
A Report Prepared for the Ministry of Health and Ministry of Education

Auditory Processing Disorder: New Zealand Review

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February 2014

About Sapere Research Group Limited

Sapere Research Group is one of the largest expert consulting firms in Australasia and a leader in provision of independent economic, forensic accounting and public policy services. Sapere provides independent expert testimony, strategic advisory services, data analytics and other advice to Australasia's private sector corporate clients, major law firms, government agencies, and regulatory bodies.

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Definitions and Terminology Regarding Hearing Devices

It became apparent during the review there is variable interchangeable and inconsistent use between stakeholders of terminology, especially relating to debate on the range of hearing devices as part of intervention strategies for children with APD.

The definitions in question relate to the following devices: hearing aids, personal FM systems and remote microphone hearing aids. These terms coupled with Ministry of Health and Ministry of Education protocols, which establish the respective roles and responsibilities of the Ministries, cause some stakeholders to use different terminology to try and access funding streams.

For the purposes of this report, to provide some consistency and comparability for the reader, the following terms or definitions apply,

Term	Working Definition for this report
Hearing aids	Personal electronic amplification device that is used to amplify and improve clarity of sound
Personal frequency modulation (FM) systems They may also be referred to by some as remote microphone hearing aids	Personal FM systems consist of two parts – the FM transmitter microphone and the FM receiver. The FM microphone worn by the speaker (e.g. a teacher, a parent) picks up their voice and sends it to the person wearing the receivers (e.g. student). This improves speech comprehension in difficult listening situations by improving the speech to noise ratio and removing effects of room reverberation on the speech signal. Usually this involves a bilateral fitting with an FM receiver in each of the child’s ears. FM systems are mainly, but not exclusively, used to focus on one primary voice, such as in whole class and group teaching situations or during formal discussions or speeches ¹ . FM systems can also connect to other electronic devices (such as TVs, computers, DVD players etc) to allow sound to be transmitted directly to

¹ Ministry of Education APD fact sheet (peer reviewed by Suzanne Purdy)
<http://www.minedu.govt.nz/NZEducation/EducationPolicies/SpecialEducation/ServicesAndSupport/AssistiveTechnology/AssistiveTechnologyFactsheets/ATAuditoryProcessingDisorder.aspx>

the listener.

There are two main types of FM receivers:

- FM receivers that attach to hearing aids (typically used by students who have sensorineural hearing loss or permanent conductive hearing loss)
- Stand-alone FM receivers are designed for wearers with normal peripheral hearing and do not need a conventional hearing aid to work. The FM receiver provides a small amount of adjustable amplification. These FM receivers do not block the wearer's ear so that sounds around the wearer, such as other students speaking in the classroom, can be heard in the normal way.

As technology rapidly continues to change, these definitions will need to be checked for continued appropriateness and accuracy.

Part of the future of improving services for children with APD in New Zealand will be to ensure clarity and consistency of relevant terms and eligibility.

Executive summary

Background, Scope and Methodology

The Ministry of Health and Ministry of Education commissioned Sapere Research Group (Sapere) to undertake independent research from which to develop a position paper. This will identify best practice and make recommendations for the management of auditory processing disorder in children (age 0 to 15 years) and, in particular, the provision of hearing devices for these children².

The research was qualitative and not an academic project nor a clinical audit. It occurred between May and July 2013. The paper was finalised in January 2014 post peer review by Professor Suzanne Purdy of the University of Auckland.

Parent, Ministry of Health, Ministry of Education, and Academic stakeholders were interviewed (total n=46). A select literature summary was undertaken. In the main, internationally respected literature was gathered by Sapere from various stakeholders, who shared most generously. Limited web based searching was also undertaken.

It is important to note that although the Ministries of Health and Education contracted this independent review it is only a division of each of the Ministries that are involved. Namely, it is the Disability Support Services division of the Ministry of Health and the Sector Enablement and Support Section of the Ministry of Education. Therefore most of the content and conclusions in this report are likely to extend beyond the mandate of these two divisions.

International Context

Science and research on the topic of auditory processing disorder (APD) has increased and advanced in the past decade. This is evidenced by the number of studies and publications emerging over this period. More is now known about the disorder and how to test and intervene for it, the range and high incidence of co morbidities and impacts on children's lives. However there is no definitive international consensus on these topics, or agreed best practice for assessing, diagnosing and what intervention strategies should be used. This makes the whole topic of APD quite complex.

APD is heterogeneous and this should be reflected in testing and intervention with remedial plans needing to be individualised. Evidence shows it is important that there are a range of intervention strategies used to meet the living and learning needs of the child. These include visual, environmental, teaching and learning strategies. Personal FM systems are reported as the intervention option to provide the most benefit, for the most children, but that they should not be used on their own without other inputs or strategies.

² Ministry of Health and Ministry of Education Communication Update on APD, May 2013

There is also evidence that over time for some children the continued use of a FM system can improve neuro-plasticity, learning, behaviour and psycho social wellbeing. This means over time some children may no longer need the use of a personal FM system. However in the first instance the primary purpose of the FM system is to improve the speech (e.g. parent or teacher voice) to noise (e.g. background noise) ratio so children can hear.

There are various international Guidelines and Consensus Statements, but of importance, they don't have consensus between them regarding specific aspects of diagnostic testing or treatment.

The impact or effect of APD can create difficulty in hearing, akin to a peripheral hearing loss, causing hearing and learning impairments. The negative impact APD can have on language and reading has also been reported.

New Zealand Context

Prevalence

Prevalence predictions vary widely. For New Zealand there is some consensus by expert stakeholders that in the general child population prevalence is around 5%. There is emerging research from South Auckland that has been presented at conferences but is as yet unpublished, that for the Pacific Island child population it is much higher, in the vicinity of 35% (six times the general population). Of interest, internationally it has been reported that minority populations present greater incidence and prevalence of many known or presumed risk factors for (C)APD³.

System for Diagnosis

DHB and private or academic clinics are where the testing and diagnosis and some of the planning occurs (including some information and advice for parents). There is no defined pathway for intervention strategies but the Ministry of Education takes responsibility for assisting some students with hearing loss to access the curriculum. In that role the Ministry of Education funds personal FM systems to assist children with the greatest learning needs to access the curriculum. Access is based on eligibility criteria and not all children diagnosed with APD and / or who are referred by an audiologist, will be eligible for publicly funded FM devices.

The system spans public health (personal health via District Health Board and disability supports) and the compulsory education sectors. In addition there are practitioners working in private or academic clinic capacities.

The disciplines involved in health for diagnosis of APD is always include an audiologist, and at times other disciplines may be involved such as speech language therapists, psychologists or (less commonly) medical specialists (paediatricians, otolaryngologists, paediatric neurologists). The disciplines involved in schools for trialing an FM system (to assess learning outcome gains by the use of the FM system) and any subsequent application for a personal FM system are typically a teacher who may be in one of a variety of roles (e.g.

³ CAPD refers to the disorder previously being referred to as Central Auditory Processing Disorder.

teaching, principals, special education needs coordinators (SENCO), resource teachers: learning (RTLB) and behaviour and Advisers on Deaf children (AODC). There may be at times educational psychology or speech language therapy involved, but this is not the norm.

It is understood⁴ that six of the 20 District Health Boards (DHBs) provide publically-funded access to testing and diagnostic services, with an additional two paying for private clinics to undertake tests. There are various private services and two Universities (working in a private clinic capacity) providing testing and diagnostic services, but this does not give equal opportunity to access across New Zealand. Currently there is no national overview or coordination of these services.

Due to the complexity of the testing and the lack of international consensus, there is no definitive consensus on which battery of tests to use for diagnosis. There is a lack of specific training for audiologists in APD beyond what is provided in audiology academic programmes. This results in the quality of testing in New Zealand being variable and hence a risk of both under and over diagnosis occurring. Some audiologists recognise this skill gap and refer more complex cases to a centre specialising in APD. As in other complex areas in audiology, peer review of complex APD cases is recommended by the professional body, the New Zealand Audiological Society.

Even where DHBs are undertaking testing, it is reported by some stakeholders that children with suspected APD get a lower priority than all others (children and adults) on a waiting list. This can mean long waiting times, and parents report expensive costs to try and access private services. Some parents cannot afford the private costs or cost of travel to an assessment service, so the children may miss out. There were three reports in this review of resource teachers of learning and behaviour having assisted with access to school funding for private testing, on a one off ad hoc basis.

The barrier to DHBs and private services undertaking testing and diagnostic services is reported by them as being time and cost. For example audiologists report that they can test between four to six children with other hearing losses in the same time it takes to test one child with APD. In addition private practices report they have trouble charging enough to cover costs and that is why some choose not to do the APD tests and / or if they do, refer to other centres for more in depth testing. Note: The time and cost aspect was reported by the majority of stakeholders. There is a move in the literature to develop more efficient diagnostic test batteries that may improve this somewhat, however testing for APD will always be more time consuming and complex than a simple hearing test.

Another issue reported by stakeholders is the difficulty at times of interpreting the audiologists' reports and some of the terminology used in them. Examples given relate to medical language that Ministry of Education staff have to interpret and not seeing a definitive "formal" diagnosis of APD on the report.

All of this leads to creating inequities of access to diagnostic services. This is both geographic (i.e. some areas are testing, either or both public and private) and socio economic (i.e. some families can afford to pay privately and some can't).

⁴ Correspondence with Flora Kay, audiologist Hutt Valley DHB, re District Health Boards undertaking APD testing

Education - access to the curriculum

The Ministry of Education is the part of the system which funds personal FM devices for those eligible children. Other strategies to allow students with hearing loss to access the curriculum are variable and not always assessed for, including support for teachers and schools, classroom amplification systems based on individual school based funding priorities and decisions. Knowledge of APD and mitigation strategies varies across the Ministry of Education and school system and within individual schools.

Due to the Ministry of Education criteria, diagnosis of APD along with an audiologist's recommendation for an FM system does not lead to automatic funding for a personal FM device. The Ministry of Education only provides funding for those with the greatest learning needs and a large number of students who are diagnosed with APD are not identified by their schools as having the greatest learning needs. This is a significant point of tension between Ministry of Education policy and most other stakeholders, who would seek public funding for FM systems, and feel the criteria does not meet the needs for children with APD, creating an inequitable and unfair system.

Note: The Ministry of Education also funds personal FM systems for other children with other sensory hearing losses who have a learning need and may benefit from them. There is a protocol between the Ministries of Health and Education which clarifies their respective roles and responsibilities based on the primary need for the device, with the Ministry of Education funding when the primary need is access for learning in the classroom.

Navigating the System

Parents and stakeholders report extreme difficulty and frustration in navigating and accessing the system, across both the health and education sectors. It is very expensive for some families if they are not able to access publically funded testing, diagnosis services, interventions and devices. Most parents interviewed reported significant stress and frustration in their lives and major negative impacts on their children. Impacts included significant loss of confidence, unwillingness to attend school, fatigue, loss of social skills and frustration. Some reported depression in their children.

FM systems

Nationally, the Ministry of Education funded 51 FM systems for students with APD and over 200 FM systems for all students with sensorineural hearing loss in the 14 months from January 2012 to April 2013.

There is a protocol in place between the Ministries of Health and Education relating to respective roles and responsibilities for funding for sensorineural hearing loss, which has been in place since the late 1990's. Apart from a short period in the late 2000's when the Ministry of Health funded some FM systems due to some confusion about terminology, all FMs for school aged children have been allocated through the Ministry of Education.

Although good practice would mean there should be a range of strategies engaged in intervention, by far the highest profile and most controversial one in New Zealand at the time of writing is publically funded access to personal FM systems. Controversy from many stakeholders exists with four key aspects of funding and allocation of FM systems for APD..

First, Ministry of Education’s eligibility criteria mean that only some students with APD are eligible for publically funded FM systems. In summary Ministry of Education’s eligibility targets only those who have significant learning difficulties, as identified by the school. Those who have significant learning difficulties may be given extra support either through allocation of school resources (such as teacher’s aide time) or through special education practitioners employed through Education initiatives such as Resource Teachers – Learning and Behaviour (RTLB), Speech Language Therapists (SLT) support or On-going Resourcing Scheme (ORS) and at least one of these is required to be in place for a child to be considered eligible for access to a FM device⁵.

Second, schools are involved in trialling, fitting and managing FM systems, in accordance with the Ministry of Education’s eligibility criteria of allocating FM systems based on the greatest learning needs. The purpose of the trial is to see if the FM system makes a difference to learning outcomes (the trial does not assess hearing).

Third, the general lack of awareness of APD in the education sector means that students with APD may not be identified and even when identified, not all intervention strategies are consistently deployed in the school setting, with or without personal FM devices being involved.)

Fourth, that there is variation in how the Ministry of Education policy is operationalised in schools regarding when a school will let a child use the personal FM outside of the primary classroom. This is both within the school (e.g. for assembly) and in the wider community. In some cases this can be due to difficulties or confusion regarding insurance requirements for the equipment.

In addition, three parents interviewed had had both positive and negative experiences at different schools with their child, leading them to conclude that schools can provide a variety of different learning and physical environments that can address children’s different needs in different ways.

Home Schooling

It is acknowledged the sample of parent interviews is small (n=14) and may be skewed due to self-selection. However, of note is that eight of the 14 are or have been home schooling their child/children with APD. Of these, four gave up employment to do so. The reasons for home schooling were given as trying to reduce the extreme stress for their child in attending school, schools / teachers not believing in APD so not willing to assist through to their child being bullied for being “dumb”.

Findings

Key findings

Overall there is a lack of international and national consensus on aspects of the system relating to APD such as how to diagnose, intervention strategies and how to achieve best

⁵ Ministry of Education, Assistive Technology Guidelines, 2012

outcomes for children with APD. In addition there is a lack of practical understanding of APD in those that work with children in New Zealand schools.

Due to the lack of consensus the area of APD is fraught with issues and the divisions of the Ministry of Health and Ministry of Education who commissioned this research cannot solve all of these within their own remits. There will need to be further work to establish consensus and a pathway forward in New Zealand. To this end this report recommends a national expert Reference Group be established.

