveals that in some households some children and carers can receive more than the allowable daily noise exposure limits from shouting and screaming when children are not at school. This noise exposure adds to the noise exposure which children experience in child care and at school. If children are also exposed to loud noise in these places they may not have enough of the 'recovery time' that ears need after being exposed to loud noise.

Children are also often exposed to high noise levels from adult activities – generated by both interpersonal exchanges and the use of electronic and entertainment equipment.

Two unemployed single mothers spoke about watching daytime TV with the volume turned up about half way. After the children arrived home and began playing and running outside and through the house the mothers turn the volume on the TV up to the maximum output. The noise exposure for children in the household over a seven hour period after school one day exceeded the ADE.

The most extreme (and concerning) example of children's exposure to adult generated noise in the survey data was the use of firearms from vehicles in which whole family groups were passengers.

In some families hunting occurs when travelling so that the whole family, including babies and young children, are exposed to noise from guns fired from the front passenger seat. "When we go travelling in country we have to watch that old man because he sees kangaroo and shoots him quick. You got to watch him to put your hands over your ears real quick". If not sufficiently alert and able to cover their ears, passengers are exposed to the unmuffled sound of a gun used in close proximity and fired in a confined and enclosed space. When children are too young to cover their own ears, carers must choose between protecting themselves or the child. Repeated exposure to the noise of discharging firearms is a common cause of permanent hearing loss.

A 'Critical Mass' of Individuals with Hearing Loss in Households

The noise created when a 'critical mass' of residents with existing hearing loss live in one household contributes to a heightened risk of future hearing loss for residents with no current hearing loss or only unilateral hearing loss.

It is known that crowded housing increases the risks of conductive hearing loss by enabling cross-infection among children with middle ear disease [11]. The results of this study indicate that when a high proportion of people with existing hearing loss live in a crowded house, noise generated by the people with conductive hearing loss and the 'crowd' of residents may contribute to sensori-neural hearing loss among other family members. The people with existing hearing loss are often the most active initial generators of excessive noise (shouting, screaming and turning up the volume of TV and music devices).

"My husband had lots of ear problems growing up and has a hearing loss now, and two of my five children have had ear problems for years. It's them who always want the TV up loud and it's the kids with ear problems who are the ones often shouting and screaming over the TV. It's those kids with ear problems and my husband who are the ones are making most noise in our family". – Indigenous mother.

Similar noise generating behaviour is evident in non-Indigenous homes where there are people with hearing loss. However, the non-Indigenous hard-of-hearing are fewer in number and mostly over 50. They do not as often cohabit with others with hearing loss, in large households, or with children. This means non-Indigenous hard-of-hearing people are not as likely to encounter competing noise from other hard-of-hearing individuals.

In contrast, in many Indigenous families it is usual to find adults with hearing loss who share a home with a number of children who have mild to moderate levels of hearing loss. This can, and often does, result in an escalation of 'competing'[F] noise – all become noisier than they would otherwise be. The noise survey results and noise level measurements confirm that higher noise exposure profiles are present in many Indigenous households when many of the individuals are hard-of-hearing. This results in the exposure of those with no, or minimal, existing conductive hearing loss to potentially damaging levels of loud sound, and the risk of sensori-neural hearing loss in households where there is a 'critical mass' of residents with hearing loss.

Expert opinion [vi] suggests that those with bilateral conductive hearing loss are largely protected from sensori-neural hearing loss as a result of excessive noise exposure. However, the noise generated by those people can jeopardise the better hearing of other family members with normal hearing or unilateral (one ear) conductive hearing loss. In recent years the capacity of those with hearing loss to generate noise has increased as their access to potentially very noisy electronic equipment has increased (flat screen TVs, hi-fi systems, games and personal listening devices).

Exposure to loud noise for those who are most at risk of sensori-neural hearing loss is often through 'passive noise exposure'. Like 'passive smoking', which results from proximity to smokers, 'passive noise exposure' occurs when people are in environments where others are generating excessive noise. However, unlike smokers who put their own as well as others health at risk, many of those generating excessive noise in Indigenous households are protected from the risks themselves, because their preexisting conductive hearing helps to protect them from noise-induced hearing loss.

The survey data also indicates that some individuals with a history of ear disease but no current hearing loss tend to listen to electronic noise for longer and at louder volumes than those without such a history. This appears to be because:

- Firstly, there is evidence that children with a history of ear disease, but with no current hearing loss, tend to turn the volume of TVs and music to higher levels than other children do. Children with a history of ear disease but normal hearing commonly have greater difficulty when coping with background noise [12]. They appear

F The 'Lombard effect' is the involuntary tendency of speakers to increase the intensity of their voice when speaking in a noisy environment. When listening to music or TV in an environment where there is competing noise, people turn the volume up so they can better hear what they are listening to.

to need higher volumes of sound to hear clearly and override background noise.
- Secondly, some children with a history of ear disease may listen to electronic devices to avoid challenging social situations. Children with a history of ear disease tend to experience more social difficulties[13].

This suggests that children with a history of ear disease but no current hearing loss may be at higher risk of excessive noise exposure than other children.

Different Electronic Noise Exposure Profiles

The results of this study reveal quite different profiles of exposure to loud noise in different homes and in different communities.
- When fewer people live in a house the noise exposure levels tended to be less than in homes where many people live.
- Noise levels tend to be higher in homes where the residents include people with conductive hearing loss.
- The noisiest houses are the ones with the most people and where there are also more people with conductive hearing loss.

Some examples of 'at-risk' household noise exposure profiles are listed below.

1. In many of the homes in some remote communities hi-fi systems on high volume were used every afternoon and evening, often for up to 8 to 12 hours each day. This exposes the whole family to loud music.
2. In many communities there were regular weekly house parties where noise levels were similar to those generated at discos, but where those present were exposed to the noise for longer than would generally be the case for people going to discos.
3. In a number of remote communities there are weekly or twice weekly local discos. These are a major social event which the older children and teenagers in the community attend. They add to the cumulative noise exposure from watching TV and listening to music for many hours during the rest of the week.
4. In one urban home with six children and two adults, there was high volume noise from multiple TVs for long hours (including use of the DVD to play music CDs through the TV). Noise from weekend or after school use of the TV, together with shouting and screaming in competition with the TV noise, regularly exceeded the ADE limits for the children in this home.
5. In one family of 12 children and 8 adults living in a town camp, there is a single TV. The stereo system was broken. Instead, eight mobile phones were shared. Most were in constant use for many hours throughout the day; to listen to music, either individually or in groups. Noise doses were measured at 75-86 dB if near the face and 86-92 dB if close to an ear. Exposure using headphones would often be higher. The volume was often set at, or close to, the maximum level to over-ride competing noise.
6. In one family, teenage girls and their friends listened to music on the verandah of a house for long periods, especially at weekends, while sitting close to a hi-fi system. Their personal noise exposure in this situation was measured at consistently above 85 dB. They would take an occasional break to go swimming at the nearby pool. The noise levels at the pool were also often high (above 85 dB) because of the many children screaming and shouting. When not listening to music as a group, the girls often listened to music on mobile phones with headphones. The girls' daily noise exposure often exceeded allowable daily exposure limits (ADE), especially during weekends.
7. In one remote community there was only one house with a loud hi-fi system. However, there were a number of vehicles with loud sound systems. It was common for these vehicles, filled with passengers, to be driven round and round the small community with windows shut and music playing at maximum volume, for up to, and sometimes longer than, four hours during the afternoons and evenings. The measured passenger noise exposure level was over 90 dB. This activity alone exceeded ADE levels for participants.

The levels of electronic 'background noise' in all these settings meant that communication between people would often involve attempts to shout or scream over the other noise. It was not uncommon for people to describe ringing in their ears (a sign of acoustic distress) after time spent with people who were shouting and screaming. The frequent shouting and screaming adds to the overall 'loud noise exposure' from other sources which was found in many homes. When people are exposed to combinations of loud noise (shouting and screaming, television and music) consistently over many years, from a young age, in the home environment, they face a significant risk of future hearing loss.

Discussion

Excessive noise exposure does not usually have an immediate permanent effect on hearing, although people may have a temporary change in hearing[G] for some hours after being exposed to excessive noise, frequently together with ringing in their ears. A permanent effect on hearing capacity generally happens progressively and only becomes evident some years later, after consistent exposure to excessive noise. Adult workers exposed to excessive noise during their working years often experience hearing loss in their 50s. However, there is now widespread concern that teenagers who regularly listen to loud music at concerts and on personal listening devices are experiencing sensori-neural hearing loss at an earlier age[8].

The preliminary findings from the present study are cause for serious concern. While it is generally thought that domestic noise does not result in exposure to excessive noise, except perhaps in the case of some teenagers using personal amplification devices, the results show that many Indigenous people are exposed to loud noise for long periods in their home environments. Crowded housing, the high proportion of Indigenous people with conductive hearing loss and easier access to noise-generating entertainment equipment appear to result in an extreme noise exposure profile in many Indigenous households. In addition, high levels of unemployment and low school attendance rates also mean that many Indigenous people will often spend a considerable amount of time in and around the home.

The results indicate that there is excessive noise exposure among quite young Indigenous children. They may, as a result, experience permanent hearing loss in early adulthood. It will affect them for the rest of their lives. Hearing loss experienced during the years when most people make the most productive contribution to their family and community (through involvement in work and child rearing) usually has a greater impact on the individual and their community than does later onset hearing loss[1]. The consistent early exposure of young Indigenous children to excessive noise is the most alarming and concerning feature of the preliminary results from this project.

In addition to the risk of hearing loss, exposure to excessive noise can have other adverse outcomes.

G It can feel to people like they have cotton wool plugs in their ears and it can take up to 16 hours for hearing to recover.

- Children may have more difficulties with reading and recall (memory) [14, 4].
- Adults may experience more depression [15], and more cardio-vascular disease [16].
- In Australia, research findings indicate that Indigenous children with conductive hearing loss display more antisocial behaviour when it is noisy in classrooms [13].

Persistent exposure to excessive noise may be a hitherto little recognised contributing factor to these elements of Indigenous disadvantage.

The identified noise exposure patterns have important implications. The results suggest that action to limit the exposure of Indigenous people to excessive noise is an urgent priority. There is already widespread conductive hearing loss in the Indigenous community – caused by endemic middle ear disease. This is the 'first wave' of preventable hearing loss. What this study is showing is that there may be a 'second wave' of preventable noise-induced sensori-neural hearing loss for those in Indigenous communities. It is building now. Urgent action is needed to prevent this 'second wave' of hearing loss in Indigenous communities.

The risks from excessive noise in Indigenous households are often a family problem and there is a need for family-based solutions [vii]. Indigenous families need information on the potential dangers of contained and repeated noise; from firearms, from listening too long to loud music (whether at discos, house parties, using personal listening devices, or driving), from TVs, from persistent shouting and screaming. Programs will need to target the risks of 'passive noise exposure' by focusing on the behaviors of those with existing hearing loss and the need to 'look after whole family's hearing'. Indigenous health workers have an important role to play in the development and implementation of these programs. They will often be the ones who can best inform families about the danger of too much loud noise, and of the particular dangers for children with a history of ear disease to exposure to loud noise, for too long.

