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THE FUTURE IS HEAR

A social cost-benefit analysis

Early intervention programs to assist children with hearing loss develop spoken language

July, 2011

Preface

In 2006, the HEARing CRC's Listen Hear! Report[1] estimated the real financial cost of hearing loss at $11.75 billion, with the largest component being productivity loss, accounting for well over half of all financial costs. It is well recognised that a healthy start to life is critical in maximising each child's educational potential, and their eventual contribution to and participation in the community. For children with hearing problems and their families, research has provided evidence that early identification of hearing loss, appropriate selection and fitting of hearing prosthetics, and most importantly, individualised intensive early intervention are all factors associated with better speech perception and language development outcomes, which in turn leads to achievements in education, employment and productivity – a virtuous circle.

The members of First Voice are the premier Australasian centres providing critical early intervention services. This social cost-benefit analysis provides clear evidence that language benefits of early intervention do in fact translate to productivity gains and other real economic benefits. First Voice's study also provides a clear cost-benefit analysis of early intervention services, providing evidence to the true value of, and need for investment and support for these services.

The HEARing CRC is a strong supporter of evidence-based research, and was delighted to support First Voice in conducting this critical study which we hope will provide guidance to the ongoing development of governmental policy in hearing healthcare services.

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CEO, HEARing CRC
Principal Research Fellow, The University of Melbourne

THE HEARING CRC

[1]Listen HEAR! The Economic Impact and Cost of Hearing Loss in Australia, a report by Access Economics, commissioned by the HEARing CRC and Victorian Deaf Society, February 2006.

This is a summary of a cost-benefit analysis commissioned in February 2011 by First Voice. It was prepared by Raoul Craemer, Director of Econtext Pty Ltd. For more details or technical questions about the cost-benefit analysis please email raoul.craemer@econtext.com.au

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Executive Summary

This cost-benefit analysis (CBA) examines the intensive early intervention programs (EIPs) provided by First Voice to assist children with hearing loss develop spoken language. The children enrolled with First Voice have different types and degrees of hearing loss and use a range of hearing devices. Around 15% of these children have additional needs.

The First Voice EIPs are in the auditory-verbal/oral tradition with an emphasis on Auditory-Verbal Therapy (AVT). The intensive support provided to children consequently emphasises *listening* and spoken language and incorporates parents. First Voice employs a range of professionals including audiologists and speech pathologists, ensuring that multi-disciplinary care is coupled with continuous, long term case management.

The literature reviews carried out for this CBA revealed that:

- Research on language development shows that speech and language competency responds to early intervention and training.
- Customised, intensive interventions are likely to produce better outcomes, and AVT is *at least as effective* as other approaches for most children.
- The earlier the intervention begins the better the prognosis for language development.
- The proportion of deaf children who can benefit from auditory-verbal/oral approaches is high.
- Benefits of early intervention include likely gains in areas such as quality of life, employment and productivity, which are expected to be life-long.

The CBA uses a 50 year horizon to reflect the fact that the majority of the benefits flow later in life. The costs incurred up front can therefore be seen as an investment in the child's future.

What are the costs?

The CBA presents, for the first time, a comprehensive assessment of a range of costs involved in the EIPs. Carer's loss of income is one of the most important of these and is nearly as high as the operational cost of running the First Voice centres. While the child is enrolled with a First Voice EIP, on average, the following annual costs are estimated:

- Operational costs ($17,136)
- Carer's wages forgone ($16,162)
- Opportunity cost of capital ($2,086)
- Deadweight loss associated with raising tax ($1,650)
- Better/earlier devices ($985)
- Travel, accommodation and meals ($981)
- Child care ($408)
- Short term psychotherapeutic intervention ($183)
- Complications ($107)

The assessment suggests that while the child is enrolled, the representative total annual cost is $39,697. Follow-up costs for years 6 to 21 were also included in the analysis at $1,798 per year per child.

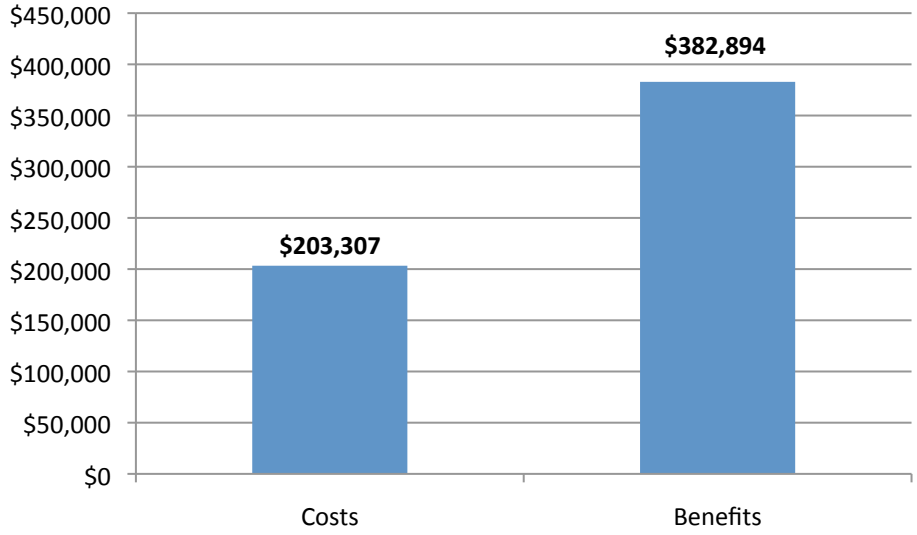
The present (discounted) value of all costs is $203,307. Over 90% of this cost is incurred in the five years while the young child is enrolled with the EIP – a significant investment in the child's future.

What are the benefits?

On the benefit side, it is important to note that the EIPs and modern hearing technology are complementary. Evidence on the long term impacts of early intervention on outcomes such as educational attainment, employment status and productivity is still emerging, as the early beneficiaries of modern technology and First Voice type early intervention are only just reaching adulthood. However, some outcomes have been reported by First Voice centres, including enrolled children's language assessment scores, admission rates to mainstream schools, Year 12 completion rates, and initial evidence on employment.

These indicators suggest that EIP graduates have language competency within the normal range of hearing children. Nearly all of the children enrolled with First Voice who have no additional needs are able to graduate into mainstream school settings, and a survey of a First Voice centre's school leavers from 2001-2010 which was carried out for this CBA revealed that nearly all (96%) had completed Year 12 at school. This contrasts favourably and markedly with the international experience whereby the majority of deaf children typically leave school by the age of 16.

Figure 1: The costs and benefits of early intervention (Present Values)



The approach taken to quantifying these benefits was extremely conservative. To estimate productivity gains it was assumed that, on average, the EIPs generate only one additional year of school attendance, and a 3.4 percentage point increase in labour force participation was attributed to the EIPs. For quality of life (disability) an average improvement of 4.8 percentage points was attributed to the EIPs.

The quantified benefits are as follows:

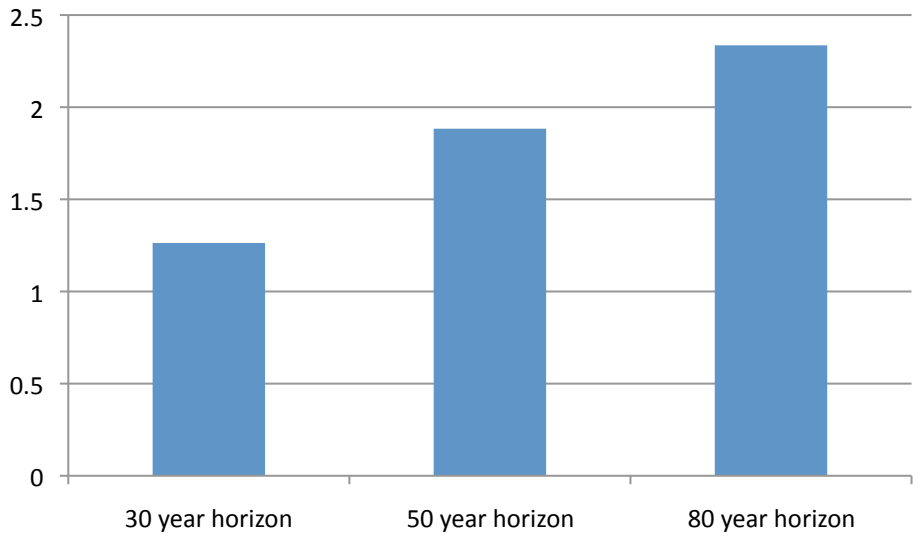
- Productivity gain / higher incomes ($10,327 per year from age 18 onwards)
- Reduction in disability / better quality of life ($7,829 per year)
- School costs avoided ($2,381 per year from age 6 to 17)
- Likelihood of being in paid work ($2,341 per year from age 18 onwards)
- Injuries avoided ($72 per year on a risk adjusted basis)

The present (discounted) value of these benefits is $382,894. The benefit-to-cost ratio (BCR) is therefore 1.9:1 – indicating that a dollar invested produces nearly two dollars of benefits in return.

Sensitivity analysis

The key result of this CBA – a benefit-to-cost ratio which is greater than 1 – is robust to changes in assumptions. Reducing the project horizon to 30 years, as is the norm in public infrastructure CBAs, does not affect this key result as the BCR continues to stay above 1 at 1.3:1. As benefits are life-long, a more plausible alternative project horizon of 80 years was also tested. As shown in Figure 2, extending the timeline in this way produces a higher BCR of 2.3:1.

Figure 2: The benefit-to-cost ratio (BCR) for different project horizons

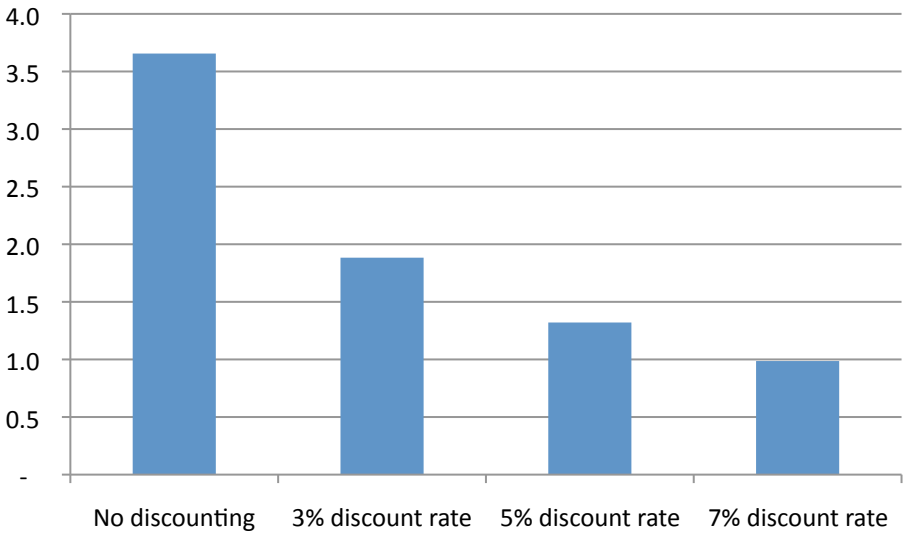


If time preference is ignored and the discount rate set to zero, the BCR rises further to 3.7:1. Such an approach is sometimes advocated on the basis of inter-generational equity. The BCR is still positive at 1.3:1 with a 5% real (inflation-adjusted) discount rate, which is a discount rate commonly applied in public infrastructure projects. With a 7% discount rate the BCR drops to exactly 1:1.

Government perspective

The CBA analysis assumed that the government contribution is 40% of operational costs or $6,000 per child per year ($30,000 over five years). The government is thus able to leverage private contributions to achieve an important social outcome with economic benefits that significantly exceed the government co-contribution.

Figure 3: The BCR for different discount rates



Unquantified costs and benefits

A number of costs and benefits could not be quantified. On the cost side, the *effort* children put in to acquire language could not be valued, nor could the potential impact on shifting cultural identity (e.g., feeling rejected by members of the deaf community, such as those relying on sign language). Finally, the cost to parents of acquiring literature and researching the different communication options could not be quantified.

On the benefit side, items that could not be quantified at this stage include benefits to carers over the long term, savings to business, lower support costs in the voluntary sector, additional non-pecuniary returns such as reduced rates of smoking associated with higher educational attainment, and so-called existence and option values which are becoming increasingly important in economic evaluations (they reflect society's willingness to pay for the *option* of being able to use a service, or for knowing that such a service exists even if one never intends to use it).

Psychosocial benefits to families should not be underestimated. The private and social costs of marital breakdown, for example, have previously been estimated at over $120,000 per divorce. Anecdotal evidence suggests that the rate of marital breakdown among First Voice families is lower than would be expected in families with a child with a disability. Inclusion of even a small reduction in marital breakdown would therefore significantly raise the quantified benefits.

One final type of benefit that could not be quantified but which is likely to be significant is the demonstration and research value created by First Voice. State and Federal health departments benefit from being able to observe progress and receive briefings and updates from members of the First Voice alliance. Through the efforts of First Voice, uncertainties around early intervention are also being addressed over time and knowledge is improving. The work undertaken by First Voice may therefore be laying the foundations for important future research.

Conclusions and recommendations

From a social cost-benefit perspective, early intervention is clearly a worthwhile investment even under stringent assumptions about the flow of future benefits. This investment may come from private or public sources. The argument for additional government funding is however strengthened by the findings of this CBA, and is also strong on equity grounds.

It is obvious that the main beneficiary – the children involved – cannot pay for the services themselves, and as this report demonstrates, the costs to parents (such as lost income) will be too high for many families, in particular those on lower incomes. It is highly likely that this plays a role in delaying some parents' decision to enrol their children in EIPs, especially where the hearing loss is perceived to be mild.

Other conclusions and recommendations include:

- There is a need for more research and consistent collection of statistics. First Voice is well placed to take a national leadership role in this space.
- First Voice needs to be able to further promote its outreach activities to engage children that would otherwise miss out on services.

These are however largely matters of which First Voice is already aware and which may currently be impeded or restricted by a lack of resources.

1 Introduction

This cost-benefit analysis (CBA) was commissioned in February 2011 by First Voice, a coalition of leading Australasian centres supporting children with hearing difficulties and their families. The foundation members of First Voice are:

- Cora Barclay Centre – South Australia
- Hear and Say Centre – Queensland
- Taralye – Victoria
- Telethon Speech & Hearing – Western Australia
- The Shepherd Centre – New South Wales and the ACT

An allied centre – The Hearing House, in Auckland, New Zealand – also works closely with the Australian First Voice Centres.

These non-profit organisations are well established centres of excellence; for example, the Cora Barclay Centre is the oldest organization in the Southern Hemisphere established for the purpose of teaching deaf children to listen and speak – in 2011 the Centre celebrates its 65th anniversary.

Anthea Green from The Shepherd Centre initiated the CBA. First Voice provided summary cost and cohort data, as well as comments on a draft report. Particular assistance was received from:

- Michael Forwood from the Cora Barclay Centre, who managed the project for First Voice and assisted in the development of the CBA methodology,
- Dimity Dornan from the Hear and Say Centre, who provided a number of relevant papers and ongoing feedback,
- Emma Rushbrooke from the Hear and Say Centre who coordinated data collection, and
- Aleisha Davis from The Shepherd Centre, who facilitated a site visit which allowed the lead consultant to observe a support session in March 2011.

Dr Anthony Hogan (Australian National University), a leading Australian researcher in the field of hearing loss, cochlear implantation, and measurement of long term impacts,[1-9] also provided expert advice during the project period.

1.1 Why this study?

Over the past twenty years, hearing devices have improved tremendously, giving many deaf children access to *sound* – but access to sound does not directly translate into access to *language*. Children must first learn how to listen and speak. Parents must also be equipped with appropriate strategies to help their children through this very intensive, accelerated learning phase. The First Voice early intervention programs (EIPs) provide specialist, targeted support that aims to give children the best chance to fully develop spoken language.

No CBA of these types of support services or programs has been published to date. Given the intensive nature of these programs, and the amount of specialist labour involved, they may appear as an expensive luxury to some observers. Others believe that intensive early language training of the type provided by the First Voice centres is likely to be an extremely good investment. However, currently there is no independent analysis to support either view.

1.1.1 Hearing loss among pre-schoolers

It has been estimated that one child per thousand will have moderate or greater hearing loss in both ears at birth.[10] In Australia, this equates to 300 children each year (i.e., 1,800 children in total in the preschool age group of 0-6). Nine out of every ten children who are born deaf are born to parents who can hear.[11] It is therefore a disability that could strike a baby born to any family.

Current epidemiological evidence suggests that following birth the prevalence of hearing loss more than doubles in the first five years of life (and possibly triples from 1 per 1,000 to 3 per 1,000),[12-24] as some children's hearing deteriorates and others newly acquire hearing loss for a variety of reasons such as chronic ear infections, complications from surgery or other illnesses and accidents.

The true prevalence of hearing loss amongst pre-schoolers in Australia remains unknown. Using the above statistics one can conservatively estimate that across Australia there are 3,500 children in the pre-school age group who suffer from hearing loss significant enough to warrant fitting of a hearing aid (either in one or both ears). All children fitted with a hearing aid are potential beneficiaries of First Voice type early intervention.

Australian Hearing data for 2010 show that 3,071 children aged zero to six had been fitted with hearing devices, with fittings and audiological services growing to record highs in recent years.[10,12] This demonstrates that newborn hearing screening is making an impact. There is still an indeterminate number for whom either the newborn testing and referral process has not resulted in fitting (such as occurs with some unilateral cases of hearing loss) or where the hearing loss develops in the years after birth and for reasons such as lack of recognition of the importance of unilateral hearing loss the child is not brought to Australian Hearing and fitted.

With a growing population, the number of children born with and acquiring hearing loss in their early years can only be expected to grow further in Australia. It is important to note that:

> Hearing loss, even loss that is mild in magnitude or unilateral (only one ear affected), can affect a child's potential to develop speech, language, social skills, and school performance, including grade retention.[14]

There is ample evidence that untreated hearing loss has a number of negative long term consequences,[1] but even children whose hearing loss has been detected will require specialist support to enable them to fully benefit from any hearing devices that they may be fitted with:

> Even after getting cochlear implants a child will have to go through many hours of therapy to learn how to listen and speak.[25]

Being born with, or acquiring, hearing loss has a particularly damaging impact on a child's ability to learn language. If children are not exposed to language early, the window of opportunity to acquire it starts to close, and by five years of age, it is substantially shut.[25,26] On the other hand, as noted in an evidence statement by the Centers for Disease Control (CDC):

> Research suggests that most preschool-age children with hearing loss will have language development within the normal range if intervention begins by 6 to 12 months of age.[14]

Furthermore it has also been noted that:

> If parents desire a listening and spoken language outcome for their child with hearing loss, an educational approach that emphasizes the development of auditory brain pathways through listening and spoken language is necessary.[27]

Research is showing that the earlier and the more intensive the intervention, the more impact it will have.[28] This is in line with the Position Statement by the US Joint Committee on Infant Hearing (JCIH):

> The goal of early hearing detection and intervention is to maximize linguistic competence and literacy development for children who are deaf or hard of hearing. Without appropriate opportunities to learn language, these children will fall behind their hearing peers in communication, cognition, reading, and social-emotional development. Such delays may result in lower educational and employment levels in adulthood.[29]

1.1.2 The current level of service provision

First Voice currently provides early intervention services to 610 children in the pre-school age group around Australia,[13] equivalent to around one fifth of the children in that age group fitted with hearing devices by Australian Hearing.

The exact mix and level of service being received by the 3,500+ children in the affected cohort is currently unknown. Most worryingly, as already mentioned, there may be 1,500 or more who are not on any dedicated EIP.

Information on patterns of care for those who receive *some* form of support is extremely limited. As there are no national standards for or coordination of these services, children receive different types and levels of support across the States and Territories. National datasets are also not available to enable comparison of treatment approaches.

First Voice argues that many affected children are currently on programs that cannot generate the same speech and language outcomes for the children as the First Voice programs. Reasons for why children may receive inadequate support include:

- Fragmentation of responsibilities across government agencies tasked with assisting these children.
  - Children fall through the gaps at various stages of their treatment and recovery pathway.
- Absence of a single point of contact or 'case manager' for these children (apart from their parents).
- Current health care arrangements typically rely on parents to 'opt in' rather than to 'opt out'.
  - Parents are often unaware of the options or unable to make informed evidence-based choices, thus leading to delay in, or cessation of, support services for the child.
- A knowledge deficit with regard to best practice in language assessment, development and support for children with hearing problems enrolled in child care, pre-school and Kindergarten programs.
  - Systematic testing of language skills, for example, does not routinely take place within the Australian school system.
- Cost of services and/or access to appropriate services, especially in rural areas, present another stumbling block.

All of this means that there are still significant opportunities to improve the quality of life for children and their families, to achieve better educational outcomes, and to reduce their risk of mental health and other problems in later life.

In this respect, Australia is no different from other major OECD countries. The current situation in the US, for example, was recently summarised by a former Surgeon General of the United States:

> Universal newborn hearing-screening programs are now functioning throughout the United States. With assistance from the federal government, every state has established an Early Hearing Detection and Intervention (EHDI) program as a part of its public health system.
>
> In some areas with the most effective EHDI programs, most infants and young children who are deaf or hard of hearing are being identified at less than 3 months of age. And, research is documenting what we always believed to be the case: deaf or hard-of-hearing children who are identified early and given appropriate educational and health care services develop better language and achieve better in school.
>
> I believe it is only a matter of time until we document that such children also grow up to have better jobs and are able to participate more fully and effectively in our communities. The seeds we planted in the 1980s are beginning to bear fruit and will continue to do so.
>
> However, there is still a lot of work to be done before we can reap the full harvest. As exciting as it is to see what happens when EHDI programs function to their full potential, it is clear that most EHDI programs need continued

improvement and many children and families are not yet enjoying all of the benefits of early identification and timely and appropriate intervention.

There are still many challenges and barriers that need to be addressed. Lack of funding, shortages of trained professionals, problems with follow-up, poor coordination of services and programs, inadequately informed families, lack of access to or inadequate use of new technology, and many other challenges continue to interfere with children who are deaf or hard of hearing getting the services they need and making the progress of which they are capable.[30]

Much the same could be said about Australia.

Box 1: Common issues for children with hearing loss

Regardless of culture, children around the world with untreated hearing loss tend to experience:

- problems with speech development, language, and communication skills (especially if severe hearing loss occurs at birth or before speech and language is acquired)
- emotional difficulties and low self-esteem
- learning and behaviour problems in school

Children who have their hearing loss treated, enjoy many life benefits including:

- closer relationships with their family and friends
- better feelings about themselves and higher self-esteem
- improved mental health, greater self-confidence, independence, and security
- learning skills equal to children with normal hearing

Source: *http://www.cochlear.com/au/child-hearing-loss-statistics accessed 14 April 2011*

1.2 The cost-benefit argument in simple terms

The rationale for the First Voice EIPs is simple – investing in early language training reduces a range of costs and delivers a number of additional benefits. Most notably, apart from enjoying a higher quality of life in general, children participating in the EIPs can expect to join mainstream educational settings, do better at school, and become more easily employable and thus able to choose from a greater variety of jobs in the workforce in the long term.

There is also a significant value or benefit to parents knowing that their children are being looked after professionally, and that their children will have a better chance to achieve to their full potential, in whatever setting they may choose to do so.

A reduced rate of marital breakdown is among several psychosocial benefits. In reducing a number of hardships in the long term, the children themselves can also look forward to a life with better mental health than would otherwise be the case.

The direct and indirect benefits to the children, their families, and society at large

are therefore potentially manifold. Costs of specialist schooling could drop, claims for disability pensions may decline, costs previously incurred by employers fall, and productivity rise. Many of these benefits will be shared by the rest of the community.

In the short (or shorter) term, on the cost side in the economic sense, children and their families have to work hard to acquire 'normal' levels of spoken language, parents or carers may lose opportunities to earn income as they dedicate themselves to the intensive language training programs for their children, and costs are incurred in attending and running the EIPs (e.g., transport, accommodation, staff costs, rent, child care for siblings, and so on).