Science and evidence

1. Science and evidence on APD has developed over the past decade and therefore there is a changed environment in which to understand and work with children with APD across the continuum (testing, diagnosis, intervention, follow up, outcomes). Some literature notes audition is pivotal for communication and learning.
2. Evidence and stakeholder input noted that APD is a hearing impairment or disorder and the impact of this is a negative impact on hearing, at variable levels for different children, as is the case for sensorineural hearing loss.
3. Overall, New Zealand should be up to date and remain more contemporary and conversant with evolving evidence based practice across all parts of the systems that affect children with APD, to provide more consistent access to higher quality services.
4. There are various international APD Guidelines or Consensus Statements, some of which contradict each other. The stakeholders interviewed had a general consensus that the American Academy of Audiology Guideline (2010) (the AAA Guideline⁶) is the one that New Zealand should work to in the interim before more consensus is gained
5. Evidence strongly shows that APD in individuals is heterogeneous and therefore intervention strategies should be individually planned and evaluated and that a multidisciplinary approach is needed.

Access and awareness in New Zealand

6. The system in New Zealand for children with APD and their parents is fragmented, difficult to access, confusing and inequitable in both access and outcome.
7. There is an opportunity in New Zealand to take a national expert approach (if possible across the health and education sectors and including other key stakeholders, i.e. a national expert reference group is established) to improving quality and access to services for children with suspected or diagnosed APD. It is suggested there could be a role for the relevant national professional body to assist, namely the New Zealand Audiological Society. Four topics suggested to start with include:
 - (i) Audiology workforce – to improve access to quality testing, diagnosis and treatment.

⁶ From interviews this appears to be the most widely respected Guideline in New Zealand.

- (ii) Testing and diagnosis – developing a consensus statement on the battery of tests and who should use them
 - (iii) APD diagnostic reporting – quality, clarity and consistency and to be “fit for purpose” for the organisation receiving them
 - (iv) How the parts of the system can work better together to ensure a child centric focus i.e. across diagnosis and intervention strategies
8. Parents should be offered high quality contemporary information on APD and what is available in New Zealand to support them and their child, who is eligible for public funding and how to access it.
 9. Ministry of Education and school staff who work with children with APD, including classroom teachers, should have access to high quality resources to assist with supporting children with APD.
 10. Of note is the emerging evidence of the higher prevalence of APD in Pacific children, and likely Māori. Planners should continue to link with the Pacific Island Family Research and consider strategies for targeting high incidence areas and schools to provide support. Research is needed to determine the prevalence of APD in Māori.

Suite of Intervention Strategies

11. There is a suite of intervention strategies to assist with APD including addressing classroom acoustics, teaching strategies, parenting strategies and other learning and listening therapies. The suite includes hearing devices such as the personal FM system. Due to the heterogeneous nature of APD and the individual nature of the child and their learning needs an individual plan should be in place, to determine and assess the mix of strategies that is best for the individual child.
12. Other hearing or amplification systems can be used such as personal hearing aids or classroom amplification systems. However the evidence supports personal FM systems as being of most beneficial (parent interviews, research and stakeholder interviews) for most children, but not all children.
13. The suite of strategies for children with APD should also include at the outset, the assessment of the acoustics and sound levels in the classroom⁷. This would benefit all children and teachers as well.

Personal FM Devices

14. Personal FM systems provide the best singular remedial intervention for most (but not all) children with APD.

⁷ BRANZ Designing Quality Learning Spaces: Acoustics

15. There is general agreement from stakeholders that Personal FM systems do also provide some level of amplification (this can be verified electro acoustically). This means that the speech coming through microphone to the ear is amplified.
16. Provision of a personal FM system, or not, should be based on a child centric team approach, across the diagnosis and intervention parts of the system, with information and recommendations by personnel experienced in audiology and APD, and also including the funders (i.e. Ministry of Education's) current eligibility criteria.
17. Consideration should include a holistic approach to a child, including outside of the classroom. The ability to benefit from the device and the impact on their life with and without it should be considered, including considering the views of the parents⁸.

Roles and responsibilities

18. There is a significant philosophical difference in expectations from stakeholders and the Ministry of Education in how resource allocation is targeted (i.e. who gets what, when) and what the majority of stakeholders perceived to be necessary and fair.
19. Assessing, application for, trialling and fitting of hearing devices in children should include audiology and people who have knowledge in APD, with clarity between the role of the audiologist and that of Ministry of Education's eligibility criteria for access to public funding for personal FM devices.
20. One aspect of this review was to comment on was the relative roles of Ministries of Health and Education in the future and a future Pathway. This cannot be done at this point as there was no consensus between stakeholders on this topic, however by far the majority of stakeholders considered that all of the system should sit with the Ministry of Health, although a few said it didn't matter who was the funder and an even smaller number said it should be Ministry of Education due to their rationale of personal FM systems being the primary purpose for classroom learning. Rationales for suggesting the Ministry of Health varied and included that it aligns with other management of hearing assessment and devices, a more holistic approach, reduction of fragmentation between two systems through to relative ease of access in Ministry of Health compared to the Ministry of Education. Lastly the position of some stakeholders, especially parents, is that the child's need is for whole of life, not a singular primary need only in the classroom. As this point held no consensus between all stakeholders and that the wider policy and funding implications if Ministry of Health did take on this responsibility means that further work is required before any decisions are made.

⁸ Note all parents interviewed, except one, whose child had a personal FM system reported the importance of their child having access to it outside the classroom. This was for other educational pursuits and also home and wider community life. For some it was a safety issue.

Summary of Conclusions

The summary of Key Conclusions is:

- Internationally there is a lack of consensus on many aspects of the APD continuum, however work continues in this field
- In New Zealand there is a general lack of recognition and understanding of APD – in the general community, families, and many health and education professionals
- The exception to non-consensus is that there are issues with the current system that need addressed – stakeholders want things to be improved for children and families as well as workforce
- This research ended up taking a broader approach than the original scope of the project due to the complexity of the topic and non-consensus of the issues
- Of note re scope is that the divisions of Disability Support Services of the Ministry of Health and Sector Enablement and Support of the Ministry of Education commissioned this project but that they are not responsible for some parts of the findings e.g. diagnosis
- There are inequities of access for both diagnosis and access to funded personal FM devices and implementation of other parts of a suite of strategies
- The contract for this project asked for a Pathway to be detailed. This could not be done due to the complexity and non-consensus. However it is believed there is a genuine willingness in the Sectors to resolve this and therefore establishment of a national expert reference group is recommended. This research is a step in a many faceted stream of work to address the issues
- Personal FM systems are only one aspect of a suite of strategies children may need for intervention for APD. However the fact that more children may benefit from a personal FM system than the Ministry of Education eligibility targeting criteria funds is a contention and tension with some stakeholders and families

The review was to answer four specific questions. The following table is a summary of the findings and addresses those questions.

	Question	Summary
1	What the prevalence of APD is in New Zealand and how are children’s needs identified and diagnosed	<ul style="list-style-type: none"> • Prevalence in New Zealand is thought to be around 5% for the general population with emerging evidence showing it could be up to 6 times higher for the Pacific Island child population (this may well be able to be extrapolated to the Maori child population due to similar genetic and health characteristics) • However overall prevalence may well be under represented due to variable diagnostic coverage and quality of services in New Zealand • Assessment and diagnosis is done by audiologists in a

		<p>public or private capacity but there is no national coverage agreements or services, creating inequities of access for children and families</p> <ul style="list-style-type: none"> • The system for identifying and diagnosing children’s needs is fragmented, difficult to navigate and access is inequitable across New Zealand • Where services are in place they are variable in quality and outcome creating an inequity of access and outcome
2	Are the needs of children with APD being met or is there an unmet need or service gaps	<ul style="list-style-type: none"> • For the majority of children with APD their needs are not being met across the continuum of assessment, diagnosis and intervention / management • There are service gaps across the continuum creating inequity of access and outcome. Gaps are caused by workforce skill gaps, not all DHBs providing APD assessment services (i.e. publically funded and geographic gaps), and the cost of providing quality APD assessment services being prohibitive for some services and for many families as private payers • There is an overall lack of awareness of APD across the system and in the community • Information gaps about APD exist in the health, education and school sectors as well as in the general community. This can mean lost opportunities for identification of APD in children • Only children who have significant learning needs (as determined by the school and special education practitioners) associated with their APD are eligible for public funded FM systems via the Ministry of Education • A further large group are not eligible for public funding via the Ministry of Education and costs make FM private purchase prohibitive for many families
3	Does the provision of hearing devices add value in the treatment / management of APD and are there other treatment or management options that would assist	<ul style="list-style-type: none"> • Yes hearing devices add value in management of APD for most children (but due to the heterogeneous nature not all children) • Other intervention / management options include strategies such as addressing acoustics and noise levels in classrooms and other environments, teacher or parent strategies, listening strategies, positioning in relation to the speaker and visual cues or strategies. • In addition some courses and therapies may assist

		<p>some children. These are not mutually exclusive to each other and / or the use of hearing devices, and some may work better for some children than others</p> <ul style="list-style-type: none"> • There is no consensus on the value of various web based or computer strategies / programmes
4	<p>If it is clearly established that hearing devices are beneficial to children, what type of devices could be funded and by which agency – subject to budgetary constraints</p>	<ul style="list-style-type: none"> • Yes it is clearly established that hearing devices are beneficial to most (but not necessarily all) children with APD • Personal FM systems as the best for most children, but there is increasing anecdotal, case-based evidence that other hearing devices, e.g. hearing aids can assist some children, as evidenced by some of the stakeholder feedback, e.g. audiologists, families. Hearing aids do not provide the same signal to noise ratio advantage as personal FM systems and there is only one, low-quality study reported in the literature on hearing aids as a treatment for APD, hence hearing aids would typically only be considered where there are specific reasons for a personal FM system not being an appropriate treatment in an individual case. Through the review, various interviewees could recount individual examples where hearing aids did provide some of the benefit being sought. • Which agency should fund requires more policy and financial work • Due to the non-consensus on some aspects of APD diagnosis and treatment, without further exploration and consensus, it is not possible to make a definitive statement or recommendation re a future Pathway. However it is recommended that there is a national expert reference group set up to consider some of the issues and to aim to reach a consensus statement.

1. Background

The Ministries of Health and Education are seeking to identify the latest research, best practice guidelines and evidence to inform policy development in the provision of hearing devices for children with Auditory Processing Disorder (APD). Such policy development is undertaken to ensure that the children with the greatest need get access to appropriate hearing devices.

A decision was therefore made by both Ministries to jointly undertake an independent review of APD services and the system in New Zealand, specifically relating to the funding and supply of hearing devices. As a result of this review, this paper has been developed identifying best practice and making recommendations for the management of APD and, in particular, the provision of hearing devices for children with APD.

Over the past decade international and national research and knowledge of APD has increased. This paper briefly summarises this and the situation in New Zealand and note how services and supports in New Zealand could improve for children with APD in the future.

2. Methodology

2.1 Mixed methodology

This was a qualitative review using a mixed methodology that included:

1. Interviews with a sample of parents of children with APD

Parents were recruited via a variety of methods including referral by audiologists, personal networks of key stakeholders, NGOs and via the Australia New Zealand APD Facebook Page

Interviews were via telephone with one being in person. The sample was from across the North Island as no South Island parents came forward.

In total 14 parents were interviewed.

2. Interviews with selected key stakeholders including:

- Academics and researchers
- Health professionals e.g. audiologists, speech language therapists
- Ministry of Education professionals e.g. advisors of deaf children, assistive technology coordinators
- Non-Government Organisations
- Suppliers of hearing products
- Funders: Ministry of Health and the Ministry of Education
- Accessable, the Ministry of Health's contracted provider for the management and provision of hearing aids

Names of those to contact were given originally by the Ministry of Health and Ministry of Education. The list grew as stakeholders recommended others. In total 32 stakeholders were interviewed (other than parents).

3. Electronic web based survey for stakeholders

A web based survey was advertised via the New Zealand Audiological Society and via Ministry of Education networks. The survey ran between the dates of 18 June 2013 and 28 June 2013. In total 175 people responded to the survey from all across New Zealand, the majority being audiologists or those in educational and school specialist roles.

4. Selected literature summary

Health, education and research stakeholders, as well as the Ministry of Health and the Ministry of Education gave literature they regarded as important to Sapere. A full international literature review was not within scope. Over 75 articles and texts were reviewed with consideration for robust research methodologies and articles. The requirement was specifically to look at literature within the past five years; however

expert stakeholders referred Sapere to other regarded and cited literature that may have been older than that. Aiming to get the best possible outcome for the research, this regarded or well cited literature was included.

Once all these inputs were gathered thematic analysis was undertaken.

2.2 Scope

2.2.1 In scope

The project scope was:

“The Ministries of Health and Education are seeking to identify the latest research, best practice guidelines and evidence to inform policy development in the provision of hearing devices for children with Auditory Processing Disorder (APD). Such policy development is undertaken to ensure that the children with the greatest needs get access to appropriate hearing devices.

A decision was therefore made by both Ministries to jointly undertake an independent review of APD. As a result of this review, a paper will be developed which will identify best practice and make recommendations for the management of APD and, in particular, the provision of hearing devices for children with APD”⁹.

Therefore the scope is to focus on:

- Policy development;
- For the provision of hearing devices;
- So the children with the greatest need get access to appropriate hearing devices.

However to address this there are links across the continuum of the system from assessment and diagnosis of APD, workforce, information and advice for parents, application for, trial and provision of hearing devices, strategies to assist children with APD, teaching and follow up. Therefore although not the focus, it is necessary this paper makes comment on those aspects as well.

2.2.2 Out of scope

The divisions of the Ministries of Health and Education who contracted this research were parts of the wider Ministries, namely, Disability Support Services of the Ministry of Health and the Sector Enablement and Support of the Ministry of Education. Although this report comments on wider aspects of the systems (e.g. assessment and diagnosis which is part of

⁹ Ministry of Education and Ministry of Health Communication Update, May 2013.

personal health, not Disability Support Services, in the Ministry of Health) and schools (such as teacher awareness of strategies for APD and classroom acoustics) technically this was not in scope for the project and the two divisions of the Ministries have advised they are not responsible for these other areas, even though they relate to APD.

APD does not necessarily cease to exist upon entry to adolescence and young adulthood, but APD in adults was out of scope.

Several stakeholders were keen for this project to consider the medium to long term impact for people with APD in their long term educational, employment, career and life choices and life outcomes. An example that was repeatedly raised was the assumption that a high percentage of the prison population has APD that was not diagnosed or addressed in childhood. In addition in teenage boys who are incarcerated there is potentially a high number who might have a hearing issue, including APD. These topics were outside the scope of this project.

In addition the physical and pre-natal development of APD in children is outside of the scope.