Notes

i This research was funded by the Commonwealth Department of Health and Ageing

ii or 1.0 pascal squared hour in acoustical terms

iii Sound pressure levels (in decibels) are measured in a logarithmic scale which creates some issues when working with these figures.

iv These refer to continuous noise exposure. Such continuous noise exposure is more typical of occupational noise exposures while many types of recreational noise exposure (such as shouting and screaming) are more spasmodic.

v In regards to a safe level the WHO [17] has stated that there is insufficient evidence to prescribe a safe level due to lack of evidence and individual sensitivities which will vary widely across populations. However the WHO suggest that a lifetime exposure of average level of less than 70 dB is unlikely to cause any significant damage in the greater population even over a 24 hour exposure. (LAeq 24 h < 70 dB)

vi Lou Leidwinger is an audiologist with many years' experience working with Indigenous people.

vii There are also implications for other noise exposure reduction strategies, for example in the standards set for housing built for Indigenous people. Music is often played, and TV watched, in bedrooms as well as in living areas. As far as possible, houses should be built to minimise possible noise transfers between rooms – to limit competing noise sources and the resulting use of personal listening devices to block out background noise at night.

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References

1. Access Economics (2006). *Listen Hear! The economic impact and cost of hearing loss in Australia* report. CRC Hearing and the Victorian Deaf Society. Available online: http://www.accesseconomics.com.au/publicationsreports/getreport.php?report=71&id=81. [cited 20 Jan11].
2. Shargorodsky J, Curhan S, Curhan G & Eavey R. (2010). Change in prevalence of hearing loss in US adolescents. *Journal of the American Medical Association*, 304(7), 772-778. doi:10.1001/jama.2010.1124. [cited 20 Jan11].
3. Henderson E, Testa M & Hartnick C. (2011). Prevalence of noise-induced hearing-threshold shifts and hearing loss among US youths. *Pediatrics*, 127(1), e39-e46. doi:10.1542/peds.2010-0926. [cited 20 Jan11].
4. Stansfeld S, Hygge S, Clark C & Alfred T. (2010). Night time aircraft noise exposure and children's cognitive performance. *Noise Health*, 12(49), 255-262. PMID: 20871180. [cited 20 Jan11].
5. Australian Hearing, (2010). *Binge listening*. Available online: http://www.hearing.com.au/upload/binge-listening.pdf. [cited 20 Jan11].
6. Daniel E. (2007). Noise and hearing loss: a review. *Journal of School Health*, 77(5), 225-231. PMID: 17430434. [cited 20 Jan11].
7. Shah S, Gopal B, Reis J & Novak M. (2009). Hear today, gone tomorrow: an assessment of portable entertainment player use and hearing acuity in a community sample. *Journal of the American Board of Family Medicine*, 22(1), 17-23. DOI: 10.3122/jabfm.2009.01.080033. [cited 20 Jan11]
8. Cone B, Wake M, Tobin S, Poulakis Z & Rickards F. (2010). Slight-mild sensorineural hearing loss in children: Audiometric, clinical and risk factor profiles. *Ear & Hearing*, 13(2), 202-212. doi: 10.1097/AUD.0b013e3181c62263. [cited 20 Jan11].
9. Hodgetts W, Rieger J & Szarko R. (2007). The effects of listening environment and earphone style on preferred listening levels of normal hearing adults using an MP3 player. *Ear & Hearing*, 28(3), 290-297. PMID: 17485978 [PubMed - indexed for MEDLINE]. [cited 20 Jan11].
10. Bailie R & Wayte K. (2006). Housing and health in Indigenous communities: Key issues for housing and health improvement in remote Aboriginal and Torres Strait Islander communities. *Australian Journal of Rural Health*, 14(5), 178-183. DOI: 10.1111/j.1440-1584.2006.00804.x. [cited 20 Jan11].
11. Lehmann D, Arumugaswamy A, Elsbury D, Finucane J, Stokes A, Monck R, et al. (2008). The Kalgoorlie otitis media research project: rationale, methods, population characteristics and ethical considerations. *Paediatric and Perinatal Epidemiology*, 22(1), 60-71. DOI: 10.1111/j.1365-3016.2007.00891.x. [cited 20 Jan11].
12. Zumach A, Gerrits E, Chenault MN & Anteunis LJC. (2009). Otitis media and speech-in-noise recognition in school-aged children. *Audiology and Neurotology*, 14, 121-129. DOI: 10.1159/000162664. [cited 20 Jan11].
13. Howard D. (2006) *Conductive hearing loss and behaviour problems amongst urban Indigenous students*. Unpublished PhD Thesis. Charles Darwin University, Darwin.
14. Stansfeld S, Berglund B, Clark C, Lopez-Barrio I, Fischer P, Ohrstrom E, et al. (2005). Aircraft and road traffic noise and children's cognition and health: a cross-national study. *Lancet*, 365, 1942-49. Available online: http://www.teamsofangels.org/publication/medical_journal_articles/Noise.pdf. [cited 20 Jan11].
15. Öhrström E. (1991). Psycho-social effects of traffic noise exposure. *Journal of Sound and Vibration*, 151(3), 513-517. doi:10.1016/0022-460X(91)90551-T. [cited 20 Jan11].
16. Gan W, Davies H & Demers P. (2010). Exposure to occupational noise and cardiovascular disease in the United States: the National Health and Nutrition Examination Survey, 1999-2004. *Occupational Environmental Medicine*. doi:10.1136/oem.2010.055269. [cited 20 Jan11].
17. World Health Organization. (1999). *WHO Guidelines for community noise*. Available online: http://whqlibdoc.who.int/hq/1999/a68672.pdf. [cited 20 Jan11].

Agencies interested in participating in 'keeping hearing strong' programs can contact Damien Howard at damien@phoenixconsulting.com.au.

Attachment 3

NT prevalence update & What Works

- Prevalence Surveys - 2001 to 2014
- Longitudinal birth cohort - 2012 to 2016
- Risk Factors
- Interventions
  - a selection and summary of 2016 evidence reviews
  - Menzies' RCTs in remote Aboriginal communities

Presentation to Ear Disease Roundtable, AMA, Canberra Nov 2016. Prof Amanda Leach

Conceptual framework to study causal pathways to Otitis Media (Lehmann et al.)

Attachment 3

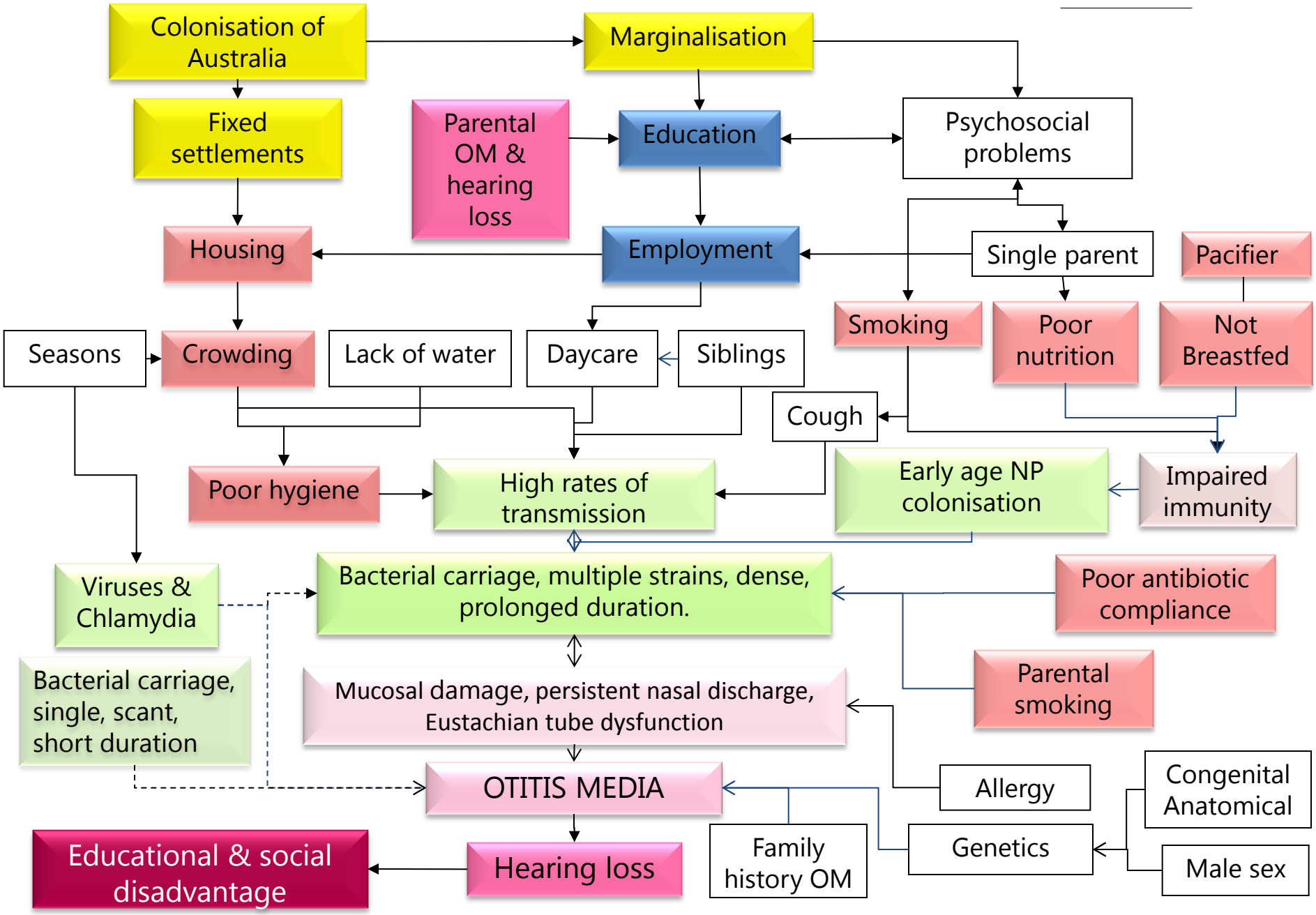
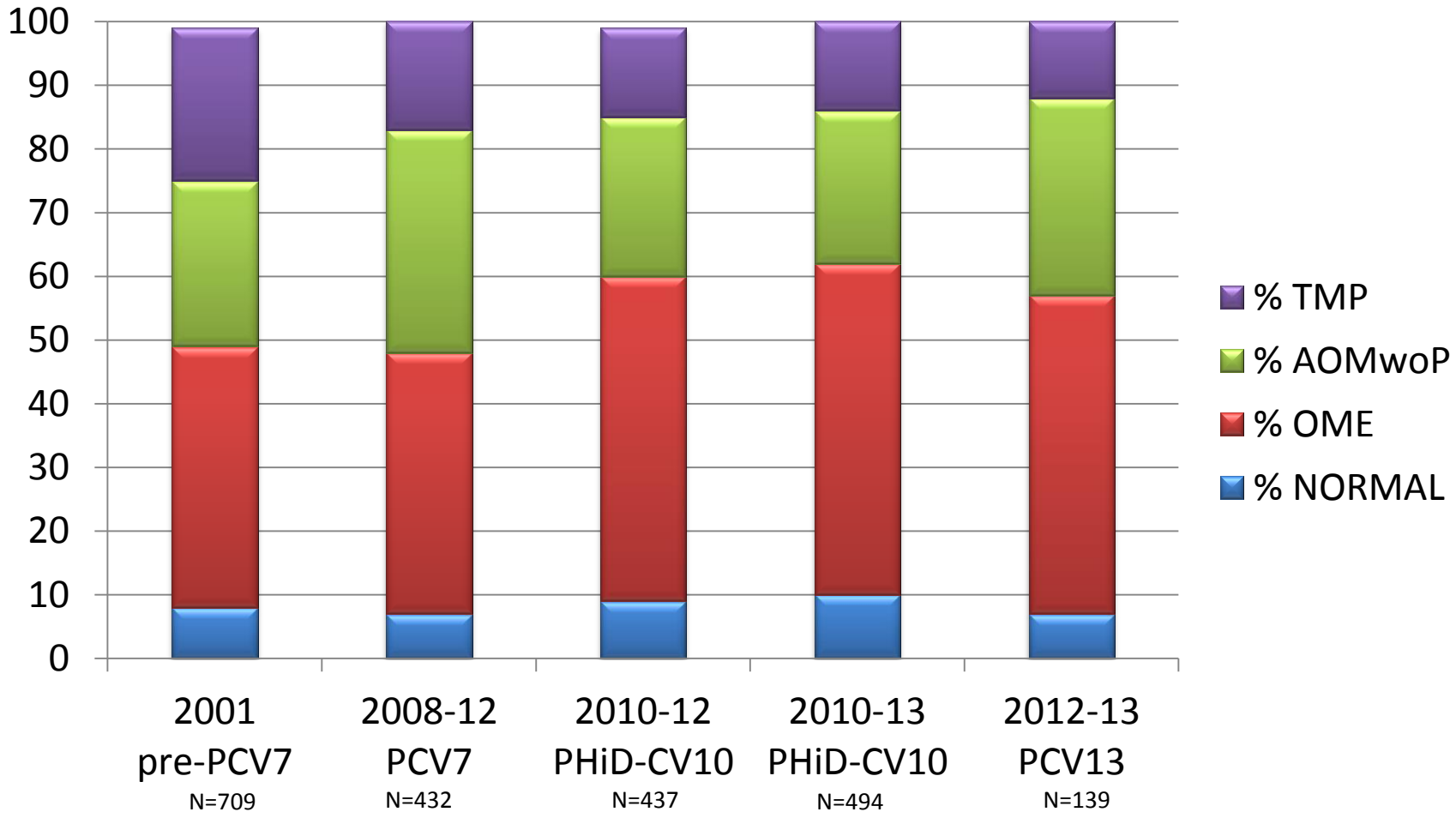