In some cases, participating in the EIPs may also generate additional costs, for example, for devices that would otherwise not have been acquired (because the problem would have gone undetected). Schools may also share some of the cost burden of bringing children into mainstream schooling – whether it is additional staff time or training and liaising with the EIP.

To help gauge the extent and likelihood with which some of these benefits will be reaped it is important to quantify some of the variables mentioned above. The CBA does this in more detail in Section 4, however the following 'headline' statistics provided by Anthony Hogan, the expert adviser to the CBA may be considered. These are based on a national Commonwealth Government sample of 5,000 Australian school children. Children with hearing loss in Australia were found to:

1. start talking later than other children
2. be more reluctant to speak to others
3. be more likely to have speech unclear to the family
4. be more likely to have speech unclear to others
5. have more difficulty finding words
6. have more difficulty putting communication together
7. have more difficulty understanding what their parents say
8. have more difficulty understanding what others say to them
9. have more general communication problems than other children
10. have poorer physical health
11. have poorer psycho-social health
12. have poorer social functioning
13. have poorer interpersonal skills
14. be more hyperactive
15. have more emotional problems
16. suffer from a higher prevalence of sleep disruption

Higher levels of health and social service usage by this target group can also be shown. Using absolute indicators of poverty, data on mothers of children with hearing problems show that they are:

1. More likely to be unable to pay bills on time
2. More likely to be unable to pay their mortgage on time

3. More likely to have had to pawn something recently
4. More likely to have sought support from welfare agencies
5. More likely to have had financial limits on food purchases

All results statistically significant $p < 0.05$.

The challenge for this CBA is to come to a reasonable assessment of the balance of the costs that hearing loss imposes on children, their families and society at large, and the benefits that are generated by the First Voice EIPs.

As benefits occur mainly in the future, and the future is discounted in economic assessments such as this, it cannot be assumed that they will outweigh the upfront costs.

1.3 The nature of this report

1.3.1 Data limitations

As indicated earlier, the last twenty years have seen rapid advances in hearing related technology, with life changing devices such as cochlear implants being made available and adopted through the community. One commentator has noted that:

> A large percentage of early identified deaf children are now receiving cochlear implants (close to 100% in some places).[31]

Newborn hearing screening has also led to significant improvements in early detection across most Australian states. The first generation of beneficiaries of newborn hearing screening, modern hearing technology, and First Voice type support services are however only just reaching adulthood. Evidence on the lifelong impacts of these advances in technology and management of hearing loss is therefore only just beginning to accumulate.

In addition, early intervention programs are also continually evolving. As a result, accurate and scientifically robust estimates of long term benefits of specific programs will only become available over the coming decades; however, investment decisions about services such as those provided by First Voice have to be taken now.

In line with other assessment reports on emerging health technologies this report has to make assumptions about some future impacts. The approach taken throughout this report has been to use conservative assumptions and to test any results using sensitivity analysis, as is standard practice. All of the assumptions are highlighted and referenced throughout the report.

1.4 What does this study evaluate?

Cost-benefit analysis is traditionally a forward-looking analysis tool, used to gauge the likely rate of return on an investment. This always requires a scenario *with* the investment to be compared to the situation *without* the investment, which is also

often referred to as the 'base case', 'baseline', 'counterfactual' or 'do nothing' scenario.

For this CBA, the First Voice centres have not put forward any specific infrastructure investment proposal. The CBA instead examines the benefits that can be expected given the existing levels of expenditure.

1.4.1 The baseline or base case

The base case refers to what would happen in the absence of the First Voice EIPs, including the possibility that some children receive an equally effective service from other providers, a reduced level of (or less effective) service, or no support services at all. Unfortunately, national representative data on the type and intensity of support services received by children with hearing loss are currently not available. It is thought that most, if not all, children whose hearing loss has been diagnosed and who have been fitted with hearing devices do receive *some* form of support.

For the base case, it is however critical to recognise that there are large variations in the support packages provided, and that a significant proportion of children are currently not receiving intensive early language training. Furthermore, while the exact proportion not receiving intensive early language training is unknown, there is no doubt that if the First Voice EIPs were not in operation that many children would not receive intensive early language training.

The base case for this study can therefore be thought of as a child who has received a hearing aid or other device but has not benefited from intensive early language training.

1.4.2 Technology and language development services

The development of effective cochlear implants has led to their increasing and now widespread use in Australia, but not all children enrolled on First Voice EIPs have cochlear implants (see Section 2.4).

As mentioned earlier, to get the best out of cochlear implants requires many hours of therapy. The same is true for other types of devices and also for children who may not use any hearing devices at all – technology alone cannot deliver language outcomes.

Children who are deaf at birth will likely have some delay even if they are diagnosed early and receive the most modern technology. Intensive language development services aim to avoid or overcome any delay in language development. The role of the First Voice EIPs is therefore *complementary* to that of technology.

This has implications for the attribution of value. The analogy here is with the value of a steering wheel. Without the steering wheel a car would be worth very little, but does that mean that all the value is to be attributed to the steering wheel?

It is worth noting that there is generally no fixed rule for attributing proportions of value where complementary goods and services deliver a single outcome, especially

in the health domain.

A basic assumption for this CBA is that for any improvement in health state that is achieved with technology and early intervention, ***half is attributed to the technology and half to the EIP*** (as discussed in Section 4.3.1). This is a conservative assumption – there is no theoretical problem for both the EIP and technology to claim the full value each.

It is important to recognise that both the hearing technology and the language development services sit along a 'value chain' that delivers a better outcome for the individual and society as a whole. They deliver a reduction in the cost of illness, as identified for example in the *Listen Hear!* report, the relevance of which is briefly discussed in the next section.

Box 2: A five year old from a Spanish language background

CC is a five year old girl who was diagnosed at birth with a bilateral profound sensorineural hearing loss. Her parents had recently arrived from Spain and were not covered by the free government medical services. So they joined a private health fund and waited 12 months before she could receive a cochlear implant (CI). CC's parents speak Spanish and they want their child to learn both English and Spanish.

CC received her first cochlear implant in her left ear in June 2007 aged 1 year 3 months, but it became infected and had to be removed 5 months later. She was then implanted in her right ear in January 2008 aged 1 year 8 months and re-implanted in her left ear in October 2008 aged 2 years 7 months. This was all very traumatic for her parents as they felt her progress would be hindered.

Meanwhile, CC and her family continued to attend weekly AVT sessions as well as the Cora Barclay weekly music program and in time CC began to make steady progress developing speech and language in both Spanish and English.

CC was first assessed as having significant developmental delay in language (over 1 year's delay when compared with her hearing peers), as she had not been able to hear and learn to talk. At her latest annual speech and language assessment she had language skills within one standard deviation of the mean. In the past 12 months she has made more than 12 months' progress so the gap is narrowing for her.

1.5 Relevance of the *Listen Hear!* report

The frequently cited *Listen Hear!* report estimated the annual cost of hearing loss in Australia at $12 billion in 2005.[32] On this basis, at least in theory, any set of interventions that could be implemented to effectively negate the impact of hearing loss at a cost of less than $12 billion would have a positive benefit-cost ratio.

A problem arises when trying to assess more specifically how to go about reducing the impact of hearing loss, i.e., determining which approaches are most prospective or efficient at achieving desired outcomes and/or how the different interventions interact with one another.

Broad cost-of-illness studies typically do not examine the prospectivity of specific interventions. A cost-benefit framework such as the one employed in this report is more appropriate in that context. It examines the costs of implementing a specific intervention, in this case the First Voice EIPs, and compares this to the benefits that can be expected to flow from the intervention.

At least in theory, all costs and benefits of the First Voice EIPs should be included in the analysis, such as the costs of running the centres, costs to families, and so on. Not all of these costs can be quantified, however, in which case they are discussed qualitatively. In this respect, as well as in terms of the design of the CBA, this report conforms to a range of Australian guidelines.[33-36]

2 The First Voice model and cohort

As indicated in the introductory section, members of the First Voice coalition have many years of practical experience in running early intervention programs (EIPs). The First Voice service model continues to evolve as new technology and research findings emerge; however, broadly speaking, it currently consists of a package of services of which the following are key features:

- Emphasis on Auditory-Verbal Therapy (AVT)
- Focus on intensive support to young children
- Incorporating parents
- Continuous and long term case management

All of the centres have a very similar focus, but given that First Voice was only formed in 2010 they continue to run their own, slightly differing, customised EIPs.

2.1 An ambitious objective

Perhaps most important feature of the First Voice EIPs is that they are ambitious as they aim for:

> ...children to achieve speech and language in the normal range for their age by six years of age giving them the opportunity for a mainstream education, employment of choice and social integration with the hearing world.[37]

Clearly, such success depends partly on the intake of children, as there will always be a proportion of children whose hearing problems and language skills cannot be rectified. As noted in the literature, about 30% of children with hearing loss have another condition at birth,[14] and a proportion of these will always have some delay in speech and language due to the multiple and sometimes complex nature of the health challenges that they face in their everyday lives.

The last 20 years have however shown that the line between what is achievable and what is impossible is continually shifting, so that the majority of deaf children can now realistically aim for ambitious outcomes. Certainly, for the 70% of children with hearing loss who do not have another condition at birth, attending a mainstream school would seem to be a reasonable aspiration; but the same is also true for many of those who do have other conditions from birth.

The First Voice centres do not discriminate against children with other health conditions but do assess every applicant's ability to benefit from intensive language training. Recent results from at least one centre, which enrolled a number of children with a range of co-morbid conditions show that ambitious outcomes for a cohort consisting of a mix of children with and without other health conditions from birth are indeed possible:

> In keeping with our clinical expectations, 100% of the children who graduated in 2010 from Hear and Say's early intervention Auditory-Verbal Therapy program are attending mainstream educational settings.[37]

2.2 Description of the service model

The following sections provide more detail on the First Voice service model, to provide a deeper understanding of the services that the First Voice centres provide. Case studies of children with differing aetiology of disease and from different age groups have also been included here (as well as elsewhere throughout the report).

2.2.1 Essential characteristics

A First Voice draft document[38] summarises the essential characteristics of First Voice EIPs as follows:

- Need to look at whole child and family needs
- Multi-disciplinary approach
    - Audition
    - Speech
    - Language
    - Cognition
    - Social skills
    - Fine and gross motor development
- Education program, not speech pathology
- Case management accountability for clients
- Initial interviews
    - Fully informed parental choice
    - Provide hope
    - Parent support, e.g., Parent Mentoring Program
- Streams / Intensity of service (dependent on needs of client – quality not quantity)
    - Intensive
    - Standard
    - Low
    - Monitoring
- Best outcomes achieved when programs are multi-disciplinary, parent based and family focussed

These bullet points indicate that the programs are in line with international guidelines, such as the Joint Committee on Infant Hearing (JCIH) Principles and Guidelines for Early Hearing Detection and Intervention Programs, which state that:

> Appropriate early intervention programs are family-centered, interdisciplinary, culturally competent, and build on informed choice for families.[28]

We now turn to the types of services that are typically provided by the First Voice EIPs.

2.2.2 Services typically provided

In practical terms, any child enrolled in a First Voice EIP, and his or her carers, will benefit from 1:1 auditory-verbal/oral therapy sessions at which a parent is usually also present, audiology sessions, child and family counselling sessions, home visits, pre-school and childcare visits, playgroups, parent support groups, and information sessions.

As soon as families make contact with First Voice centres, a range of actions is initiated, including baseline hearing assessment (audiology), language competency, and an induction into the program. A battery of speech and language assessments is administered annually and on an as-needs basis.

Sections 2.2.2.1 to 2.2.2.11 below are based on a recent submission by The Shepherd Centre (TSC) to the ACT Government,[39] and describe in more detail the types of services provided by TSC in Canberra. This gives a good indication of the programs run by First Voice nationally.

2.2.2.1 Introductory program

The introductory program offers families that are interested in joining TSC with a comprehensive sample of TSC's services allowing families to make an informed decision on the service that best suits their family's needs and vision for their child. It is comprised of an initial meeting with the family followed by joint AVT and audiology sessions, child and family counselling sessions and is ended with a family meeting in which a decision is reached by the parents regarding continuation in TSC's early intervention program.

2.2.2.2 Auditory-Verbal Therapy sessions

These are individual one hour diagnostic sessions held with each family that focus on guiding and coaching the parents how to teach their children how to learn to listen and speak. These are based on the 10 principles of AVT (see Attachment A). The frequency of these sessions is determined based on the needs of the child and family and may be held weekly, fortnightly, monthly or less.

2.2.2.3 Individual Family Service Plan (IFSP)

As part of TSC's program, an Individual Family Service Plan (IFSP) meeting is held annually with the parents and any other professionals involved in the child's care in order to collaboratively set goals for the coming year. This plan is signed by all members and reviewed quarterly with the family.

2.2.2.4 Assessment of progress

Every child receiving early intervention services from TSC undergoes regular listening, speech and language assessments. These assessments formally and informally assess the child's progress and assist in ensuring that all children at TSC continue to make adequate progress over time. The formal measures used compare

TSC's children's results with a standardized sample of other children of the same age with typical hearing. Once the assessments are completed and scored a comprehensive listening, speech and language report is written with copies provided to parents and other professionals working with the family. Ongoing informal rates of progress forms are also completed for each child in the program. These allow for close and continual monitoring of the child's listening, speech and language skills and immediate identification if for any reason children are not making the progress that would be expected to improve their educational opportunities and learning outcomes as they move towards school.

2.2.2.5 Audiology sessions

TSC's audiologists regularly visit the Canberra centre to conduct sessions with families including hearing testing, cochlear implant programming and parent education on topics to do with hearing loss such as the technologies available, how hearing works, middle ear management, causes of hearing loss, management of devices, etc. Having audiologists as key members of the multi-disciplinary team for the child and family ensure that children are optimally aided thus allowing children to access the full spectrum of speech sounds that is essential for them to develop age-appropriate listening, speech and language skills.

2.2.2.6 Child and family counselling sessions

Child and family counsellors visit the ACT centre on a regular basis to provide counselling and support services to families at TSC Canberra. Parent engagement and commitment can significantly impact upon the outcomes of children with a hearing loss and, as such, this service plays an integral role in the early intervention program.

2.2.2.7 Playgroup

A two hour playgroup session is held at the Canberra centre. It is facilitated by a child and family counsellor, AVT therapists and parents and is held weekly. It provides an opportunity for families who are experiencing the challenges of raising a child with a hearing loss to come together and provide support to each other through discussion of the issues they are facing, share stories and hear from other parents that have been through similar challenges and further on in their journey.

2.2.2.8 Music Therapy group & School Readiness groups

Focus groups are provided for families and children at the centre to facilitate the development of their skills in specific areas. In the ACT, the music group focuses on developing the children's listening skills with music, intonation, melody, song and pattern identification. Singing is a common strategy with AVT to help children use intonation in their voice, learn to match pitches and sound like their typical hearing peers. School readiness groups are held to help children learn the skills needed as they transition to school. These groups focus on teaching advanced listening skills to the children such as listening in background noise, listening in groups and listening

from a distance, all of which children will need to do as they move into the school environment. Providing children with hearing impairment practice in learning these skills is essential to give them the greatest opportunity to succeed in the more complex listening environments of schools.

2.2.2.9 Pre-school visits

TSC conducts visits to pre-schools and childcare centres on a quarterly basis. This allows Auditory-Verbal therapists, audiologists and child and family counsellors to liaise directly with other educational service providers to the child, and assess the child's functional listening skills in an everyday environment. As such, recommendations and plans can be made in consultation with the family and teachers to optimise the child's listening in that environment that is often more challenging with increased background noise and requires distance listening which are both very difficult for children with hearing impairments.

2.2.2.10 Parent Support Network

A parent support network is currently being facilitated at TSC by a past parent. It serves several purposes including an opportunity for children to socialise with their Shepherd Centre friends after graduation, setting up buddy systems so that older children can mentor younger ones currently at TSC and provide assistance to families who are undertaking the transition from TSC to 'big' school and working with other organisations that support hearing impaired children to create a strong community that fosters their success.

2.2.2.11 Transition to School Program

For those children who will be 'graduating' from TSC at the end of each year, a transition to school program is incorporated into their therapy sessions. This program focuses on developing their pre-literacy, numeracy and writing skills alongside their listening, speech and language skills in preparation for school. It also involves therapists providing parent education on aspects of schooling, liaising with itinerant teachers, attending school meetings and providing information to the school regarding the child's level of functioning.

2.2.3 The range of professionals employed

The First Voice centres employ a range of support service specialists. This includes therapists who are qualified speech therapists, audiologists or teachers of the deaf with additional training in AVT (acquired through a three year full-time certification and mentoring process), paediatric audiologists, occupational therapists specialising in sensory integration, psychologists and family support staff, all of whom work together to assist new families that enrol their children on a First Voice EIP. As noted in a recent paper evaluating AVT, the therapist is:

> ...a qualified and experienced teacher of hearing-impaired children, speech and language therapist or audiologist who has undergone further postgraduate

training and is certified as an Auditory Verbal Therapist.[40]

The First Voice centres employ the following personnel with special training:

- 36 speech and language pathologists (SPLs), 32 teachers of the deaf, 21 paediatric audiologists, 7 social work/child and family counsellors, 8 psychologists, 3 occupational therapists (OTs), and 17 ear, nose and throat (ENT) specialists
    - Of these, 31 are certified Auditory-Verbal Therapists (also referred to as Certified Listening and Spoken Language Specialists) out of the total of 52 Certified Auditory-Verbal Therapists currently in Australia and NZ

2.2.4 Staff-to-client ratio

Based on these numbers, in total the First Voice group currently employs 124 health professionals in their EIPs (equivalent to an estimated 80 full-time equivalents); when set against total enrolments of 650, this indicates a high staff-to-client ratio of 1 FTE per 8 children, reflecting the intensive nature of the support provided.

2.2.5 Education program for parents

The aforementioned emphasis on families includes an important function of teaching parents how to teach their children. The approach recognises the critical role that parents play in helping their children acquire language skills.

The consultant was able to observe a therapy session involving an Auditory-Verbal Therapist, parent and a child with a cochlear implant. It was immediately clear that the parent had already learnt not to 'signal' or indicate meaning to his child through body language, gesture, raising voice, etc. Instead, the parent was proficient at setting tasks verbally, including challenges that could only be mastered by the child if he listened carefully. At the same time, techniques were used to encourage the child to enunciate accurately and spontaneously.

2.2.6 Analogy with modern approaches for acquired brain injury

The intensive treatment and rehabilitation approach has proven to be effective in other settings, for example, in modern approaches to assist those with acquired brain injury (ABI). Under normal circumstances, the untrained carer will solve many 'problems' for the person with ABI, as it is often easier for a carer to do this in the short term. Through careful repetition of common tasks and the introduction of coping strategies such as the use of lists, however, persons with ABI can often regain a significant amount of independent functioning. In Australia, the Brightwater Group has for example achieved impressive results with rehabilitating patients with ABI at the Oats Street Campus in Perth. A key feature of Brightwater's intervention program is its highly intensive nature.

This approach to rehabilitation for ABI has emerged at the same time, and was influenced by, research revealing a higher degree of plasticity of the brain than perhaps previously thought. Research in developmental neuroscience is also

showing greater plasticity of the brain in the early periods:

> The sensitive period of phonology is from the sixth month of fetal life through the first year.[41]

Some researchers believe that neuroplasticity of the brain also plays a role in language development.[27,41,42] This is still an active area of research and the relationship between neuroplasticity of the brain, language development, and academic and social outcomes is still very much under debate.

2.2.7 Integration with clinical and other pathways

The First Voice EIPs supplement existing clinical pathways rather than replacing them. As an example, Appendix C shows how the EIP fits in with newborn hearing screening and the referrals / management processes for the clinical pathway at multi-disciplinary hearing clinics in Queensland. Appendix D illustrates how the relationship with the cochlear implant program is managed.

2.2.8 Implication for the CBA

The previous sections demonstrate that the First Voice centres provide a range of services to the children enrolled in their early intervention programmes. This means that the CBA should not be seen to be an assessment of AVT only.

2.3 How does First Voice differ from other providers?

It has already been stated that First Voice emphasises an auditory-verbal/auditory oral approach. Across Australia and New Zealand, a number of service providers implement differing support programs; as noted in a report on early intervention policy by DEAF Australia:

> Early Intervention services vary nationally. Some states have better services than others. The education of deaf and hard of hearing children has always been characterised by differences of opinion and method, so the wide range of approaches are at least partly the result of this history, not necessarily because Australia has been unusually inconsistent or haphazard in developing these services.[31]

According to the Australian Hearing *Choices* booklet the early intervention approaches are broadly classified as:

- AUDITORY-VERBAL/ORAL-AURAL (such as the EIPs provided by First Voice): Programs using the auditory-verbal or oral-aural approach focus on the use of even minimal amounts of amplified hearing to develop spontaneous speech and to process language in a natural way through auditory pathways. These programs enable children with hearing impairment to learn to listen, understand spoken language and communicate through speech using their residual hearing, and in the oral-aural approach, using lipreading as well. These programs usually place the parent in the role of primary educator.

- TOTAL COMMUNICATION: Programs supporting a total communication philosophy focus on the use of a wide range of methods of communication including speech, lipreading, listening, signing and finger spelling. These various methods of communication may be used alone or in combination with each other. When speech and signing are used together this is known as simultaneous communication. Simultaneous communication is used to manually represent English using a sign system known as signed English.

- BILINGUAL/BICULTURAL: Programs supporting a bilingual/bicultural approach focus on education through two languages, Auslan and English. English is taught as a second language via reading or writing or through sign systems representing English. In many educational programs and school settings, children who are Deaf or hearing-impaired may learn about the Deaf community and its history, language and culture, as well as learning about the hearing community.[43]

Box 3: Megan – a 19 year old with hearing aids from the age of 16 months

Megan was diagnosed with profound hearing loss when she was 15 months of age. She was fitted with high powered hearing aids at 16 months of age and commenced early intervention at Hear and Say for weekly A-V therapy and playgroup sessions. However, it quickly became apparent that the hearing aids were not providing sufficient access to sound for the development of clear spoken language. At this time children were not receiving cochlear implants under 2 years of age, and Megan received her first cochlear implant, in her right ear, when she was just under 3 years of age.

When Megan was 14 she received her second cochlear implant. She had not worn a hearing aid in her left ear for a long time because it did not give her any useful access to sound in that ear, but was very keen to have the second cochlear implant. Whilst she will always have better speech perception and discrimination in her originally implanted right ear, Megan has obtained some discrimination abilities on the left side, she also hears better in noisy situations and it allows her to better localise the direction of sounds and voices. Megan has stated that she would not be without her bilateral now and that she hears much better and with less effort.

Megan attended a mainstream school for all her education and has speech and language on par with her peers; she even attended school in Japan and learned some Japanese when her parents, who are both teachers, moved there for a year when she was 9 years old (Megan had a younger sister to give her company).

Megan performed well both socially and academically at school and she is currently attending Griffith University at the Southbank campus where she is studying for a Bachelor of Fine Arts. She hopes to move into graphic design and business studies. Megan also learned the piano during her school years and has recently returned from a six week holiday in Europe with two of her friends. The holiday was over her university summer break. Megan works part time at Big W on the cosmetics counter and she funded the trip herself from this job.

2.4 Description of First Voice cohort

Figure 4 shows the distribution of First Voice EIP enrolments for the Australian partners and the NZ foundation member (The Hearing House). In total, as at March 2011, 650 children were enrolled; of these, 610 were in Australia.

The three Centres with largest enrolments were in Queensland where 216 children were enrolled with Hear & Say, followed by NSW and the ACT where 164 children were enrolled with The Shepherd Centre, and then Victoria where 122 children were in the EIP at Taralye in Melbourne.