3. History and context

3.1 What is APD?

As noted in the Sharma, Purdy and Kelly paper (2009) APD has been defined by the American Speech-Language-Hearing Association (ASHA) Task Force on Central Auditory Processing Consensus Development (1996) (the ASHA Task Force) as problems in one or more of the following auditory behaviours: sound localization and lateralization, auditory discrimination, auditory pattern recognition, temporal aspects of audition, and auditory performance decrements with competing acoustic signals and degraded acoustic signals.

Because of the complexity of auditory processing and the heterogeneity of APD, the ASHA Task Force recommended that clinical tests for APD include temporal processing, localization and lateralization, perception of low-redundancy monaural speech, dichotic listening, and binaural interaction.

Typically the literature and many stakeholders interviewed noted the main issue was hearing sound in noisy environments, such as, but not limited to, school classrooms. It is also important to note that APD is not a disorder with heterogeneity, which means that APD is complex, difficult to diagnose correctly in all situations and may manifest differently in individual children (Sharma, Purdy Kelly, 2009); Musiek and Chermak, vol I, 2007).

One stakeholder's description, in lay person's terms, described people with APD as having to interpret "*What that sound is, where it came from and when it occurred?*" Once this has happened the auditory system then hands over to the "*attention, memory and language*" processes. This is how it can be seen that any combination of these disorders may coexist or not, and may or may not aggravate each other.

Missed diagnosis can often be labelled as children being uncooperative "*They just don't listen!*" and "*He is just obstructive*" through to having moderate to severe behaviour or attention issues

in class and or at home. It is important that a holistic approach for a child is taken so that all needs can be addressed for the best outcome for the child.

Testing for APD can show two children with identical results but when language, memory, cognitive or other issues are also considered there could be significant differences in impact. Co morbidities and individual differences are important to understand.

3.2 Evolving APD science and research

The science surrounding APD is relatively new in terms of the history of the world's medical developments. It is an evolving science and the body of knowledge continues to be researched and grows over time. Various clinical and academic disciplines are interested in APD and have at times differing positions e.g. audiology, speech language, psychology, acoustics, sound engineering, etc.

The American Academy of Audiology Guideline (2010) (the AAA Guideline¹⁰) summarises the recent growth in awareness of APD as:

“Intervention for (C¹¹)APD has received much attention recently due to advances in neuroscience demonstrating the key role of auditory plasticity in producing behavioural change through intensive training. With the documented potential of a variety of auditory training procedures to enhance auditory processes, the opportunity now exists to change the brain, and in turn, the individual's auditory behaviour through a variety of multidisciplinary approaches that target specific auditory deficits. Customizing therapy to meet the client's profile (e.g., age, cognition, language, intellectual capacity, co-morbid conditions) and functional deficits typically involves a combination of bottom-up and top-down approaches.

In addition to auditory training, the management of acoustic conditions (e.g., classroom acoustics) and signals (e.g., through high fidelity listening devices), coupled with educational, cognitive, language, metacognitive, and metalinguistic strategies can serve to reduce auditory deficits and lead to more effective listening, communication, and learning.

While there has been significant progress in professional education and training in (C)APD, as evidenced by the increasing number of conference presentations, published articles, and professional association reports on this topic, there remains a documented need for additional improvements in this area at the graduate education level and through continuing education. In particular, additional course work in the basic sciences will provide clinicians with the knowledge needed to critically apply diagnostic tools and treatment strategies.

¹⁰ From interviews this appears to be the most widely respected Guideline in New Zealand.

¹¹ (C) referring to the fact APD used to be called Central (C) Auditory Processing Disorder, and is still called this in some parts of the world. The term APD is used in NZ based on the recommendation of Professors Musiek and Jerger (2000) [from Consensus Conference on APD held at the Callier Center in Dallas (http://www.bsnpa.org/geeklog/public_html/filemgmt/filemgmt_data/files/Auditory_Processing_Disorders_in_Children.pdf)

Among the most pressing professional issues is the lack of intensive treatment provided in schools. Ironically, although large numbers of individuals with (C)APD are children in schools, current school policies and caseloads do not support the intensive training required for cortical reorganization and behavioral change.” Page 3.

The Canadian Association of Speech Language Pathologists and Audiologists in the Canadian Guideline on Auditory Processing Disorder in Children and Adults (2012) (the Canadian Guideline) notes:

“The document aims to introduce a theoretical ecological framework that considers the Canadian context, and takes into account changes in audiology practice environments, the most recent international recommendations regarding auditory processing disorder, changes in general approaches to health and advances in relevant sciences (such as cognitive hearing science and cognitive neuroscience). It is based on the foundation laid by the World Health Organization International Classification of Functioning, Disability and Health, or ICF (WHO, 2002). The ICF has functional health as its primary focus, and emphasizes the importance of the interaction between an individual’s health conditions or status, and the contextual factors around him/her. This report is based on a perspective that shifts the focus from cause to impact, from biological dysfunction to an individual’s ability to participate fully in his/her own life and in society; it emphasizes the importance of thinking about auditory processing as a part of the construct of cognitive hearing science, which considers the interaction between hearing and cognition.” Page 5.

One stakeholder interviewed noted the following (summarised from the interview for this paper):

There are five historical positions and approaches on APD, starting from the 1940’s and 1950’s.

- (a) The Psychologist / Educational approach. This notes that auditory processing is made up of discreet measurable skills (i.e. separable skills). This was based on early 1900’s work linking brain injury for the first time to behavioural change and made a link between neuro-anatomy and behaviours.
- (b) The Audiological position. That APD is a site of lesion in the audiological nervous system.
- (c) Speech Pathology and Linguistics position. This promulgates that APD is a breakdown in auditory processing and that it can cause language disorders. This position is less well supported now as it is mainly thought auditory processing in itself does not cause language disorders, but it may well be a risk factor.
- (d) Auditory Attention position. This is relatively new and is being promulgated by a lead researcher in the United Kingdom (David Moore, now based in Cincinnati).
- (e) Non Definition. Still being developed and not yet defined but that APD should not be defined but just measure the child’s listening levels and address that (being led by Harvey Dillon, Australia). This is a flow chart type approach that tries to determine the most efficient method for diagnosing children with classroom listening difficulties, without consideration of cause.

Considering these five approaches there has been the development of four major evidence based guidelines or country specific consensus papers.

- (a) The American Academy of Audiology (AAA) Clinical Practice Guidelines (2010), overall supports the audiological position re site of lesion, with some psycho-educational links.
- (b) The United Kingdom Position Paper (2011) tries to consider many aspects of the five approaches above but “is most loyal” to the auditory attention theory.
- (c) The Canadian Guideline (2012) is in-between the AAA and the United Kingdom guideline.
- (d) The German Guideline of the Society for the Phoniatriy and Pedaudiology says they align with the AAA guidelines but also draw from others¹². There is one distinctive difference from the AAA Guideline, in that they perceive APD as broader than just linked to the audiological nervous system. The German Guideline leaves out the term “central” (when compared to the American, who use the term (Central) Auditory Processing Disorder) because it implies that the condition finds it root in the productivity and effectiveness of the central nervous system, which the Germans say is not in line with current research. The Germans put similar emphasis on the “perception of sound” as on the “processing of sound”. This can also be seen in the terminology they use: Audiological Processing and Perception Disorder. This places emphasis on the link between the auditory periphery and processing within the central nervous system.

The interviewee who noted all this also notes that due to the population having APD not being homogenous all the guidelines or positions, this could all be right to some extent. The majority of stakeholders interviewed in New Zealand for this project, noted their alignment and respect for the AAA Guideline.

It is reported (anecdotally by one stakeholder) that Frank Musiek, a prominent author on APD, said in one of his conference deliveries, “*Don't use the word 'consensus' when talking APD*”. Since then, however, the inaugural CAPD Global Conference was held in 2012 in association with the AAA annual conference in North America and a second CAPD Global Conference will be held in 2014, as part of international efforts to improve consensus.

3.3 Age of Diagnosis

“The term, diagnosis, refers to the identification and categorization of impairment or dysfunction, often providing a description of auditory strengths and weaknesses”.
(AAA Guideline page 5)

¹² <http://www.ncbi.nlm.nih.gov/pubmed/21647834>

The Ministry of Education requires a “formal diagnosis”¹³ of APD before a child can be considered eligible for Ministry of Education support, e.g. for a trial of a personal FM system.

At times it is more clinically appropriate for an audiologist not to make a definitive diagnosis of APD. Instead they may state the tests show outcomes in line with APD. This is an issue for two groups of students:

1. Those under seven years of age. The AAA Guideline notes it is recommended not to diagnose before age seven, however this is receiving more discussion in recent literature linked to developmental age and type of tests, and newly available tests suitable for younger ages.

For example there are increasing tests that are age standardised for lower ages, and it will also depend on the child’s developmental age, not chronological age. That is another reason why the choice of the test battery is important. e.g:

The SCAN3C diagnostic test battery is now normed down to age 5 and also provides qualitative information down to age 3.

The LiSN-S Test is normed down to age 6.

2. Those children who have other learning or communication difficulties. As the test for APD are behavioural and norm referenced it is difficult to provide definitive diagnosis for this group. Typically children with APD show a variable pattern of performance across different assessments, showing deficits in some areas only. One approach that is used clinically to determine the validity of APD test results when assessing children with learning difficulties is to check that they are able to complete all the tasks, they do pass some of the assessments, but have performance outside the normal range for other assessments.

Many felt that due to New Zealand’s typical focus on early intervention that it is not reasonable for families and services to wait until a formal diagnosis is made at 7 years, if something can be achieved earlier.

There has been some effort to develop screening tools suitable for younger children (e.g. Auditory Skills Assessment (ASA) Author(s): Donna Geffner, PhD & Ronald Goldman, PhD) “Screen children as young as 3 years 6 months for early auditory and phonological skills — and get fast results to put children on the right track.” This test has been used clinically in New Zealand and has been positively received but has not been independently verified with New Zealand children.

¹³ APD fact sheet

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/SpecialEducation/ServicesAndSupport/AssistiveTechnology/AssistiveTechnologyFactsheets.aspx>

4. Prevalence and cause

4.1 Prevalence

Lack of agreement

There is no international agreement on prevalence of APD, mainly due to a lack of large scale studies measuring prevalence. There is also a variation in the test batteries used and therefore how fail or pass criteria are applied. In addition research literature shows the use of non-comparable research cohorts, which therefore may lead to variable prevalence estimates. It is also thought many cases in children may go undetected and they may get labelled with other issues, for example attention deficit disorder (ADD) or autism spectrum disorder (ASD). Gifted, or intellectually able children, children with good family and educational support may develop their own strategies to compensate for APD at school; occasionally these children present clinically as adults when they are no longer able to manage their auditory difficulties due to workplace listening demands.

One well cited American study estimated APD affects 2-3% of children with a 2-to-1 ratio between boys and girls (Chermak and Musiek, 1997). Other research has estimated the prevalence of APD in the paediatric population to be around 3-5% (Santucci, 2003).

More recently, estimates of childhood APD prevalence in the general population have been proposed with some New Zealand experts suggesting that likely prevalence is 5%¹⁴.

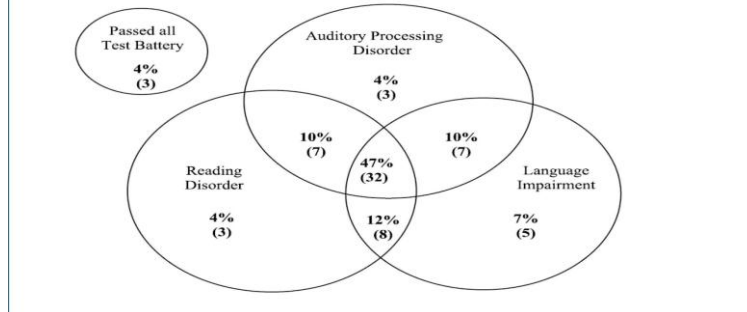
In general, estimates of APD prevalence in the older adult population have been higher than in children. Reports vary, ranging from well over 50% in clinical studies (Stach et al, 1990) to around 23% in a longitudinal population study (Cooper & Gates, 1991).

Co morbidities

Auditory Processing Disorder often occurs in conjunction with other disorders like dyslexia, ADD, attention deficit hyperactivity disorder (ADHD), language impairment, autism spectrum disorder (ASD) and / or reading disorders. A well cited University of Auckland study found 94% of children with APD also had language impairment and/or a reading disorder (Sharma, Purdy, Kelly, 2009). But it is not known about the cause and effect and if the language and learning difficulties may be caused by the APD. Causality is difficult to establish as research in APD is primarily based on cross-sectional rather than prospective longitudinal studies.

¹⁴ Personal communication with Dr Suzanne Purdy and Dr Bill Keith

SHARMA M., PURDY S.C., KELLY A.S. (2009). Co-morbidity of auditory processing, language, and reading disorders. *Journal of Speech-Language-Hearing Research*, 52, 706–722.



Results from the 2006 Statistics New Zealand disability survey (SNZ, 2007) reported learning disability¹⁵ prevalence estimates of 10-14 year olds of 5.8% in Maori, 4.9% in non-Maori and 5.2% in the total population. Pacific estimates were not reported, but assuming that Pacific children have the same learning disability prevalence as Maori children the non-Maori/non-Pacific prevalence of 10-14 year olds would have been 4.8 % resulting in a prevalence ratio of 1.19. This evidence supports that Maori have higher levels of learning disabilities than non-Maori in New Zealand. Through the co-morbid association of these conditions with APD there is the possibility in New Zealand that Maori have higher APD prevalence than non-Maori.

As yet unpublished (as they are still completing the study but early findings have been presented at a professional conference) results of research carried out in New Zealand on a cohort of Pacific Island children¹⁶ who underwent a range of audiology tests of auditory processing reported high levels of difficulty. Dependent on the specific test, from 14% to 49% of this cohort had results poorer than a two standard deviation normative cut-off. In addition the study estimates prevalence in this cohort of Pacific children at 35.5% based on the percentage failing two or more of the four tests (performance two standard deviations or more below the norm). The reasons are still being explored but based on literature to date it may be linked to higher incidence of otitis media (glue ear), maternal health, early nutrition and living conditions. This will be an important piece of research for the planners for APD to keep abreast of.

In this report we have opted for what could be viewed as a conservative approach when determining prevalence and services gaps, except in the case of Pacific children where we have a specific estimate of prevalence. We have tested two prevalence scenarios based on slightly different formulations of the information available.