Figure 1. Prevalence of all forms of otitis media among Aboriginal children living in remote communities of the Northern Territory : 2001 to 2013

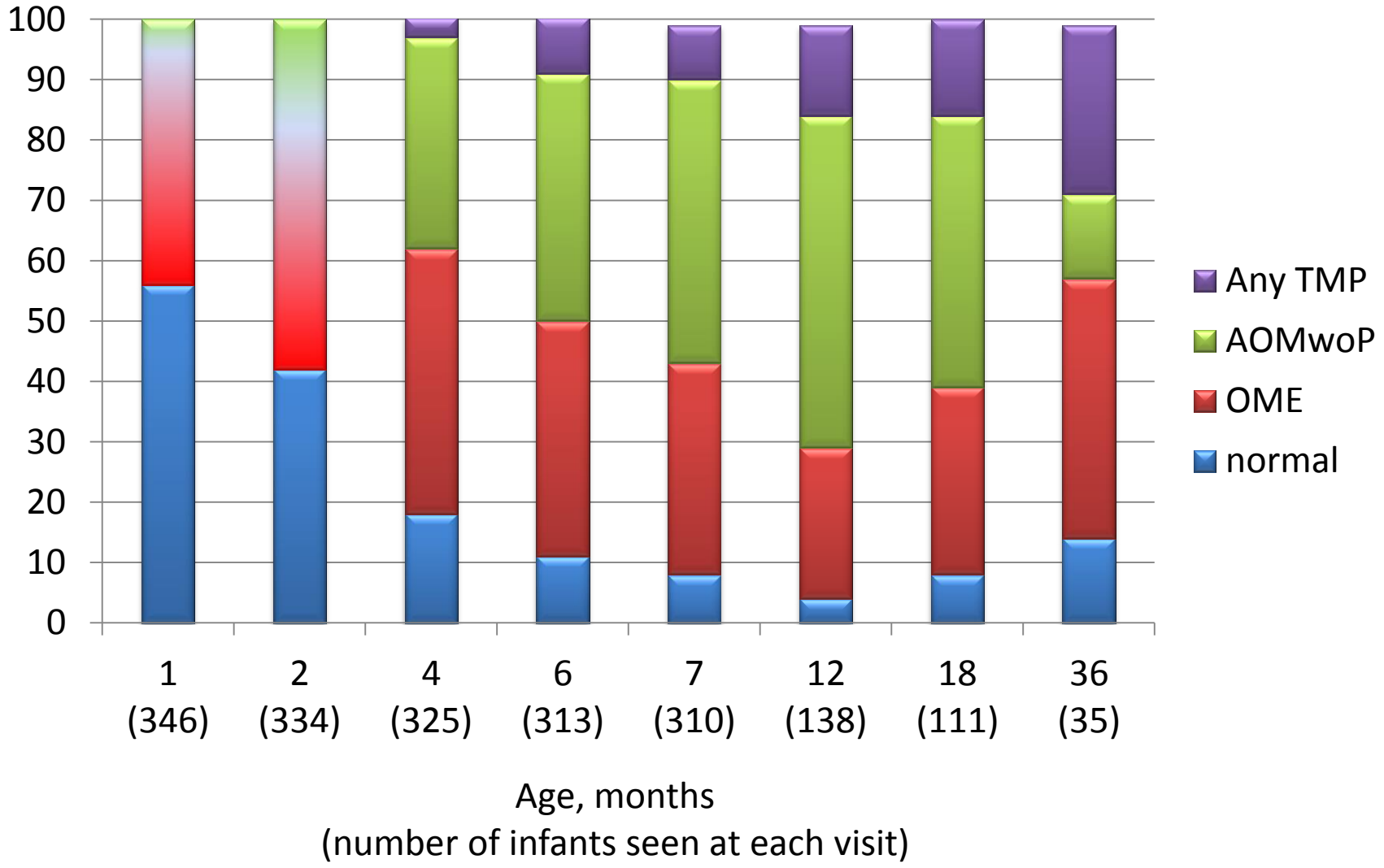


Pneumococcal Conjugate Vaccine (PCV) in NT childhood immunisation schedule

Number of children – mean age ~18 months

Attachment 3

Diagnoses by age (months) in a birth cohort of Aboriginal infants living in remote communities, NT & WA (2012-2016).



Risk factors for Suppurative OM in Aboriginal children

	% OM	Difference OR - multivariate	p
Vaccine			
PCV7	51%		
PHiD-CV10	39%	**0.6**	0.001
Children < 5yo in household			
0	39%		
≥3	60%	**2.4**	0.009
Age			
< 1 yr	58%		
2-3 yrs	30%	**0.3**	0.000
Gender			
male	41%		
female	49%	**1.5**	0.016
Antibiotics, Haemoglobin, Day Care, Sibling with “runny ears”, maternal smoking, campfire smoke, maternal age, maternal education, breastfeeding, pacifier, gestational age			Not significant

Attachment 3

Effects of various strategies for prevention of AOM in children

Prevention	Outcome	Intervention	Control	Difference QUALITY
Breastfeeding: exclusive 6mo	AOM	31%	45%	**OR 0.6 MOD**
Maternal smoke: avoidance	AOM in first 6 mo of life	8%	10%	**OR 1.3 LOW**
Hygiene: in day care	Days ear ache in <3yo	5 days/ch/yr	7 days/ch/yr	**2 days/child/yr LOW**
Vaccine: PCV	AOM PCV-AOM	17% 0.7%	18% 1.5%	**RR 0.9 MOD** **RR 0.5 MOD**
Vaccine: flu	any AOM	21%	26%	**RR 0.8 MOD**
Xylotol 3mo	any AOM	23%	30%	**RR 0.8 MOD**
VitaminD	AOM	45%	66%	**HR 0.5 V LOW**
Probiotics	AOM	18%	24%	**RR 0.8 LOW**

Bold indicates statistically significance difference.
QUALITY: across many methodological measures. red=low confidence; blue=moderate confidence; green=very confident

Antibiotic and Surgery trials for **AOM & rAOM**

Attachment 3

Treatment: population	Outcome	Intervention	Control	Difference QUALITY
Antibiotics: < 2yo	AOM at 3-5 days	37%	48%	**RR 0.8** **HIGH**
Antibiotics: Perforations	Persistent perforation	31%	60%	**RR 0.5** **MOD**
Antibiotics:	New perforation	2%	5%	**RR 0.4** **HIGH**
Antibiotic prophylaxis: rAOM	AOM or CSOM	36%	56%	**RR 0.7** **MOD**
Antibiotic prophylaxis: rAOM	Antibiotic resistance @3mo	31%	23%	RR1.4 MOD
TTs: rAOM	Hearing loss @6mo	na	na	-4dB **LOW**
TTs +/- Adenoidectomy: rAOM < 2yo	Any failure	16%	27%	**RR 0.6** **MOD**

Antibiotics, Surgery & other trials for OME

~~Attachment 3~~

Treatment: population	Outcome	Intervention	Control	Difference QUAL
Antibiotics for 2-3mo: OME	Resolution	55%	21%	**RR 2.2** **LOW**
Antibiotics for 6 mo: OME **Aboriginal**	Failure - Perforation	12%	28%	**RR 0.4** **V LOW**
Antibiotics for 6 mo: OME **Aboriginal**	Resolution	9%	1%	**RD 10%** **V LOW**
Antibiotics for 4 wks	Hearing threshold	15dB	17dB	na
TTs: OME	Hearing loss @ 6-9mo			-4dB MOD
TTs: OME	Failure - Otorrhoea	3%-74% 36% in **Aboriginal**	na	na MOD
Autoinflation	Hearing threshold >20dB	20%	67%	**RR 0.3** **LOW**

Antibiotics, Surgery & other trials for CSOM

Attachment 3

Treatment: population	Outcome	Intervention	Control	Difference QUAL
Topical antibiotics vs cleaning	Failure: Discharge @ 1 week	36%	81%	**RR 0.45** MOD
Topical antibiotics +/- oral bactrim	Failure: Discharge @ 6 weeks	29%	59%	**RR 0.49** LOW
	Failure: Discharge @ 12 weeks	25%	48%	OR 0.36 LOW
	Failure: Discharge @ 52 weeks	17%	22%	OR 0.7 V LOW
		Ciprofloxacin	Sofradex	
Aboriginal children < 6 yrs	Failure @ 8 weeks	76%	72%	RD 4%