Figure 4: Enrolments in Early Intervention by Centre, April 2011

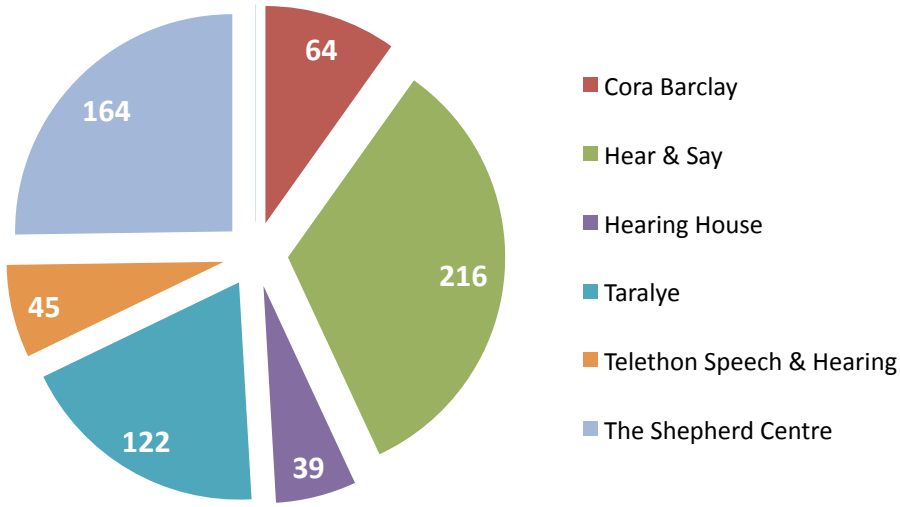


Figure 5 reveals the degree of hearing loss seen in the children enrolled with First Voice. Slightly more than one quarter have mild or mild-moderate hearing loss. At the other extreme, nearly one third have severe-profound or profound-total hearing loss. The rest range from moderate to severe and include children with Auditory Neuropathy Spectrum Disorder (ANSD).

First Voice has compared the degree of hearing loss prevalent in its cohort with the population as estimated using Australian Hearing data on children under 21 years of age. Although this is not a direct comparison, because the First Voice cohort is aged 5 or less and the categorisations of hearing loss are slightly different, the comparison indicated that First Voice may have a higher proportion of children with greater hearing loss (60dB and above) than are in the population of deaf and hard of hearing children as a whole.

Figure 5: Percentage of children by degree of hearing loss in First Voice EIPs

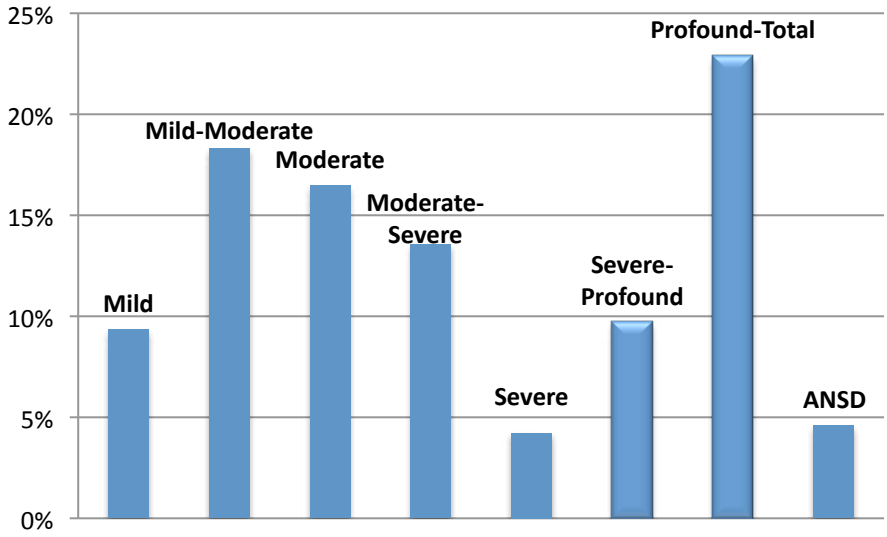
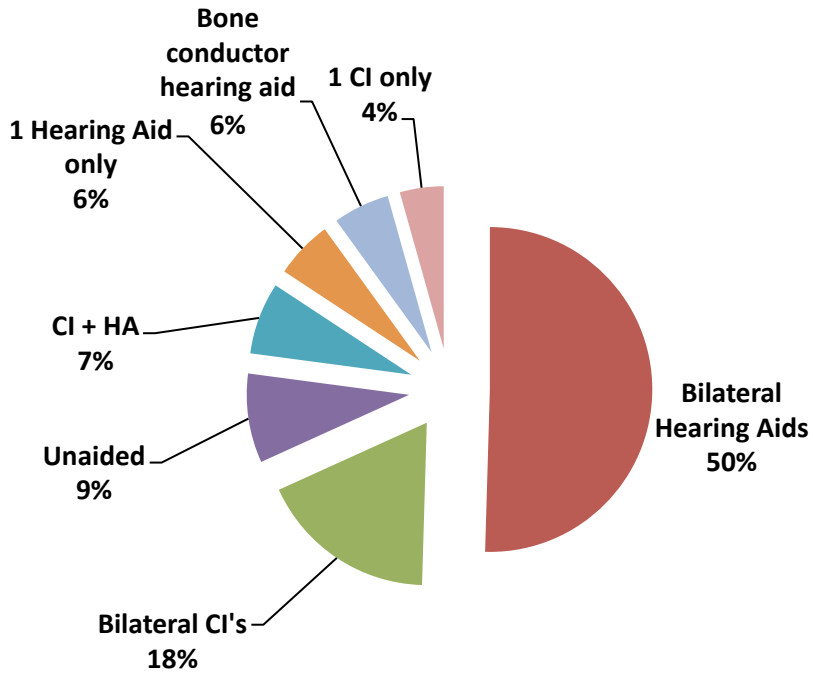


Figure 6 breaks the First Voice cohort down by type of device used; this shows that bilateral hearing aids are most common at 50% of the cohort, followed by bilateral cochlear implants (18% of the cohort) and unaided children which make up 9% of the group enrolled with First Voice (but it may be noted that not all centres within First Voice see unaided children).

Figure 6: Devices used by children in First Voice cohort



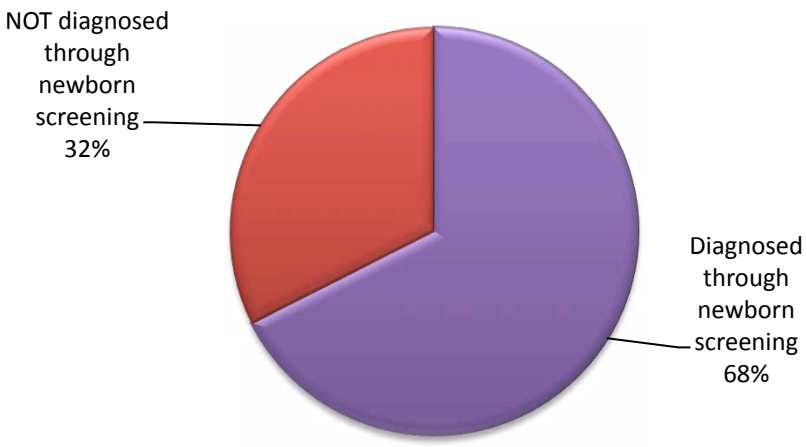
Box 4: An 18 year old male with acquired hearing loss from meningitis

AH is an 18 year old male who was diagnosed with a bilateral profound hearing loss at 2yrs 4 months following pneumococcal meningitis a month earlier. He received a cochlear implant at 2 years 6 months and commenced AVT sessions at the Cora Barclay Centre Early Intervention Program. He attended mainstream school, receiving direct itinerant support right through to middle school and then monitoring support through to the end of high school. The continued support through the middle years schooling facilitated the further refinement of his audition skills in the educational learning environment. His audition skills were developed to such a level as to enable him to complete the International Baccalaureate Diploma, including Italian as a language, which none of his family speak. Assessment in Italian required a 15 minute oral exchange with the examiner, with AH sharing the year 12 subject prize for Italian. He received a merit certificate in high level economics, and a graduating TER of 94.55 and has been accepted into a double degree Bachelor of Mechanical Engineering/Masters in Biomedical Engineering.

Figure 7 illustrates the proportion of the First Voice cohort that was diagnosed through newborn screening. Given that current epidemiology suggests that prevalence at least doubles in the first five years of life (and possibly triples from 1/1000 to 3/1000), one would expect the proportion of children in an EIP who were detected at birth to be lower than that of those who enter later.

The current First Voice data, however, reveal that two thirds of the children in the cohort were diagnosed through newborn screening. This strongly indicates that a number of children who acquire hearing loss after birth are currently not enrolled with EIPs, as already identified in the introduction to this report.

Figure 7: Children in First Voice EIPs diagnosed through newborn screening



The reasons for this situation are still unclear – it could be because the children who are not being picked up go to other providers, although a systematic bias of this nature against First Voice seems highly unlikely. Other suspected reasons are that they have lower levels of loss and the parents don't think they need support from

First Voice; or they slip through the system because their parents don't know about First Voice and other providers.

As argued in this report, it is also suspected that the costs associated with carers having to give up their jobs to look after the child full time, especially where that child's hearing loss is perceived to be mild, could be preventing some children from being enrolled in EIPs. This deterrence effect may be particularly strong for families on low incomes.

3 What is the relevant evidence?

3.1 The nature of the literature reviews

Having reviewed the current status quo in early intervention for children with hearing problems in Australia, and having examined the First Voice service model, it would appear that the 'value proposition' for the First Voice EIPs hinges on whether they *bring forward* a number of developmental milestones and are effective at producing outcomes such as integration into mainstream schooling and an improved employment outlook.

In reviewing the medical and economic literature, these questions were kept in mind. The literature reviews were however broader than this and included searches on outcomes for children with cochlear implants, patterns of care, and cost-of-illness, cost-effectiveness studies and cost-benefit studies.

The literature reviews presented below should not be considered to be exhaustive. They were carried out in the context of the CBA to allow the consultant to gain a better understanding of the type and range of questions being asked in the literature, and to help inform assumptions made in the CBA.

The findings presented in this section of the report thus provide relevant background information. Further supporting evidence, which is not reviewed in detail here, is also referenced in later sections of the report.

3.2 Early intervention programs

3.2.1 Early intervention generally

For this CBA, literature reviews were based on searches of PubMED and the Internet more widely by first using a variety of search terms, then analysing abstracts to identify relevant articles and finally by reading full versions of a selection of handpicked articles.

The first search was for 'early intervention programs' which yielded 58 results on PubMED. Most of these were unrelated to hearing or speech and language development. However, some of the findings coming out of this body of literature are relevant to the First Voice EIPs. For example, one meta-analysis of 74 primary research studies on early intervention for handicapped pre-schoolers found that:

> (a) early intervention with handicapped populations produces a positive sizeable effect size; (b) longer, more intense programs are associated with efficacy.[44]

From a cursory reading of the literature it appears that there is a trend towards intensive early intervention across a range of fields. Amongst recent articles, interventions including for autism,[45-50] ADHD and difficult behaviours,[51,52] dyslexia and reading,[53-55] mental health,[56-58] and nutrition and obesity,[59] were identified.

Childhood development programs

A body of literature on childhood development programs was also identified. These programs are aimed at socio-economically disadvantaged children. Perhaps the most well known of these interventions is the Head Start program in the US (including Early Head Start), the curriculum of which includes important language development and literacy components. The Head Start web site notes that:

> ...the Early Head Start program was established [in 1995] to serve children from birth to three years of age in recognition of the mounting evidence that the earliest years matter a great deal to children's growth and development.[60]

A systematic review of publications relating to Head Start and other childhood development programs concluded that:

> consistent improvements were found in measures of intellectual ability (IQ), standardized academic achievement tests, standardized tests of school readiness, promotion to the next grade level, and decreased placement in special education classes because of learning problems. The Task Force considered (1) retention in grade and (2) placement in special education as preventable outcomes that result from developmental delay or dysfunction.[61]

The reduction in retention in grade and placement in special education across the studies reviewed was around 14%, but ranged from 2% to 25% thus indicating important differences among intervention programs.

The systematic review however also concluded that the evidence on longer term social and family outcomes was still inconclusive.

Long term outcomes and a cost-benefit assessment were reported for only one of the more intensive childhood development programs, the Perry Pre-school Program, where outcomes for a 24 year follow up period were available.[62]

In the Perry Pre-school Program, 128 African-American 3-year-olds of low socioeconomic status from a single school attendance area received 2.5 hours of classroom time with four teachers each weekday and one 1.5-hour home teacher visit over a period of 30 weeks. The comparison group did not receive a preschool program.

Costs included in the economic impact analysis of the Perry Pre-school Program were teacher and support salaries, school overheads, classroom supplies, and future educational expenses (college). The quantified benefits included lifetime salary differential, avoided welfare costs, and avoided costs of criminal activity. On balance this study found that:

> The net benefit of the program in 1997 US$ was $108,516 for males and $110,333 for females. This study was classified as very good according to Community Guide quality assessment criteria. The Perry Preschool program differs from other programs, however, in terms of the degree of support and quality of implementation, and its results, therefore, cannot necessarily be generalized to less intensive programs such as Head Start. Nevertheless, careful consideration of the program is valuable because of the importance of the

> outcomes, the lasting long-term effects, the consistency of findings across numerous measures, and the strong quality of the research design.[61]

This may be directly relevant to the First Voice EIPs which are seen as qualitatively different from some of the other support programs due to their more intensive nature. The Perry evidence points to better outcomes from 'model' programs.

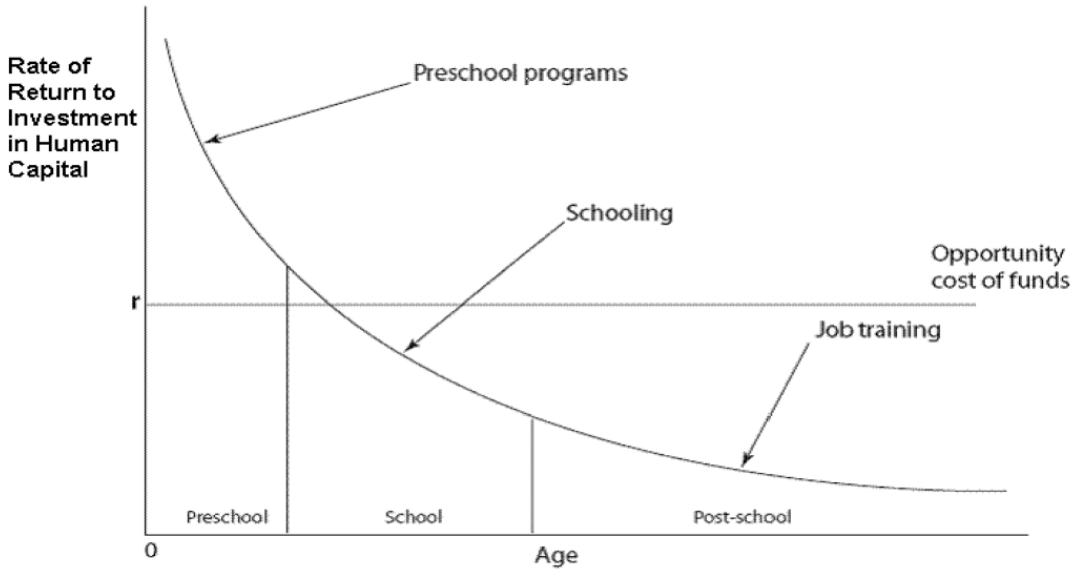
One recent paper from the economic literature examined the 'antenatal investment hypothesis'.[63] The paper provides an overview of the impact of adverse risk factors during the antenatal and early childhood periods on outcomes later in life, with the authors noting that:

> socioeconomic gradients in cognitive skills, socio-emotional functioning and health can be observed by age three, suggesting that preventative programmes starting earlier in childhood may be even more effective... Intervening in the zero-to-three period, when children are at their most receptive stage of development, has the potential to permanently alter their development trajectories[63]

The paper discusses the optimal timing of early childhood intervention with reference to recent research in developmental neuroscience.

Figure 8 below is taken from the publication; it suggests that if a fixed amount of money could be invested in human capital it would be best invested in the early years, where it yields the highest rate of return.

Figure 8: Rates of return to a fixed amount of investment in human capital across age groups



Source: Doylea et al, *Investing in Early Human Development: Timing and Economic Efficiency.*[63]

3.2.2 Early intervention specific to hearing loss

The initial search of PubMED which used the term 'early intervention programs' yielded eleven articles that were related to early intervention for children with hearing loss.[28-30,64-71] This included the JCIH Position Statements and the commentary by the former Surgeon General of the United States which have already been cited in this report. The initial searches also led to the identification of the August 2010 Supplemental Issue in the journal *Pediatrics* which addressed the issue of 'Improving the System of Care for Infants and Children With Early Hearing Loss'.

A slightly widened title search for 'early intervention and language development' yielded a further eight relevant papers.[72-79] An even wider title search of 'early intervention and hearing' produced 78 results; after excluding duplicated papers and those published prior to 2000, a scan of the titles suggested that 37 of these were potentially relevant. Analysis of abstracts revealed that a number of these were related to genetic factors, or set in a developing country context. These were also excluded. The remaining papers probably represent a good sample of the current state of debate on the subject. Some of the key findings and arguments presented in these papers are highlighted below.

A recently published paper on the impact of early intervention on expressive vocabulary hypothesized that the number of words produced would be higher for children with hearing loss who enrolled in early intervention before the age of three months. Using a prospective longitudinal matched cohort study design, the authors concluded that this was indeed the case, stating that:

> Although multiple factors are associated with expressive vocabulary growth of children with HL, enrolment in EI </=3 months has sustained beneficial effects on expressive vocabulary at 18 to 24 months.[80]

Another recent longitudinal study from the US similarly found that children who enrolled prior to the age of six months were more likely to have age-appropriate language skills than children enrolled at or after six months, and maintained age-appropriate skills over time. Also, children enrolled at or after six months had lower baseline skills but made significant language progress, irrespective of hearing loss severity.[72]

A study of a group of 112 children with hearing loss by Moeller et al looked more closely at age of enrolment (rather than age at diagnosis), with findings that strongly support the current mainstream view that earlier intervention is associated with better outcomes:

> Children who were enrolled earliest... demonstrated significantly better vocabulary and verbal reasoning skills at 5 years of age than did later-enrolled children. Regardless of degree of hearing loss, early-enrolled children achieved scores on these measures that approximated those of their hearing peers. In an attempt to understand the relationships among performance and factors, such as age of enrolment, family involvement, degree of hearing loss, and nonverbal intelligence, multiple regression models were applied to the data. The analyses

> revealed that only 2 of these factors explained a significant amount of the variance in language scores obtained at 5 years of age: family involvement and age of enrolment... Importantly, there were interactions between the factors of family involvement and age of enrolment that influenced outcomes. Early enrolment was of benefit to children across all levels of family involvement. However, the most successful children in this study were those with high levels of family involvement who were enrolled early in intervention services. [75]

Of the group of children studied by Moeller, 59 attended an auditory/oral program and 51 attended a total communication program, but the analysis was presented for the combined group only. The above findings are in line with earlier work by Yoshinaga-Itano which, who analysed data for the US state of Colorado:

> Children who were early-identified and had early initiation of intervention services (within the first year of life) had significantly better vocabulary, general language abilities, speech intelligibility and phoneme repertoires, syntax as measured by mean length of utterance, social-emotional development, parental bonding, and parental grief resolution.[81]

Another paper which was identified later during the literature review process looked more specifically at the relationship between speech and language outcomes and the age at which a child receives a cochlear implant. The authors of this paper examined latent-growth curves for 100 children who had received their implants when they were between one and ten years of age and had used their devices for between one and twelve years, finding that:

> There seems to be a substantial benefit for both speech and vocabulary outcomes when children receive their implant before the age of 2.5 yr. This benefit may combine a burst of growth after implantation with the impact of increased length of use at any given age. The added advantage (i.e., burst of growth) diminishes systematically with increasing age at implantation.[82]

In contrast to the general thrust of findings, however, an Australian paper by Wake et al published in 2005 came to the conclusion that the degree of hearing impairment was the predominant factor determining language outcomes for 7-8 year olds, and not the age at diagnosis.[83] This paper raised considerable debate, but as Das points out in his comments on the paper by Wake et al:

> We need to conduct larger well constituted, prospective, multicentre studies to gather detailed information about all factors which may influence outcome.[84]

It is therefore important to note that a number of important research questions are still being debated. To emphasise this point, another paper from 2006 which evaluated the spoken language skills of 76 children who had used a cochlear implant for at least seven months is briefly considered.

The authors of this paper used a 30-minute language sample analysis, a parent-completed vocabulary checklist, and a teacher language-rating scale to assess spoken language skills. Children were recruited from and enrolled in oral education programs or therapy practices across the US. Only children who were presumed deaf since birth, spoke English as the primary language, had no other known

conditions that interfere with speech/language development, were enrolled in programs using oral education methods, and had had no known problems with the cochlear implant lasting over 30 days, were included in the analysis.[85] This evaluation concluded that:

> Longer use of a cochlear implant in infancy and very early childhood dramatically affects the amount of spoken language exhibited by three year old profoundly deaf children. In this sample, the amount of pre-implant intervention with a hearing aid was not related to language outcome at 3.5 years of age. Rather, it was cochlear implantation at a younger age that served to promote spoken language competence. The previously identified language-facilitating factors of early identification of hearing impairment and early educational intervention may not be sufficient for optimizing spoken language of profoundly deaf children unless it leads to early cochlear implantation.[85]

This quote was included here to highlight the fact that approaches to early intervention are still being actively debated in the scientific community. The overall thrust of the findings is nevertheless quite clearly that earlier intervention is better. It is the finer details such as which device to use at what age and when language training becomes most effective that are still being debated.

3.2.3 Other relevant research

A recent German paper identified incidentally during the literature review process reports the results of a randomised controlled trial (RCT) which was undertaken to evaluate the effectiveness of a short, highly structured parent based language intervention group programme for 2-year-old children with specific expressive language delay (SELD).[86]

The children in the study did not have deficits in receptive language, nor was this group affected by hearing problems. For the RCT, 58 children with SELD were randomly assigned to an intervention group or a 12-month waiting group. In the intervention group, mothers participated in the 3-month Heidelberg Parent-based Language Intervention (HPLI). All children were reassessed after six and twelve months. Assessors were blind to allocation and previous results.

> At the age of 3 years, 75% of the children in the intervention group showed normal expressive language abilities in contrast to 44% in the waiting group. Only 8% of the children in the intervention group versus 26% in the waiting group met the criteria for specific language impairment (t score < or =35)... By applying the short, highly structured HPLI in children with SELD, the rate of treatment for language impairment at the age of 3 years can be significantly reduced.[86]

Given the randomised nature of this intervention, it provides a strong indication that the intervention was effective. This supports other research evidence that language development can be supported through customised interventions.

Another study of children with severe reading and/or language disorders found that placement in a special teaching program and intensive speech therapy (3

hours/week) had a significant impact on the children's achievement in a number of areas:

> The entire group demonstrated during the year significant progress for reading ($p = 0.0001$), spelling ($p = 0.0001$) and numeracy ($p = 0.0001$). Nineteen children (61 percent) showed more progress in reading than normally expected over nine months. Out of the remaining 12 children, 10 demonstrated more progress in spelling and/or numeracy than normally expected over nine months. All three reading evaluation tools disclosed a progression although one was less efficient ($p = 0.05$).[87]

Again, whilst this was not a group of children with hearing problems, studies such as this demonstrate that intensive work on language skills can make an important difference to achievement levels, also indicating that a significant degree of 'catching up' is possible.