Firstly, in scenario one, we can assume an overall prevalence of 5% (based on expert advice) for the general New Zealand population of children aged 6-14 years. This assumes no difference in prevalence between Māori and NZ European children and takes into account

¹⁵ Learning disability in this survey was classified as ADHD, ADD and/or Dyslexia

¹⁶ Personal communication with Dr Suzanne Purdy, lead investigator on the Pacific Island Families Study

evidence that APD prevalence for Pacific children is maybe six times that of non-Pacific children. This is based on the few studies of childhood prevalence of APD available, ranging between 2% and 5%. It was felt this estimate was too low, however, and that not having a differential prevalence of APD between Māori and other ethnic groups is unrealistic.

In the second scenario, we let the total prevalence vary, set the Pacific childhood APD prevalence to 35.5%, the Maori children’s APD prevalence to 5% and the children of other ethnic groups APD prevalence to 2%. This results in an overall New Zealand childhood prevalence of 6.2%. Alternatively expressed as counts, about 6,350 Maori children, 18,700 Pacific children, 6,800 children of other ethnic groups equating to 31,850 thousand children overall¹⁷.

The results from scenario two are presented in Table 1. This is not the exact ethnic-specific prevalence of APD in New Zealand in 2013 but we believe it is the best that can be offered at present and that it will suffice for the purposes of reflecting the number of children with APD and the service gaps.

Table 1 Estimated childhood APD prevalence in New Zealand - 2013

Estimated 6-14 year old population	126,850	52,740	340,290	519,880
Estimated prevalence (%)	5.0%	35.5%	2.0%	6.2%
Estimated prevalence (n)	6,343	18,723	6,806	31,871

Source: Statistics New Zealand population estimates 2013 and Sapere analysis

Ministry of Education funded students with APD

The Ministry of Education funded 70 students for assistive technology (personal FM systems or FM systems for children with APD) from January of 2011 to April of 2013 (28 months). All students were between the ages of 6 and 14 years, with seven Māori students, no Pacific students and 63 students of other ethnic groups.

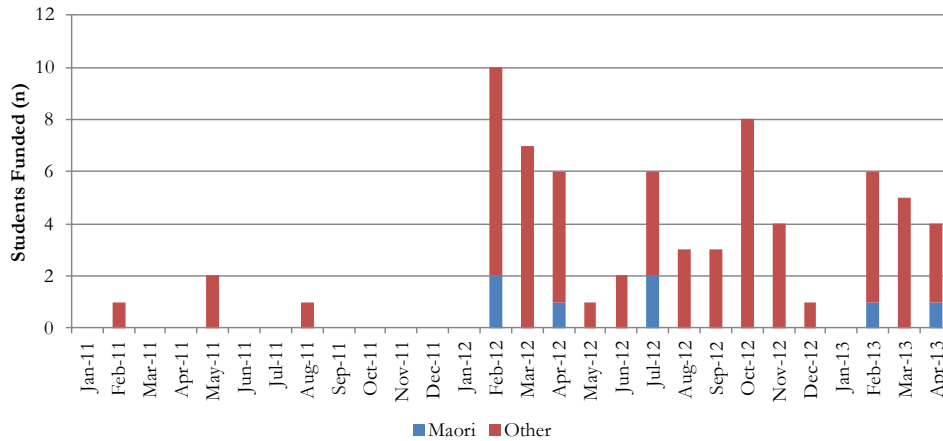
For the 14 months from January 2012 to April 2013, 51 students were reported as funded, with 5 Māori and 46 students of other ethnicity.

The Ministry of Education has also reported that some students that have had funding approved may not have been reported in these figures but that these numbers would be very small. Recent publicity and education about APD are likely drivers for recent increases in numbers funded. It should be noted that this period overlaps with the Ministry of Health funding some personal FM systems before they discontinued this practice, because it did not meet intended funding guidelines, and a continuing transition in 2011.

¹⁷ As modelled by Sapere based on Statistics New Zealand data and extrapolations

Figure 1 shows the numbers of students with APD funded by the Ministry of Education in 2011-2013 and receiving FM systems. There are no Māori students funded in 2011 and then a rapid increase in 2012 with some Māori children being funded.

Figure 1 Students with APD reported having Ministry of Education funding 2011-2013



Source: Ministry of Education

Table 2 presents the rate at which funding was approved by the Ministry of Education amongst Maori, Pacific and other ethnic group children based on the ethnic-specific estimates of APD prevalence. These rates are based on the numbers of students funded in 2012 as the only complete year of data reflecting the much higher recent counts. Clearly the rate of student funding for Maori and Pacific students over time is much lower than students of other ethnicities, even considering a conservative estimate of Maori and Pacific prevalence.

It is noted that this rate is only for publicly funded FM systems and that there will be private sales in addition to this. As reported through parent interviews, many parents speak of the difficulty of meeting the costs of diagnosis, let alone the “FM-system”. It is hypothesised the skew in terms of funding rates by ethnicity will be more strongly reflected in the private sale of systems due to income disparities across ethnic groups in New Zealand.

Table 2 Ministry of Education funding rates for students with APD – 2012

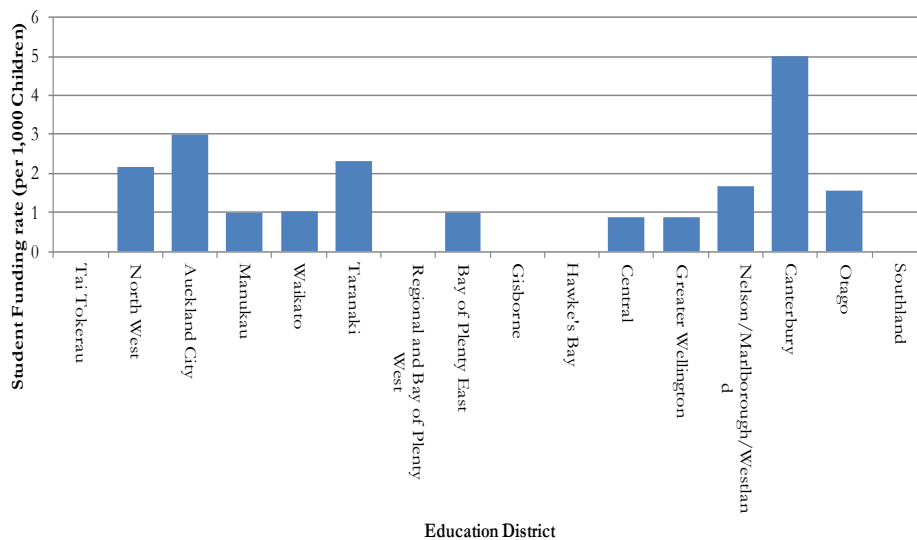
Estimated prevalence (n)	6,343	18,723	6,806	31,871
Funded students (n)	5	0	46	51
Rate (per 1,000 children)	0.8	0.0	6.8	1.6

Source: Ministry of Education and Sapere Analysis

To further expand on the distribution of Ministry of Education student funding in New Zealand, Figure 2 presents the rates by geographical region of children aged 6-14 years. The

pattern that emerges is one of higher rates in and around Auckland and in the Canterbury region, moderate rates in regions with larger population centres and very low rates in more rural areas. This pattern is to be expected based on where testing clinics and the population numbers are located. One should note that the rate for Auckland City is lower than Canterbury because of the high estimates of Pacific children with APD in Auckland City and that no Pacific children with APD have received funding for FM systems from the Ministry of Education.

Figure 2 Ministry of Education Student Funding rates - 2012



Source: Ministry of Education and Sapere Analysis

Note: for Te Tai Tokerau this funding rate does not equate to the anecdotal evidence a wider range of stakeholders gave saying Ministry of Education of funding for FM devices there is relatively simple and children do have access.

4.2 Cause

There are various aetiologies (causes) noted in the literature yet not one is fully defined (Musiek and Chermak, vol I, 2007). For example a higher incidence of otitis media with effusion (OME or glue ear) is thought to lead to APD issues. Evidence for this comes from studies that have followed children over time after treatment or resolution of OME, showing delayed recovery of temporal auditory processing ability [e.g., Moore DR, Hartley DEH, Hogan S (2003) Effects of otitis media with effusion (OME) on central auditory function. *International Journal of Paediatric Otorhinolaryngology* 67S1, S63-S67].

It is of note that in the yet to be published Pacific Island Family study in Auckland¹⁸ that Pacific Island children have earlier onset of otitis media and it lasts longer than their European counterparts. In the study 25% of children have had middle ear problems in the

¹⁸ Purdy, s. Et al.

past based on assessment of the children at age 2-3 years, and these problems have persisted in some children through to age 11 when their auditory processing was assessed.

5. Literature summary

A short literature summary is provided for general themes and an overview. However throughout the report evidence is also referenced where possible.

Overview

Headway has been made in past years on the description of the disorder and in factor analysis studies of relevant tests (Musiek and Chermak 2007).

Data is starting to suggest that there are all kinds of disorders that may be intertwined and the aim should be to put the child in a better situation for learning, not based on diagnosis. Improving the signal to noise ratio to facilitate better listening is still the most researched evidence based success factor.

The body of literature on APD is characterised by a lack of consensus and diversion of opinions.

The pre- and peri-natal development of APD in children is outside of the scope of this review. However, discussions on this topic have been held by Eggermont and Ponton (2003) and Chermak and Musiek (1992). There is emerging evidence for links between nutritional status and infant auditory brain development [e.g., Algarin C, Peirano P, Garrido M, Pizarro F, Lozoff B. Iron deficiency anemia in infancy: Long-lasting effects on auditory and visual system functioning. *Pediatric Research*. 2003; 53: 217–223]. Iron deficiency varies with ethnicity and is more common in Māori and Pacific than in NZ European children [Grant CC, Wall CR, Brunt D, Crengle S, Scragg R. 2007. Population prevalence and risk factors for iron deficiency in Auckland, New Zealand. *J Paediatr Child Health*; 43: 532–8.] Future research in this area may enhance understanding of factors contributing to APD and prevention strategies.

No consensus on signals and testing for APD

There is consensus on the need to use a battery of tests but no consensus in the literature on which tests and the best way to test. However the AAA Guideline does make comment on this.

The AAA Guideline stresses the necessity to consider the individual's cognitive and language abilities before interpreting APD test results. It is good practice to incorporate cognitive and language screening in an evaluation.

“The individual's mental age and cognitive status (including IQ) can influence the individual's ability to complete complex behavioral measures of auditory function, making accurate interpretation of results difficult and, in some cases, rendering the test results invalid. In cases of questionable cognitive function or intelligence, the need for multidisciplinary assessment becomes imperative.”

“It is therefore important to ensure that the individual has adequate receptive and expressive language skills to complete the tasks within the test battery (see Baran & Musiek, 1999; Richard, 2007).”

Some experts also advocate the inclusion of attention and memory screening checks in an evaluation. A screen for visual processing disorder is also advisable. The Guideline does not recommend inclusion of these items but makes a statement concerning the value of multidisciplinary assessment.

“For these reasons, a multidisciplinary approach to assessment of the individual at-risk for (C)APD is an important complement to the audiologic diagnosis of (C)APD (ASHA, 2005b; Baran, 2007; Bellis, 2003, 2007; Chermak, 2007; Chermak & Musiek, 1997; Ghazanfar & Schroeder, 2006; Hurley & Hurley, 2007; Musiek & Baran, 2007, Musiek, Bellis, & Chermak, 2005). (Levels of evidence: 2, 3, 4, 5).”

The outcomes of the studies done on this subject are mainly determined by the initial assumptions. Most studies compare a group of APD diagnosed or suspected children, and then look at the test outcomes of these children.

For example Rosen (2010) evaluated the auditory and cognitive abilities of children with suspected APD and a control group. 65% of the children with suspected APD performed in the bottom 5% of the population on one or both of a verbal and a non-verbal discrimination task. Testing performance on the verbal discrimination task provides a better differentiation between the two groups. Other differences were found in non-verbal IQ assessments, but the control group performed substantially higher than the population average. There was no correlation between performance on the auditory discrimination tasks and nonverbal IQ for the suspected APD group.

Another similar example is the study of children referred to a specialist APD clinic done by Dawes et al. (2008), finding that children identified with APD on the basis of commonly used APD tests cannot be distinguished from those not meeting the diagnostic criteria on the basis of presenting features or aetiological factors. Two possible conclusions are discussed: one that learning problems exist independently of auditory processing difficulties, and aetiological factors thought to contribute to poor auditory processing do not have a strong causal link to APD diagnosis. The second possible conclusion discussed is that the commonly used APD tests, as used in this study, are unreliable.

Kraus and Banai (2008) challenge some of the assumptions embedded in current conceptualization of APD, pointing out that sub-cortical auditory processes are more dynamic than typically thought, suggesting that they relate to cognitive processes involved in language and music perception, rather than solely to specific aspects of fine-grained auditory perception. Kraus and her colleagues have provided evoked potential evidence for poor sub-cortical auditory processing in children with suspected APD, but have also shown altered cortical processing [Wible B, Nicol T, Kraus N. (2005) Correlation between brainstem and cortical auditory processes in normal and language-impaired children. *Brain* 128: 417-423.]

Moncrieff (2012) discusses the value of dichotic listening tests. She points out that a number of studies have identified the presence of binaural integration deficits in children with learning and reading disorders (referring to Hynd et al. 1979; Obrzut et al. 1988; Moncrieff and Musiek, 2002), and points out that similar patterns have been recognized in adults who demonstrate difficulties wearing two hearing aids (referring to Jerger et al. 1993). She continues by pointing out that, according to Jerger and Musiek (2000), for many years dichotic listening tests have been an essential part of the test battery for assessing APD in individuals of all ages.

Despite some ongoing controversies, the literature does point to some form of consensus or agreement so improved consistency and quality of testing can be achieved, as well as improved rates of accurate diagnosis.

Effects of APD

There is no evidence that auditory deficits are causally related to language disorders, but they do occur in association with them (Rosen 2003; Sharma et al 2009; Watson et al 2003). Musiek et al (2005, 2007) add that even though not the main cause of learning or reading problems, auditory processing should not be discounted as a small but important component of listening and learning. Moore (2009) points out that there are strong signals that language and listening skills in children could be improved by auditory learning, but that we still don't really know how this interaction plays out.

No consensus in the discussion on co-morbidities

Children with APD are often thought to have ADHD. When children with APD feel lost or overwhelmed, they may lose interest and divert their attention, making them look as if they have ADHD (Young 2001).

Veillet et al (2007) find that some auditory system processing mechanisms are impaired in children with dyslexia; these effects can be diminished by audio-visual training.