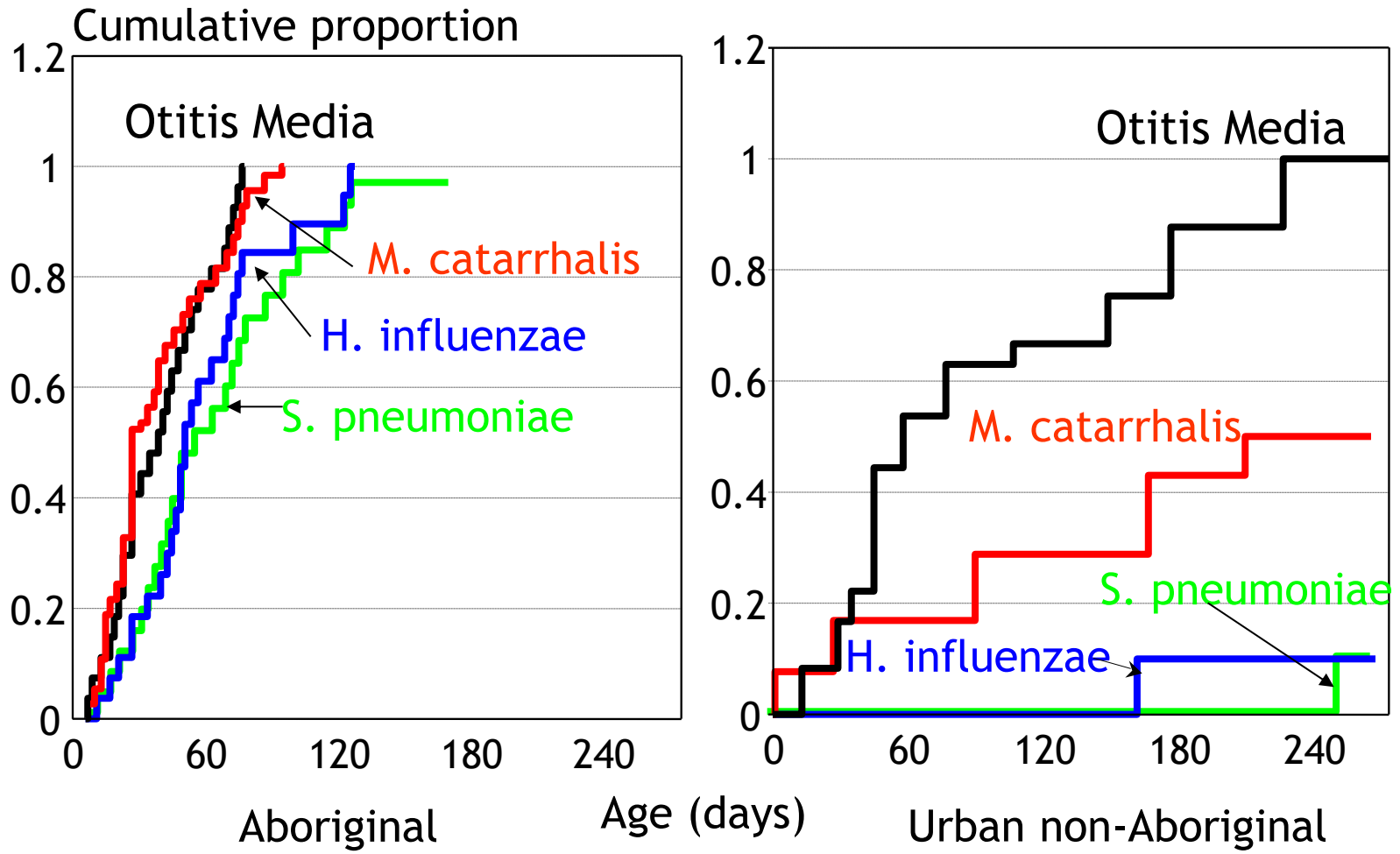
Attachment 3

Azithromycin for AOM

		Azithromycin	Amoxicillin+/- clavulanic acid	
12 RCTs	Failure 7 to 14 days	18%	15%	**RR 1.2** MOD
		Azithromycin Single dose	**Amoxicillin BD 7 days**	
Aboriginal children	Failure day 7	45%	49%	RD -4%
	Azithromycin resistance	9%	3%	RD 6%
		Azithromycin 2 doses day 0,7	**Placebo**	
Aboriginal children	Failure (overall) day 14	58%	70%	RD -13%
	Failure (perforation or azithromycin resistance) day 14	8% (0% perforation)	25% (5% perforation)	**RD -17%**

Nasopharyngeal bacterial colonisation predicts early onset of persistent otitis media "60% by 60 days"

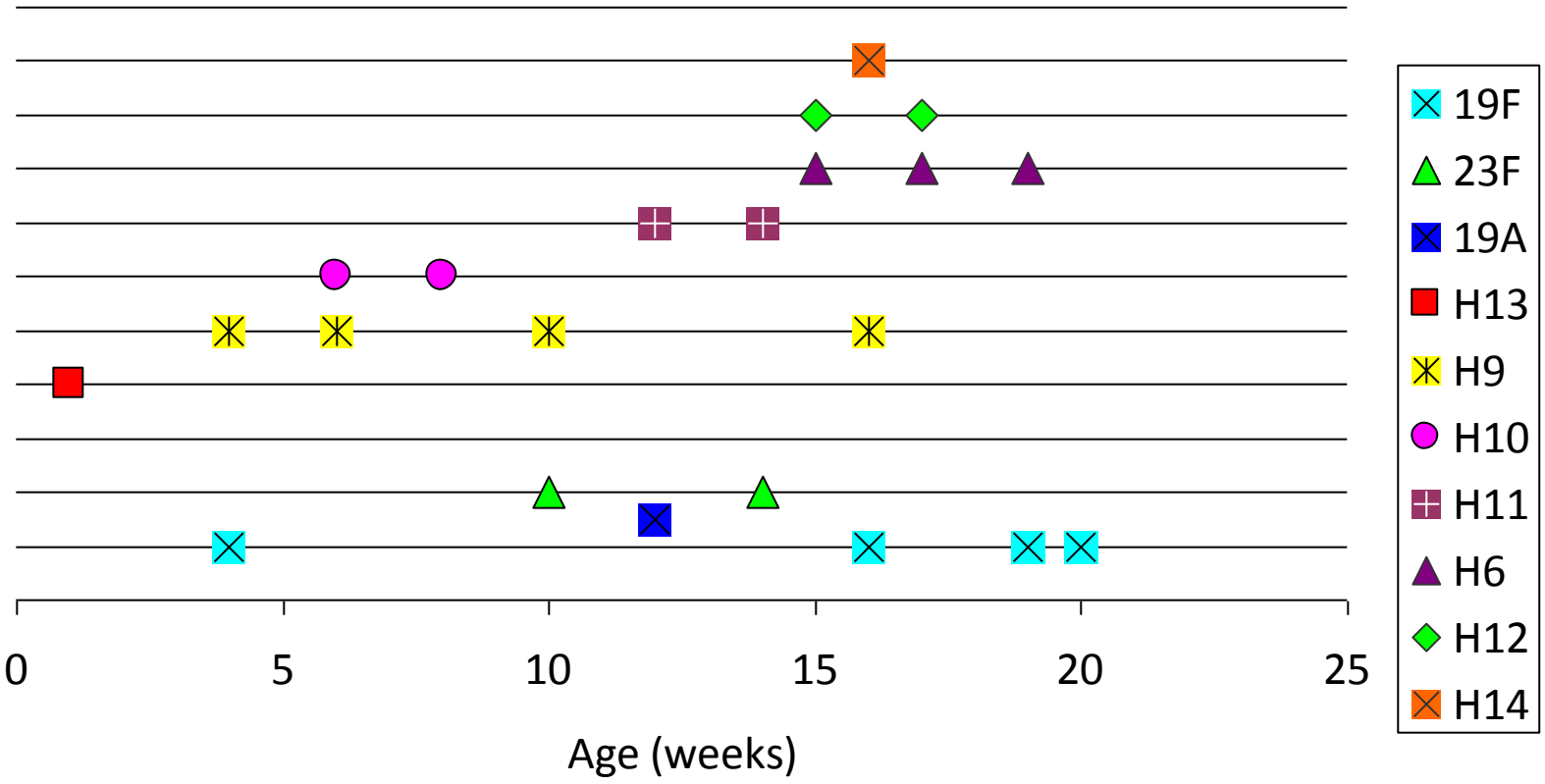
Attachment 3



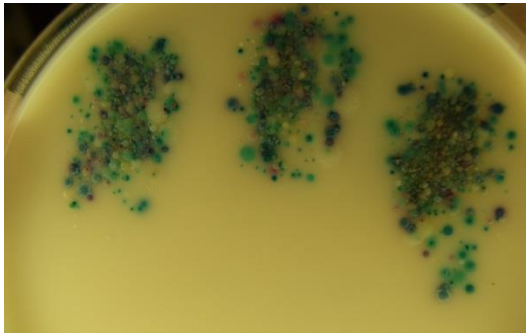
The risk of OM was 33–fold higher in children with NTHi & Spn compared to M.cat or no carriage

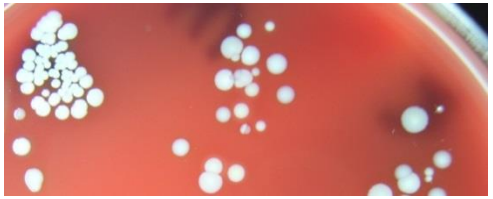
Leach et al. 1994

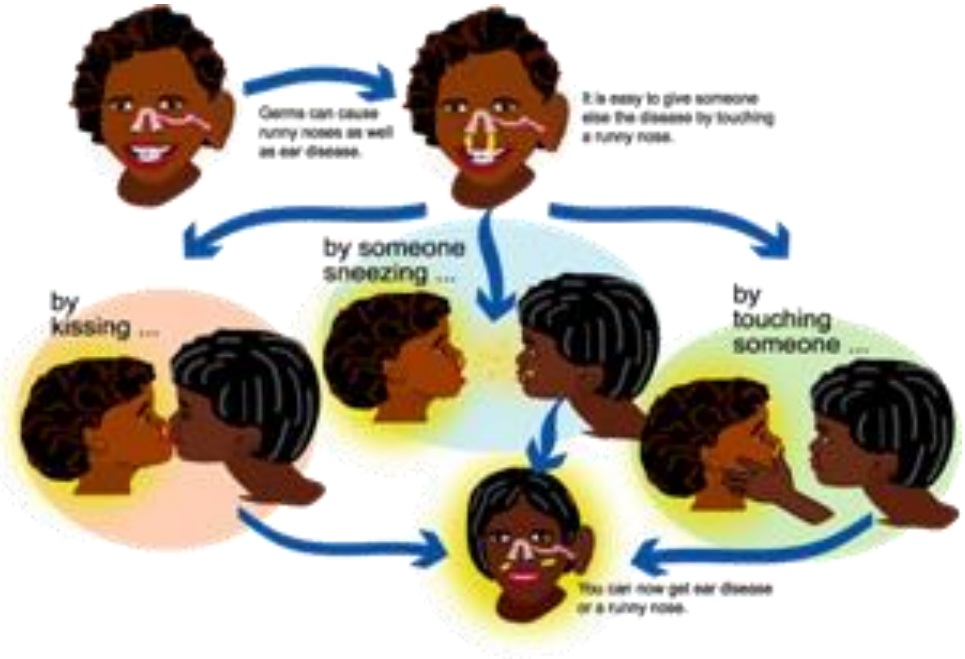
Combined pneumococcal and NCHi dynamics in one child from birth to 6 months of age