3.3 Auditory-Verbal Therapy (AVT)

As discussed in Section 2 of this report, the First Voice centres specialise in Auditory-Verbal Therapy (AVT), ten principles of which are listed in Appendix B. It is one of the main modern approaches to early therapy that is currently available to children with hearing loss:

> Auditory Verbal Therapists work over time with families to maximise listening and to ensure that they are equipped with knowledge and skills to maximise their child's spoken language potential... AVT is an approach based on the assumption that "hearing" is the most effective modality for the teaching of spoken language (speech), reading, and cognitive skills.[40]

At the time of writing, the Cochrane Library did not contain any systematic reviews of evidence for the clinical effectiveness of AVT. An initial PubMED title search for 'Auditory-Verbal Therapy' yielded only five results, of which two were irrelevant to this CBA. The remaining three included one paper from 2000 which examined child and family factors associated with deaf children's success in Auditory-Verbal Therapy, finding that:

> Fifty-seven percent of the clients who remained in this program for over 1 year were fully integrated into regular education, with no services from a teacher of the deaf. The population was affluent, with more females than expected. Those who left dissatisfied tended to be males with greater degrees of hearing loss who left the program soon after 1 year.[88]

The second paper described AVT to a Singapore audience,[89] and the third paper related to the needs of the parents of children who attended an AVT counselling program, noting that long-term continuing intervention generates additional psychotherapeutic, social and financial needs for parents.[90]

Widening the term used in the initial search to include abstracts yielded 153 results; once this was narrowed by including 'hearing' as an additional search term in the abstracts, the number of hits fell to 19.

On inspection, at least one was predominantly descriptive and simply asserted that AVT was beneficial,[91] one reported on the sub-group of children with cochlear implants and attention deficit hyperactivity disorder (ADHD),[92] and another dealt with differences in outcomes for children with cochlear implants versus children with hearing aids.[93] This latter study included children in AVT programs who were also receiving instruction in sign language, concluding that those with cochlear implants were more likely to be 'gap closers' and that:

> Average language estimates at 84 months of age were nearly identical to the normative sample for receptive language and 7 months delayed for expressive vocabulary. Children demonstrated a mean rate of growth from 4 years through 7 years on these 2 assessments that was equivalent to their normal-hearing peers. [93]

A further study identified by the widened search reported gender differences in results with AVT, with girls achieving better outcomes; however, the authors suspected that the group of 70 children included in this study could have been atypical and therefore felt that these findings could not be generalised to the broader population.[94]

One German study claiming to be one of the first to empirically analyse the impact of AVT was based on 103 children with profound hearing loss, who were younger than 24 months old at the time the study began.[95] They were followed in three separate surveys between 1996 and 1998. The authors analysed progress made in the auditory-verbal skills of infants suffering a loss of hearing of 90 dB or more and who were educated using an AVT approach, coming to the conclusion that:

> The children's development is impeded by such factors as late initial diagnosis; delayed supply of hearing aids and late commencement of early education; poorly-adjusted hearing aids and short periods of wearing them. A system of early education that is only to a very limited degree hearing-oriented, and a family environment where little is spoken and where the child's auditory disability receives only scant attention, may also play a part. On the other hand, under favourable circumstances, even children with profound hearing-impairments may attain a development level of natural auditory-verbal skills which corresponds to that of children who can hear well-perhaps with a certain time-delay, and certainly involving a greater effort on the part of the children, but basically, in the same natural way and with a very similar quality of results.[95]

In an effort to identify possible predictors for why a small number of cochlear implant recipients do not realise significant improvements in speech perception, one retrospective study of adults compared pre- and post-implant audiologic data in two distinct groups ('poor' and 'high' performers).[96] Poor performers were those who saw improvements of less than 10%. This group numbered 58 in the study (13% of the group). High performers consisted of 194 patients (44% of the group) who scored between 91 and 100% post-implantation.

Of particular interest for this CBA is the subset of 109 of the implant recipients who had been deaf since birth or early childhood. Thirty-three of these were poor performers and 24 were high performers. Importantly, the paper noted that 79% of

the poor performers in this group had not received any auditory/oral training in childhood but all of the high performers had been identified early and had been recipients of a strong auditory/oral education. The authors concluded that:

> A high preimplant speech score, auditory verbal therapy, and postlingual deafness statistically correlate with higher postimplant speech scores 1 year after cochlear implantation. Device type, caloric response and hearing aid use preimplantation, age at surgery, and sex do not statistically correlate with either poor or excellent speech discrimination scores postcochlear implantation.[96]

Box 5: Lily – a 10 year old with hearing aids from the age of 1 month, letter from parent

Our daughter Lily is now 10 years old, she was born with a profound hearing loss which was detected here in Perth by newborn hearing screening at 3 weeks of age. There is no trace of family hearing loss so this all came as a huge shock but we wanted to do the right thing for Lily and to ensure she had all the same opportunities and choices in life as everyone else. We enrolled her at an early intervention agency right away at one month of age and the journey started. Lily received her hearing aids right away and then had her first cochlear implant at 10 months and the second implant at 7 years of age.

We live in central Perth so attending the many appointments and weekly visits to Telethon Speech and Hearing was easy for us. Fortunately, my work position was flexible and I could adjust my working hours around appointments and visits. The first 2 years were very intense; however by the time Lily had reached Kindy, the benefit of early detection and immediate high quality auditory verbal education programs was very obvious. This enabled Lily to be fully integrated into her local primary school at the age of 4. A massive achievement for a child who was born profoundly deaf.

Lily attended the program at Telethon Speech and Hearing for 4 years utilising services such as, speech pathology, psychology and audiology. I have to say, Lily is still benefiting from the Speech and Hearing Centre's support and will do so for the rest of her life. Lily is now attending her local primary school in her age appropriate class. Her results are steady and in some areas above average. She is also learning how to play the piano and joined a netball team last year.

Lily's school made the students aware of her hearing loss and the equipment she uses to enable her to hear. This was not to make Lily special, but to just be aware. Educating the other children at such an early age to accept a difference in one of their fellow students has been a huge success. There is no special treatment toward Lily, she is totally accepted and this makes her no different from anyone else. Consequently she is a very social and happy girl. Sometimes we forget that Lily cannot hear!

She is proof that when a problem has been detected early in a child's development, immediate therapy and education to rectify or prevent the problem getting worse is paramount to a successful outcome. The Telethon Speech and Hearing Centre not only educated Lily, but educated both myself and Lily's dad to continue her development at home. In a nutshell, we didn't feel at a loss as parents and we were given sound direction.

Another study of early deafened adult cochlear implant users reported that they perceived significant benefit from cochlear implantation and that:

> ...family and peer support, prior Auditory-Verbal Therapy, and a positive attitude are considered important factors in maximizing this benefit.[97]

Having exhausted obvious search strategies for interrogating the PubMED database

the consultant then searched the Internet using Google. This approach unearthed a number of other publications relevant to the CBA.

One of these was a recent evaluation of the AVT approach which compared actual and predicted rates of language improvement in a group of children in the UK, and concluded that:

> For all age groups and for each of the different hearing technologies, AVT was found to be a highly effective programme for accelerating spoken language development when using RLD [rates of language development] as an outcome measure[40]

The same authors however also noted that:

> Due to the intensive nature of the post-graduate training, AVT is an expensive service. Although there have been some published studies looking into the efficacy of AVT which have been reviewed, there is not yet enough data on the benefit of AVT to conduct either cost-benefit analysis ... or to be able to compare the benefits found from other therapies. To date, there have been no studies of randomised control trials involving large numbers of children undertaking AVT.[40]

3.3.1 Previous reviews of evidence on AVT

The Google search identified at least one previous review of empirical evidence on AVT. This was a paper by Alice Eriks-Brophy published in *The Volta Review* in early 2004.[98] The paper summarises evidence available up to 2003, namely from seven studies that were previously cited in support of AVT. Eriks-Brophy concluded that at the time of writing in 2004 the strength of evidence was insufficient to draw strong conclusions about the efficacy of AVT, noting the retrospective and in some cases anecdotal nature of some studies, small sample size in others, and also the heterogeneous nature of the outcomes reported.

Eriks-Brophy did note that one of the research projects covered by two studies in her review had been of truly experimental, prospective design.[99,100] This project included children aged 50 to 120 months which, it may be noted, is older than ideal for an assessment of truly early intervention. Nevertheless, research on this group did demonstrate that children developed age-appropriate language skills and the authors concluded that AVT was a "highly viable communication option", although causality could not be strongly established.

In another summary of the evidence published just two years later, Ellen Rhoades concludes that:

> ... there is emergent justification for the implementation of the Auditory-Verbal approach... Those professionals who would continue to argue that children with severe-profound degrees of deafness have not demonstrated they can learn to hear and speak the prevailing language seem to be unaware of the evidence now at hand.[101]

In the last five years, additional information has accumulated, and although this was

not uncovered using standard literature searches, fortunately members of the First Voice team were able to point the consultant in the right direction and supply some more recent, relevant papers.

The first is a paper by Dornan et al,[102] which includes a brief review of previous evidence (and refers to an earlier review carried out by Dornan). The paper reports on a longitudinal study of 29 children with hearing loss in one of the First Voice programs who were compared with a matched control group with typical hearing at 9, 21, and 38 months after commencement of the study. Children were matched for language age, receptive vocabulary, gender, and socioeconomic status. As eight children in the First Voice / AVT group and two children from the typical hearing group moved away during the study period, only 19 matched pairs remained for statistical analysis. The authors report that:

> An assessment battery was used to measure speech and language over 50 months, and reading, mathematics, and self-esteem over the final 12 months of the study. Results showed no significant differences between the groups for speech, language, and self-esteem ($p > 0.05$). Reading and mathematics scores were comparable between the groups, although too few for statistical analysis. Auditory-verbal therapy has proved to be effective for this population of children with hearing loss.[102]

3.3.2 Other communication methods

The evidence on other communication methods, such as total communication (TC) or oral communication (OC), when compared to AVT, appears to be limited to studies of children with cochlear implants. It is nevertheless valuable to briefly review some of the evidence as this could affect the validity of assumptions for the base case in the CBA.

First, a summary presentation on research carried out at the University of Michigan from 2006 reports statistically significant and clearly superior outcomes for AVT in children with cochlear implants, when compared to TC or OC methods.[103] The research was based on 174 children with cochlear implants, of which 97 were enrolled in OC, 54 in TC, and 23 in AVT. The relatively small number of children enrolled in AVT was due to the University of Michigan's Centre having only recently begun to offer AVT as an option. Those enrolled in AVT were also younger, on average, but these differences were adjusted for in the statistical analysis. As mentioned by the authors, the findings of the research were strong enough to convince the team at the University of Michigan to now routinely recommend AVT to most of the children at their Centre.

Three different test measures for speech perception and three different measures for speech and language were used by for this research project. Data were collected during routine one or two year post-activation evaluations. The striking result was that AVT scored significantly higher than the other two methods on *all of these measures*.

On speech perception measures, the AVT group scored around 90% or higher in two

of the three tests at 12 months and in all three tests at 24 months. Children using other methods scored much lower at 12 months (at least 20 percentage points lower but up to 70 percentage points lower), and while they improved by 24 months, the gap to the AVT group was still very significant (between 10 percentage points on one score and 60 percentage points on another score). The narrowing in the gap between AVT and the other methods was mainly because AVT scores were so high that little further improvement was indeed possible, whilst the two other approaches had ample scope for improvement. The authors noted that the AVT group's receptive vocabulary scores, which rose to around 85 at 24 months, was close to the average for children in their age group (stated as ranging from 85 to 115).

Turning now to speech production, AVT again scored highly and significantly above the two other methods, on all three tests. While children on the OC programs did also improve between 12 and 24 months on the three tests used, children in the TC group recorded a decline in two out of the three tests.

An important earlier study published in the Lancet in 2000 examined the determinants of speech perception in children after cochlear implantation.[104] This study used a prospective design and tracked 40 children of which 26 used a total communication approach (i.e., communication included a signed input of whatever degree) and 14 just communicated orally prior to implantation.

Speech perception was measured with connecting discourse tracking (CDT), which assesses understanding of speech in conversation without lipreading (unfamiliar text is presented by means of live voice to a listener). The study's summary reports the following findings and interpretation:

> The mean number of words per minute perceived increased from 0 before implantation to 44·8 (SD 24·3) 5 years after implantation. Repeated-measures ANOVA showed that children significantly progressed over time (p=0·001). Age at implantation was a significant covariate (p=0·01) and mode of communication was a significant between-individuals factor (p=0·04)... Young age at intervention and oral communication mode are the most important known determinants of later speech perception in young children after cochlear implantation.[104]

The distinction between oral and AVT approaches was not made in this study but it would appear that children being educated using the oral approach, as defined in the study, would have included children enrolled in AVT. As the authors noted, the educational setting and communication approach varied between children, and depended on factors such as parental choice and local educational policy.[104] On balance, this paper provided strong evidence for better speech perception in children whose education emphasised listening and speaking. Another study published in the same year reported similar results, but noted that:

> ...it remains to be explored whether children use oral communication after cochlear implantation because they are doing well, or whether they do well because they are using oral communication.[105]

Another earlier study of 147 children came to a more ambivalent conclusion, noting mixed results.[106] In this study, which was also published in 2000, children's consonant-production accuracy and vocabulary development was measured over time, comparing oral with total communication. Children who participated in the study had profound sensorineural hearing loss and had used cochlear implants for between 6 months and 10 years:

> The results of this study suggest that children may benefit from using cochlear implants regardless of the communication strategy/teaching approach employed by their school program and that other considerations, such as the age at which children receive implants, are more important.[106]

As already noted the literature reviews presented here cannot claim to be exhaustive, but given the age of some of the earlier studies and having reviewed abstracts of a number of more recent papers it appears uncontroversial that ***AVT as a communication method for children who are deaf or hard of hearing is at least as good as other options, and potentially the best option for most of the children to whom it may be recommended***.

3.4 Patterns of care

As part of the literature review, PubMED and online databases were also interrogated using search terms such as 'patterns of care' and 'hearing' or 'ear' in title and abstract and other field searches, but yielded very few results.

One paper reported results of a survey designed to investigate audiologic referral patterns of primary care physicians and, more specifically, their referral of patients for hearing aids and cochlear implants:

> Of the 260 physicians who received a questionnaire, 85 (32.7%) responded... Although 97.6% of the responding physicians indicated that hearing loss affected patients' quality of life, only 60% assessed patients for hearing loss. "Lack of time" and "more pressing issues" were the most common reasons given for not evaluating patients for hearing loss. Although 76 physicians (89.4%) said they were aware of cochlear implants, only 22 (25.9%) had referred patients for implant evaluation. Lack of referral most commonly resulted from uncertainties about "where to refer" and "which patients were potential candidates".[107]

A number of other studies of attitudes and referral patterns in the primary care setting were also identified but yielded no information on links to early intervention programs.[108-112] As with the previous paper, these were all in the US setting.

The general impression gleaned from these papers was that primary care practitioners value infant screening, may begin routine screening in their own practices from around the age of 3, but are often still unsure about how to best manage referrals.

3.5 Cost-effectiveness and economic studies

Cost-effectiveness studies were identified using a range of search terms on PubMED and using Google for online searches. These provide important background information in terms of previous methodologies and assumptions used, for example, on project horizons and discount rates.

An early paper published in JAMA in 2000 presented a 'cost-utility analysis' for cochlear implantation.[113] This study surveyed the parents of 78 profoundly deaf children who had received cochlear implants (averaging 1.9 years of implant use). Costs and benefits were discounted at 3% per year. Direct and total cost to society per quality-adjusted life-year (QALY) were estimated using three methods, Time-Trade-Off (TTO), Visual Analog Scale (VAS), and Health Utilities Index-Mark III (HUI). Parents rated their child's health state at the time of the survey and immediately before and 1 year before implantation. The following results were reported:

> Mean VAS scores increased by 0. 27, from 0.59 before implantation to 0.86 at survey. In a subset of participants, TTO scores increased by 0.22, from 0.75 to 0.97 (n = 40) and HUI scores increased by 0.39, from 0.25 to 0.64 (n = 22). Quality-of-life scores were no different 1 year before and immediately before implantation. Discounted direct costs were $60,228, yielding $9,029 per QALY using the TTO, $7,500 per QALY using the VAS, and $5,197 per QALY using the HUI. Including indirect costs such as reduced educational expenses, the cochlear implant provided a savings of $53,198 per child. CONCLUSIONS: Cochlear implants in profoundly deaf children have a positive effect on quality of life at reasonable direct costs and appear to result in a net savings to society.[113]

One US paper looked at the expected cost-effectiveness of universal newborn hearing screening (UNHS), which included assumptions about the impact of early language training.[114] The paper noted that UNHS could potentially reduce the typical age of identification of hearing impairment by six to twelve months, an expectation that has recently been confirmed by data discussed in the study by Young et al, who found that the mean age at diagnosis of fell by 10.3 months after implementation of mandatory UNHS.[115]

The main outcomes were incremental cost per infant whose deafness was diagnosed by 6 months, which included only the cost of screening and diagnostic evaluation; and incremental cost per deaf child with normal language, which also included the costs of medical care, education and assistive devices, and lost productivity over the lifetime of the deaf individual. The study concluded that:

> Under the base-case assumptions about lifetime savings that result from normal language with early intervention, UNHS resulted in normal language achievement for more deaf children and was cost saving in the long term compared with both selective screening and no screening... If early identification results in improved language abilities, lower educational and vocational costs, and increased lifetime productivity, then UNHS has the potential for long-term cost savings compared with selective hearing screening and no screening. To understand the actual long-term economic effects of UNHS, better evidence is needed regarding the impact of early intervention on

language outcomes and subsequent changes in educational costs and lifetime productivity.[114]

3.6 Evidence from the First Voice centres

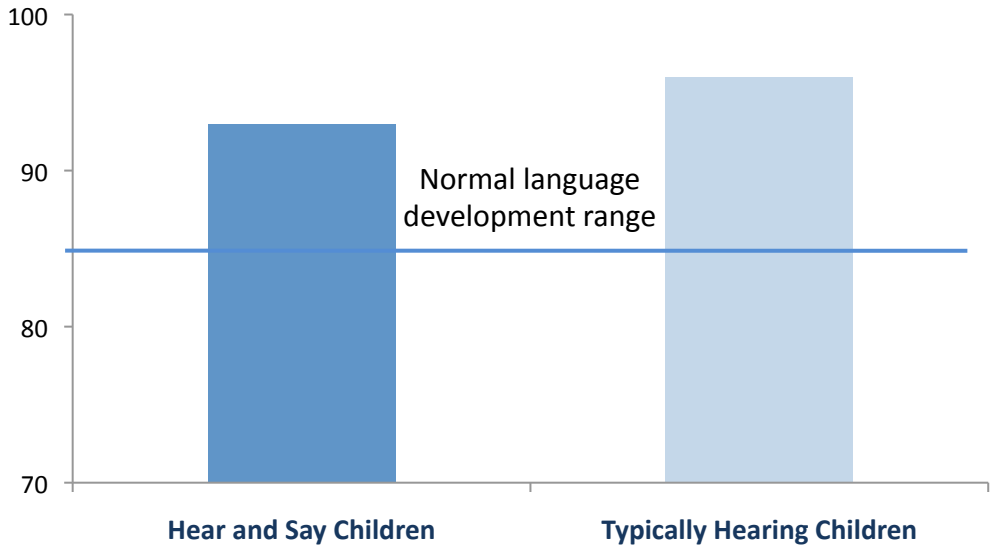
3.6.1 Results reported by individual centres

First Voice centres have reported some of the relevant language and school participation outcomes on their respective websites and in their Annual Reports. For example, the Hear and Say 2010 Annual Report mentions that:

> 94% of Hear and Say graduates obtain full inclusion into mainstream educational settings and our research outcomes have shown that children in our program can progress at the same rate as their normally hearing peers.[116]

Figure 9, which is taken from the Hear and Say Centre's 2010 Annual Report, illustrates that mean language assessment scores of Hear and Say children are close to those of typically hearing children (scores above 85 are in the normal language development range).

Figure 9: Mean language assessment score, Hear and Say Centre EIP



Source: Hear and Say 2010 Annual Report.[116]

The Shepherd Centre's 2009 Annual Report reveals that the Centre helped more than 1,500 children since 1970 and that more than 90% of students graduate to mainstream schools.[117]

The website of The Shepherd Centre also includes the following information for last year's graduates:

> In 2010, 100% of graduates from The Shepherd Centre program for whom English is their first language and who have no additional needs graduated with age appropriate language skills.

Taralye's 2010 Annual Report provides some further information on the children who are enrolled in the EIP in Victoria:

> Between January 2009 and March 2010, 153 families of children with hearing loss participated in Taralye's early intervention program... Of the total cohort, 124 (81%) were from English speaking families... 57 of the 153 children (37%) have a disability other than deafness... Language skills are reported for 83 children in the Taralye program where English is the majority language spoken at home and who have no additional disability... In the general population it is expected that 84% of children will have language scores at or above the normal range. For the 65 children in the Taralye cohort in which the PLS-4 and Rossetti scales were used to assess speech and language skills:
>
> - 74% scored at or above the normal range for Receptive Language
> - 72% scored at or above the normal range for Expressive Language
>
> These children varied in the age at which their hearing loss was diagnosed (birth – 4 years 7 months), in their hearing level (mild – profound) and the length of time they had been enrolled at Taralye (1 month – 6 years).[118]

The 2009 Annual Reports of the Cora Barclay Centre and Telethon Speech & Hearing did not provide data on outcomes. The consultant requested that more data on outcomes for First Voice children be made available for the CBA, ideally pooled data for the First Voice cohort as a whole.

In response to this, First Voice organised a data collection and analysis effort that ran parallel to the writing of the CBA. Emma Rushbrooke at Hear and Say in Queensland coordinated the national data collection effort and Gabriella Constantinescu from Hear and Say provided statistical analysis and drafting inputs. The results of this analysis are presented in the next section.

3.6.2 Pooled data on language outcomes

The total number of children that graduated in 2010 across the First Voice Centres was 88. For the analysis 3 children were excluded due to English as a second language (ESL), 13 due to disabilities and 20 due to unilateral hearing losses, time in the EIPs less than 12 months, or missing data. This section therefore reports results for a sample of 52 children that graduated in 2010 from the EIPs across the five First Voice Centres in Australia – a group of 'typically developing' children with hearing loss with no additional disabilities or ESL background. All children were enrolled in their respective EIP for at least 12 months.

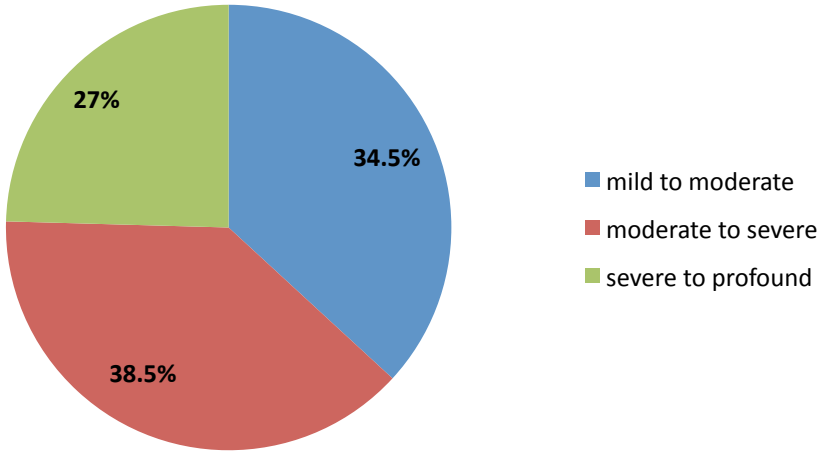
Language and receptive vocabulary results are presented here for the children at ages 3 and 5 years from standardised assessments that are normed on children with normal hearing. Standard scores between 85-115 are considered within the average range.

At age 3 years, the group showed receptive (M=89), expressive (M=93) and total language scores (M=90) within the average range, with 62% of the total group showing total language scores within the average range or above. At 5 years, the group showed consistently higher scores than at 3 years which were maintained

within the average range (M = 97 receptive; M = 94 expressive; M = 95 total language), and with the higher 73% of children within the average range or above.

A similar trend of scores within the average range was also observed for receptive vocabulary at both 3 years (M = 96) and 5 years (M = 97), with 76% and 82% of children within the average range or above respectively. Overall, the findings show that the majority of children graduated from the EIPs with age appropriate language and vocabulary skills, in line with their hearing peers.