Dawes et al (2008) found that when APD children and non-APD children, whom were all referred to a specialist APD clinic, were compared they found similar rates of co-morbid learning problems. Thus children with learning difficulties associated with APD can present very similarly to children with other diagnoses, highlighting the important role of multidisciplinary assessment.

Sharma et al (2009) in their well cited article, show extensive overlap between APD, reading disorder and language impairment, 10% of children diagnosed with APD had reading disorder, 10% had language impairment and 47% had both co-morbidities with APD. Students selected for this study had either suspected APD, already were diagnosed with APD, or parents had concerns. There was no control group for this study however all the assessments were standardised and children's performance was compared to established norms.

Hornickel et al (2012) link temporal processing deficits, phonological awareness, reading and dyslexia.

No consensus exists on definitive intervention strategies, however empirical studies focus on FM systems

Although the standard recommendation after an APD diagnosis is the use of a personal FM system, there is little ground for the assumption that personal FM amplification is the only management strategy for students with APD. Instead personal FM systems should be considered as part of the management process and not as the sole primary management strategy (Rosenberg, 1999 and 2002). Sharma et al (2012) found in a randomised control study that therapy plus amplification gave better results for core language and phonological awareness, than therapy alone.

Cacace and McFarland (2006) state that the peer reviewed literature does not contain any evidence of a validated model of APD intervention. Slauterbeck (2009) provides an overview of the available strategies and intervention approaches for children diagnosed with (C)APD, including classroom-based strategies and compensatory strategies.

Examples of some empirical studies that do exist are:

- The benefits of FM technology, including improved auditory processing (e.g. Smart et al. 2010; Hornickel et al 2012) Keith and Purdy, 2014)
- Improved literacy and academic achievement and child and teacher reported benefit, (Loven et al., 2003; McCarty and Gertel, 2003; Johnston et al 2009 Hornickel et al 2012)
- Improved speech perception in noise and in quiet (Prendergast 2001; Updike and Connor, 2003; Chisolm et al. 2004; Johnston et al 2009; Hoen et al 2010),
- Attending and listening (Loven et al 2003; Rosenberg et al 1999),
- Improved ability to hear and learn and neuroplastic development (Friederichs and Friederichs 2005),
- Improved auditory working memory (Umat et al 2011), and
- Improved psychosocial status (Johnston et al 2009).

However their results are variable, in line with current lack of international consensus and knowledge that not all studies are as robust as others. Studies have used different outcome measures, different APD assessments and varying populations, making it difficult to draw strong conclusions.

Long term benefits of personal FM systems have been found on subjective measures and psychoacoustic tests as well as improved neural maturation in the auditory pathway (Hoen et al 2010; Keith and Purdy, 2014).

Beneficial results of FM systems have also been found for children who did not have APD diagnosed, for instance in primary-level children with developmental disabilities (Flexer 1990), or children with reading delay (Purdy et al 2009). Musiek and Chermak (2008) suggest FM systems as an appropriate first step toward recovery for the management of APD in head injury patients. Munro (2008) discusses that hearing devices change the sensory environment by stimulating a deprived auditory system, and hence may be capable of inducing changes within the central auditory system.

Rosenberg (2002) notes that the acoustical conditions in the classroom, home and social environments are often barriers to listening and learning for students with APD. The effective management of APD requires careful attention to classroom acoustics and the use of personal frequency modulated (FM) systems as strategies to improve the quality of the listening environment and the student's access to acoustic information. As members of the multidisciplinary team responsible for both auditory assessment and management, audiologists have the responsibility to guide the evaluation of the listening environment and make recommendations for modifications, as well as the selection, fitting, and monitoring of personal FM technologies. Demonstrating efficacy is an essential part of the management process (as in proving that the treatment and compensatory strategies are making a difference for the child with APD).

The literature evidence for conventional hearing aids for APD is very limited as there have been few studies in this area. Although there is anecdotal support for this approach no study has compared conventional hearing aids to personal FM systems which provide a better signal to noise ratio for the child with APD.

A number of studies verify that FM systems improve hearing in people with central auditory conditions causing temporal distortion, such as Friedreichs ataxia.

The existence of dichotic listening difficulties in some children with APD is well established. Some children have a very large disparity in listening abilities between ears when they undergo dichotic testing, and have a condition that is now referred to as amblyaudia. Because effective listening in a school environment requires good sound localisation, the ability to integrate information heard in the two ears in order to extract speech from noise and the ability to selectively attend to information heard on the left and right side, having a large disparity in listening between the two ears is problematic. Hence amblyaudia (like lazy eye, but lazy ear), if present, should be treated first [Moncrieff, D. W., Wertz, D. (2008) Auditory rehabilitation for interaural asymmetry: Preliminary evidence of improved dichotic listening performance following intensive training. *International Journal of Audiology*, 47:84-97]. FM systems, if indicated should be fitted second to maximise the opportunities that the child has for listening with an enhanced signal to noise ratio. Auditory discrimination training and phonological awareness training if indicated should take place next since these are core skills for listening and language development. Language, meta cognitive and other top-down therapies should follow with the exception that parent and teacher guidance and hearing strategies should be introduced at the start of the FM trial.

Impact

There are various theories on the impact of APD on learning, socialisation, psychosocial wellbeing and behaviours, at the least. Chermak and Musiak (2007) note the clinical implications of a (C)APD on academic performance are undeniable. They went on to summarise that the collaboration between audiologists and speech language pathologists is essential to address the issues of efficacious treatment and service delivery in (C)APD.

Serious psychosocial effects of APD are well documented (Johnson et al, 2009). Children often become withdrawn and may have difficulty forming relationships with peers. Two Master's thesis on the topic have been completed under the guidance of Professor Suzanne Purdy at the University of Auckland; results were consistent with Johnson et al (2009). The negative psychosocial effects are rapidly reversed as a result of treatment of APD (Johnson et al, 2009).

6. Situation analysis: New Zealand

6.1 Funding responsibilities, definitions and eligibility

Funding responsibilities for testing and diagnosis regarding APD span public and private health sector funding (personal health and disability – although very little in disability), private and University based clinics (Auckland and Christchurch – where people pay to attend).

The Ministry of Education funds FM systems for students with APD who have significant learning needs that are identified and supported by the school team or through other special education initiatives. Most stakeholders noted that the issue of use of FM hearing devices is mainly in primary schools, a little in intermediate but by the time children have got to secondary schools they often choose not to use them. Anecdotally the three key reasons are:

- (1) Teenagers don't want to seem different to their peers
- (2) It is very difficult for a teenager to go to multiple teachers per day to get them to wear the microphone and
- (3) They may have less of a need for them as they develop their own language and learning skills.

These factors could lead to the conclusion that there needs to be an early intervention approach to treatment for APD. Also it is likely that some children would use hearing devices if they were less obvious, hence some may choose to use conventional hearing aids, even if the outcome is not as good as with FM devices, as modern hearing aids can be very discrete.

In summary the public funding responsibilities can be demonstrated as:

	Hearing Aids for sensorineural hearing loss:	FM Systems for sensorineural hearing loss:	FM Systems for APD:
0 – 5 years	Ministry of Health	Ministry of Health	No public funding due to no diagnosis at this early age
6 – 21 years	Ministry of Health	Ministry of Education: Limited funding**	Ministry of Education: Limited funding**
Adults	Ministry of Health	Ministry of Health	No public funding

****** Only if in (1) compulsory education, and (2) the child has significant learning needs (is already receiving one of the Special Education Initiatives) and (3) the school team assesses it will positively impact on learning outcomes.

6.2 The Continuum: How children access services for APD in New Zealand

6.2.1 Testing, diagnosis and who pays

Best evidence based practice as per the international Guidelines would indicate that a multidisciplinary team should diagnose. Audiologists are required to be part of that team as should speech language and psychology disciplines. In New Zealand the disciplines vary from a singular audiologist to a mix of others.

Note: Health, via District Health Boards (DHBs), funds public (free) audiology services usually in a DHB, but sometimes subcontracted by DHBs to private providers. A survey of DHBs (Kay, F. Hutt Valley DHB, updated 2013) noted that only five of the DHBs were providing APD diagnosis. Other DHBs may be offering traditional hearing screening or testing but this will not usually pick up APD, either because a lack of awareness for it and / or the wrong tests are used.

Five out of the 20 DHBs are providing APD testing, with two further DHBs subcontracting this service out to private audiologists:

- Northland (subcontracting out)
- Auckland
- Waikato
- Hutt Valley
- Capital and Coast (subcontracting out)
- Mid Central
- South Canterbury

Other than this, parents pay privately. There are a range of private clinics undertaking APD testing but there is not equal national coverage or consistency or quality of testing.

Education Funding

Two parents, and one clinic, reported resource teachers of learning and behaviour (RTLBs) in schools had accessed school funds to access private testing for diagnosis.

Private¹⁹ Funding

The majority of people pay privately to access tests and for APD diagnosis, with many having to travel to out of town centres. Private clinics include private audiology and two University clinics.

In locations where there is a specialist service providing APD testing and diagnosis other audiologists and professionals may refer to them. For example one private service noted in an interview that they could only test up to a certain level and if it was more complicated they would refer to a more experienced testing centre with more highly specified testing equipment and skills.

Costs of private testing and assessment vary, as do the components of the test battery and the disciplines within each test centre. Costs start at around \$300, but often a few assessment visits are required. Parents also reported having a range of traditional hearing tests before getting to the APD test, each of which meant additional costs.

The other biggest variables are the travel and accommodation that families may have to undertake to get to the testing site. Some families report having to take all of their children, take time off work and to pay for accommodation. For some, once all costs are incorporated, the costs to a family may all up be over \$10,000 (including the cost of any devices).

The process to access testing and diagnosis services

Families report significant difficulties in accessing testing and diagnosis. The two key issues being not knowing where to go and secondly having to pay privately. Various stakeholders noted there are long waiting lists (months) in DHBs. Even when they do APD testing, some DHBs report they continuously reprioritise APD testing to lowest priority when demand is higher than available resources.

Many families have had previous numbers of hearing tests which have come back as indicating no hearing loss (consistent with an audiogram not recognising APD). Typically they have had to pay for each hearing test privately and / or wait for long periods of time to get in to a DHB service (e.g. reports of 18 months, 12 months, more than 6 months).

Quality and reliability of testing and diagnosis services

There are workforce gaps in New Zealand for testing for APD. In general, audiologist training does not cover APD in enough detail for quality assessments, or audiologists do not see high enough volumes to maintain their APD testing skills. Many stakeholders suggested that audiologists who want to cover this field should undertake additional and extra training and on-going professional development.

In line with variable skills and levels of geographic access, there are anecdotal reports in New Zealand of both under and over diagnosis of APD. This includes missed diagnosis as some do not consider screening for it, or do not refer for testing. Specialist APD services that see

¹⁹ “Private” refers to private commercial businesses as well University run clinics where families have to pay

children after many prior assessments may diagnose APD frequently because of the various screening processes that families have been through before they get to that service.

Time and cost of testing and diagnosis

Most audiologists interviewed, as well as many other stakeholders, noted the additional time and costs, over and above typical hearing assessments, involved with quality testing for APD. These included:

- Best practice to have a multi-disciplinary assessment
- The need to have a traditional audiogram and middle ear check first, as well as the other battery of tests
- Test time: e.g. an audiologist can undertake one APD test versus four to six basic hearing tests
- Many stakeholders, including public, private and other stakeholders, noted the challenge of testing and providing comprehensive diagnostic services that financially break even. Anecdotally (out of project scope to review financial records) some are cross subsidising the APD assessments from other services to be able to continue with APD testing. Others may only test to a certain level before referring on.

Reaching a diagnosis

Complicating the matter for testing and diagnosis is the lack of an agreed battery of tests and agreed multidisciplinary assessments. It may also mean other needs, e.g. language or learning needs, are not diagnosed and therefore remedial strategies are not well designed.

The AAA Guidelines note that an APD diagnosis before the developmental age of seven years, or a level of cognitive functioning that is consistent with this age range, can be difficult for a range of reasons.

“Many behavioral tests of central auditory processing in current clinical use require a minimum developmental age of seven or eight years, or a level of cognitive functioning that is consistent with this age range. This is particularly true for most behavioral tests involving inter-hemispheric (corpus callosum) function, as the maturational time-course of this region of the brain is highly variable in children, especially young children below the age of seven or eight years (e.g., Musiek et al, 1984). As such, normative ranges for the majority of behavioral tests in very young children have limited clinical utility due to very large standard deviations and resultant floor or chance effects. Therefore, for children younger than seven or eight years of age, behavioral diagnostic testing for (C)APD should be undertaken with extreme caution. As noted previously, assessment of (C)APD in very young children may include the use of screening measures and behavioral checklists that provide insight into children who may be “at-risk” for (C)APD and a recommendation for close monitoring of skills and regular follow-up to reach a diagnosis as early as possible (see Baran, 2007).” Page 14.

This however does not preclude a diagnosis or treatment at an earlier age based on an assessment by skilled personnel and the level of impairment experienced by the child, as well as their own learning age. For example the AAA Guidelines also go on to note intervention should be as early as possible:

“Early identification followed by intensive intervention exploits the brain’s inherent plasticity. Successful treatment outcomes are dependent on stimulation and practice that induce cortical reorganization (and possibly reorganization of the brainstem), which is reflected in behavioral change (i.e., learning) (Kolb, 1995; Merzenich & Jenkins, 1995; Russo, Nicol, Zecker, Hayes, & Kraus, 2005).” Page 23.

6.2.2 Ministry of Education policy, eligibility and process

Eligibility and Policy

The Ministry of Education funds all FM systems for school-age children. As noted earlier in this report this is part of a protocol between the Ministry of Health and Ministry of Education which clarifies roles and responsibilities of each agency based on the primary need for equipment.

Personal FM systems are considered to be primarily needed for access to education so these come under Ministry of Education responsibility. This protocol has been in place since the late 1990s and, apart from a short period in the late 2000s when the Ministry of Health funded some FM systems due to some confusion about naming of some new devices, all FMs for school-age children have been allocated through the Ministry of Education.

Under the current protocol a large number of students with sensorineural* hearing loss are funded for FM systems (around 200 per year) and a smaller number of students with APD are funded (around 50 per year).²⁰

The wholesale cost of an FM system is about \$3,300 – \$3,500 when required for two ears. If for one ear only it may be cheaper.

Students with learning needs associated with a sensorineural hearing loss are eligible for a number of services in education, including support from Teachers of the Deaf, Advisers on Deaf Children and they are eligible to apply for FM systems.