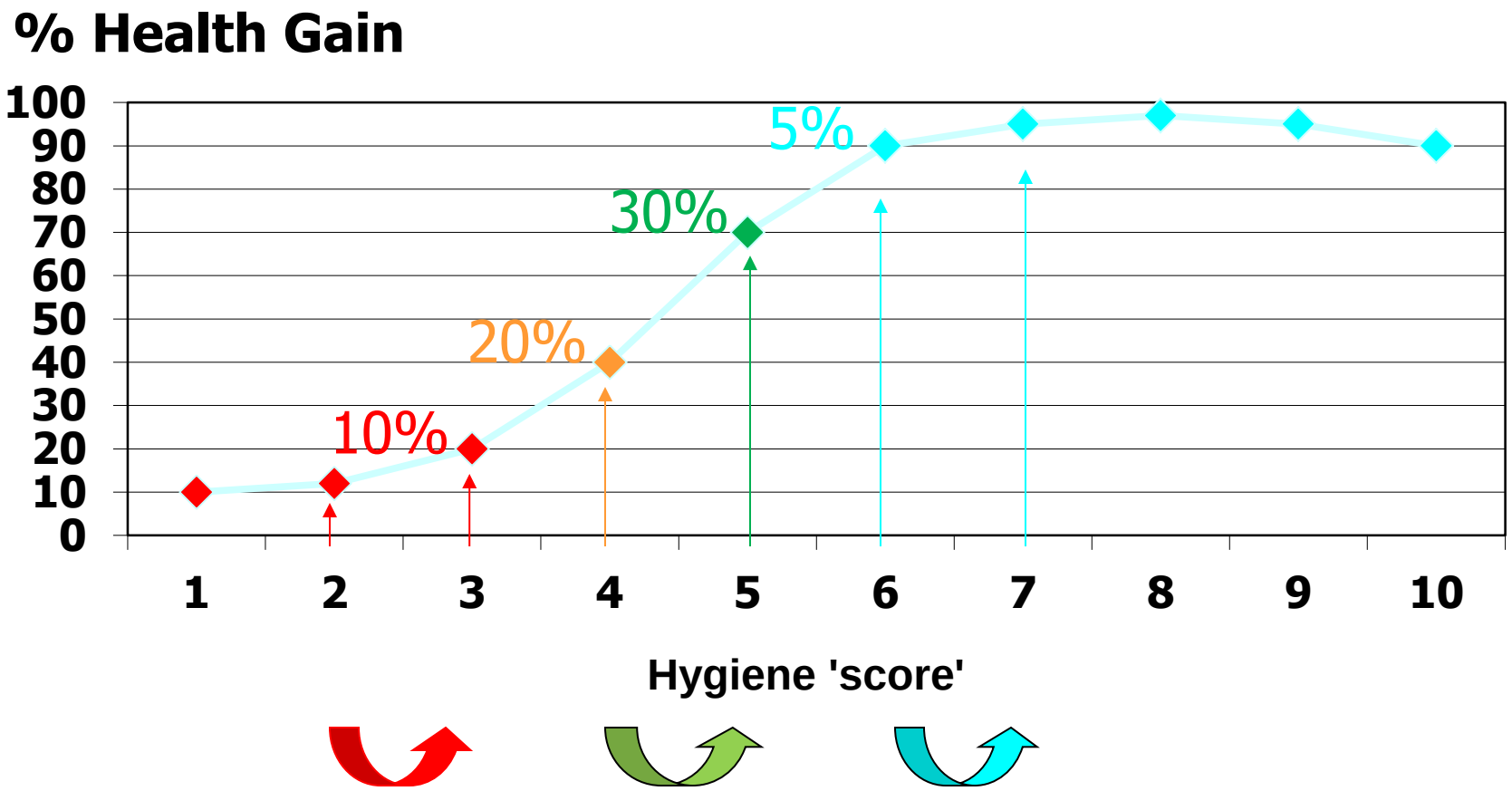
Bacterial infection and hand & face contamination







Schematic of the non-linear health gains from interventions



Reducing otitis media and hearing loss: what we need to do

The health department must invest in equipment and clinical training to improve diagnostic skills and application of evidence-based practice; including appropriate antibiotic treatment for what is almost exclusively a bacterial infection.

The education department must invest in pre-school and family programs to improve school readiness and attendance; and implement effective strategies for overcoming communication problems in children with hearing loss.

The housing department must ensure public housing provides access to working taps, soap, mirrors and basins that drain to prevent spread of the germs that cause otitis media. All houses should also have **refrigeration for safe storage of medications.**

Local councils and retail outlets must ensure adequate supply of affordable and appropriate products for families to purchase to keep their children clean.

Reducing impact of rheumatic heart fever and disease: what we need to do

Attachment 3

Set targets on the road to disease control which reflect its true burden (number of new cases, how severe they are and where they are) and serve as indicators to determine if strategies are on track.

Improve diagnosis and treatment of throat and skin infections – including better delivery of antibiotics – along with care for people with rheumatic heart disease.

Focus on **improved living conditions, reduced overcrowding** and **maintenance of sanitation hardware** in Indigenous communities; as well as delivery of **preventative penicillin**.

Include the voice of people living with RHD in all aspects of RHD control.

A vaccine to prevent group A streptococcal infections is currently undergoing trials. We must support its accelerated development, as well as **improved forms of penicillin**.

Eliminating trachoma: what we need to do

Ongoing government support and funding beyond 2017 for screening, treatment and health promotion activities, until trachoma is eliminated.

Target responses to infection hotspots and keep up the pressure to maintain hygiene practices in other communities so good levels of facial cleanliness are maintained to stop the infection bouncing back.

The departments of education, health, housing and Prime Minister and Cabinet must work together to make sure every house, school, preschool or children's centre has **access to working taps and basins that drain; and soap, paper towels and mirrors.**

The housing departments in the Northern Territory, Western Australia and South Australia must **ensure remote community houses have safe and functional bathrooms.**

Audiology waiting times for Aboriginal children < 3 years of age.

Attachment 3

Of 63 babies eligible for a hearing test (OME >3mo or rAOM):

- 23 (36%) received a hearing test
  - 30% waited > 6mo.
  - 48% waited ≤ 3mo
  - 22% waited 3-6mo
- 34 (54%) have had no hearing test to date
  - 68% have waited > 12mo to date
- 6 (10%) had no hearing test to 3 years of age

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SOUND-FIELD AMPLIFICATION: ENHANCING the CLASSROOM LISTENING ENVIRONMENT for ABORIGINAL and TORRES STRAIT ISLANDER CHILDREN

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Abstract

Sound-field amplification is an educational tool that allows control of the acoustic environment in a classroom. Teachers wear small microphones that transmit sound to a receiver system attached to loudspeakers around the classroom. The goal of sound-field amplification is to amplify the teacher's voice by a few decibels, and to provide uniform amplification throughout the classroom without making speech too loud for normal hearing children. This report discusses the major findings of a study which investigated the effects of sound-field amplification intervention on the communication naturally occurring in the classrooms of Aboriginal and Torres Strait Islander children. The audiological findings of the sample population of children are presented, as well as details of the classroom acoustic environment. Sixty-seven percent of the children began the field trials with a slight hearing loss. The results confirmed the extremely noisy and reverberant conditions in which teachers and children are operating on a daily basis. The findings indicated that sound-field amplification intervention encouraged the children to interact with teachers and peers in a proactive way. Teachers identified voice-related factors to be a major personal benefit of the systems.

Introduction

The classroom serves as a communication channel for listening and learning. Unfortunately, the typical classroom can provide a hostile listening and learning environment for both teachers and students. Sound-field amplification is an educational tool that allows control of the acoustic environment in a classroom. This paper discusses the major findings of a study which investigated the effects of sound-field amplification intervention on the communication naturally occurring in the classrooms of Aboriginal and Torres Strait Islander children in Cherbourg and Yarrabah, Queensland.

Background: Barriers to effective communication in the classroom

The goal of classroom instruction is comprehension. However, for speech to be comprehended, the child must be able to hear well enough to discriminate the word-sound distinctions of individual phonemes. Normal hearing for children is now considered to be 15 decibels hearing level (dB HL) or better at all frequencies, and with normal middle ear function (Northern & Downs, 2002). A slight hearing loss extends from 16 to 25 dB HL. Studies have indicated there are significant numbers of children with this degree of unidentified hearing loss in every school, many as a result of middle ear problems (Flexer, 1992). Unfortunately, the term "slight hearing loss" erroneously implies that the loss has little consequence. This is not the case. The high prevalence of early onset, long-term middle ear disease and consequent hearing loss amongst Aboriginal and Torres Strait Islander children has been well documented (McPherson, 1990; Nienhuys et al., 1994). Australian studies have indicated that 50% to 80% of Aboriginal and Torres Strait Islander school children have sufficient middle-ear related hearing loss to adversely affect classroom performance (Nienhuys, 1994).

In addition to hearing problems, the combination of excessive noise and reverberant classrooms contributes to the difficulties faced by all school children in understanding the teacher's verbal instruction. The teacher's voice may be so poor at the child's ear that the speech is masked by the noise, a term known as the

"signal-to-noise" ratio (S/N ratio). Flexer (2002) referred to the recently adopted United States national acoustical standards (American National Standards Institute, 2002) which calls for unoccupied classroom noise levels to be less than 35 dB, and reverberation time (RT) (the amount of "echo" in the room) to be less than 0.6 seconds for medium size rooms. The recommended S/N ratio in a classroom for young learners is +15 dB (American Speech-Language-Hearing Association, 1995). Teachers working in noisy classrooms must constantly raise their voices in response to varying levels of background noise to achieve this S/N ratio, thus producing vocal strain. Gotaas and Starr (1993) found that 80% of teachers reported vocal fatigue compared to 5% of the general population.

According to the literature, classroom communication for the Aboriginal and Torres Strait Islander child is a complex interaction of cultural influences, language mismatch and different learning preferences. Non-Indigenous teachers bring different expectations and interpretations to the classroom which may lead to misunderstandings (Kearins, 1985). Language differences can be a major barrier to effective classroom participation (Lowell, 1993). As formal Western education is traditionally heavily dependent on verbal language, any mismatch will mean the Aboriginal and Torres Strait Islander child will have difficulty predicting or filling in the language gaps, particularly when hearing under adverse listening conditions and with a hearing impairment (Burnip, 1994). This can affect the child's emotional world, and lead to feelings of inadequacy and failure (Sherwood & McConville, 1994). Additionally, Aboriginal and Torres Strait Islander children's learning preferences are informal and less reliant on verbal interaction as the predominant medium of learning (Lowell, 1993; West, 1994). Peer interaction is an important source of communication and learning, and children naturally learn through observing their peers and being helped by peers (Howard, 1994). Such behaviours contrast with the Western educational approach of paying attention to the teacher.

What is sound-field amplification?

Sound-field amplification has also been termed "classroom amplification" and, more recently, "sound-field distribution systems" (Flexer, 2002). Teachers wear small microphones that transmit sound to a receiver system attached to loudspeakers around the classroom. The goal of sound-field amplification is to amplify the teacher's voice by approximately 8 to 10 dB, and to provide uniform amplification throughout the classroom without making speech too loud for normal hearing children (Crandell, 1998).

Originally designed as an assistive technology for children with mild hearing loss, research in the United States over the past 20 years has shown that sound-field amplification benefits all children. The benefits have included improved academic achievement, speech recognition, attending skills, and learning behaviours (Rosenberg & Blake-Rahter, 1995). Benefits identified for teachers include reduced vocal strain and vocal fatigue, increased ease of teaching, increased versatility of instructional techniques, and increased teacher mobility (Rosenberg et al., 1999).

In the early 1990s, the National Acoustic Laboratories (NAL), the research arm of Australian Hearing, developed a dual-channel sound-field amplification system with the needs of Aboriginal and Torres Strait Islander children living in both remote Australian communities and urban areas in mind (Page, 1995). The first of these systems was installed in four schools in North Queensland in 1992. Two of the systems were installed at schools in Aboriginal and Torres Strait Islander communities in the Gulf of Carpentaria. The other two systems were installed at a school north of Cairns which had a high proportion of Indigenous students. Page et al. (1995) outlined the following benefits based on teacher comments:

- the children were less distracted;
- it was easier to gain the children's attention;
- there was lack of shame associated with using the system for the whole class compared with devices for individuals; and,
- children with normal hearing appeared to benefit.