Figure 10: Level of hearing loss in better ear for First Voice sample



The data was broken down further into the 'early' and 'late' groups. The 'early' group represents the 34 children in this sample that met the criteria of early diagnosis, aiding and EIP enrolment before 2 years of age. This more closely represents the trend of children currently enrolled at the Centres.

The early group showed language scores within the average range at both 3 years (n = 23; M = 90 receptive language; M = 95 expressive language; M = 92 total language) and 5 years (n = 32; M = 98 receptive language; M = 95 expressive language; M = 95 total language), with an increase in scores at 5 years and with a greater number of children performing within the average range or above (65% vs 84% respectively), and reflecting a similar trend to the normal population.

Receptive vocabulary scores (M = 96 at 3 years, n = 16; M = 97 at 5 years, n = 28) remained within the average range and the number of children performing within the average range or above reflected that of the normal population (81% at 3 years; 82% at 5 years).

The 'late' group consisted of 18 children that met the criteria of diagnosis, aiding and EIP enrolment after 2 years of age for one or more of these variables, with at least 12 months in the EIP. This group also demonstrated language and vocabulary scores within the average range at both 3 years (n = 9; M = 87 receptive language; M = 87 expressive language; M = 85 total language; M = 97 receptive vocabulary)

and 5 years of age (n = 15; M = 95 receptive language; M = 91 expressive language; M = 93 total language; M = 96 receptive vocabulary).

Figure 11: Language outcomes at 5 years (EIP Graduates, 2010)

When compared to the 'early' group, a lower percentage of children in the 'late' group were performing in the average range or above for total language at 3 years (55% for the late group versus 65% for the early group) and 5 years (60% for the late group versus 84% for the early group), and for receptive vocabulary at 3 years (60% for the late group versus 81% for the early group).

Overall, the findings demonstrated that both the 'early' and 'late' groups achieved language and vocabulary scores within the average range at both 3 and 5 years of age, with better performance at 5 years. The 'early' group typically performed better than the 'late' group on all measures of language and vocabulary at both the 3 and 5 year time points. This is in line with the findings reported in Sections 3.2 to 3.5, and suggests that the combination of early diagnosis and intervention plays an important role in the child's language and vocabulary development.

In addition to the statistical analysis reported here, members of the First Voice team at the Cora Barclay Centre in South Australia volunteered to follow up children who were potential school leavers between 2001 and 2010. The idea behind this approach was to identify children who had benefited from early intervention and who may by now be in employment or pursuing further studies. The results of this important investigation are reported in the next section.

3.6.3 School leaver outcomes study (2001-2010)

The Cora Barclay Centre identified 39 potential school leavers from its historical records. Attempts were made to contact all of these students directly, although in some cases parents answered the survey questions. Importantly, no sub-group was

excluded from this investigation, i.e., children with additional disabilities or children from a non-English speaking background were not excluded for the purposes of this exercise. Four students/families were found to be no longer contactable, reducing the target group to 35.

Staff members from the Cora Barclay Centre attempted to contact the target group by telephone several times over a 2-3 week period in May 2011. At the time of writing this report, 23 results had been gained, with results pending for 12 students (response rate = 65.7%). Messages had been left with family members, emails, or on answering machines, but no further responses were received prior to writing this report. The findings for the 23 respondents were as follows:

- 22 finished Year 12 (95.7% of respondents)
- 18 respondents achieved SA Certificate of Education (i.e., 78.3%),
- 18 respondents have either completed, or are currently enrolled in, further education post completion of high school (78.3%)
- More respondents (who completed Year 12) have gone on to university tertiary education than TAFE/Technical certificates, or no further study
- 17 respondents have a good/consistent history of work place participation (73.9%)

Three of the four students who completed Year 12 but did not achieve SACE nevertheless appeared to have good prospects as far as workforce participation is concerned. One is already working full time at a superannuation firm, the second has completed a security course and has been in part-time employment, and the third is on an apprenticeship to become a plumber.

Of those known to be currently pursuing further education, students are on track to join the workforce in diverse fields including graphic design, financial services, veterinary nursing, occupational therapy, teaching, child care, and in retail and hospitality. One student has already completed a Masters Degree in Accounting & Finance at Adelaide University, and is studying to become a Chartered Accountant whilst currently working as a Senior Business Analyst with an insolvency accounting firm.

When compared to results reported in the national and international literature on school achievement and employment outlook for children who are hard of hearing, these outcomes are almost stunningly positive. The reader is referred to Section 4.3.2 of this report, where some of the relevant statistics are presented – for example, the British Association of the Teachers of the Deaf reports that 86% of deaf and hearing impaired students leave school by the age of 16 years.[119]

The results are good even when compared to national averages – in 2010, the proportion of 20–24 year olds with Year 12 stood at 78%.[120]

The results of the Cora Barclay Centre's retrospective analysis therefore suggest that those attending the early intervention program have achieved very good educational outcomes and have good employment prospects.

4 Costs and benefits

A simple version of the cost-benefit argument has already been presented in Section 1.2 of this report. Section 4 puts numbers on the propositions put forward earlier, where possible, and provides more detail on methodological aspects of the CBA.

4.1 The project horizon and discount rates

One key question for CBAs relates to the timeframe over which costs and benefits are assumed to flow. A 30-year horizon is typically used for projects that involve investments in physical assets such as roads and buildings, although a 50-year horizon is sometimes applied where there is good reason to believe that the asset will yield benefits over a longer period.

The benefits of improved hearing and language are life-long and therefore it seems intuitive that the appropriate project horizon would be set by life expectancy. It is important to realise, however, that future benefits are discounted in CBAs. With a 3% discount rate a one dollar benefit flowing in 50 years is valued at 23 cents, and if it flows in 80 years it is only valued at 9 cents in 'present value' terms.

A 50-year project horizon was adopted for this CBA. Other horizons are covered in the sensitivity analysis in Section 4.5 of this report.

4.1.1 The discount rate chosen for the CBA

The literature reviews carried out for this and previous reports by the consultant revealed that a discount rate of 3% per annum is standard for health economic assessments. A 3% discount rate is thus adopted for the CBA. This rate is in line with the economic literature on the social rate of time preference (SRTP), and strikes a balance between an extreme SRTP of zero (no discounting, as is sometimes recommended on the basis of intergenerational equity), and rates commonly used in CBAs for public investments in physical infrastructure which are in the region of 5-7%.

4.2 What are the costs?

Ideally, costs would be broken down to show how costly it is to deal with children with different degrees of hearing loss – at least for the four broad categories of mild, moderate, severe and profound. This would permit a comparison of the number of direct hours of AVT (or other service) allocated to a child in each of those categories. As pointed out by the expert advisor for this CBA, Anthony Hogan, when looking at the First Voice cohort:

> 45% have no more than moderate loss ... they will take a benefit from the program – however as they still have considerable residual hearing ability (i.e. the middle and inner ear functioning is working at least moderately well which

means some signal – even unaided – gets up the sensory nerve and we expect with devices lots gets in) the amount of time needed to benefit from therapy will be far less than those with profound hearing loss where there is likely to be significant existing damage to the auditory pathways. [*pers. comm.*]

Differentiated cost data were not available to the consultant as First Voice does not collect costs in this manner. Instead, the CBA develops representative average values per child per year in EIP. This methodology is sound as the CBA ensures that the calculation of averages reflects case mix on both sides of the ledger (costs as well as benefits).

4.2.1 Average costs reported by First Voice

First Voice members provided average cost data for the EIPs. In addition, Annual Reports of the First Voice members were consulted. Table 1, which shows costs for Taralye in Melbourne, demonstrates that total costs of the EIP were fairly stable over the two financial years shown (at around $2 million p.a.); but they fell on a per head basis because the number of children enrolled in the programs rose from 148 in 2008-09 to 174 in 2009-10.

Table 1: Taralye EIP costs per child

	2009-10	2008-09
Total cost *	$1,972,429	$2,088,971
Average cost per child	$11,336	$14,115
Source of Funding:		
State Govt. DEECD EI Subsidy	$5,441	$6,352
Taralye	$5,895	$7,763
	$11,336	$14,115

*Costs exclude Development and Kindergartens salaries. Costs include all EI related salaries and other related costs. Known administration and building and equipment costs are allocated to Development and Kindergartens.

The Shepherd Centre's total EIP program costs grew from $2.1 million in 2008 to $2.6 million in 2009 (the most recent years for which data were available at the time of writing). With enrolments also rising from 153 to 169 over the same period, the TSC's average cost per child increased from $13,957 to $15,246.

Table 2: The Shepherd Centre EIP costs per child

	2009	2008
Total cost *	$2,576,622	$2,135,379
Average cost per child	$15,246	$13,957
Source of Funding:		
EIP Government Grants	$3,134	$3,350
The Shepherd Centre	$12,112	$10,607
	$15,246	$13,957

*Costs exclude Fundraising & Preschools. Of all remaining costs, 95% are attributable to EIP (5% are attributable to SA).

The funding model for the Cora Barclay Centre in South Australia was recently reviewed by Warren McCann.[121] Total costs assigned to the EIP for 2011 came to

$850,373. With a case load of 70, this implies an average cost per child of $12,148.

By comparison, the CEO of Telethon Speech and Hearing (TSH) in Western Australia reported an average cost of $22,150 per child per program year in early intervention based on 2011 budget figures.

The Hear & Say Centre's budgeted expenditure for the 2011 financial year is approximately $4 million,[116] and with enrolments reaching 250 this equates to an average cost of around $16,000 per child per annum.

Representative average costs

Using the figures for the most recent year available for each of the First Voice centres, as shown above, ***the average annual cost per child in an EIP across the group as a whole is estimated at $14,916***. This is similar to a figure previously quoted by First Voice in the 'Hearing Loss Early Intervention Support Package – Funding Proposal' document from July 2010, which refers to a total cost of "approximately $15,000 per child".[122]

4.2.2 Treatment of land and built infrastructure

The cost estimates shown above include some rental payments, however, the First Voice EIP providers currently also own land, buildings and other physical assets, some of which were acquired decades ago and for which they do not currently pay any hire or rental charges.

The value of these assets shows up on the balance sheet rather than the income and expenditure statements. The cost of acquiring land and costs of construction are however relevant to a CBA which considers *all* costs of providing the EIP services.

It is not viable to retrospectively survey, estimate and adjust to the current year all of the capital costs incurred by the First Voice centres for this CBA. However, a good proxy for this cost is the current (commercial) rent that would be expected to be paid on these facilities were they not owned or hired at subsidised cost.

Table 3: Property details for The Shepherd Centre, 2011

Asset Description	Type	Area (sq m)	Rental Rate
Darlington Centre	Free rental	1,500	$1,500-$2,000/week
Wollongong Centre	Owned	968	$1,500-$1,800/week
Liverpool Centre	Owned	847	$1,500-$1,800/week
Roseville Centre	Owned	1,863	$1,800/week
ACT Centre	Rental		$1,800/month

Source: Email from Natasha Khushalani, Assistant Accountant, The Shepherd Centre, dated 15 April 2011

Table 3 above shows property details for The Shepherd Centre. The mid-point values shown in that table yield an imputed rental of $6,850 per week. On an annual basis this would be $356,200, and with a case load of 150 children this

equates to an average cost of $2,375 per child.

The Hear & Say Centre from Queensland also supplied information on its properties (see Table 4 below). For the owned properties the imputed lease cost per annum was calculated by valuers in 2010. The table shows that 78% of the space utilised by Hear & Say was owned space. The imputed rental for the owned spaces is $350,434 per annum, and using the EIP enrolment numbers supplied by First Voice, the imputed rent per child comes to $2,091 p.a. (see calculations in Table 4).

Table 4: Property details for the Hear & Say Centre, 2011

Asset Description	Type	Area (sq m)	Rental Rate
Munro Street Auchenflower	Owned	470	$136,000
RiverCity Private Hospital	Leased	278.9	$101,520
Gold Coast Varsity Lakes	Owned	337	$102,840
Sunshine Coast Nambour	Owned	350	$93,250
Cairns - Sheridan Street	Leased	30	$12,806
Toowoomba - Ruthven Street	Leased	25	$5,150
A. *All properties total a)*		***1490.9***	
B. *All properties total b)*			***$451,566***
C. % owned		78%	
D. Imputed rent on owned (= C x D)		$350,434	
E. Children in H&S cohort		216	
F. EIP children in 'owned' (= C x E)		168	
G. Imputed rent per child (= D / F)		$2,091	

Source: Email from Tom Barry, Operations Manager, Hear and Say Centre, dated 12 April 2011

Taralye in Melbourne provided an estimated rental for all areas of the Blackburn site building of $334,880 per annum. For the other sites at Essendon, Heidelberg Heights and casual facility hire a further $50,000 pa was also estimated. Together this comes to $383,880 and with 174 children enrolled in the EIP the average annual cost per EIP child is therefore $2,212 for Taralye.

4.2.3 Average costs including imputed rent

A weighted average of the Hear & Say, TSC and Taralye rent per head reported in the previous section is adopted for this CBA as representative of the whole First Voice cohort. The figure is $2,220 per year per EIP child.

Adding this imputed rental to the reported cost of $14,916 raises the average cost per EIP child to $17,136.

4.2.4 Carer's loss of income

The CBA now turns to cost items that extend beyond the costs of implementing the programs. The first of these is the income foregone by carers. Anecdotally, First Voice board members have noted that "one of the parents, usually the mother, typically gives up work to look after the child" (*pers. comm.*). Unfortunately no

survey data are available to ascertain the extent to which this happens for parents of children enrolled with the First Voice EIPs compared to parents of hearing-impaired children not in a First Voice EIP.

Several steps are needed to determine an appropriate figure to estimate this cost. First, it must be recognised that some parents would not participate in the formal economy anyway. Secondly, the costing methodology can be based on lost wages, replacement cost, or carers' self-valuation.[32] The foregone wages approach is adopted for this CBA.

In March 2011, the overall female labour force participation rate was 59.1%.[123] However, previous Australian estimates suggest that the employment rate of women with a youngest child under the age of three was only 44%, rising to 58% with a youngest child of 3-5 years. [124] Given that the First Voice cohort is split roughly half and half into children below three years of age and above three years, the mid-point figure of 51% provides an initial reference.

In addition, it must be recognised that mothers of disabled children have a lower rate of workforce participation than other mothers.[125] An Australian study into this workforce participation effect concluded that:

> There was a marked difference between mothers with a child with a severe/profound activity limitation (38.5% in workforce) and mothers without a child with a disability (60.9% in workforce), with a smaller difference when mothers of all children with disabilities (51.2% in workforce) were considered.[125]

The latter figure suggests that the participation rate for mothers of children with disabilities is, on average, a full 9.7 percentage points below that of mothers without a child with a disability (60.9% minus 51.2%). This gap is acknowledged in this CBA by deducting 9.7 percentage points from the initial 51% reference participation rate identified above.

This means that 41.3% of the mothers in the First Voice group could be expected to have been in paid employment (51% minus the gap of 9.7%), or in other words that 58.7% would have been expected to be outside the formal, paid workforce anyway.

For the CBA, we assume that the lower earning household member gives up work to look after the child; in practice this typically means the mothers. To support the assumption that it is mothers who give up work, note that a recent study of parents of children with cochlear implants reported that 88.7% of survey respondents were mothers, 10.1% were fathers and 1.6% were grandmothers, foster parents, or stepfathers.[126]

The latest available ABS data show that in 2009-10, average weekly earnings for females were $752.56.[127] On an annual basis this comes to $39,133. As discussed above, for this study we assume that this applies to 41.3% of the mothers.

The representative or average loss of income is on this basis estimated at $16,162 per year per child in early intervention (= 0.413 x $39,133).

4.2.5 Transport and accommodation

Detailed consumer or client surveys were not available to inform the discussion of this cost factor; however it is clear that families travel to and from the First Voice centres. Families from rural areas may have to pay for accommodation if returning home on the same day is not an option. There is anecdotal evidence that some families move homes to be closer to the treatment centres, which would involve significantly higher costs, but these are not included here. An extract from one of the case studies supplied for this report by Taralye in Melbourne is relevant here:

> JF's family made the decision to drive him to Taralye every week so that he could benefit from more intensive early intervention services. JF attended Taralye's inclusive Early Learning Program, Book Club and individual sessions for two years. It was a commitment which impacted the whole family. It was undertaken at a time when petrol prices were rising and it meant waking up at 5:30 am for the three hour drive, and relying on friends to ensure JF's three older siblings were delivered to and from school. The decision also necessitated JF's mother seeking flexible working arrangements from her employer.

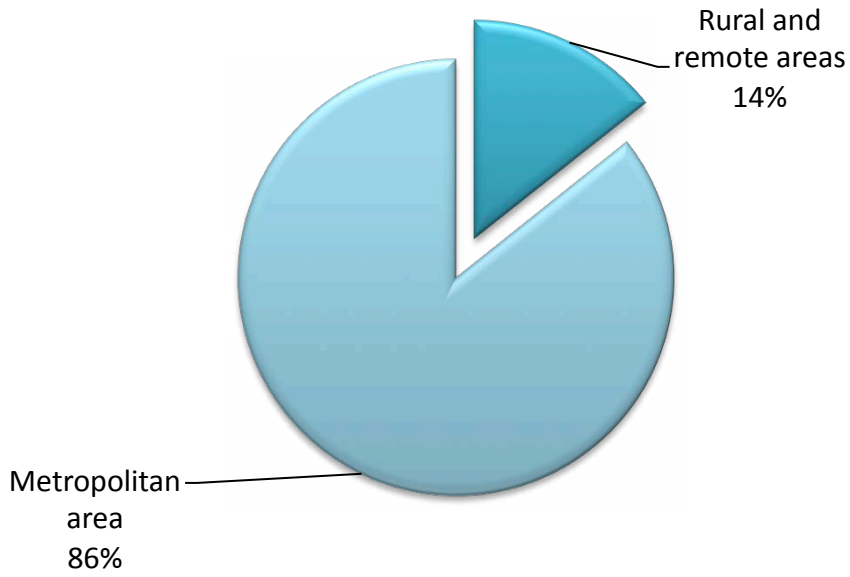
In a previous Australian cost-of-illness report of which the consultant was the lead author,[128] an allowance of $100 per trip was used for accommodation, after reviewing costs from an Accommodation Directory published in 2005.[129] In the report, this cost was applied to patients who were from 'remote' or 'very remote' regions (ARIA categories). The report also used the Australian Taxation Office (ATO) tax deduction rate of 58 cents per kilometre to estimate costs according to typical distance travelled.

The approach used in the current context is based on the percentage of the cohort that lives in rural and remote areas (see Figure 12), and is informed by the hypothetical treatment scenario decribed in the Hear and Say Centre's 12 month treatment plan for children on the cochlear implant program.[130] This suggests that a child will receive 34 AVT lessons and 24 post-implant audiology sessions in the first year. Some of these will occur on the same trip.

The number of audiology visits, AVT sessions and other meetings declines in subsequent years on the program, as the child's hearing and language progresses and there is a reduced need to travel to the treatment centre. Sessions will initially be weekly (possibly several days per week in the very initial phase), later every couple of weeks, and finally only monthly or so (Aleisha Davis, *pers. comm.*).

As this CBA utilises *average* values, a reasonable assumption has to be arrived at for the average number of trips per year, over the five year period the child may be enrolled with an EIP. On balance, one to two visits per month would seem fair.

Figure 12: Families accessing services living in outside metropolitan areas



CBA assumption

This CBA assumes that 20 trips to and from First Voice centres are made by each child, on average, each year (100 trips over five years). This is in line with the First Voice cohort as reported in Dornan et al (2010).[102] For 86% of the cohort these will be 'local' visits, assumed to be 40km return trips made by car. For the remaining 14% from rural and regional areas, it is assumed that the trip involves one overnight stay and a 100km return trip by car. Parking has been assumed to be free of cost. Using these assumptions, the average annual cost per EIP child is estimated at $981 (see Table 5).

Table 5: Travel and accommodation cost assumptions

Description	Assumption
Average number of annual trips	20
Distance travelled – local return trip	40
Distance travelled – regional return trip	100
ATO petrol allowance / km	$0.58
Accommodation cost per night	$100.00
Cost of additional meals per overnight trip	$50
% urban	86%
% rural	14%
Local travel and accommodation cost, annual	$464
Regional travel and accommodation cost, annual	$4,160
Travel, accommodation and meals, weighted average	***$981***

4.2.6 Additional medical costs

Once a person enters a clinical/medical pathway, additional medical costs tend to be incurred. These may include costs of physical check-ups, additional diagnostic tests and work-ups, referrals to other health practitioners including specialists, new or upgraded devices, as well as prescriptions for medication that the child or his or her family may otherwise never have gone on to take.

Therese Kelly, CEO of Taralye in Melbourne suggested that medical expense fee gaps, additional medical intervention fees (both child and carer), and pharmaceutical costs should be considered for the CBA.

This CBA estimates additional medical costs per child at $1,274 per year, including costs from the earlier use of better (more suited) hearing devices than would otherwise be the case, additional psychotherapeutic intervention, and medical complications relating to use of hearing devices.

These cost items are discussed in further detail below.

4.2.6.1 Costs related to hearing devices

For this CBA, an example would be a child with hearing loss that may not otherwise have been fitted with a cochlear implant – or perhaps would have been fitted with one later than generally happens when the child joins the EIP.

If the former is the case, the child's family would incur an additional cost of at least $30,000 for a single cochlear implant, over and above the previous device used (if any). If the latter is the case, the cost depends on how far the time to implant is brought forward.

Bringing the time to implant forward by six months, for example, would imply an opportunity cost of $750 to $1,500 depending on the rate of interest used ($1,500 to $3,000 for a bilateral implant). Having decided to go for a cochlear implant, the child would also have to go through additional pre-implant audiology and AVT sessions, estimated at $2,775 using First Voice data.[130]

For children with mild to moderate hearing loss, participation in an EIP may also lead to early acquisition of a hearing aid, or changing/upgrading of a hearing aid. Hearing aids prices range from around $1,500 to $11,000 a pair (i.e., $750 to $5,500 each).[131]

Based on anecdotal evidence and consumer statements identified by a web search, the typical cost of a hearing aid may be around $4,000 each (i.e., $8,000 per pair). The 'step up' for a single hearing aid may thus be between $750 (from no hearing aid to the cheapest one) and $3,250 (from the cheapest one to one costing $4,000). The average of this works out at $2,000.

CBA assumption for additional, better or earlier use of devices

As reported by First Voice, 72% of the children in the First Voice cohort have hearing aids (50% have bilateral hearing aids; see Figure 6 on p. 19).[13] The CBA

assumes that a single 'step up' occurs for these children whilst they are on the EIP, i.e., once during the five year period. Using the $2,000 cost estimate from the last section the average annual cost per child with mild to moderate hearing loss would therefore be $400.

To this are added costs for cochlear implants. The CBA splits the cochlear group (19% of the First Voice cohort) into two, assuming that:

- half the group would only have been fitted with one cochlear implant (i.e., would have had only one, or in a very few cases, no cochlear implant)
- for the other half, the time to implant is brought forward by three months per cochlear implant (six months in total for those with bilateral CIs).

For the remaining 9% of the cohort who do not use any device, no 'step up' cost is applied. On this basis, using a weighted average across the First Voice cohort, the cost is estimated at $985 per child per year.

Table 6: Hearing device 'turnover' assumptions

	Share of cohort	Cost over five years	Cost/year
No hearing aid or device	9%	0	0
One 'step up' in hearing aid over five years	72%	$2,000	$400
Bringing forward cochlear implant	9.5%	$3,900	$780
One additional cochlear implant	9.5%	$32,775	$6,555
Weighted average			***$985***

4.2.6.2 Additional psychotherapeutic costs

In the short term, families that join a First Voice EIP may be prompted to seek additional counselling and/or other psychotherapeutic intervention from external sources. This may be because parents are for the first time receiving appropriate, timely advice from multi-disciplinary sources when they join the EIP.