For students with APD with learning needs associated with their hearing loss the funding pathway is school-based. Students are identified as having learning needs by their school and usually get learning support through the RTLB, a Ministry of Education SLT or the school (e.g. through provision of a teacher’s aide).

“School students with special education needs are eligible to be considered for assistive technology funding if they are supported through any of the current special education initiatives. Special Education initiatives include: Ongoing Resourcing Scheme (ORS) Speech-Language (Communication) Initiative, Severe Behaviour Initiative, Resource Teachers: Learning and Behaviour (RTLB), National provision for students with moderate sensory impairments and physical disabilities School, High Health Needs Fund (SHHNF), Special Education Grant (SEG – applications under SEG should show

²⁰ Note that there may also be some cases of permanent conductive hearing loss, e.g. unilateral atresia, included in this figure.

that the student has been receiving ongoing support from the school.” Special Education Assistive Technology Guidelines, page 2.

The Ministry of Education has recently clarified its policy and pathways for students with APD²¹ but three key issues still remain:

Firstly, the Ministry of Education does not provide funding for all children who have APD. The Ministry of Education is clear that they only fund for the primary purpose of learning in the classroom for students who have significant learning needs that are recognised and supported through the school or one of a number of Ministry of Education special education initiatives.

This means that for many students with a diagnosis of APD there is no public funding pathway. Many families interviewed had the expectation that if an audiologist diagnoses APD and recommends the trial of an FM device, then this should be publically funded.

Secondly, there is a lack of awareness or acknowledgement of APD in schools and personnel which may mean that the learning needs of students with APD are not well recognised. Students may be thought to be lazy or distracted when they actually have difficulty hearing.

Lastly, even with the clearly written national eligibility criteria (refer to the APD factsheet²²) there were reports of variability in how this is interpreted and operationalised on in schools.

Some of the variable examples were:

- A school chose to trial and pay for an assistive device themselves and not go via the Ministry of Education system
- Various reports of a school inserting RTLB support just before the trial in order to make the child eligible for a trial and then withdrawing it. RTLBs sourcing funding to pay for a private audiology test to see if there is a diagnosis of APD
- Some respondents reported variability of funding decisions between Ministry of Education Districts and what they will approve. The reason for the variation was not obvious.

Also, part of the Ministry of Education requirements is that the disability, that is, the APD, affects the child’s learning.

“Clear links must be made to show the impact of the disability on the student’s learning and achievement. If the assessor, for example, has noted that the student has a hearing loss, the impact on the student’s learning may be that they are unable to follow the

²¹

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/SpecialEducation/ServicesAndSupport/AssistiveTechnology/AssistiveTechnologyFactsheets.aspx>

²² Ministry of Education APD Fact Sheet

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/SpecialEducation/ServicesAndSupport/AssistiveTechnology/AssistiveTechnologyFactsheets/ATAuditoryProcessingDisorder.aspx>

teacher’s instructions independently or that they spend extra time asking their peers about required tasks.” Source: Special Education Assistive Technology Guidelines, page 11.

In conjunction there must be a demonstrable improvement in the child’s learning with the device in the trial to then go on and be considered for public funding through the Ministry of Education.

Education process

Some of the stakeholders had concerns that the education process does not have any trained audiology skills in the mix, or at least there should be open communication between the teams with a child centric focus guiding the outcome.

Others felt that Ministry of Education personnel were being put in a difficult position of interpreting clinical tests, without the right skills or experience. This is outside many of their scopes of practice and can create professional tensions between parties.

The Ministry of Education requires a “formal diagnosis”²³ of APD before a child can be considered eligible for Ministry of Education support, e.g. for a trial of a personal FM system but as already noted at times for good practice reasons, audiologists cannot make a definitive diagnosis of APD. Instead they may state the tests show outcomes in line with APD. This is an issue for two groups of students:

1. Those under seven years of age. The AAA Guideline notes it is recommended not to diagnose before age seven.
2. Those children who have other learning or communication difficulties. As the test for APD are behavioural and norm referenced it is difficult to provide a definitive diagnosis for this group.

These students cannot access Ministry of Education services because they do not meet eligibility requirements that require a “formal diagnosis”.

Examples given included:

- An example from an audiologist’s report: “[child’s name] test results are consistent with significant auditory processing difficulties when compared with other children in his age group. In my opinion [child’s name] hearing deficits are due to auditory processing disorder”. From which Ministry of Education declined the trial application saying this diagnosis was not a formal diagnosis so the child was not eligible.
- Audiologists at times cannot definitively say that APD is the single or primary concern therefore will use words to the effect of: “Shows strong signs and symptoms of APD”, or “Is consistent with APD...”. Ministry of Education will decline eligibility on this.

It is noted by some stakeholders that this diagnostic reporting practice indeed was good practice at some times when there were complexities and co-morbidities.

²³ Quoted from a Ministry of Education assistive technology decline letter, 2013.

In addition it was evident from interviews that different Ministry of Education Districts and schools, even though operating under nationally consistent policies, may be operationalising these differently. This creates inconsistencies.

FM systems – use at school and home

Consistent with the policy of “primary purpose” being for learning stakeholders understood that the Ministry of Education’s policy is that the personal FM system stays at school.

The national policy clearly states that FMs allocated by the Ministry of Education can go home as long as the school principal agrees (as the equipment is owned by the school). Most of the feedback has indicated that this policy, though in place for several years, has not been operationalised consistently in schools.

Lack of flexibility around the use of FM systems has been raised as an issue by stakeholders. This raises the debate for the stakeholders, including parents, regarding the usefulness of the personal FM system outside of the classroom setting (note use is usually restricted to the actual classroom and no other sites at school, including for example school assembly).

Of note here is also the strong stakeholder feedback by many that funding for personal FM systems should be the responsibility of the Ministry of Health. If the device is primarily for “daily living” rather than primarily for the “learning” then funding would be the responsibility of the Ministry of Health.

The issue exists for a number of assistive technologies such as devices for reading and writing – as even though students are expected to read and write in all environments and not just school (a similar argument could be made for effective listening), the Ministry of Education still funds these items under the protocols because they are for the primary purpose of learning.

If a change in policy and funding responsibilities were to be considered this would be for a much wider group that included students with sensorineural (and permanent conductive) hearing loss as well as those with APD.

The strongest opposing views of the current system are that children learn across the continuum of life “*Learning happens at home too*”, through to there is no place for an FM system outside of the classroom “*I cannot see any instance where the child would need it outside of the classroom*”. The latter type of view was more commonly held, but not exclusively, by those working in the compulsory education sector. Parents (all but one) were adamant that they are useful for whole of life.

Literature reports that the child would benefit from having the device in a range of settings. The literature also notes that the more a child wears the devices, the more opportunity there is for neuro-plasticity to potentially occur in some children (Hornickel et al, 2012).

During parent interviews, where their child did have access to the FM system outside of the classroom, they were asked what they used them for. The range of answers included:

- When driving in the car, especially to and from school, to talk about their day, planning, homework, friends etc – sharing experience and conversation. In this instance the parent was usually the sole adult occupant in the car and wore the microphone (this was the most common response)

- Shopping – particularly in noisy streets or malls. The parent can keep in touch with their child and monitor their safety without having to yell
- Large family, cultural, church or community events
- Teaching and learning at home. For example if there is loud background noise such as others talking, other children playing, dishwasher on in the background. (Note: Some stakeholders did deny this as a reason saying parents should provide a quiet home like environment, however this may not be realistic especially for a large family in a small home)
- Playing with groups of friends
- Doing homework
- Children using their FM device to link in to their music or the TV – providing a quieter less stressful background for the whole family
- Sports (not everyone mentioned sport and some said it was not appropriate for contact sports)

Current Ministry of Education policy states that FM systems can be taken home as long as the school Principal agrees but it appears from stakeholder input, the teacher is not always aware of the policy. Currently this policy is not interpreted or operationalised consistently in schools. Better awareness of flexible use of FM systems and better understanding of the issues schools may face when FM systems are taken home needs further investigation.

Many stakeholders interviewed believe the child should have an ability to be able to access a publically funded trial of a device even when the student did not have special education needs.

There is a strong theme from the interviews that if the funding and eligibility was the Ministry of Health's responsibility then children would have better opportunities for equal access via health eligibility criteria.

6.2.3 Application systems for hearing devices

The Ministries of Health and Education have different systems for applying for hearing devices. The Ministry of Health system (via DHB's and private clinics) is clinic based and relies on audiological assessment of hearing loss. In contrast the education system is a classroom based functional assessment of the difference that devices make to learning outcomes.

The Ministry of Health accepts applications for hearing aids for children and young people with sensorineural and permanent conductive hearing loss via assessors who are approved within a defined accreditation framework in the field.

For hearing aids funded by the Ministry of Health, through the Hearing Aid Funding Scheme, an audiologist conducts the assessment and if required, recommends and submits an application for hearing aids to the Ministry of Health's contracted organisation to administer hearing aid funding. The organisation then pays the supplier of the hearing aids and invoices the Ministry of Health. The audiologist then trials the hearing aids with the person.

The Ministry of Education has applications for FM systems for both students with APD and students with sensorineural/conductive hearing loss via the student team.

It was consistently reported by stakeholders who mentioned the two systems that the Ministry of Health has “*Got it about right*” now [the process for applying for hearing aids] and that it is much better than it was. In contrast stakeholders felt the Ministry of Education application system was cumbersome, extremely time consuming (for example, one application taking three people’s time for three days; many hours) and set in place to deter applicants. Some reported not trialling devices as they didn’t want to do the application. Parents reported having to push for a trial in many instances, as schools were resistant.

In addition for the Ministry of Education assistive technology application system any teacher or specialist can fill in the forms therefore some may be inexperienced. In the past year, two applications for an FM system for APD were declined, one because the student didn’t meet eligibility criteria and one because the FM systems was not shown to make a difference to the student’s learning outcomes. It is not known how many were not applied for due to any one of a number of reasons.

One Assistive Technology Coordinator interviewed reported working with those filling in the applications to assist so declines didn’t occur and would prevent time wasting for everyone.

The Ministry of Education has also released an APD Fact Sheet²⁴ in May 2013 to explain what APD is, what to do if you suspect a student has APD and the support available through the Ministry of Education.

6.3 Workforce

The overall workforce assessing and working with children with APD and other hearing issues or impairments varies.

Audiologists report that to diagnose correctly for APD they need to have additional professional development over and above what is taught in the main audiology training (Masters degree in Audiology in New Zealand), and have on-going experience in testing for APD. Audiologists work in the publically funded health system and in a private capacity.

For children with APD, Education requires an audiologist to diagnose APD, which is not funded by the Ministry of Education (it is publically funded via DHB or private funding).

If the child has a diagnosis of APD, personal FMs can be publically funded by the Ministry of Education if the child meets the eligibility criteria for access to Assistive Technology. Ministry of Education Advisors on Deaf Children are specifically trained to fit FMs and do so for around 200 students with sensorineural hearing loss each year. AoDCs are contracted to work with students with sensorineural hearing loss and do not normally work with students with APD.

²⁴ Ministry of Education - APD fact sheet

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/SpecialEducation/ServicesAndSupport/AssistiveTechnology/AssistiveTechnologyFactsheets.aspx>

National Education policy outlines the role for AoDC in support students with APD²⁵. AoDCs are expected to undertake the technical task of fitting the FM device and obtaining, setting up and advising on the monitoring and evaluating the effectiveness of the FM system for a student. These are core competencies of AoDCs.

..... the role of the AoDC in the process is as follows:

1. Obtain trial FM system
2. Trial: Liaise with designated lead worker (e.g. Speech Language Therapy, RTLB, SENCO) and:
 - i. train student, family and staff involved in the use of the FM system
 - ii. discuss trial goals and data collection
 - iii. follow up.
3. Peer review the assistive technology application if undertaken ²⁶

The finding of this review is that the policy of AoDC involvement is not operationalised consistently for students with APD and is becoming less so with an increased workload for the AoDCs, as reported by education stakeholders. Practice is variable around the country as lack of capacity in the AoDC workforce means that some students cannot access this expertise in a timely manner. Although FM provision is a core competency for AoDCs, there may be differing levels of confidence in undertaking this work.

Also, AoDCs do not have access to hearing aid measurement equipment that is available in audiology clinics for electroacoustic verification that is recommended best practice for checking that the FM system is working appropriately (see AAA 2008, updated 2011 American Academy of Audiology 2008, update 2011, Clinical Practice Guidelines Remote Microphone Hearing Assistance Technologies for Children and Youth from Birth to 21 Years, available at:

http://www.audiology.org/resources/documentlibrary/Documents/HAT_Guidelines_Supplement_A.pdf

Any one of a variety of the education workforce may apply for, trial and observe the outcomes of a personal FM system for APD because the trial does not assess hearing. The trial in the education setting (school) is designed to assess if the fitting of the FM has any effect on learning outcomes. For example this may be a classroom teacher, an Advisor on Deaf Children, a Resource Teacher Learning and Behaviour (RTLB), or a special education needs coordinator (SENCO). Of these, only the AoDCs typically have any training in hearing issues and generally they only see children with sensorineural or permanent conductive hearing loss. Resource Teachers of the Deaf have training in hearing issues, but not related to APD.

²⁶ Special Education internal document

There are various reports of the variability in technical and APD expertise these personnel might have. Some AoDCs might only see one or two children with APD in their teaching career so to assess the children's learning needs based on the existence of APD and the impact on learning can be difficult. There is no specific training for other professionals such as SENCOs who might be supporting children with APD.

6.4 School classrooms

6.4.1 Acoustics and noise levels

Acoustics in the classroom and overall noise levels are an important factor when considering issues for all children and especially children with APD. The Ministry of Education document Acoustics Design Guide for Schools and Boards of Trustees (BRANZ²⁷) 2007, notes the following:

“Poor acoustics can greatly influence learning, particularly for young children. Many older-style classrooms have poor acoustics; long reverberation times and ambient noise intrusion.

The MLE tool encourages boards of trustees to self-assess classrooms and judge whether their acoustic performance needs to be improved. Generally, this can be done through installing acoustic ceiling tiles and acoustic wall linings.” Source: Ministry of Education web site²⁸.

Room modifications are commonly proposed in textbooks as being helpful for children with APD. In reality significant improvement in classroom acoustics is a challenge requiring the expertise of an acoustics engineer and significant expenditure; however this may be easier for refurbishment or new build projects. Simply reducing reverberation and background noise levels is likely to be insufficient for children with APD, but does assist as a component of the overall strategy.