The teachers also reported significantly less voice strain and feeling less tired at the end of the day. Loades (1993), reporting on a trial of classroom amplification at two Aboriginal schools in western South Australia, found there was not as much variation of "time on task" behaviours compared with individual FM amplification systems. In a trial performed at a school with a high proportion of Aboriginal kindergarten children in New South Wales, Dowell (1995) reported improvements in listening behaviour during the six month period. While anecdotal evidence and the findings from these few Australian investigations suggest benefits, the present research programme was the first quantitative investigation on the efficacy of sound-field intervention in the classrooms of Aboriginal and Torres Strait Islander children.

Research questions

This study aimed to examine the following questions:

- What was the hearing status of a sample population of Indigenous school children?
- What were the acoustic characteristics of the classrooms and what levels of amplification were produced in the field?
- What were the effects of sound-field amplification intervention on the communication occurring between the teachers and the children?

Procedure

An eight-week field trial of sound-field amplification was carried out in four classrooms, two in each of the rural Queensland communities of Cherbourg and Yarrabah. These communities were chosen for their accessibility and diversity of lifestyle. Cherbourg is the closest rural Indigenous community to Brisbane, the capital city of Queensland. Located a few kilometres from the large town of Murgon, the people lead modern lifestyles. Yarrabah is a North Queensland coastal Aboriginal community with some Torres Strait Islanders within the community. It is located within driving distance from Cairns, a major urban centre. This research programme adhered to the ethical research guidelines issued by the National Health and Medical Research Council issued in 1992 and published in 1993. Ethical clearance for this project was obtained from the ethics committee at the University of Queensland. Of the 64 children participating in the study, 48% were males and 52% were females. The ages of the 64 subjects ranges from 6 years 1 month to 10 years 3 months (M=8 years 2 months). One Year 2 class, two Year 3 classes, and one Year 5 class participated in the study. Of the two female teachers at Cherbourg State School who volunteered to participate in the study, one was a new graduate who had lived in Cherbourg community all her life and was of Aboriginal and Torres Strait Islander descent. The other teacher was non-Indigenous with over 13 years teaching experience with Indigenous children, eight of which had been at Cherbourg State School. At Yarrabah State School, both classes had non-Indigenous teachers. One volunteer teacher, a female, had one and a half years teaching experience. The fourth teacher was a male with three years teaching experience, all of which had been with Indigenous children.

The listening environments of the four classrooms were alternated between unamplified "OFF" and amplified "ON" conditions at two-weekly intervals over the eight week period. Hearing tests were performed on the 64 children. Acoustic measurements, including ambient noise levels, reverberation times (RT) and S/N ratios, were obtained for each classroom. Structured classroom observation was used to record the communicative interactions occurring spontaneously between the children, teachers and peers. A modified Environmental Communication Profile, originally developed by Calvert and Murray (1985), was used by trained observers to record the communicative interactions occurring between the child, teacher and peers simultaneously.

Two self-report instruments were used in the study. These were the Screening Identification for Targeting Educational Risk (S.I.F.T.E.R.) rating scale (Anderson, 1989) and a teacher questionnaire devised for the study. The former is the most widely used protocol to measure the efficacy of sound-field amplification (Crandell, 1998) and focuses on the teacher's observation of classroom performance in relation to listening skills. The teachers were asked to rate each child before and after the sound-field amplification trials in the performance subtests of academic performance, attention, communication, class participation and school behaviour. Each teacher was asked to complete the teacher questionnaire at the end of the field trials.

Results

Audiological results

The mean pure tone average hearing level for this population of children was 20 dB pre-trials, and 19 dB post-trials. These levels fall into the category of slight hearing loss, as defined by Clark (1981). Twenty percent of the children began the trials with normal hearing levels, and 67% of the children began the trials with slight hearing loss levels in the 16 to 25 dB range. Eight percent of children had mild hearing loss (between 26 and 40 dB) and 5% of children had moderate hearing loss (between 41 and 55 dB).

Classroom acoustic measurements

Each of the classrooms demonstrated extremely noisy listening conditions. Classroom noise levels and reverberation times were very high relative to recommended levels (Table 1). All the mean S/N ratios were in the negative range under normal listening conditions (see above), indicating the teacher's voice was softer than the noise levels usually found inside and outside the classrooms.

Classroom communication

The observational data were combined and compared to determine whether the effects of the amplification

Table 1. Results of acoustic measurements for each classroom (dB=decibels).

Classroom	Noise levels (occupied)	Mean RT (unoccupied)	Mean S/N (unamplified)	Mean S/N (amplified)
Classroom 1	62 dB	1.8 seconds	-3 dB	+3 dB
Classroom 2	67 dB	1.3 seconds	-2 dB	+2 dB
Classroom 3	72 dB	1.7 seconds	-9 dB	+1 dB
Classroom 4	75 dB	1.8 seconds	-9 dB	-4 dB

intervention occurred immediately (over a two-week time span), in the short-term (over a four-week time span), or whether the effects were cumulative (at the end of the field trials). The results showed there were no significant changes in the dynamics of communication occurring in Class 1, the classroom with the Aboriginal teacher. Conversely in Classes 2, 3 and 4 with non-Indigenous teachers, common significant changes in communicative interactions were demonstrated for each of the temporal comparisons during the field trials.

The results of the immediate comparisons for Classes 2, 3 and 4 indicated:

- an increase in the total number of communicative interactions;
- an increase in child, teacher and peer verbal communication;
- an increase in the number of interactions initiated by the children;
- the children initiated more communication without being directly prompted (Figure 1); and,
- there were trends for the children to initiate more interactions to the teacher, and to respond to communication directed to the entire class.

The results of the short-term comparisons for Classes 2, 3 and 4 indicated:

- an increase in the total number of communicative interactions occurring between the children, teacher and peers;
- an increase in verbal communication between the children, teacher and peers; and,
- an increase in the number of times the children initiated communication.

Comparison of data recorded at the beginning and at the end of the field trials for Classes 2, 3 and 4 indicated:

- an increase in the total number of communicative interactions occurring in each of the classrooms;
- an increase in child and peer verbal communication and total verbal communication (Figure 2); and,
- an increase in the number of times the children initiated communication.

Self-report measures

The results of the S.I.F.T.E.R. rating scale for the four classes indicated the teachers observed improvement in attention and increased class participation following the use of sound-field amplification (Table 2). The former performance subtest relates to the child's distractibility and attention span compared with peers, as well as the child's ability to respond to oral directions. The latter performance subtest refers to how often the child volunteers information to class discussion or in answers to questions, and the amount of difficulty the child has in starting to work after instruction. In addition, a significant improvement in total scores for the five performance subtests was demonstrated pre- and post-trial for all the classes, indicating the teachers considered there had been overall improvement in the areas of academics, attention, communication, class participation and school behaviour (Table 2). Teachers identified voice related factors to be a major personal benefit of the systems.

Significance of findings

The results of this study confirmed the extremely noisy and reverberant listening environments in which both teachers and children are operating on a daily basis, and emphasised the very urgent need for classroom acoustics treatment in conjunction with sound-field amplification installation. The very poor S/N ratios evident in each of the classrooms would have resulted in considerable

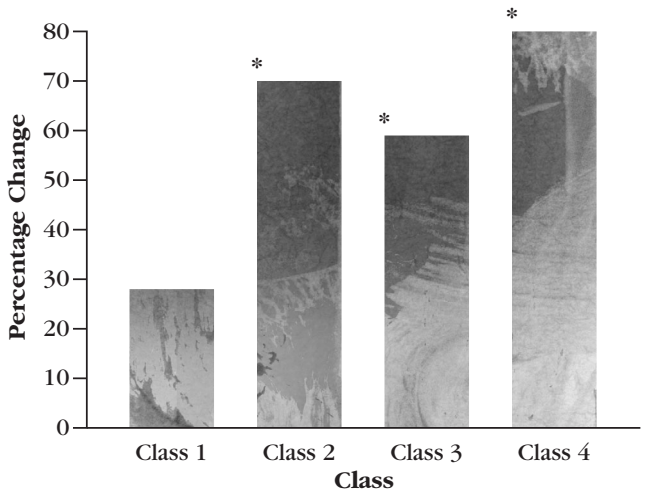

Figure 1. Immediate comparisons per class: Percentage change in the number of communicative interactions initiated by children without prompting (*=p <0.05).

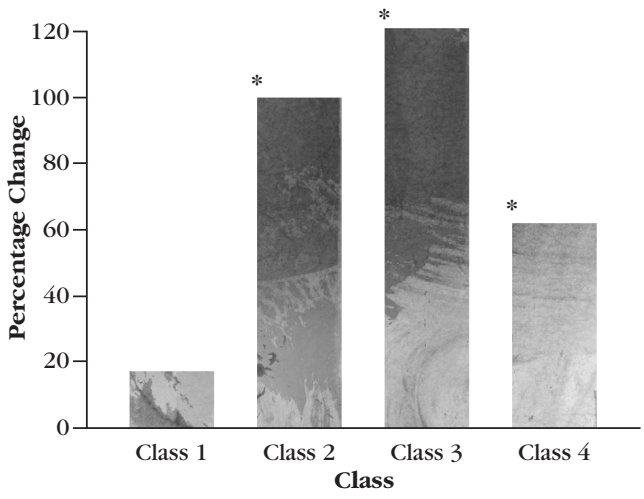

Figure 2. Percentage change in "total verbal communication variable" (child, teacher and peer) for each class from beginning to end of field trials (*=p <0.012).

Table 2. Results of S.I.F.T.E.R. comparisons for the four classes (*=p <0.05).

Performance subtest	Mean (pre-trial)	Standard deviation	Mean (post-trial)	Standard deviation	p*
Academics	9.60	3.94	9.67	4.20	0.742
Attention	8.17	3.57	9.27	3.78	0.001**
Communication	9.70	3.43	9.87	3.79	0.516
Class participation	9.60	3.38	10.40	3.83	0.004**
School behaviour	10.87	3.72	11.32	3.92	0.169
Total score	47.95	15.52	50.52	17.55	0.007**

reduction in speech recognition for all the children. In addition, given that Western education is heavily dependent upon verbal language, the fact that only 20% of the children began the trials with normal hearing levels, and 67% of the children began the trials with slight hearing loss in the 16 to 25 dB HL range would have exacerbated their speech perception difficulties.

The results indicated that improving the classroom listening environments had positive effects on the communication occurring between the teachers and the children. However, few changes in the dynamics of classroom communication were evident for Class 1 during the field trials. It was concluded that, because the Indigenous teacher in Class 1 provided a culturally responsive learning environment, the communication breakdowns reported in the literature to occur in cross-cultural educational settings did not occur in this classroom. The teacher naturally adopted a teaching approach which was less reliant on verbal strategies and teacher-centred learning. Therefore, compared with Classes 2, 3 and 4 which had Western-style teachers, the improved S/N ratio provided by the amplification system had less measurable impact on the communication naturally occurring in the classroom.