There are, of course, benefits from such additional intervention and these flow over time and as such are noted on the benefit side of this CBA – for example, a lower rate of marital breakdown and lower rates of chronic depression among families that participate in the First Voice programs are amongst the positive longer term outcomes that may be expected. Nevertheless, it is possible that in the short term some additional psychotherapeutic costs are incurred; in fact, the only study of an Auditory-Verbal intervention program which reported on this impact did suggest that this is the case.[90]

Parents have also reported that the decision-making process about cochlear implantation is stressful in itself, and at least in some cases, the discussion or prospect of cochlear implantation will be initiated or brought forward by the EIP (as argued above in the section on upgrading devices or bringing forward the date of implantation).[132]

Another recent paper discusses the impact of high expectations among parents of

children receiving cochlear implants,[126] commenting on other research which had found that:

> 64 mothers' stress levels and expectations of cochlear implantation ... did not decrease as time passed and ... the initial period of parents' high hopes and expectations associated with the implant decision and process can give way, over some years, to a realization that their child is still deaf and that intensive rehabilitation efforts remain necessary.

On balance, given the range of different impacts noted here, it seems appropriate to make an allowance for some additional psychotherapeutic costs in this CBA.

To further inform this discussion psychotherapeutic approaches and costs are briefly reviewed. The following costs would be involved for a 'standard' treatment pathway for depression or anxiety in Australia: (i) a course of antidepressant medications taken over six months, e.g. fluoxetine, paroxetine or venlafaxine, (ii) two GP visits (one at the start of the period and one at the end), and (iii) the drawing up of a GP Mental Health Care Plan. The basic cost of this medications-based approach is $450 over a six month period. If an in-depth psychiatric assessment occurs, a further $200-$400 will be incurred. Indirect costs such as those arising from side-effects of medications are for simplicity excluded here.

The psychotherapy comparator can be pegged at a minimum level using the following costs (i) an initial GP visit and the drawing up of a GP Mental Health Care Plan, and (ii) 12 planned face-to-face counselling sessions lasting 30-40 minutes each (Medicare's Focused Psychological Strategies approach). The health system cost of this program would be around $1,175 at Medicare list fees. This clearly involves a cost escalation over the pharmaceuticals-based approach, at least during the first six months.

CBA assumption about additional psychotherapeutic costs

The CBA assumes that families receive additional counselling or psychotherapeutic intervention on one occasion over the five year term of their child's enrolment in the EIP. Based on the costs reviewed in the last section, an average representative cost of $912.50 over five years is used, or $182.50 per year.

4.2.6.3 Costs related to complications

As discussed on page 49 in Section 4.2.6.1 above, one would expect that participation in the EIP is linked to a higher rate of uptake or turnover of hearing devices as children on the program are diagnosed in a more timely fashion and fitted with the most appropriate device (this may involve switching from one type to another). One consequence of this is, of course, that it will also create a small number of additional cases with complications arising from the use of those additional devices.

Complication rate for cochlear implants

Again, to start with the example of cochlear implants, recent data suggest that the overall complication rate for paediatric cochlear implants may be 14.7%, although

major complication rates are low at 1.9% in the group on which the estimate was based.[133] Complications such as minor skin irritation are reportedly very common. Among the more serious complications it may be noted that children suffer most frequently from wound infection (3.8%), vertigo (2.2%) and haematoma or oedema (2.2%).

Another recent study found post-operative complications in 15.7% of cochlear patients. The majority of these complications were minor (11.2%); 4.5% were major.[134] Between these two studies, it would appear that it is fair to assume a overall complication rate of around 15% with cochlear implants (serious and minor complications), and major complications in 2-4% of cases.

Complication rate for Baha

Turning now to other devices, reported complications for bone-anchored hearing aids (Baha) in paediatric patients include infection, soft tissue hypertrophy, loss of osseointegration, and need for further surgery. Soft tissue complications were very common and, in the most recent study identified during the preparation of this report,[135] it was also found that 37% of patients had major complications (defined as requiring revision surgery or removal of the implant). Recurrent antibiotic treatment was also required in 30% of patients.

Another recent study which presented long-term follow up data on Baha patients found post-operative complications such as primary bleeding (2%); severe skin reactions requiring intravenous antibiotics, cautery or grafting (8%); thickening or overgrowth of skin requiring excision (8%); failure of osseointegration requiring a new fixture (18%); and graft necrosis requiring revision (1%). Overall, 57 patients (34%) underwent revision surgery.[136]

A third study from Glasgow found that minor temporary skin infection was common (33%) and that thickening of the skin around the implant occurred in 17%, but that there were no serious complications.[137]

On the basis of these three studies it would seem that for the sub-group using Baha, a minor complication rate of 35% would be a reasonable assumption.

Complication rate for earmold devices

Finally, for earmold type devices Kohan et al report that patients may encounter severe complications from improper earmold fitting.[138] Kohan et al state that perforation of the tympanic membrane with impaction of earmold material in the middle ear or mastoid bowl may occur but can be successfully managed by standard otologic surgical techniques. An incidence rate of complications was not reported in this paper, nor could it be identified through literature review. This suggests that serious complications from earmold devices are a rare event.

CBA assumption about complications

As discussed in Section 4.2.6.1, we assume a 'step up' or change in device occurs for 91% of the children on the EIPs once over the representative five year period enrolled with the EIP. The CBA assumes that for the additional devices used, mild

complications occur in 20% of the cases, and that these can be treated with a single day visit to their health care provider (e.g., open clinic) and a single course of antibiotics, together estimated at a cost of $150.

The CBA also assumes a 2% rate of serious complications requiring surgical correction, an overnight stay at hospital, and replacement of the device. The cost of surgery and stay in hospital may vary on the type and complexity of surgery required. In a previous report the consultant estimated costs of a typical surgical intervention in a rural setting in Australia:

> A precise costing of the surgical procedures undertaken in the Pilbara is not possible, but using this figure the annual cost of ear operations performed by Dr McManus on children in the Pilbara is estimated at $12,333.[139]

The cost of the surgery used in this report is based on the Hear and Say Centre's costings of medical and surgical fees for a child receiving a cochlear implant ($9,005), [130] and the cost of the new device is $18,760 (weighted average of $25,000 for cochlear and $4,000 for other device).

Table 7: Rate of complications assumption

Description	Cost	Incidence
Serious complications (incl. replacement of device)	$27,765	2%
Minor complications	$150	20%
A. Weighted average	$585	
B. Relevant share of cohort (i.e., with device)		91%
C. Adjusted weighted average (= A x B)	$532.62	
D. Average per year (= C / 5)	***$106.52***	

4.2.7 Child care costs for siblings

Due to the nature of AVT and the focus on parent education, it may be necessary for siblings to be looked after by someone else while the parent is attending a session with the child with the hearing problem.

According to the latest ABS report on family characteristics in Australia, 34% of parents aged 35 to 54 who have had natural children reported that they have had three or more children. For families like these which have a child enrolled in a First Voice EIP, it is likely that some form of child care will have to be organised on occasion. In the economic sense, even if the child is in the care of another relative or friend, or being cared for by a volunteer at a First Voice centre, a value should be placed on their time.

Using a valuation of $20 per hour for either paid or unpaid child care, and a three hour requirement of child care each time a sibling or siblings are left in child care while the deaf child participates in the EIP, an economic cost of $60 per occasion is suggested. This report has previously assumed 20 trips per year on average, hence there will be 20 instances of service per year for the 34% of the cohort to which this applies.

The annual cost of child care is estimated at $408.00 (= 20 x $60 x 34%), based on the assumptions detailed above.

4.2.8 Costs of follow-up

First Voice confirmed that children typically continue to be followed up from age 6 to 21, and that follow up incurs between 5% and 10% of the cost of running the intensive programs.

For this CBA, the annual follow up cost (excluding the Cora Barclay Centre which provides a full school support service) has been estimated at $1,798 per year. This is based on 5% of the annual cost per child in EIP. As this cost flows over 15 years it works out at 9.6% of the discounted cost for the child over the project horizon as a whole. This is in line with figures reported by First Voice.

4.2.9 Costs of additional education

In at least one economic assessment of an early intervention program,[62] it was recognised that higher attainment at school raises the likelihood that the children will pursue further education and therefore incur additional costs such as university fees and associated living costs. The child or young adult also stays out of the workforce for the period of additional training. The way in which this cost factor has been dealt with in this CBA is, on the benefit side, to use a rate of return on education which has already netted out the cost of acquiring that education. Two further cost categories must be recognised to comply with best practice CBA methods.

4.2.10 Opportunity cost of capital

In addition to the costs detailed above, the CBA also recognises that there is an opportunity cost of capital (i.e., the amount that could have been earned in interest had the money not been spent, or foregone, due to the child's participation in the EIP). To estimate this a positive rate of time preference of 5.8% has been used. This annual cost comes to $2,086 in the first five years and drops to $104 for years 6 to 21.

4.2.11 Deadweight loss due to taxation

Finally, where government subsidy or investment is involved, CBAs also increasingly recognise that there is a cost to raising tax revenues. Estimates of this cost vary enormously, but for this CBA the figure used by Access Economics in the *Listen Hear!* report is adopted (a cost of 27.5 cents for every dollar raised).

Figures submitted to the consultant by different members of the First Voice coalition indicated that there is variation across the States in the proportion of funding that comes from government sources. For the average amount of government subsidy, the figures reported in the recent funding proposal for the hearing loss early intervention support package are used.[122] This means that for the CBA it is assumed that 40% of the cost is funded by government (= $6,000/$15,000).

4.2.12 Other, unquantifiable costs

To the best of the consultant's knowledge, the list of costs identified above is more exhaustive than any other that has been attempted in the literature on this subject. Nevertheless, a number of other costs need to be recognised. One type of cost is the *effort* that the children have to put in to acquire language, which is harder for them than for hearing children. There is no way to quantify this at present. Another type of cost may be related to *cultural identity* issues;[140] children identify less with the deaf community and may be (or feel) rejected by it once they have completed their journey through the EIP. Finally, as families adjust to the EIP they will acquire literature and spend time researching the different communication options (although the *Choices!* booklet is available free of charge). This clearly takes time and resources. Estimation of this was not possible for the current study.

4.2.13 Summary of costs (incl. time profile)

Table 8 summarizes all of the costs described above. During the first five years, whilst the child is enrolled with the First Voice EIP, the full annual cost per child per year is estimated at $39,697. For the next 16 years, follow up costs are incurred. As discussed in Section 4.2.8 above, this cost is estimated $1,798 per child per year. These costs also imply an attendant opportunity cost of capital and deadweight loss. After the child has reached age 21, it is assumed that no further follow up takes place and costs consequently drop to zero for the rest of the project horizon.

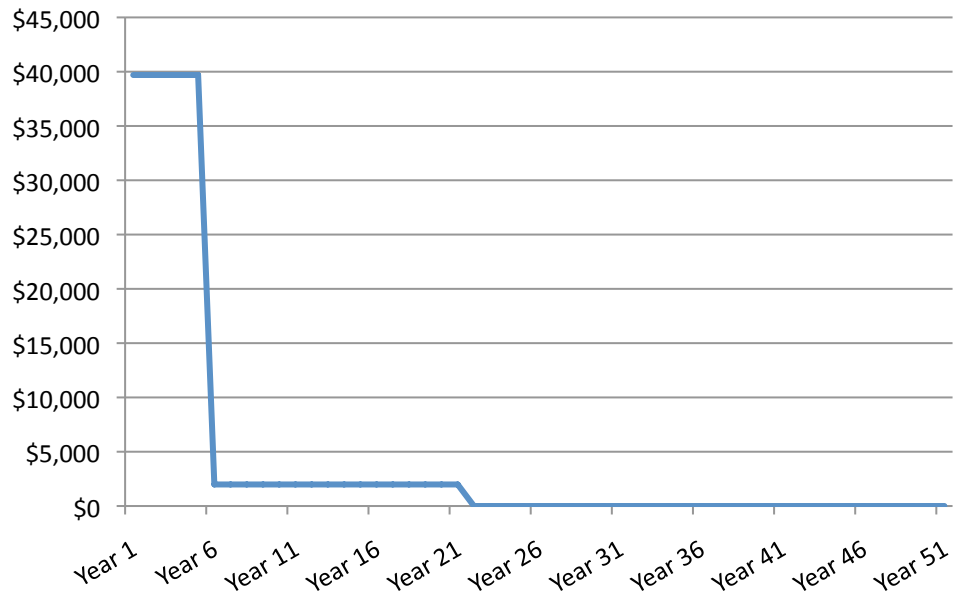
The net present value of this stream of costs is $203,307 per child. This can be seen as the 'investment' that is made in the child's future.

Table 8: Summary of costs over time, per child per year

	Years 1-5	Years 6-21	Year 22 onwards
Average reported operational cost	$14,916	-	-
Imputed rental	$2,220	-	-
Better/earlier devices	$985	-	-
Additional psychotherapeutic intervention	$183	-	-
Complications	$107	-	-
Child care	$408	-	-
Wages forgone - based on female	$16,162	-	-
Travel, accommodation and meals	$981	-	-
Follow-up cost (age 6-21)	-	$1,798	-
Opportunity cost of capital	$2,086	$104	-
Deadweight loss (raising tax)	$1,650	$83	-
Total	***$39,697***	***$1,985***	***-***
Net present value (NPV) – Years 1 to 50	$203,307		
NPV of follow up costs	$19,483		
Follow up as %	9.6%		

Figure 13 presents the time profile of the cost per child diagrammatically.

Figure 13: The time profile of costs per child in early intervention



4.3 What are the benefits?

Congenital hearing loss or hearing loss acquired early on in life, and associated delays in language development, have a number of negative impacts. The First Voice EIPs aim to accelerate language development so that EIP graduates achieve communication skills that are sufficiently in line with their hearing peers to facilitate joining a mainstream school. Where this is achieved, children are able to communicate better with their teachers and participate more actively alongside other pupils in mainstream schooling.

In the shorter term, a key benefit for the child involved is that he or she learns more effectively. Further down the line this should translate into lower grade retention and dropout rates, and higher participation in further education, which in turn improves the child's long term earnings outlook.

Improved social integration also has consequences for a child's sense of achievement and emotional wellbeing in the short as well as longer term, and the greater degree of acceptance from the rest of society should in turn also help to improve participation in a range of settings continuing from childhood into adulthood, including better acceptance and integration in the workplace.

4.3.1 Improved quality of life / reduced disability

Perhaps the most important benefit is to the quality of life of children who benefit from participation in a First Voice EIP. There is a significant body of literature on the relationship between hearing loss, quality of life and disability.[3,5,6,113,141-143] This

literature clearly indicates that any intervention which improves hearing and enables more effective communication will indeed improve quality of life and/or reduce disability.

Cost-effectiveness studies often report costs per quality adjusted life year (QALY), based on a variety of methodologies measuring health-related quality of life (HRQoL). Another way of looking at this benefit is to emphasize the reduction in disability. Cost-effectiveness studies which take this approach report costs per disability adjusted life year (DALY). QALYs and DALYs are related but do not measure the same thing.

The measurement of, and assumptions about, health states continues to be an active field of research, with a number of instruments being tested and outcomes reported. This makes it difficult to compare results across studies, but it should not deter an assessment of this key benefit for the CBA.

For the purposes of quantifying the benefit in this CBA, a ten percent improvement in quality of life is valued the same as a ten percent reduction of disability.

4.3.1.1 Value of a statistical life year (VOSLY) method

The method for valuing changes in DALY or QALY used here applies the concept of the value of a statistical life year (VOSLY). The method is very simple: a VOSLY is multiplied by the percentage improvement in the health state to arrive at a valuation of that improvement. In the Australian context, the enHealth Council some years ago recommended a figure of $150,000 per VOSLY.[36] This would mean that a 10% reduction in disability (or improvement in quality of life) sustained over the course of a year would be valued at $15,000 (= $150,000 x 0.1).

The interested reader is referred to a comprehensive survey by Viscusi for further information on the range of plausible VOSLY assumptions, as well as to the *Listen Hear!* report for further information on methodology.[144] For this CBA, the *Listen Hear!* report's assumption of $162,561 per VOSLY is adopted.

4.3.1.2 Weights for health states

Table 9 lists disability weights from the WHO's Global Burden of Disease (GBD) study as well as preceding work in the Australian context by Mathers.[145] The figures presented in that table indicate that if an intervention were to completely 'remove' disability from hearing loss, this would be equivalent to a 2% reduction in disability for those with mild hearing loss, a 10-12% reduction for those with moderate hearing loss, and a 32-37% reduction for those with severe hearing loss.

As has already been mentioned, such a reduction could in most cases not be achieved without a hearing device, but at the same time it could also not be achieved without appropriate language development services. To better understand the reduction in disability one might plausibly attribute to the First Voice EIPs, further literature reviews were undertaken. According to a study of which the expert adviser to this CBA, Anthony Hogan is first author:

> The literature indicates that on average, the use of hearing aids and devices is associated with a 50% improvement in health related quality of life, but significant residual disability remains.[146]

This suggests that one should take care not to overestimate the impact of technology and early language training on quality of life. For this CBA the assumption is therefore made that, at best, a 50% improvement can be achieved.

Table 9: Disability weights

Site	Disability weight	Notes
From Mathers (1999)[145]		
Mild hearing loss	0.018 to .020	
Moderate hearing loss	0.104 to 0.120	
Severe hearing loss	0.324 to 0.370	
GBD study as shown in Mathers (2004)[147]		
Deafness	0.224 (0.229)	At least moderate impairment resulting from meningitis (otitis media).
Hearing loss, adult onset (moderate or severe)	0.121	Cases of adult onset hearing loss due to ageing or noise exposure. Excludes hearing loss due to congenital causes, infectious diseases, other diseases or injury.

The paper by Hogan and colleagues also notes an important finding about mental health outcomes from another study, namely that they appear to be *independent* of the degree of hearing loss:

> This insight is consistent with the hearing literature which observes that it is the degree of communicative difficulty experienced, rather than the measured degree of loss, which is most predictive of any restriction in social participation.[146]

By implication, this means that any strategy that resolves issues with communicative difficulty is likely to lead to better mental health outcomes. Some of the literature reviewed by Hogan et al suggests that even children who have benefited from early intervention (though not necessarily First Voice EIPs) are still experiencing significant issues:

> In a review of the literature Wake et al[148] reported that children with hearing loss exhibit more behavioural and social problems than their hearing peers, and that their parents report elevated stress levels. The Wake study reported on HRQoL using the Child Health Questionnaire (CHQ). It also reported on developmental concerns including language outcomes using PEDS, and receptive vocabulary using the PPVT and the CELF. Notably, a majority of the sample (89%) had attended an early intervention service for hearing loss. They reported that when compared with a population sample of children in the State of Victoria, children with hearing loss scored far below (1.3 – 1.7 SDs) the normative populations on the PPVT and on the Receptive, Expressive and Total

> language scores of the CELF ... HRQoL scores were significantly lower than normative population scores. Significantly poorer outcomes were also reported for children with hearing loss on the PEDs: 'the most common areas of concern were expressive language (66%), social-emotional language (56%), and receptive language (55%)'.[146]

Change in health state assumptions for this CBA

The CBA assumes that with use of modern technology and attendance at an EIP, on average, a 50% change in the health state is achievable (i.e., reduction in disability or improvement in quality of life) – some will do better and some will do worse.

For the purpose of this CBA, half of this improvement is attributed to the EIP and the other half to technology.

Finally, the mid-point of the disability weights listed by Mathers (1999) are used for mild, moderate and severe hearing loss, and the improvement in the health state attributable to First Voice is weighted by the proportions of the First Voice cohort with the corresponding levels of hearing loss (see Table 10).

The result is that, on average, a 4.8% improvement in the health state is attributed per child in the First Voice EIPs. In the consultant's opinion, this is a conservative assumption – a figure 2 to 3 times as high would still be within the plausible range.

Another question for the CBA is the time profile of the flow of these benefits. Whilst quality of life and/or disability (and perceptions thereof) no doubt varies over time, the child will feel supported and enjoy the benefits of intensive language training from an early stage. It is therefore assumed that this benefit flows from the date of enrolment with the EIP.

Table 10: Change in health state attributable to EIP

	Disability weight	50% change	Attribution to EIP	Proportion of cohort
Mild	0.02	1%	0.5%	10%
Moderate	0.11	6%	2.8%	51%
Severe	0.35	17%	8.6%	39%
Change in health state (weighted average)	***4.8%***			
Annual value using VOSLY of $162,561	***$7,829***			

Source: Econtext estimate.

4.3.2 Educational attainment and long term earnings outlook

There is now a significant body of literature which strongly indicates that children with untreated hearing loss do not achieve as well academically and have a worse long term employment and income outlook than other children. A more recent Australian study by Stephen Winn for example noted that:

> Compared to the rest of the community, deaf adults have had and continue to have higher unemployment rates, are underemployed in terms of the range of occupations, and typically earn less than the general population in similar occupations.[149]

The 'chain of events' begins in primary school, where for example Coates et al have stated that even children with mild hearing loss may miss up to fifty per cent of classroom discussion.[150] Section 1.2 of this report already outlined some other impacts on children such as difficulty finding words, communicating, hyperactivity, and so on. The difference widens over time. One stark finding mentioned in the literature reviewed earlier is that, for example, reading of deaf children at graduation compares to year 4 level reading in hearing children.

Over time, these clearly have a negative impact on learning experience and ability to achieve good educational outcomes, and in the long term this affects these children's employability and earnings potential.

4.3.2.1 Impact on being in paid work

Definitive data on this will only accumulate over time, as the number of graduates from the EIPs becomes large enough to provide statistically robust data. The findings reported in Section 3.6.2 do, however, strongly indicate that those who attended early intervention programs will have significantly better prospects of being in paid work than those who were not enrolled in EIPs.

The *Listen Hear!* report has summarised the literature on this topic. Key assumptions in that report were based on the following finding:

> Of people with hearing problems aged 15–64 years, 55.6% reported being in paid work compared with 62.4% of people without hearing problems, a net difference of 6.8%.[32]

The question for the CBA relates to how much of that 6.8% gap one can expect participation in the First Voice EIPs to close.

Statistics currently available from First Voice indicate that 90% of EIP graduates (or more) have language and communication skills that allow them to graduate into a mainstream school setting – significantly better than would be expected if early intervention had not occurred.

First Voice data however also show that 15% of the EIP children have additional needs. For this subset of children it is conservatively assumed that their long term employment outlook does not change. Furthermore, for the remaining 85% of children, inspection of the assessment scores achieved also indicates that they sit towards the lower end of the average band (see, for example, Figure 9 on page 37 of this report).

It is at present unclear how these children then continue to track through the system. The results reported in Section 3.6.2 would suggest that most graduate from school at par with hearing children. A proportion will however continue to

have some developmental and language delay which affects their employment outlook.

On balance, it is conservatively assumed that only half of the 6.8% gap identified in the Listen Hear! report is closed in the First Voice cohort.

For the CBA this means that from the age of 18 onwards, a gain of $2,341 per year is applied. This is based on the latest available ABS estimate of average wages for those in full time paid employment ($68,848 p.a.).[151]

This is likely to be a conservative estimate for two reasons: first, the survey of school leavers described in Section 3.6.2 found that the proportion of First Voice graduates completing Year 12 is at least as high as the national average, and secondly the 6.8% gap itself is based on all people with hearing problems aged 15–64 years and therefore includes those who benefited from early intervention (in other words the gap would be larger if those who benefited from early intervention were excluded).

4.3.2.2 Impact on earnings outlook

The literature has also identified a link between hearing loss and type of employment. For example, another recent Australian study by Winn on the link between hearing aid use, employment and income found that:

> The highest concentration of individuals was employed as Tradespersons (10, 21.7%) ...and this was higher than the state average at the time of the study. There were 10.9% (5) participants employed as Professionals which was slightly less than the state average of 12.2%.[152]

One can expect this bias to be stronger for those suffering from worse hearing loss. For the purposes of this CBA, however, it is sufficient to note that a pattern has been detected which indicates over-representation in less well paid professions which are also those for which fewer academic qualifications are required.