It is noted by several stakeholders that primary school children are also still learning language therefore need a higher level of sound to noise ratio to hear. This is well established for children with normal hearing, and is even more important when there are hearing difficulties. When people with normal hearing listen to speech in poor acoustic conditions (high noise, long reverberation times) recall and learning is compromised even when the speech is audible (Ljung 2010, http://pure.ltu.se/portal/files/4667355/Robert_Ljung_Doc2010.pdf)

Teachers should be given support and education to know how to modify their teaching approaches in different environments, for varying their teaching styles in different settings that may change the noise levels. A recent survey of 1879 primary and secondary teachers in New Zealand has shown high rates of voice disorders, as is seen in other countries (33.2%

²⁷ BRANZ is an independent and impartial research, testing, consulting and information company providing resources for the building industry. http://www.branz.co.nz/cms_display.php

²⁸

<http://www.minedu.govt.nz/NZEducation/EducationPolicies/Schools/PropertyToolBox/StateSchools/Design/ModernLearningEnvironment/MLEDQLSStandards.aspx>

prevalence across their teaching career) and hence teachers may not be able to adequately raise their voice in a background of noise (SHS Leão, JM Oates, SC Purdy, RP Morton, D Scott. Voice problems in New Zealand teachers: A national survey. Submitted to Journal of Voice).

6.4.2 Classroom amplification systems

There is some research as well as varying opinion on the role of classroom amplification systems²⁹. It is reported by some stakeholders and there is evidence (Chermak and Musiek vol II, 2007) that overall, if properly installed, they do improve sound to noise ratio for most children, giving them a better position to start to learn efficiently (Rosenburg et al, 1999). They also reduce the need for the teacher to raise their voice and can provide for less physical stress on their vocal cords and reduce overall fatigue. Teachers report needing to use less energy to use their voice and that it increased their efficiency as teachers in not having to repeat themselves (Rosenburg et al, 1999).

However for some children with APD they may increase the background noise so that they can hear less of the direct teacher voice. In addition if the teacher raises their voice e.g. yells, if the system is not set up correctly with a cut out level, then it can “boom” in the children’s ears. (Note there are no formal standards around who can set these systems up and anecdotally it appears that maintenance and setup of classroom amplification systems is variable).

A New Zealand study (Dodd, G et al 2001) noted that overall there was benefit in installing these systems however in a follow up study many were not being used. This leads to a conclusion that any system needs a framework around it to ensure ongoing maintenance and utilisation, so there is a return on the investment, and there is consistent sound quality.

²⁹ Often referred to as SoundField Systems. However this is a brand name (e.g. like Hoover for a vacuum cleaner) not the type of technology or device.

7. Parent reported experiences

7.1 Overview

Imperative to this research was to hear the experiences of parents of children diagnosed with APD, of how the system actually works and how they experienced it. 14 parents were interviewed and four responded to the web survey.

Parents were recruited via a variety of sources including referral by audiologists, personal networks of key stakeholders, NGOs and via the Australia New Zealand APD Facebook Page. The sample was from across the North Island as no South Island based parents were able to be contacted.

It is acknowledged this was a small sample, as a full survey of parents was out of scope of the research³⁰, however from all but one the experiences were similar and very negative. All but two of experiences were current (as in the parent / family was currently working through the system, as some part of the continuum)

The one parent who had a positive experience was working with an audiologist who worked in a very flexible manner to support children with APD.

7.2 Summary

The core summary points of parent experiences are that they want:

- A fair system
- More information
- Wider awareness of APD
- For them and their child to be respected – get services, supports and be listened to
- Access, at least, to a personal FM system trial so they can see if it helps their child

Specific areas are listed below and then the shaded areas are direct quotes for emphasis.

7.3 Health sector

The health sector – including testing and diagnosis

- Not knowing where to go to when something is wrong with your child
- Not knowing what to do if traditional hearing testing (e.g. pure tone audiogram) shows all is OK (i.e. lack of audiologist or other knowledge of APD). Some have had multiple tests

³⁰ E.g. to do a national survey via various organisations audiology databases etc.

- Finding a public funded audiology service that tests for APD
- Significant delays in getting a test and diagnosis – some up to 2.5 years post query
- Even if a diagnosis of APD is given, uncertainty as to what is next, what is available. For example how to get funded access to supports, strategies and devices and who pays
- Affordability. Not being able to afford the test or having to plan and budget for the test

7.4 Education sector and at school

The education sector - including intervention options

- Having to “fight” and “constantly advocate” in / against the school system
- “Judgemental and discriminatory attitudes” from within the school and Ministry of Education staff
- Lack of school and / or teacher support
- School and community lack of understanding of APD
- Lack of access to FM system trial and then even if trialled, and successful, not being funded by Ministry of Education (because they don’t meet the eligibility criteria for funding)
- The Ministry of Education application assistive technology process being very difficult, time consuming and stressful so that some schools won’t even consider applying
- Not knowing who to talk to
- Home schooling being a better option even if having to give up employment, due to reducing stress and bullying on their child
- Their child’s extreme distress at school (fear of failure, frustration at not being able to hear, bullying, teacher punishing them for not being able to hear)
- Parents not being able to afford the FM system even if was recommended by the audiologist
- Lack of transparency and fairness in the system therefore being confused
- Those that are funded for FM devices can’t take them home unless an additional agreement is reached with the school (an additional barrier for families)

Challenges at school

Parents related examples of what they perceived to be threats or bullying from schools.

“They said to me: If you buy your own private FM device we will withdraw all other [special educational] supports your child already has.”

“If he doesn’t start to listen we will have to stop him coming to school.”

“School was no help what-so-ever. They let him be teased terribly for not knowing the alphabet – but he couldn’t hear it.”

In the classroom

“The noise level in the classroom would go up as the teacher got the kids to work in groups and they got excited, so he’d turn his aids off.”

“The focus is only education – not them as a child. This is about their health……. them growing up……. their social life and learning with their friends…….”

7.5 Worked best and least well

Parents were asked what worked best.

“Taking them out of school.”

“Not having to fight the principal and the teacher when once I took him out of school.”

One parent said, “Everything. For us it has been great.”

Positive reports

“The biggest thing about home schooling was he got himself back……. he got his confidence back…….”

“When she got her hearing aids I said her name and she turned to me straight away – that was a major moment!”

One child said to her parent, “I am doing so much work at school now [post getting hearing device] because I can hear!”

“He loves going to school now and is happy to leave his hearing aids at school as he knows they’ll be there when he gets there.”

Parents were asked what worked least well

“The audiologist sent a letter to the school about what to do – and they did nothing. What a waste of time that was.”

“No one is taking responsibility……. for who does what. What is meant to happen? Actually who does what for these children?”

“We weren’t told anything after diagnosis. We didn’t know what to do and now he is suspended from school.”

7.6 Financial

Financial costs

“We spent thousands on this. Hearing tests that didn’t show anything, then finally an APD test! Then what? Then having to pay for a FM thing as education would not fund it yet it made such a huge difference. Why wouldn’t they fund it when it helped her learning so much?”

“We didn’t mind having to pay. We restructured our debt. But having to travel all the way to Auckland with all the kids…… that was a biggie!”

7.7 Impacts

Children’s stress and psychosocial wellbeing

(Note: psychosocial is the researcher’s terminology not parents)

“He was in such a mess…… at that point we had to pull him out of that school. We had no option. He’d be screaming in the car and I physically couldn’t pull him out [once we got to school].”

“He had headaches every day and could not stand the noise at school. He was so fatigued.”

“For all those years he was told [by the schools] and thought he was dumb. Now look at him. He is looking at University next year.”

7.8 FM use outside the classroom

For those who did have a FM device, we asked about use outside of the classroom……

“Of course they are useful outside the classroom! He uses them for sport…… I use them for in the car. He doesn’t just have APD at school. That is silly.”

“Oh she uses them [FM aids] all the time out of school - shopping, the mall, church. Also for tuning in to TV and her music so it doesn’t disrupt the rest of the family.”

“Yup – her and her friends can talk while they are out – it is so important to them. You know what teenagers are like. Talking about clothes and all that. Otherwise she’d miss out.”

One point made by a stakeholder was that not all homes are quiet and able to provide an acoustically sound learning environment.

Additional quotes from some parent interviews are noted in the shaded box below.

“She just sat in the toilets at school all day crying. The teachers said it was bad behaviour.”

“He sits a lot with his hands over his ears in class.”

“The worst thing was he lost all his confidence and friends. The best thing we did was take him out of school. For all those years he thought he was dumb. It took ages for him to get his confidence and self esteem back.”

The following is a statement from a father of a young child with APD, who also has APD:

“Throughout school I thought I was “stupid” Why? Because that’s what “school” told me, my academic achievements at school were very poor but not through lack of trying (just like my daughter) I’m sorry to say even some of my teachers told me I’d never succeed. I now realise this was in part because I could not understand what was being said to me in the classroom. Let me explain further - I can only focus on the first piece of information

someone tells me, I can't listen and write things down at the same time – still to this day I can't..."

8. Stakeholder survey analysis

8.1 Overview

The non-parent stakeholder survey was a web based survey and was advertised in the week before its launch via the New Zealand Audiological Society and Ministry of Education networks. The survey was created using the online Survey Monkey tool and respondents were linked to it via the address <https://www.surveymonkey.com/s/NZAPDSurvey>. The survey ran between the dates of 18 June 2013 and 28 June 2013. In total 175 people responded to the survey from all across New Zealand, the majority being Audiologists or those in educational specialist roles.

The following table shows the role grouping of the 124 respondents who work with children or young people with APD and of the 175 respondents overall. The distribution of the roles reported by all respondents and those that work with children with APD was the same, meaning about a thirty percent of respondents in each role group do not work with children with APD. The majority of respondents were educational specialists (51%) and where reported the vast majority of these specialists were RTLBs. The next most frequent role reported was that of Audiologists (35%) followed by Health professionals (5%), most of whom reported being SLTs or psychologists. The Other group was made up mostly of parents of children with APD.

Role of respondent

Role	Work with children with APD (n)	Work with children with APD (%)	Total (n)	Total (%)
Audiologist	40	32%	62	35%
Education specialist e.g. Teacher, RTLB, Education Advisor on the Deaf, SENCO, or other	67	54%	89	51%
Health professional (other than audiologist) or specialist in APD e.g. Speech language therapist	8	6%	9	5%
Other	5	4%	10	6%
Not reported	4	3%	5	3%
Total	124	100%	175	100%

Source: Sapere online stakeholder survey

Responses were received from all regions, although Gisborne and the West Coast only had one response each. The regions with the highest number of responses were Auckland with 55 (31%), Wellington with 33 (19%), and Canterbury and Northland with 15 responses (9%) each.

Respondent region		
Region	Total (n)	Total (%)
Northland	15	9%
Auckland	55	31%
Waikato	6	3%
Bay of Plenty	10	6%
Gisborne	1	1%
Hawkes Bay	8	5%
Taranaki	5	3%
Manawatu / Whanganui	5	3%
Wellington	33	19%
Nelson / Marlborough / Tasman	5	3%
West Coast	1	1%
Canterbury	15	9%
Otago	7	4%
Southland	3	2%
Not Reported	6	3%
Total	175	100%

Source: Sapere online stakeholder survey

The analysis shows a great many conflicting views are presented. On the whole, these views appear to reflect individual's (audiologists, RTLBs, AODCs, teachers, educational psychologists, SLTs and parents, among others) experiences of isolated parts of APD services, for geographically (DHBs) distinct parts of New Zealand. What is experienced by one child, parent or professional as working well in one service and area in New Zealand can, due to the highly variable nature of services, result in a completely different experience for another child, parent or professional living or working nearby.

8.2 Summary of key responses to survey questions

8.2.1 Your main interest in responding

Audiologists

- Professional interest in APD – assessment, diagnosis and also academic research, supplying technology and rehabilitation
- Want improved and increased provision of assessment and diagnosis in New Zealand
- Variability of services [an issue]
- Funding system for FM systems needs to be revisited and streamlined
- Overall willingness to help with the Review, to assist families and children with APD

Educational specialists

- Professional interest in APD
- Support the development of a Findings Paper
- Inform selves and others

8.2.2 What works well

Audiologists

- Role of and links with Education specialists including their role in aiding communication
- Benefit of personal FM systems in classrooms

Educational specialists

- Need to focus on awareness of APD (i.e. it works well if this occurs) and strategies to support children, importance of providing strategies to teachers and coping strategies to children with APD

- The ease and benefit of the Education FM trial and application system (at odds with other responses in the survey)

Other respondents

- Very little worked well

8.2.3 What doesn't work so well

Audiologists

- Differences in getting funding for children with APD compared to hearing loss (e.g. hearing aids)
- Skills and lack of clinical experience in: (a) Education staff, (b) training and experience of some audiologists including the lack of use of a multi disciplinary team
- Lack of consistent protocols for a national consistent battery of assessment tests

Educational specialists

- How teachers teach children with APD; not adapting to strategies for these children
- Assessment and diagnosis; waiting lists, mixed messages, variation in diagnostic reports
- Ministry of Education application process for assistive technology, and strictness of the eligibility criteria
- Lack of awareness of APD in the school and education workforce

8.2.4 Key issues

Audiologists

- Assessment process
- Funding (public) for FM systems
- Lack of awareness of APD leading to quality issues

Educational specialists

- Funding and resourcing overall
- Lack of understanding of APD, strategies and what teachers should watch for [re children with potential APD]
- The classroom environment e.g. acoustics, poor sound proofing (e.g. outside noise gets in), poor ventilation (e.g. have to open windows for ventilation so outside noise gets in)

Others

- Lack of awareness and knowledge of APD and knowledge of differences around APD
- Testing for hearing loss but not for APD

8.2.5 Enablers for change

Audiologists

- Overriding response – better access to (a) additional and (b) more equitable funding across referral, assessment, management and rehabilitation
- For Ministry of Health and Ministry of Education to recognise the issues across children’s learning and development – a whole of life
- Better access to agreed and consensus diagnostic tools

Educational specialists

- Communication needs improved
- Awareness and knowledge of APD especially for teachers, including their knowledge of classroom strategies
- The classroom environment
- Improved access to assessments especially for those with early intervention needs

8.2.6 Key barriers to change and how can these be changed

Audiologists

- Government, Ministry of Health and Ministry of Education to acknowledge APD is a real problem for children and work together to address it
- Improve funding and policy for APD including reducing inequalities for Māori and Pacific Island children
- Reduce inconsistencies of provision of services across referral, assessments, coordination and management

Educational specialists

- Lack of awareness e.g. for teachers and their attitudes, knowledge, strategies, identification of APD
- Increase funding resourcing levels
- Minimise importance placed on FM systems in the range of other strategies

Options

- Develop nationally consistent Guidelines to give nationally consistent agreements, well defined pathways and measurable set of outcomes
- Consider resources: number of audiologists in APD field, amount of multi-disciplinary teams, and potentially well-defined teams in defined areas e.g. tertiary Health centres

- Improve access to well-trained AoDC resources for children with APD

8.2.7 Anything else you wish to comment on

Summary

- Need standard, nationally consistent agreed comprehensive test battery and a system across the continuum
- Acknowledge the economic and social impacts on parents and families

9. Findings and Conclusions

9.1 Key Findings

Overall there is a lack of international and national consensus on aspects of the system relating to APD such as how to diagnose, intervention strategies and how to achieve best outcomes for children with APD. In addition there is a lack of practical understanding of APD in those that work with children in New Zealand schools.