For Classes 2, 3 and 4, the results generally showed there was significantly more communication occurring between the teacher, children and peers during the course of the trials, and that the effects were cumulative. The findings suggested the children in these three classes used more verbal language and were playing a more proactive role in classroom communication as the trials progressed. It was concluded that even short and intermittent exposure to an enhanced listening environment fostered the children's confidence and subsequent involvement in classroom interactions, a notion supported in the literature (Grauf, 1994). The results of the S.I.F.T.E.R. rating scale highlighted areas which were also identified as significant in the observational data, these being improvements in the areas of attention and class participation. Another important finding was that teachers indicated they had less vocal strain and felt less fatigued at the end of the day after using the systems. In view of the noisy classroom acoustic conditions under which the teachers taught, this was not surprising, and is congruent with other teacher surveys on sound-field amplification (Anderson, 2001). One of the recurring themes throughout the study was the important role the peer group played in the children's natural communication network. The results of this study confirmed the increase in peer related activities in facilitating the overall increase in responsiveness from the children, and an increase in verbal communication between the children and their peers over time. Given these findings, the question must be asked whether, in the long-term, the improved S/N ratio provided by the sound-field systems would affect learning outcomes of Indigenous Australian children.

Conclusion

Sound-field amplification intervention reduced the deleterious effects of reduced speech perception and encouraged the school children to interact with teachers and peers in a proactive way. At present in Australia, however, there are no clear or enforceable standards for classroom acoustics. Moreover, given that structural acoustic modifications can prove costly per classroom, sound-field amplification may provide a rapid, cost-effective part of the solution to improving the classroom listening environment for all Aboriginal and Torres Strait Islander children.

Acknowledgements

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References

American National Standards Institute. (2002). *Acoustical performance criteria, design requirements and guidelines for schools*. ANSI S 12.60.

American Speech-Language-Hearing Association. (1995). Position statement and guidelines for acoustics in educational settings. *American Speech-*

Language-Hearing Association, *37*(Supplement 14), 15.

Anderson, K. (1989). *Screening instrument for targeting educational risk (S.I.F.T.E.R.).* Austin, TX: PRO-ED.

Anderson, K. (2001). Voicing concern about noisy classrooms. *Educational Leadership*, April, 77-79.

Burnip, L. (1994). Hearing impairment, phonological awareness, and the acoustic environment of the classroom. *Australian Journal of Remedial Education*, *26*(1), 4-10.

Calvert, M. B., & Murray, S. L. (1985). Environmental communication profile: An assessment procedure. In C. S. Simon (Ed.), *Communication skills and classroom success: Assessment of language-learning disabled students* (pp. 135-159). London: Taylor & Francis.

Clark, J. G. (1981). Uses and abuses of hearing loss classification. *American Speech-Language-Hearing Association*, *23*, 493-500.

Crandell, C. (1998). Using sound-field FM amplification in the educational setting. *The Hearing Journal*, *5*(5), 10-19.

Dowell, J. (1995). Trial of sound-field amplification system. *Proceedings of the OtitisvMedia NSW Conference 1995 – Its implications for Aboriginal and Torres Strait Islander people*. Sydney: New South Wales Department of Health, New South Wales Department of School Education, New South Wales Board of Studies.

Flexer, C. (1992). FM classroom public address systems. In M. Ross (Ed.), *FM auditory training systems: Characteristics, selection and us* (pp. 189-206). Timonium, MD: York Press.

Flexer, C. (2002). Rationale and use of sound field systems: An update. *The Hearing Journal*, *55*(8), 10-18.

Gotaas, C., & Starr, C. (1993). Vocal fatigue among teachers. *Folia Phoniatrica et Logopaedica (Basel)*, *45*, 120-129.

Grauf, N. (1994). *Report on whole class amplification systems installed in Cape and Gulf schools*. Cairns, QLD: Torres Strait, Cape and Gulf School Support Centre.

Howard, D. (1994). Culturally responsive classrooms: A way to assist Aboriginal students with hearing loss in urban schools. In S. Harris & M. Malin (Eds.), *Aboriginal kids in urban classrooms* (pp. 37-51). Darwin: Social Science Press.

Kearins, J. (1985). Cross-cultural misunderstandings in education. In J. B. Pride (Ed.), *Cross-cultural encounters: Communication and mis-communication* (pp. 65-79). Melbourne: River Seine Publications.

Loades, C. (1993). Western Australia centre for hearing impaired children, Aboriginal hearing program. In *Otitis media in childhood: Issues, consequences and management: Proceedings of the Western Australian Otitis Media Group conference* (pp. 253-268). Perth, WA: Western Australia Otitis Media Group Inc.

Lowell, A. (1993). Otitis media and classroom communication. *Australian Communication Quarterly*, 11-13.

McPherson, B. (1990). Hearing loss in Australian Aborigines: A critical evaluation. *The Australian Journal of Audiology*, *12*, 67-78.

Nienhuys, T. (1994). Aboriginal conductive hearing loss for life. *Australian Language Matters*, *2*(1), 8-9.

Nienhuys, T. G., Boswell, J. B., & McConnell, F. B. (1994). Middle ear measures as predictors of hearing loss in Australian Aboriginal children. *International Journal of Pediatric Otorhinolaryngology*, *30*, 15-27.

Northern, J. L., & Downs, M. P. (2002). *Hearing in children* (54th ed.). Baltimore: Lippincott Williams and Wilkins.

Page, S. (1995). *Dual FM sound field amplification: A flexible integrated classroom amplification system for mild to moderate conductive hearing loss*. Unpublished manuscript.

Page, S., Hatfield, A., & Wallington, J. (1995). Sound-field amplification: Alternative technology for minimal hearing loss. In *Otitis media in childhood: Issues, consequences and management: Proceedings of the Western Australian Otitis Media Group conference* (pp. 338-334). Perth, WA: Western Australia Otitis Media Group Inc.

Rosenberg, G., & Blake-Rahter, P. (1995). Sound-field amplification: A review of the literature. *Sound-field FM amplification: Theory and practical applications* (pp. 107-123). San Diego, CA: Singular Publishing Group Inc.

Rosenberg, G., Blake-Rahter, P., Heavner, J., Allen, L., Redmond, B., Phillips, J., et al. (1999). Improving classroom acoustics (ICA): A three year FM sound-field classroom amplification study. *Journal of Educational Audiology*, *7*, 8-28.

Sherwood, J., & McConville, T. K. (1994). *Otitis media and Aboriginal children: A handbook for teachers and communities*. North Sydney: NSW Board of Studies.

West, L. (1994). Cultural behaviour, conflict and resolution. In S. Harris & M. Malin (Eds.), *Aboriginal kids in urban classrooms* (pp. 7-19). Darwin: Social Science Press.

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Attachment 5

Classroom Case Study: Cross Cultural Obstacles to the Referral of Aboriginal Children for Hearing Tests

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Hearing loss is endemic among Aboriginal children because of persistent middle ear disease. If compensating communication strategies and support programs are to be engaged, a child's hearing loss needs to be identified. Teacher recommendations are an important source of referrals for hearing tests, with school screening programs now being infrequent or nonexistent. However, cultural differences in Aboriginal children's attentional styles, together with some children with hearing loss using more face-watching as a compensatory strategy, can confuse non-Aboriginal teachers as to who may need referral for hearing testing. This article describes a classroom case study that found culturally different attentional styles and compensatory face-watching, similar to that described in a remote school, among some urban Aboriginal children. The attentiveness of one child with hearing loss confused teachers. The implication for the identification of Aboriginal children's hearing loss is discussed.

There is increasing evidence of the adverse social and educational effects of Conductive Hearing Loss (CHL), especially among Aboriginal children who experience endemic levels of the condition. CHL amongst Aboriginal children has been found to be associated with diminished social and emotional wellbeing (Zubrick et al., 2004), antisocial behaviour at school (Howard, 1990; 2004), lower levels of achievement at school (Yonovitz & Yonovitz, 2000; Howard, 2004) and greater levels of absenteeism (Couzos et al., 2003). It is estimated that, on average, Aboriginal children spend two and a half years during childhood with CHL, compared to three months for non-Aboriginal children in Australia (OATSIH, 2001).

Identification of children's hearing loss is necessary if compensatory strategies and support programs can be engaged. Referral for audiological assessment is necessary to identify current CHL. Identification of CHL generally results from primary screening programs. Individual referrals, on the other hand, take place when parents, teachers or others suspect a hearing loss.

McPherson (1995) reported that the states with large Aboriginal populations (Queensland, Northern Territory and Western Australia) mainly had screening programs for non-urban areas. There were fewer screening programs for Aboriginal children in urban areas, despite the fact that 67% of Aboriginal children live in urban areas (Australia Bureau Statistics, 1993).

McPherson (1995) suggested that the absence of screening in urban areas is related to (a) the fact that mass screening is easier and more cost effective when a population group is in close geographical proximity. In urban areas, Aboriginal children are scattered throughout the mainstream population, as opposed to their peers in rural settlements; (b) The relative 'visibility' of hearing loss where health services only service Aboriginal clients.

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However, hearing screening programs are resource intensive and, even in remote areas, are becoming less frequent, if they take place at all. In some areas, hearing screening is not carried out as it is thought to be unethical where later referral for full audiological assessment and appropriate intervention is not an option

In urban areas, identification of hearing loss has been mostly reliant on the referral of individual Aboriginal children for hearing tests. Often, non-Aboriginal professionals, mostly teachers, make these referrals on the basis of a child's attentiveness. *However, this may not be a reliable indicator of hearing loss for Aboriginal children.*

Cultural Differences in Attentiveness

Many Aboriginal people make less eye contact than westerners (Eades ,1992; Harris, 1976) and misunderstandings often arise because of crosscultural misinterpretation of what this signifies. Many non-Aboriginal people are offended when first addressing Aboriginal community meetings, where people often wander around and making little eye contact with the speaker. This response is commonly interpreted by non-Aboriginal people as indicating disrespect or disinterest. In the criminal justice system, judiciary and jurors are warned about making judgments as to guilt or honesty on the basis of demeanor such as eye contact (Eades, 1992). Conversely, many Aboriginal people find the intense gaze of a polite non-Aboriginal audience highly disconcerting.

This was illustrated in the opening of an art exhibition in Darwin observed by the author. The Tiwi island artists were placed facing the audience during the opening. There was noticeable discomfort among the artists at the polite, unrelenting gaze of the audience. Gradually, and as a group, the Tiwi artists turned around so, by the end of the official opening, they had their backs turned to the audience. Speaking with some of the artists later they confirmed that the intense watching by the audience had upset them.

Maintaining less eye contact during social interaction with their teachers is also evident among many — but not all — Aboriginal schoolchildren. Lowell (1994) described different attentional styles among Aboriginal students in a remote bilingual school. She found many Aboriginal children paid attention to their teachers, despite behaving in ways that non-Aboriginal teachers associate with lack of attention (i.e., students made little eye contact and moved around the class, but were nonetheless paying attention). Some children, meanwhile, made more eye contact with their teachers — some children with CHL. These children were using face-watching and lip-reading to compensate for limited auditory input. Lowell (1994) described that face-watching was most evident among the children who experienced most persistent conductive hearing loss.

The variety of eye contact patterns demonstrated by Aboriginal children may be quite confusing for non-Aboriginal teachers. Given their experience with non-Aboriginal children, teachers would expect greater eye contact to signify good attention and no hearing loss; while inattentiveness, as measured by less eye contact, would signify possible hearing problems. However, hearing tests may reveal that the reverse of these teacher assumptions is true. Some Aboriginal children who face-watch to compensate for hearing loss appear 'attentive', while other Aboriginal children with no hearing loss, but with a different attentional style, appear 'inattentive' to non-Aboriginal teachers. Lowell (1994) observed these type of responses among Aboriginal children who lived in a remote community and attended a school where they were mostly taught by Aboriginal teachers who were aware of cultural differences in attentional styles. In this context, crosscultural misunderstanding is unlikely. However, Aboriginal children in Australia are mostly taught by non-Aboriginal teachers. It may be that crosscultural misunderstanding is either more probable in this crosscultural context or less likely because of the greater familiarity of

urban Aboriginal children with western sociocultural etiquette. The following classroom case study sought to identify, first, if cultural differences in attentiveness (as measured by the amount of eye contact) was evident between Aboriginal and non-Aboriginal children in an urban school during one-to-one conversation with their non-Aboriginal teacher. Second, it sought to examine if the attentiveness style of urban Aboriginal children with a current CHL differed to that of urban Aboriginal children with no hearing loss.