A key benefit expected from early intervention is, of course, that educational outcomes improve and consequently in the long term that enrolment in further education and acquisition of more advanced qualifications does occur. Certainly the case studies of children that graduated from First Voice EIPs included in this report indicate that their hearing loss did not present a barrier to pursuing further studies and aiming for managerial and professional positions in the workforce (see, in particular, Section 3.6.2 of this report).

The economic literature on the returns to education is vast. Recent Australian papers by Andrew Leigh and colleagues corroborate previous international findings that each additional year of schooling significantly increases expected income.[153] One of Professor Leigh's recent papers using data from 2001-05 states that:

> Raising high school attainment appears to yield the highest annual benefits, with per-year gains as high as 30 percent ... Some forms of vocational training also appear to boost earnings, with significant gains from Certificate Level III/IV

> qualifications (for high school dropouts only), and from Diploma and Advanced Diploma qualifications. At the university level, Bachelor degrees and postgraduate qualifications are associated with significantly higher earnings, with each year of a Bachelor degree raising annual earnings by about 15 percent. For high school, slightly less than half the gains are due to increased productivity, with the rest due to higher levels of participation. For vocational training, about one-third of the gains are from productivity, and two-thirds from greater participation. For university, most of the gains are from productivity.[154]

Based on this assessment an average per-year gain of 15% is appropriate in the Australian context. The important question for the CBA relates to how many years of additional schooling/education one might expect to result from the First Voice EIPs. In the absence of long term data, it is important to note that dropout rates at all stages of the educational pathway are currently higher for those suffering hearing loss than for others. The British Association of the Teachers of the Deaf has for example reported that 86% of deaf and hearing impaired students leave school by age 16 years,[119] and a recent study from Denmark found that in a cohort of 22,162 young Danish men:

> 75% had normal hearing ... about 20% had mild hearing ... and the remaining 5% had more severe hearing loss. The proportions who had continued school education after age 16 years among the three groups were 51%, 42% and 34% respectively and their mean IQs were 101, 98 and 94. The evidence suggests that even mild hearing loss is associated with distinct educational and cognitive disadvantage which itself may result from difficulties in following classroom teaching.[155]

Similarly, a 'nuts and bolts' guide for new students arriving at a University in the US reported that:

> As compared to a 47% dropout rate for students without disabilities, the college dropout rate for students with hearing impairments is 71%.[156]

The assumption for this CBA is that, on average, participation in the EIP yields just one additional year of education. This would seem to be a minimum and once again implies a conservative approach to valuation.

Using the same ABS wage estimates used in the preceding section ($68,848 p.a.), a 15% increase in average income is equivalent to $10,327 per year. This benefit is applied from Year 18 of the CBA onwards.

4.3.3 Lower costs of schooling

Improved language development and communication skills lead to more active participation in the classroom and an expectation that the child is less likely to have to repeat a year (lower grade retention), be less likely to require assistance from special teachers, and less likely to be placed into a special school for the deaf or hard of hearing.

If the child does not have to repeat a year of schooling, whether private or public, a year's expense is avoided. If the child requires less attention from teachers

(including special teachers and assistants), those human resources can be diverted to other contexts and costs potentially avoided (e.g., for itinerant Teachers of the Deaf). And if the child is not diverted into special education, the extra expenditure that is normally incurred for children in special education is circumvented.

A study by Johns Hopkins University, for example, determined that a three-year-old child who receives cochlear implants can save $30,000 to $50,000 in special-education costs for elementary and secondary schools as they are more likely to be mainstreamed in school and thus use fewer support services than similarly deaf children.[157]

One important study on child health correlates of early school failure among the general child population, using a nationally representative sample of children in the US (n = 9.996; ages 7 to 17), found that:

> 7.6% of children repeated kindergarten or first grade. In a logistic regression model, factors independently associated with increased risk of grade retention were ... deafness (OR 1.9, CI 1.4, 2.6) ...[and] speech defects (OR 1.7, CI 1.1, 2.6).[158]

The study was based on data from 1988 and would therefore include a relatively low number with cochlear implants or other more modern devices. Similarly, the proportion benefiting from AVT would have been relatively low.

In the *Listen Hear!* report, the total 'extra' cost of education for 20,918 children with hearing loss aged 5-16 years was estimated at $117.2 million in 2005. This equates to $5,603 per year per child.

Again, the question for the CBA is the extent to which one can expect these costs to be avoided as a result of a child benefiting from a First Voice EIP. Follow up surveys to corroborate the extent of this benefit are not available at this time.

For the CBA, it is assumed that children with additional needs in the First Voice cohort will continue to require that additional support (15% of cohort). No saving is thus expected for these children. For the remaining 85% of the children, the CBA assumes that a reduction of 50% is possible.

On this basis, the CBA applies a benefit (saving) of $2,381 per year from age 6 to age 16.

4.3.4 Injuries avoided

Given the problems with communication and inability to accurately perceive direction of sound, it is logical to suspect that hearing loss is associated with a higher rate of injuries (and possibly deaths). As noted in the literature, however, research on this has been sparse. Consequently, the *Listen Hear!* report concluded that 'no direct causality has been found between hearing loss and increased mortality or injury' (p. 24).

Since the publication of the *Listen Hear!* report, however, several studies have documented elevated risks of injury. One example is a recent Canadian study which

used data from a cross-sectional survey conducted by Statistics Canada with a total of 131,535 respondents and thus had high statistical power to detect effects in subgroups.[159] The study concluded that:

> Respondents classified as having a hearing problem, whether hearing loss or deafness, were more likely to have achieved less education, less likely to be working and experience higher rates of injury and work-related injury compared with hearing respondents.

Another recent study from the US used hospital records, found that:

> Rates of injury treatment in children with hearing loss were more than twice that of the control group (17.72 vs 8.58 per 100, respectively). The relative rate (RR) remained significantly higher (RR = 1.51, 95% confidence interval, 1.30-1.75) after adjusting for age, race, sex, and the number of hospital or emergency department encounters for treatment of non-injury-related conditions. Children with hearing loss had significantly higher treatment rates for every injury type, bodily location, and external cause, with a cell size sufficient for valid comparison.[160]

There is no reason to believe that the situation would be different in Australia. As noted by a recent Australian publication, unintentional child injuries are a major public health issue in Australia, most can be prevented, and preventable injuries are higher amongst children compared with other age groups.[161]

In recent years, the annual number of hospitalisations in children 0–4 years of age has fluctuated around the 20,000 mark (an age-specific rate of around 1,800 per 100,000 is based on visual inspection of Diagram 4.27 in the *Australia's Health 2010* report recently released by AIHW).[162] The direct and indirect cost of injury (all causes) in the 0-4 year age group has previously been estimated at $716 million.[163] The cost per hospitalisation for injury is on this basis crudely approximated at $31,314.

Using the age-specific rate reported above to convert from cost per hospitalisation to cost per child in that age category, the cost is estimated at $564 per year per child. Next, using the relative risk of 1.51 reported in the American study above, on average one would expect 2,718 cases per 100,000 in the sub-group that is affected by hearing loss. For this sub-group the estimated cost per child per year rises to $851, an excess of $287 over the general population in that age group.

If the EIPs coupled with appropriate hearing devices can reduce this excess cost by 50%, and, if along the lines previously assumed, half of this is attributed to the influence of the EIPs, then ***the expected benefit per child is $72 per year***. This value has been adopted for the CBA. It is a small benefit but it is worth being recognised.

As shown in the AIHW report referred to above, the number of cases and the age-specific rate of hospitalisations rises to an initial peak in the 15-24 year old age group. Both cases and the rate then drop off with age but the age-specific rate turns around to rise sharply for the elderly. Within the CBA's 50 project horizon, however, these trend changes do not significantly affect the expected cost per incident case,

and hence the expected benefit of $72 per child per year has been applied for the remainder of the project horizon.

4.3.5 Other, unquantifiable benefits

A number of additional benefits flowing from the First Voice EIPs have been identified but could not be quantified at this stage:

4.3.5.1 Benefits to carers over the long term

While the CBA has emphasised the costs to parents who give up work, it must also be recognised that there is a long term return to these carers, both in the monetary and in the non-pecuniary sense. Parents undoubtedly value seeing their child benefit from intensive support and attaining better educational outcomes. Stress and anxiety levels may reduce over the long term as parents see their children integrate better into society. No proxy could readily be identified to place a dollar value on this benefit.

Beyond the satisfaction of seeing their child achieve to a fuller potential parents may also benefit from having greater flexibility to return to paid work as their child achieves a higher degree of autonomous functioning in the community. Such a labour force participation effect would result in a clear benefit that has not been estimated here.

Another benefit which has been noted anecdotally is that the rate of marriage breakdown in families attending First Voice EIPs appears to be lower than might be expected in families with children with a disability. The rate of marriage breakdown is very high in families with children with a disability, with some studies reporting breakdown rates of up to 85%.[164] Associated costs are substantial both to the individuals involved as well as to society at large – an Australian Senate Inquiry reported that the annual cost of marriage breakdown to Australia was in the region of $6 billion in 1998.[165] With around 50,000 divorces granted each year in Australia,[166] this works out at around $120,000 per year per divorce. Due to the absence of more specific information on the differential in divorce rates between First Voice families and other families with children with hearing problems, this important benefit has not been quantified for the CBA.

4.3.5.2 Demonstration and research value

The leadership provided by First Voice produces value to policy makers who require information on new approaches to treatment and rehabilitation. Building best practice and national standards are valuable in their own right. State and Federal health departments benefit from being able to observe progress and receive briefings and updates from members of the coalition. Through the efforts of First Voice, uncertainties around early intervention are also being addressed over time and knowledge is improving. The work undertaken by First Voice may therefore be laying the foundations for potentially important future research projects. It is very difficult to put a value on all the items summarised under the heading of

demonstration value here, but it could certainly be substantial, especially where it affects investment decisions at a senior policy level.

4.3.5.3 Savings to business

Costs to business may fall if it becomes easier to employ people with a hearing problem (i.e., reduced barriers to communication, more active participation). This is a benefit that may be realised in the long term if detection and early intervention achieves closer to complete coverage.

4.3.5.4 Lower support costs in the voluntary sector

Support costs could fall in the voluntary sector as the children lead lives with increased functional independence thus requiring a lower level of support from these organisations. Parents may also need less support.

4.3.5.5 Additional non-pecuniary returns to beneficiaries

Some non-pecuniary returns have also not been quantified in this study. For example, additional education is associated with lower rates of smoking,[167] so that the expected gain in education which flows from participating in the EIP should also translate in a health benefit down the line. Similarly, while there is an active debate about long term mental health benefits, it is certainly plausible that better communication, higher self-esteem and lower sense of isolation will reduce the incidence of depression and other mental health issues in EIP beneficiaries in the long term.[146]

Next, higher incomes may be associated with higher quality of life or, at least, lower levels of deprivation, which are once again correlated with better health and social outcomes. Finally, there is also a broader value of social integration and improved communication. There is significant literature showing that isolation and inability to communicate increases frustration and aggression, a risk of which is perhaps already indicated by hyperactivity among children that are hard of hearing. This has potential spillover effects for the rest of society which are ameliorated by participating in EIP programs.

4.3.5.6 Lower dependence on government support

This benefit has not been quantified in the CBA for methodological reasons. Whilst it is true that some of beneficiaries will move off disability pensions, unemployment benefits, etc., the benefit is a result of increased labour force participation rates and productivity which have already been included in the CBA.

4.3.5.7 Existence and option value

Finally, there is a class of benefits that is important in the economic literature but has not as yet been applied in studies of hearing loss and early intervention services. These types of benefits are routinely recorded and studied in environmental economics but have increasingly been transferred to other branches

of economics. They usually involve surveys of people's willingness-to-pay (WTP) for different states of the world.

In the hearing context, one could for example ask current non-users of the First Voice services how much they value the *option* of being able to access the service. Option value may be high to subgroups such as deaf people who are considering having children and who value the knowledge that a professional service is available to them and their children should their children be born with hearing problems.

Even more widely, economists have examined so-called existence value, where people express a WTP simply for knowing that something exists, in this case a service for young people with hearing problems. There will be many people in the general population who have in some way been touched by hearing loss or deafness, and even if they will never need to use the service they may place a value on its existence. In the absence of any research on this, however, this remains an unquantifiable benefit.

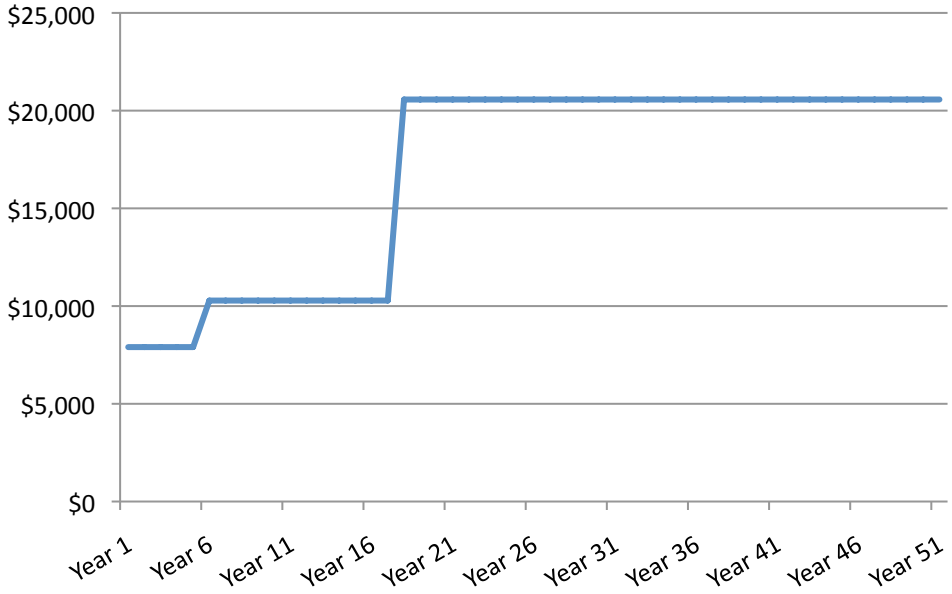
4.3.6 Summary of benefits (incl. time profile)

Table 11 and Figure 14 summarise the flow of benefits over time. This shows that benefits are smaller at the beginning of the project horizon which is in line with the long term nature of the investment which is made in the child. The majority of the economic benefits kick in at year 18 of the project horizon. The key finding of this analysis is that even after discounting the future flow of benefits, the net present value of benefits is $382,894. This is important for the comparative analysis of costs and benefits which follows in the next section of this report.

Table 11: Summary of benefits over time, per child per year

	Years 1-5	Year 6-17	Years 18+
Reduction in disability / better quality of life	$7,829	$7,829	$7,829
Likelihood of being in paid work	-	-	$2,341
Productivity gain (= higher incomes)	-	-	$10,327
Injuries avoided	$72	$72	$72
School costs avoided	-	$2,381	-
Total	***$7,901***	***$10,282***	***$20,569***
NPV	$382,894		

Figure 14: The time profile of benefits per child in early intervention



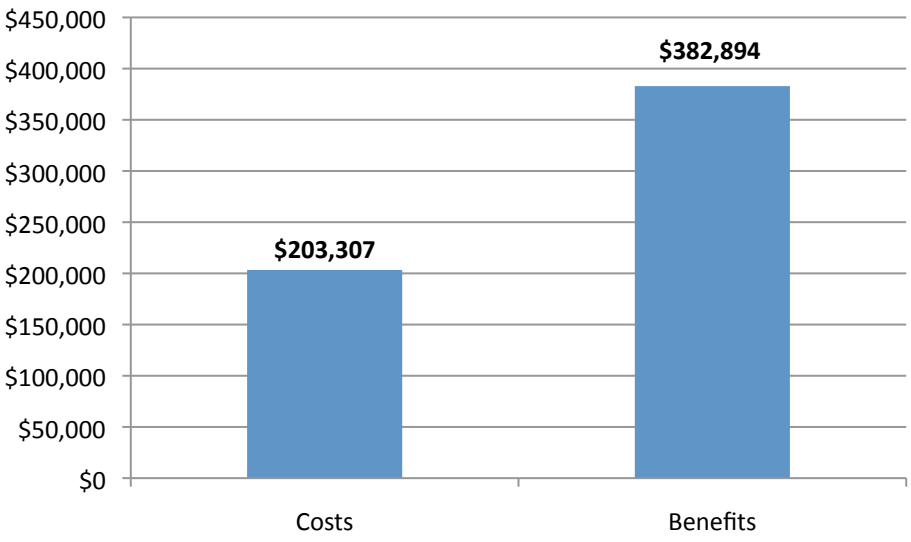
4.4 Comparing costs and benefits

4.4.1 The benefit-to-cost ratio (BCR)

The quantified costs and benefits can now be compared. As discussed in the text above, the flow of costs is estimated at $203,307 in present value terms, and the flow of benefits is valued at $382,894. ***The BCR is therefore positive at 1.9:1.***

On average, it is estimated that benefits valued at 1.9 dollars are returned on every dollar invested. From a social cost-benefit perspective, a positive BCR is sufficient to justify the investment. In this case the BCR is clearly positive despite a very conservative approach to valuation.

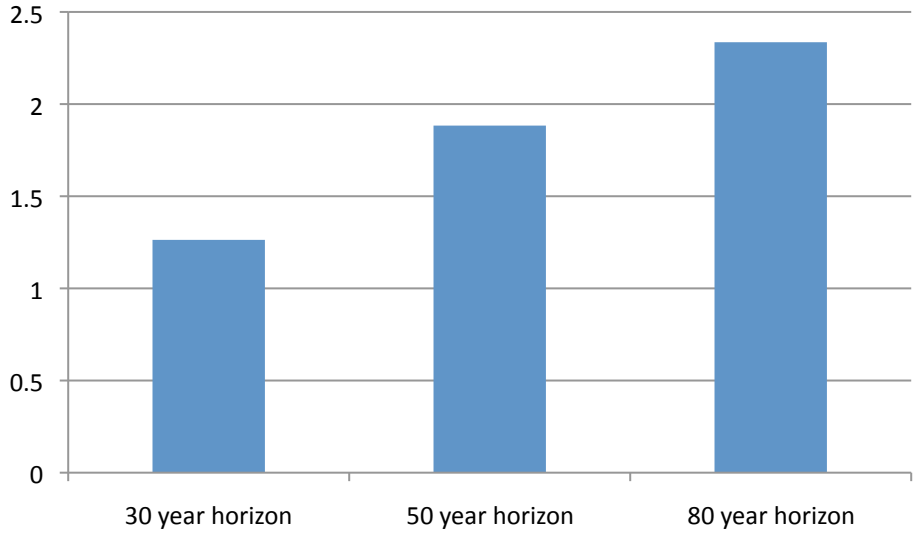
Figure 15: The costs and benefits of early intervention (NPVs)



4.5 Sensitivity analysis

4.5.1 Project horizon

Figure 16: The BCR for different project horizons



4.5.2 Discount rate

Figure 17: The BCR for different discount rates

4.5.3

Appendix A Case study – Letter from Nicole

I am a female, 31 years old who was born profoundly deaf. I have been wearing bilateral hearing aids since I was 14 months old, in 1981.

I come from an English-speaking background and there was no history of deafness in both sides of the family. My mum gave up work when my brother was born and looked after him and myself full time while my dad worked full time to support us.

Before I attended Telethon Speech Hearing Centre to receive intensive early language, and listening support, my parents discovered that I wasn't responding to sounds and not babbling, so they took me to a specialist to get my hearing looked at. It was discovered that I had glue ear so I was booked in for an operation to have grommets put in my ears. I was 8 months old at the time. After that, they thought everything was fine and went about returning to normal activities. By 14 months, I still wasn't talking so the clinic sister recommended that I should go to Australian Hearing Services to get my hearing tested. That's when they found out I had nerve deafness. I couldn't speak at the time, I used to make a funny cough to get someone's attention and when I got excited about something. My parents weren't aware that I was deaf so they didn't realise they needed to face me when they spoke.

I attended Telethon Speech and Hearing Centre from the age of 14 months old to year 12. Since then, I have had support all my life from staff at the Centre. Even today, I still keep in contact with staff from the Centre and have done a program for younger children which required me to be a role model. During my years at the Centre before I integrated into primary school, it required daily intensive early language training where my parents drove me to the Centre everyday to help and provide support to me and to keep my language training going. This went on for 6 years. Without the early training that I received, I believe I wouldn't have the speaking language skills that I have acquired today to help me get through challenges that I face everyday in life.

When I started primary school, the dynamics changed. Telethon Speech Hearing Centre provided a full time staff member at our primary school where I went with other deaf children to keep our English language going and provide support when we were facing problems at school. This helped and made the transition from the Centre to school a lot smoother and it was also a comfort to our parents that we were still getting training from a qualified teacher as it was important that it didn't stop. It made things a lot easier for not just my parents but other parents who had deaf children in the same situation as me. This continued until the end of year seven.

When I started high school, there wasn't a program in place, but it was up to my parents to decide whether I needed ongoing support by employing a therapist for my language skills. I ended up not continuing my language skills. As high school is different to primary school, Telethon Speech & Hearing Centre were always there for us. They organised which school was best for us and a school that will provide a

service to help our education and that's when we had a note-taker to look after us. Their support was always there and we could fall back onto them anytime when we had a problem.

Today, I am happily married to my husband Xavier who is a "hearing person". I have been with my husband for 11 years. We met at TAFE doing the same course. We lost our first son Ayden last year and now expecting our second child in August. We're excited about meeting our next bub. We're also building our house and have been enjoying this project immensely and it's been great fun. We're looking forward to a new year and new beginnings after what happened last year and we're in a good place.

As for my job I work for Landgate which is a government department that looks after land titles and maps. I have completed a Diploma and a Degree in Cartography. My job is to draw maps of the state and maintain land owned by the government. I'm currently a senior member of the team and have been told to apply for team leader positions which I have been successful in getting into the pool but a position hasn't come up yet. I've been in my job for 7 years. I have excellent leadership and networking skills among my peers and staff at work. I am well respected at work and everyone is good to me and gives me all the support I need. They also encourage me to aim higher in my job and go further.

I've been fortunate to have a successful sporting career as this is where I also learnt my leadership skills and being in the WAIS (Western Australian Institute of Sports) as I was selected as one of the top 10 softball pitchers in the country identified for the 2000 Olympic squad at the age of 16-17 years. I had this scholarship for 4 years and met wonderful people from all walks of life and this enabled me to be a better person today. I don't see my deafness as a barrier, I see myself as one of the others and it never comes to my mind that I'm a deaf person. I've been fortunate enough to represent my state at u/16, u/19 and open level for softball for over 10 years. I also played deaf soccer for the women's Australian Team which I represented at the Deaflympics in Melbourne 2005. I used to play soccer in the off-season to keep my fitness up for softball as it's a summer sport and it kept me out of mischief!

On a reflective note, looking back at what I have achieved in life so far, if it wasn't for the staff at the Telethon Speech & Hearing Centre who provided tremendous support to my family and the support I received from them, my family and my husband, I wouldn't be where I am today. Also, I have developed many great friendships with staff at Telethon Speech & Hearing, other parents and deaf children over the years that I still remain in contact with to this day.

Nicole

Appendix B 10 Principles of Auditory-Verbal Therapy

1) Promote early diagnosis of hearing loss in newborns, infants, toddlers, and young children, followed by immediate audiologic management and Auditory-Verbal therapy.

2) Recommend immediate assessment and use of appropriate, state-of-the-art hearing technology to obtain maximum benefits of auditory stimulation.

3) Guide and coach parents to help their child use hearing as the primary sensory modality in developing listening and spoken language.

4) Guide and coach parents[1] to become the primary facilitators of their child's listening and spoken language development through active consistent participation in individualized Auditory-Verbal Therapy.

5) Guide and coach parents[1] to create environments that support listening for the acquisition of spoken language throughout the child's daily activities.

6) Guide and coach parents[1] to help their child integrate listening and spoken language into all aspects of the child's life.