Due to the lack of consensus the area of APD is fraught with issues and the divisions of the Ministry of Health and Ministry of Education who commissioned this research cannot solve all of these within their own remits. There will need to be further work to establish consensus and a pathway forward in New Zealand. To this end this report recommends a national expert Reference Group be established.

Science and evidence

1. Science and evidence on APD has developed over the past decade and therefore there is a changed environment in which to understand and work with children with APD across the continuum (testing, diagnosis, intervention, follow up, outcomes). Some literature notes audition is pivotal for communication and learning.
2. Evidence and stakeholder input noted that APD is a hearing impairment or disorder and the impact of this is a negative impact on hearing, at variable levels for different children, as is the case for sensorineural hearing loss.
3. Overall, New Zealand should be up to date and remain more contemporary and conversant with evolving evidence based practice across all parts of the systems that affect children with APD, to provide more consistent access to higher quality services.
4. There are various international APD Guidelines or Consensus Statements, some of which contradict each other. The stakeholders interviewed had a general consensus that the American Academy of Audiology Guideline (2010) (the AAA Guideline³¹) is the one that New Zealand should work to in the interim before more consensus is gained
5. Evidence strongly shows that APD in individuals is heterogeneous and therefore intervention strategies should be individually planned and evaluated and that a multidisciplinary approach is needed.

Access and awareness in New Zealand

6. The system in New Zealand for children with APD and their parents is fragmented, difficult to access, confusing and inequitable in both access and outcome.
7. There is an opportunity in New Zealand to take a national expert approach (if possible across the health and education sectors and including other key stakeholders, i.e. a

³¹ From interviews this appears to be the most widely respected Guideline in New Zealand.

national expert reference group is established) to improving quality and access to services for children with suspected or diagnosed APD. It is suggested there could be a role for the relevant national professional body to assist, namely the New Zealand Audiological Society. Four topics suggested to start with include:

- (i) Audiology workforce – to improve access to quality testing, diagnosis and treatment.
 - (ii) Testing and diagnosis – developing a consensus statement on the battery of tests and who should use them
 - (iii) APD diagnostic reporting – quality, clarity and consistency and to be “fit for purpose” for the organisation receiving them
 - (iv) How the parts of the system can work better together to ensure a child centric focus i.e. across diagnosis and intervention strategies
8. Parents should be offered high quality contemporary information on APD and what is available in New Zealand to support them and their child, who is eligible for public funding and how to access it.
 9. Ministry of Education and school staff who work with children with APD, including classroom teachers, should have access to high quality resources to assist with supporting children with APD.
 10. Of note is the emerging evidence of the higher prevalence of APD in Pacific children, and likely Māori. Planners should continue to link with the Pacific Island Family Research and consider strategies for targeting high incidence areas and schools to provide support. Research is needed to determine the prevalence of APD in Māori.

Suite of Intervention Strategies

11. There is a suite of intervention strategies to assist with APD including addressing classroom acoustics, teaching strategies, parenting strategies and other learning and listening therapies. The suite includes hearing devices such as the personal FM system. Due to the heterogeneous nature of APD and the individual nature of the child and their learning needs an individual plan should be in place, to determine and assess the mix of strategies that is best for the individual child.
12. Other hearing or amplification systems can be used such as personal hearing aids or classroom amplification systems. However the evidence supports personal FM systems as being of most beneficial (parent interviews, research and stakeholder interviews) for most children, but not all children.
13. The suite of strategies for children with APD should also include at the outset, the assessment of the acoustics and sound levels in the classroom³². This would benefit all children and teachers as well.

³² BRANZ Designing Quality Learning Spaces: Acoustics

Personal FM Devices

14. Personal FM systems provide the best singular remedial intervention for most (but not all) children with APD.
15. There is general agreement from stakeholders that Personal FM systems do also provide some level of amplification (this can be verified electro acoustically). This means that the speech coming through microphone to the ear is amplified.
16. Provision of a personal FM system, or not, should be based on a child centric team approach, across the diagnosis and intervention parts of the system, with information and recommendations by personnel experienced in audiology and APD, and also including the funders (i.e. Ministry of Education's) current eligibility criteria.
17. Consideration should include a holistic approach to a child, including outside of the classroom. The ability to benefit from the device and the impact on their life with and without it should be considered, including considering the views of the parents³³.

Roles and responsibilities

18. There is a significant philosophical difference in expectations from stakeholders and the Ministry of Education in how resource allocation is targeted (i.e. who gets what, when) and what the majority of stakeholders perceived to be necessary and fair.
19. Assessing, application for, trialling and fitting of hearing devices in children should include audiology and people who have knowledge in APD, with clarity between the role of the audiologist and that of Ministry of Education's eligibility criteria for access to public funding for personal FM devices.
20. One aspect of this review was to comment on was the relative roles of Ministries of Health and Education in the future and a future Pathway. This cannot be done at this point as there was no consensus between stakeholders on this topic, however by far the majority of stakeholders considered that all of the system should sit with the Ministry of Health, although a few said it didn't matter who was the funder and an even smaller number said it should be Ministry of Education due to their rationale of personal FM systems being the primary purpose for classroom learning. Rationales for suggesting the Ministry of Health varied and included that it aligns with other management of hearing assessment and devices, a more holistic approach, reduction of fragmentation between two systems through to relative ease of access in Ministry of Health compared to the Ministry of Education. Lastly the position of some stakeholders, especially parents, is that the child's need is for whole of life, not a singular primary need only in the classroom. As this point held no consensus between all stakeholders and that the wider policy and funding implications if Ministry of Health did take on this responsibility means that further work is required before any decisions are made.

³³ Note all parents interviewed, except one, whose child had a personal FM system reported the importance of their child having access to it outside the classroom. This was for other educational pursuits and also home and wider community life. For some it was a safety issue.

9.2 Summary of Conclusions

The summary of key conclusions is:

- Internationally there is a lack of consensus on many aspects of the APD continuum, however work continues in this field
- In New Zealand there is a general lack of recognition and understanding of APD – in the general community, families, and many health and education professionals
- The exception to non-consensus is that there are issues with the current system that need addressed – stakeholders want things to be improved for children and families as well as workforce
- This research ended up taking a broader approach than the original scope of the project due to the complexity of the topic and non-consensus of the issues
- Of note re scope is that the divisions of Disability Support Services of the Ministry of Health and Sector Enablement and Support of the Ministry of Education commissioned this project but that they are not responsible for some parts of the findings e.g. diagnosis
- There are inequities of access for both diagnosis and access to funded personal FM devices and implementation of other parts of a suite of strategies
- The contract for this project asked for a Pathway to be detailed. This could not be done due to the complexity and non-consensus. However it is believed there is a genuine willingness in the Sectors to resolve this and therefore establishment of a national expert reference group is recommended. This research is a step in a many faceted stream of work to address the issues
- Personal FM systems are only one aspect of a suite of strategies children may need for intervention for APD. However the fact that more children may benefit from a personal FM system than the Ministry of Education eligibility targeting criteria funds is a contention and tension with some stakeholders and families

The review was to answer four specific questions. The following table is a summary of the findings and addresses those questions.

	Question	Summary
1	What the prevalence of APD is in New Zealand and how are children's needs identified and diagnosed	<ul style="list-style-type: none"> • Prevalence in New Zealand is thought to be around 5% for the general population with emerging evidence showing it could be up to 6 times higher for the Pacific Island child population (this may well be able to be extrapolated to the Maori child population due to similar genetic and health characteristics) • However overall prevalence may well be under represented due to variable diagnostic coverage and

		<p>quality of services in New Zealand</p> <ul style="list-style-type: none"> • Assessment and diagnosis is done by audiologists in a public or private capacity but there is no national coverage agreements or services, creating inequities of access for children and families • The system for identifying and diagnosing children's needs is fragmented, difficult to navigate and access is inequitable across New Zealand • Where services are in place they are variable in quality and outcome creating an inequity of access and outcome
2	Are the needs of children with APD being met or is there an unmet need or service gaps	<ul style="list-style-type: none"> • For the majority of children with APD their needs are not being met across the continuum of assessment, diagnosis and intervention / management • There are service gaps across the continuum creating inequity of access and outcome. Gaps are caused by workforce skill gaps, not all DHBs providing APD assessment services (i.e. publically funded and geographic gaps), and the cost of providing quality APD assessment services being prohibitive for some services and for many families as private payers • There is an overall lack of awareness of APD across the system and in the community • Information gaps about APD exist in the health, education and school sectors as well as in the general community. This can mean lost opportunities for identification of APD in children • Only children who have significant learning needs (as determined by the school and special education practitioners) associated with their APD are eligible for public funded FM systems via the Ministry of Education • A further large group are not eligible for public funding via the Ministry of Education and costs make FM private purchase prohibitive for many families
3	Does the provision of hearing devices add value in the treatment / management of APD and are there other treatment or management options	<ul style="list-style-type: none"> • Yes hearing devices add value in management of APD for most children (but due to the heterogeneous nature not all children) • Other intervention / management options include strategies such as addressing acoustics and noise levels in classrooms and other environments, teacher or parent strategies, listening strategies, positioning in

	that would assist	<p>relation to the speaker and visual cues or strategies.</p> <ul style="list-style-type: none"> • In addition some courses and therapies may assist some children. These are not mutually exclusive to each other and / or the use of hearing devices, and some may work better for some children than others • There is no consensus on the value of various web based or computer strategies / programmes
4	If it is clearly established that hearing devices are beneficial to children, what type of devices could be funded and by which agency – subject to budgetary constraints	<ul style="list-style-type: none"> • Yes it is clearly established that hearing devices are beneficial to most (but not necessarily all) children with APD • Personal FM systems as the best for most children, but there is increasing anecdotal, case-based evidence that other hearing devices, e.g. hearing aids can assist some children, as evidenced by some of the stakeholder feedback, e.g. audiologists, families. Hearing aids do not provide the same signal to noise ratio advantage as personal FM systems and there is only one, low-quality study reported in the literature on hearing aids as a treatment for APD, hence hearing aids would typically only be considered where there are specific reasons for a personal FM system not being an appropriate treatment in an individual case. Through the review, various interviewees could recount individual examples where hearing aids did provide some of the benefit being sought. • Which agency should fund requires more policy and financial work • Due to the non-consensus on some aspects of APD diagnosis and treatment, without further exploration and consensus, it is not possible to make a definitive statement or recommendation re a future Pathway. However it is recommended that there is a national expert reference group set up to consider some of the issues and to aim to reach a consensus statement.

Glossary

Between health and education and stakeholders there are a variety of definitions that cause much debate in the sector.

Term	Definition and discussion
<p>Hearing aid</p> <p>From the New Zealand Gazette, No 79 8 June 2011 Hearing Aid Services Notice — http://www.health.govt.nz/publication/hearing-aid-services-notice-2011</p>	<p>(a) means a personal electronic amplification device that is used wholly or principally by a person to alleviate the impact of their hearing loss; and</p> <p>(b) includes—</p> <ul style="list-style-type: none"> (i) FM systems: (ii) bone anchored hearing aids: (iii) hearing aid accessories; but <p>(c) excludes—</p> <ul style="list-style-type: none"> (i) cochlear implants: (ii) devices that have microphones and amplification systems that are designed primarily for other uses, such as stereos and mobile phones: (iii) consumable items (for example, batteries): (iv) second-hand hearing aids <p>Hearing aid accessories, in relation to a hearing aid, means equipment that has the purpose of enhancing the functionality of the hearing aid (but is not necessary for the operation or maintenance of the hearing aid) and that does not need to be replaced over time (for example, remotes, open fit tubes, speakers, and wireless devices).</p>
<p>Sensorineural hearing loss (SNHL)</p>	<p>A type of hearing loss that occurs when there is damage to the inner ear or the hearing nerve (vestibulocochlear nerve).</p>
<p>Conductive hearing loss</p>	<p>A type of hearing loss that occurs when there is a problem conducting sound waves anywhere along the route through the outer ear, tympanic membrane (eardrum), or middle ear.</p>
<p>Dichotic listening</p>	<p>Occurs when two messages are presented to separate ears, and refers to the ability to bring together or ignore differing stimuli presented simultaneously to each ear.</p>
<p>Tests for hearing loss</p>	<p>APD does not register on routine hearing loss tests namely the audiogram. However the existence of APD can create a hearing impairment based on speech perception measures (Lagacé et al. 2010) and auditory brain responses (Wible et al. 2005; Hornickel et al 2012) and other social and learning barriers (Johnston et al.</p>

	2009; Sharma et al 2009).
Impairment	<p>Some literature and many stakeholders refer to APD as causing a hearing impairment.</p> <p>Impairment may refer to:</p> <ul style="list-style-type: none"> • A medical condition that leads to disability • In health, any loss or abnormality of physiological, psychological, or anatomical structure or function, whether permanent or temporary. Identifying impairments that contribute to a functional problem for a patient is a key factor for a health professional to determine appropriate treatment. <p>Source: Wikipedia</p>
Amplification	<p>Amplification refers to the ability to increase sound by the use of a hearing device.</p> <p>Stakeholders interviewed confirmed that both personal FM hearing devices and hearing aids provide amplification, as well classroom amplification systems, albeit all at different decibel levels. The provision of amplification should be based on the need of the child and their ability to benefit from the amplification. The best signal (speech) to noise ratio is achieved with personal FM systems.</p> <p>Amplification via an FM device is of the single voice through the microphone worn by the speaker, transmitted to the ear of the device wearer.</p>

Bibliography

The contract required Sapere to consider literature of the past five years. However noting that there has not always been recent and current research in all the areas related to APD, and that literature was received by Sapere from expert stakeholders, all literature received and considered has been noted below.

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