METHOD

To consider this issue further a case study of the structured one-to-one social interaction between a teacher and a number of her students, whose current hearing status was known, was arranged. The focus of the case study was the amount of time children made eye contact while talking one-to-one with their teacher, who was asked to discuss recent school project work with students. The teacher and students (9) were video recorded conversing, sitting on chairs set up one metre apart outside the classroom, in a relatively (for schools) quiet environment (between 60 dB SPL–70 dB SPL). The amount of time each student spent watching the face of the teacher during the conversations was then timed with a stopwatch. Since CHL fluctuates — making knowledge of children's current hearing status crucial — there was limited time to organise this project soon after hearing screenings took place at the school. This meant only a small group of similar aged children from one classroom was able to be involved. The nine students involved were three Aboriginal students with current bilateral hearing loss, three Aboriginal students and three non-Aboriginal students without current hearing loss. These children were chosen as Aboriginal and non-Aboriginal students who had passed their hearing screenings and were closest in age to the Aboriginal students with a bilateral hearing loss. Children's hearing status was identified on the basis of all children in the class having their hearing assessed by pure tone audiometry (at 0.5, 1, 2 and 4 kHz) carried out in a soundproof booth, as well as simple otoscopy and tympanometry. Children who failed the screening (> 25 dB HL) were given a full hearing assessment.

The percentage of time each student spent watching the face of the teacher during the conversations is presented in Figure 1.

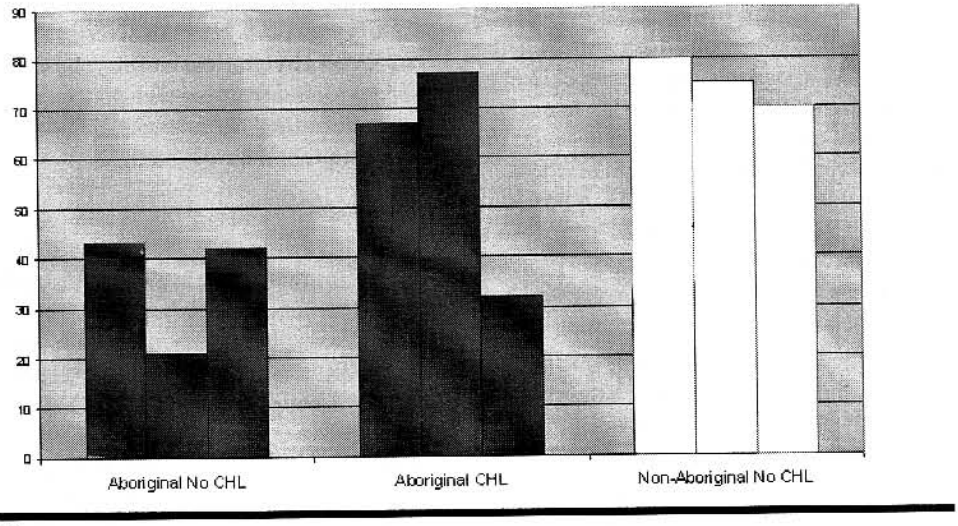

FIGURE 1
Percentage of time each subject spent watching face of the teacher.

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The three Aboriginal students with no current hearing loss spent approximately half as much time face-watching as the three non-Aboriginal students with no hearing loss. This different pattern of visual attention among these urban Aboriginal students with no hearing loss is similar to that described by Lowell (1994) amongst traditionally oriented Aboriginal students in a remote community.

However, two of the three urban Aboriginal students with current hearing loss maintained eye contact more than the three Aboriginal students with no current hearing loss, probably as compensatory visual communication strategy — face-watching. This meant they resembled the non-Aboriginal children with no hearing loss in their visual attentiveness during one-to-one conversation with their teacher. Since Lowell (1994) described this type of face-watching as most evident among children with more persistent conductive hearing loss, it is likely that the other Aboriginal student with current hearing loss, who maintained eye contact only 30% of the time, may not have experienced persistent conductive hearing loss.

Overall, the results of this case study suggest that the type of culturally shaped differences identified by Lowell (1994) among some Aboriginal students in remote communities is also evident among some urban Aboriginal students. Further, the responses of some children with current hearing loss in making eye contact is likely to be confusing for teachers who use visual attention as an indicator of good hearing. This was supported by interviews with teachers.

The teachers of one of the Aboriginal students (Kirsty) who worked in the same classroom team teaching were surprised to discover she had a hearing loss, seeing her as one of 'the attentive good listeners'.

T 1: Well, you watch her there on the floor and she really does pay attention, but Kirsty doesn't produce does she?

T 2: No, she always listens very hard, but her work doesn't show that. You look over at the table and she's always busy doing something. She's not wandering and wondering what to do next. She knows what to do.

T 1: I hadn't thought of her as having problems [with hearing] because she always paid attention. She said to me 'my mum said I must be a bit deaf' and I said, 'why's that?' and she said 'because I don't always hear what she says'. So I said, 'Oh do you hear what I say during class?' and she sort of looked a bit sheepish and said 'no, not always'. And I was really, really surprised. She was one of my best listeners.

T 2: She usually sits in the same place, near the front, she never puts herself at the back or at the side. She doesn't mess around, she watches. She doesn't fiddle with her dress or shoelaces or anything like that. She gives the impression that she's brighter than she is really.

T 1: Kirsty is always sitting in the right place looking at the right person. She wants to do it nicely. She tries so hard. I had no idea that she was having any difficulty.

Kirsty's apparent attention had led her teachers to assume she had no hearing problems and they were quite surprised to find that she did. Kirsty's attempts to visually compensate for hearing loss matched her teachers' culturally-based expectations of good attention, signifying good hearing. Her teachers had resolved the inconsistency between her apparent attentiveness and poor performance by concluding, 'she gives the impression she's brighter than she really is'.

DISCUSSION

These results suggest that the cultural differences in attentional style found by Lowell (1994) in a remote school are also evident among some urban Aboriginal students. The culturally shaped visual attentiveness style among Aboriginal students with no hearing loss, together with the compensatory face-watching among some Aboriginal students with current hearing loss means there may be systematic errors when non-Aboriginal adults use visual attentiveness to determine which

Aboriginal children may need to be referred to have their hearing tested. Many Aboriginal children with current hearing loss may not be referred for hearing tests, while Aboriginal children with good hearing may be referred because their apparent poor attentiveness is mistakenly thought to be related to hearing loss.

Crosscultural misunderstanding of attentional behaviour may help to explain some apparently paradoxical research results where data was based on non-Aboriginal teachers' perceptions of Aboriginal students' attention. Lewis (1976), in an often reported study, described that Aboriginal children with hearing loss demonstrated greater 'linguistic incompetence'. He also found a paradoxical negative correlation between Aboriginal children's teacher-identified attention and their reading ability: The students identified by teachers to demonstrate the best 'attention' in class were poorer readers than those who seemed to pay little attention in class.

The otherwise inexplicable association between attentiveness in class and limited reading skills makes sense if considered on the basis of crosscultural misinterpretation of visual attentional styles. This would suggest what was being measured is an association between Aboriginal students' limited reading ability and the use of face-watching as a visual compensation strategies by students with persistent hearing loss. This is a more plausible explanation of the results and is consistent with findings of an association between CHL and limited literacy among Aboriginal children (Walker & Wigglesworth, 2001; Yonovitz & Yonovitz, 2000).

It is also worth noting how the teachers interviewed explained Kristy's poor school performance, despite her attentiveness at school. The discrepancy between her classroom attentiveness, and poor performance was resolved by a judgment about her ability — 'she's not as bright as she appears'. It is well established that teachers' beliefs about student's ability influence students' actual performance — the Pygmalion effect (Rosenthal & Jacobson, 1968). Work in Aboriginal education indicates that Aboriginal students' educational opportunities are especially influenced by non-Aboriginal teacher's attitudes towards them (Malin, 1990). Such teacher judgments about children with hearing loss may compound the direct educational disadvantage of hearing related communication problems. This highlights the importance of teacher awareness of which children have hearing loss so they can both implement compensatory communication strategies, as well as avoid inaccurate judgments about their educational capacity.

This study supports the importance of regular school hearing screening for Aboriginal children. Without formal screening, crosscultural misunderstanding is likely to inhibit appropriate teacher referrals of Aboriginal children for hearing tests. It also indicates the need to make teachers aware of possible behavioural indicators of Aboriginal children's hearing loss. McPherson (1995) found the best behavioural indicator of hearing loss among urban Aboriginal students was having social problems with peers. Excessive teasing was also found to be associated with a current hearing loss among students in remote schools (Howard, 2004). Teacher-directed speech reception games (Howard, 1993) have also been found to help overcome the crosscultural masking of Aboriginal children's hearing loss. There are also implications for the pre- and postservice training of teachers to include, firstly, information on cultural differences in attentional styles and secondly, that care should be taken not to judge students' abilities on the basis of discrepancies between attentiveness and poor performance.

AUTHOR NOTE

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Attachment 5

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REFERENCES

Eades, D. (1992). *Aboriginal English and the law: Communicating with Aboriginal English speaking clients — A Handbook for Legal Practitioners.* Brisbane, Australia: Queensland Law.

Harris, S. (1987). Aboriginal learning styles and formal schooling. In M. Christie, S. Harris & D. McClay (Eds.), *Teaching Aboriginal children: Milingimbi and beyond* (pp. 41–57). Mt Lawley, WA: Institute of Applied Aboriginal Studies, Western Australian College of Advanced Education.

Howard, D. (2004, June). Why we need more Aboriginal adults working with Aboriginal students. *Australian Journal of Teacher Education, 29*(1), 14–21.

Howard, D. (1993). Knowing who has a hearing loss. *The Aboriginal Child at School, 21*(1), 27–33

Lewis, N. (1976). Otitis media and linguistic incompetence. *Archives of Otolaryngology, 102*(7), 387–390.

Lowell, A. (1994). *Communication and learning in an Aboriginal school: The influence of CHL.* Unpublished doctoral dissertation, University of Sydney, NSW, Australia.

Malin, M. (1990). The visibility and invisibility of Aboriginal students in an urban classroom. *Australian Journal of Education, 34*(3), 312–329.

McPherson, D. B. (1995). *Identification of hearing loss in urban Indigenous school children.* Unpublished doctoral dissertation, University of Queensland, Australia.

OATSIH Report (2001). *Recommendations for clinical guidelines in treating Otitis Media.* Retrieved June 6, 2005, from http://www.health.gov.au/oatsih/pubs/omp.htm

Walker, N., & Wigglesworth, G. (2001). The effect of CHL on phonological awareness, reading and spelling of urban Aboriginal Students. *Australian Journal of Audiology, 23*(1), 37–51.

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the classroom.* New York: Rinehart and Winston.

Yonovitz, L., & Yonovitz, A. (2000). PA-EFL: A phonological awareness program for Indigenous EFL students with hearing disabilities. *TESL: EJ Teaching English as a Second or Foreign Language, 4*, 4.