7) Guide and coach parents[1] to use natural developmental patterns of audition, speech, language, cognition, and communication.

8) Guide and coach parents[1] to help their child self-monitor spoken language through listening.

9) Administer ongoing formal and informal diagnostic assessments to develop individualized Auditory-Verbal treatment plans, to monitor progress and to evaluate the effectiveness of the plans for the child and family.

10) Promote education in regular schools with peers who have typical hearing and with appropriate services from early childhood onwards.

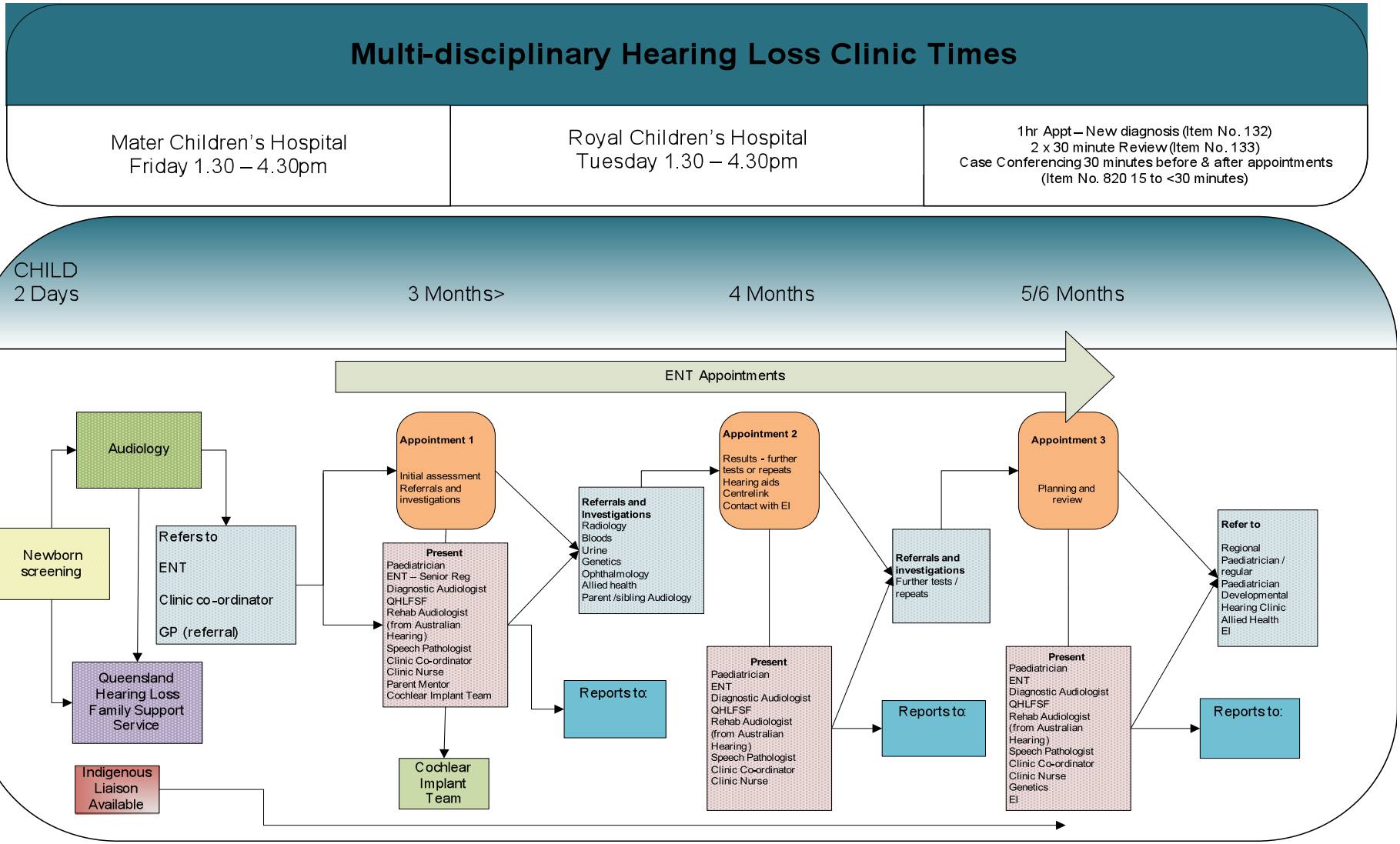
[1]The term "parents" also includes grandparents, relatives, guardians, and any caregivers who interact with the child.

(Adapted from the Principles originally developed by Doreen Pollack, 1970)

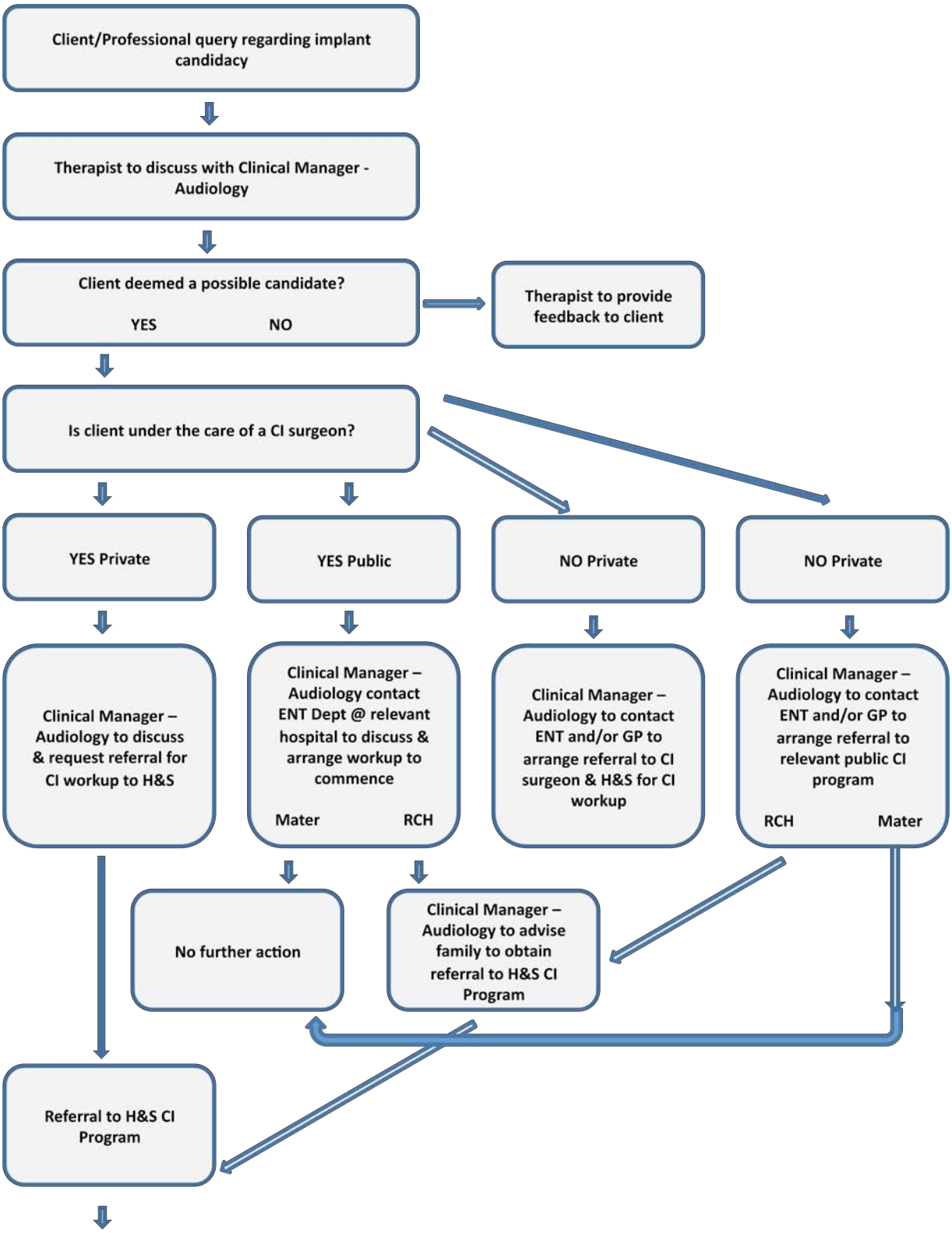
Adopted by the AG Bell Academy for Listening and Spoken Language®, July 26, 2007.

Source: http://nc.agbell.org/NetCommunity/page.aspx?pid=359

Appendix C Queensland Multi-disciplinary Hearing Loss Clinic Pathway



Appendix D Relationship between EIP and Cochlear Implant Program



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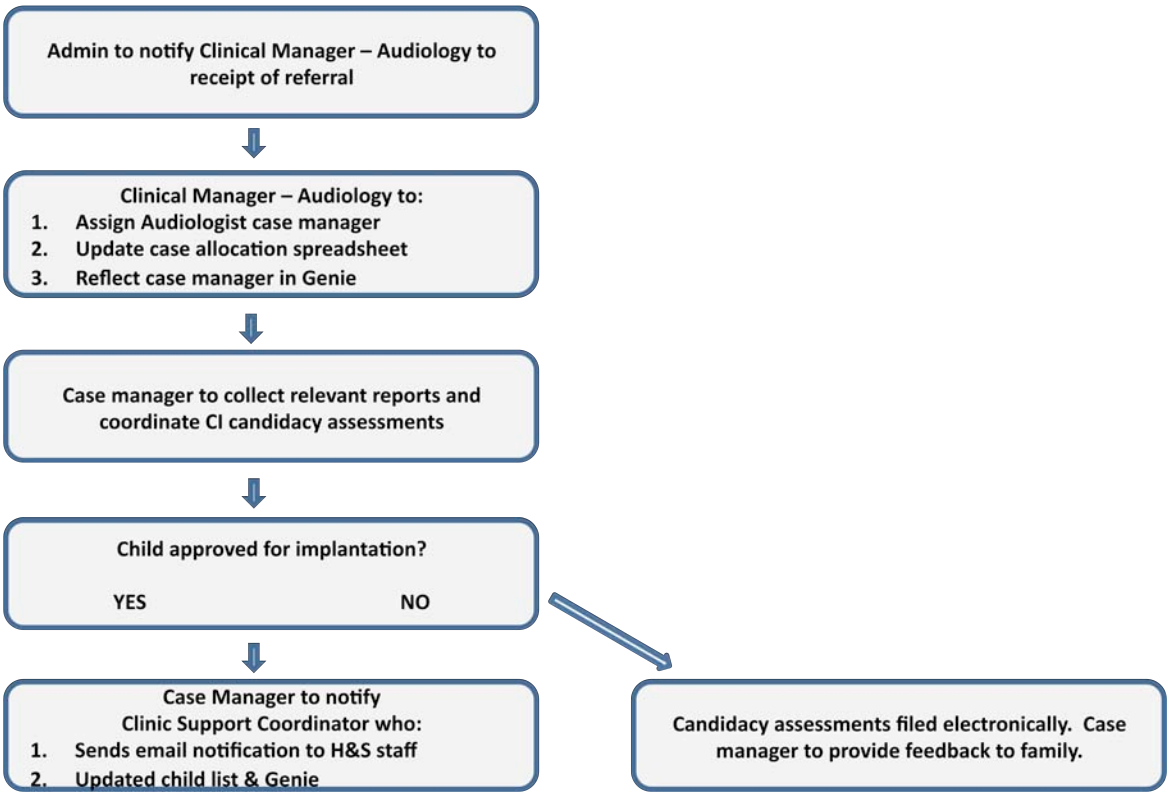

References

1. Hogan A, O'Loughlin K, Davis A, et al: Hearing loss and paid employment: Australian population survey findings. Int J Audiol 48:117-22, 2009
2. Hogan A, O'Loughlin K, Miller P, et al: The health impact of a hearing disability on older people in Australia. J Aging Health 21:1098-111, 2009
3. Hawthorne G, Hogan A, Giles E, et al: Evaluating the health-related quality of life effects of cochlear implants: a prospective study of an adult cochlear implant program. Int J Audiol 43:183-92, 2004
4. Hogan A, Stewart M, Giles E: It's a whole new ball game! Employment experiences of people with a cochlear implant. Cochlear Implants Int 3:54-67, 2002
5. Hawthorne G, Hogan A: Measuring disability-specific patient benefit in cochlear implant programs: developing a short form of the Glasgow Health Status Inventory, the Hearing Participation Scale. Int J Audiol 41:535-44, 2002
6. Hogan A, Hawthorne G, Kethel L, et al: Health-related quality-of-life outcomes from adult cochlear implantation: a cross-sectional survey. Cochlear Implants Int 2:115-28, 2001
7. Hogan A, Taylor A, Westcott S: Audiologists' attitudes to cochlear implants. Cochlear Implants Int 2:17-29, 2001
8. Hogan A: Implant outcomes: towards a mixed methodology for evaluating the efficacy of adult cochlear implant programmes. Disabil Rehabil 19:235-43, 1997
9. Reed VA, Hogan A, Munnerley GM, et al: Adults with acquired hearing loss: identification and referral patterns of community health workers. Aust J Public Health 18:223-5, 1994
10. Australian Hearing: Annual Report. 2010
11. National Institute on Deafness and Other Communication Disorders: Quick Statistics, 2010, http://www.nidcd.nih.gov/health/statistics/quick.htm
12. Australian Hearing: Report on Demographics of Persons under the age of 21 years with Hearing Aids. 2010
13. Aleisha Davis, Cheryl Dickson, Ellen Panjari, et al: A Nation Wide Review: Early Intervention and Cochlear Implant Access, Timing and Services. Presented at the 6th Annual Newborn Screening Conference, Fremantle, 2011
14. Grosse S: Newborn hearing evidence-statement: screening., in Campbell KP, Lanza A, Dixon R, et al (eds): A Purchaser's Guide to Clinical Preventive Services: Moving Science into Coverage. Washington, DC, National Business Group on Health, 2006
15. Abou-Elhamd KE, Moussa AE, Soltan MA: Prevalence of middle ear pathologies in children with bilateral sensorineural hearing loss. Int J Pediatr Otorhinolaryngol 70:1081-4, 2006
16. Attias J, Al-Masri M, Abukader L, et al: The prevalence of congenital and early-onset hearing loss in Jordanian and Israeli infants. Int J Audiol 45:528-36, 2006
17. da Silva AM, Latorre Mdo R, Cristofani LM, et al: The prevalence of hearing loss in children and adolescents with cancer. Braz J Otorhinolaryngol 73:608-14, 2007
18. MacAndie C, Kubba H, McFarlane M: Epidemiology of permanent childhood hearing loss in Glasgow, 1985-1994. Scott Med J 48:117-9, 2003
19. Parving A: Epidemiology of hearing loss and aetiological diagnosis of hearing impairment in childhood. Int J Pediatr Otorhinolaryngol 5:151-65, 1983

20. Parving A, Christensen B: Epidemiology of permanent hearing impairment in children in relation to costs of a hearing health surveillance program. Int J Pediatr Otorhinolaryngol 34:9-23, 1996

21. Parving A, Hauch AM, Christensen B: Hearing loss in children--epidemiology, age at identification and causes through 30 years. Ugeskr Laeger 165:574-9, 2003

22. Russ SA, Poulakis Z, Barker M, et al: Epidemiology of congenital hearing loss in Victoria, Australia. Int J Audiol 42:385-90, 2003

23. Saunders JE, Vaz S, Greinwald JH, et al: Prevalence and etiology of hearing loss in rural Nicaraguan children. Laryngoscope 117:387-98, 2007

24. Westerberg BD, Skowronski DM, Stewart IF, et al: Prevalence of hearing loss in primary school children in Zimbabwe. Int J Pediatr Otorhinolaryngol 69:517-25, 2005

25. Elizabeth Weise: Cochlear implants can be 'magic device', USA Today. http://yourlife.usatoday.com/health/story/2011/04/Cochlear-implants-can-be-magic-device/45987080/1, 2011

26. Niparko JK, Tobey EA, Thal DJ, et al: Spoken language development in children following cochlear implantation. JAMA 303:1498-506, 2010

27. Dimity Dornan: Hearing loss in babies is a neurological emergency, Alexander Graham Bell Association for the Deaf and Hard of Hearing, 2009

28. Joint Committee on Infant Hearing: Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. Joint Committee on Infant Hearing, American Academy of Audiology, American Academy of Pediatrics, American Speech-Language-Hearing Association, and Directors of Speech and Hearing Programs in State Health and Welfare Agencies. Pediatrics 106:798-817, 2000

29. Joint Committee on Infant Hearing: Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. Pediatrics 120:898-921, 2007

30. Koop CE: Foreword: pursuing excellence in early hearing detection and intervention programs. Pediatrics 126 Suppl 1:S1-2, 2010

31. Lloyd K: Policy on Early Intervention for Deaf and Hard of Hearing Children, Advice to the Minister for Families, Housing, Community Services and Indigenous Affairs / Parliamentary Secretary for Disabilities and Children's Services, DEAF Australia Inc., 2009

32. Access Economics: Listen Hear! The economic impact and cost of hearing loss in Australia, CRC HEAR and the Victorian Deaf Society, 2006

33. Victorian Department of Transport: Guidelines for Cost Benefit Analysis, 2010, http://www.transport.vic.gov.au/

34. Department of Finance and Deregulation: Australian Government Introduction to Cost-Benefit Analysis and Alternative Evaluation Methodologies and Handbook of Cost-Benefit Analysis, Finance Circular 2006/01. 2006

35. NSW Treasury: NSW Government Guidelines for Economic Appraisal, Policy & Guidelines Paper. Sydney, Office of Financial Management, 2007

36. enHealth Council: Guidelines for Economic Evaluation of Environmental Health Planning and Assessment, Department of Health and Ageing and enHealth Council, 2003

37. Hear and Say Centre: Welcome to the Hear and Say Centre's website, 2011, http://www.hearandsaycentre.com.au/index.html

38. First Voice: Proposed State-Wide Healthy Hearing Intervention Services Model, draft document. 2010
39. Green A: Provision of Therapy Programs for Students with a Disability in ACT Public Schools, Request for Proposal No. 2010.13737.110 – The Shepherd Centre, 2010
40. Hogan S, Stokes J, White C, et al: An Evaluation of Auditory Verbal Therapy Using the Rate of Early Language Development as an Outcome Measure. Deafness & Education 10:143-167, 2008
41. Ruben R: A Time Frame of Critical/Sensitive Periods of Language Development. Acta Otolaryngolica 117:202–205, 1997
42. Yoshinaga-Itano C: Levels of evidence: universal newborn hearing screening (UNHS) and early hearing detection and intervention systems (EHDI). J Commun Disord 37:451-65, 2004
43. Australian Hearing: Choices, a booklet for parents and carers of children who have a hearing loss, 2005
44. Casto G, Mastropieri MA: The efficacy of early intervention programs: a meta-analysis. Except Child 52:417-24, 1986
45. Freitag CM: Empirically based early intervention programs for children with autistic disorders - a selective literature review. Z Kinder Jugendpsychiatr Psychother 38:247-56, 2010
46. Kasari C: Assessing change in early intervention programs for children with autism. J Autism Dev Disord 32:447-61, 2002
47. Matson JL: Determining treatment outcome in early intervention programs for autism spectrum disorders: a critical analysis of measurement issues in learning based interventions. Res Dev Disabil 28:207-18, 2007
48. Milla MG, Mulas F: Early attention and specific intervention programs with autism spectrum disorders. Rev Neurol 48 Suppl 2:S47-52, 2009
49. Stahmer AC: The basic structure of community early intervention programs for children with autism: provider descriptions. J Autism Dev Disord 37:1344-54, 2007
50. Wise MD, Little AA, Holliman JB, et al: Can state early intervention programs meet the increased demand of children suspected of having autism spectrum disorders? J Dev Behav Pediatr 31:469-76, 2010
51. Sayal K, Owen V, White K, et al: Impact of early school-based screening and intervention programs for ADHD on children's outcomes and access to services: follow-up of a school-based trial at age 10 years. Arch Pediatr Adolesc Med 164:462-9, 2010
52. O'Neill D: A Cost-Benefit Analysis of Early Childhood Intervention: Evidence from a Randomised Evaluation of a Parenting Programme, Forschungsinstitut zur Zukunft der Arbeit / Institute for the Study of Labor, 2009
53. Torgesen JK, Wagner RK, Rashotte CA, et al: Computer-assisted instruction to prevent early reading difficulties in students at risk for dyslexia: Outcomes from two instructional approaches. Ann Dyslexia 60:40-56, 2010
54. Needlman R, Toker KH, Dreyer BP, et al: Effectiveness of a primary care intervention to support reading aloud: a multicenter evaluation. Ambul Pediatr 5:209-15, 2005
55. Justice LM, McGinty AS, Piasta SB, et al: Print-focused read-alouds in preschool classrooms: intervention effectiveness and moderators of child outcomes. Lang Speech Hear Serv Sch 41:504-20, 2010

56. Calear AL, Christensen H: Systematic review of school-based prevention and early intervention programs for depression. J Adolesc 33:429-38, 2010
57. Neil AL, Christensen H: Australian school-based prevention and early intervention programs for anxiety and depression: a systematic review. Med J Aust 186:305-8, 2007
58. Neil AL, Christensen H: Efficacy and effectiveness of school-based prevention and early intervention programs for anxiety. Clin Psychol Rev 29:208-15, 2009
59. Atkinson W: Early intervention. Childhood obesity programs aim to put kids on a new, healthier path to adulthood. AHIP Cover 49:26-8, 30, 32 passim, 2008
60. U.S. Department of Health & Human Services: About the Office of Head Start, 2011, http://www.acf.hhs.gov/programs/ohs/about/index.html
61. Anderson LM, Shinn C, Fullilove MT, et al: The effectiveness of early childhood development programs. A systematic review. Am J Prev Med 24:32-46, 2003
62. Barnett W: Lives in the balance: age-27 benefit-cost analysis of the High/Scope Perry Preschool Program. Ypsilanti, MI: High/Scope Press, 1996
63. Orla Doylea, Colm P. Harmon, James J. Heckman, et al: Investing in Early Human Development: Timing and Economic Efficiency. Econ Hum Biol 7:1-6, 2009
64. White KR, Forsman I, Eichwald J, et al: The evolution of early hearing detection and intervention programs in the United States. Semin Perinatol 34:170-9, 2010
65. Mason CA, Gaffney M, Green DR, et al: Measures of follow-up in early hearing detection and intervention programs: a need for standardization. Am J Audiol 17:60-7, 2008
66. Danhauer JL, Johnson CE, Finnegan D, et al: A national survey of pediatric otolaryngologists and early hearing detection and intervention programs. J Am Acad Audiol 17:708-21, 2006
67. Houston KT, Behl DD, White KR, et al: Federal privacy regulations and the provision of Early Hearing Detection and Intervention programs. Pediatrics 126 Suppl 1:S28-33, 2010
68. Burton SK, Blanton SH, Culpepper B, et al: Education in the genetics of hearing loss: a survey of early hearing detection and intervention programs. Genet Med 8:510-7, 2006
69. White KR: Early hearing detection and intervention programs: opportunities for genetic services. Am J Med Genet A 130A:29-36, 2004
70. Gracey K: Current concepts in universal newborn hearing screening and early hearing detection and intervention programs. Adv Neonatal Care 3:308-17, 2003
71. Finitzo T, Grosse S: Quality monitoring for early hearing detection and intervention programs to optimize performance. Ment Retard Dev Disabil Res Rev 9:73-8, 2003
72. Meinzen-Derr J, Wiley S, Choo DI: Impact of early intervention on expressive and receptive language development among young children with permanent hearing loss. Am Ann Deaf 155:580-91, 2011
73. Moller D, Probst P, Hess M: [Implementation and evaluation of a parent training for language delayed children]. Prax Kinderpsychol Kinderpsychiatr 57:197-215, 2008
74. Bubbico L, Di Castelbianco FB, Tangucci M, et al: Early hearing detection and intervention in children with prelingual deafness, effects on language development.

Minerva Pediatr 59:307-13, 2007

75. Moeller MP: Early intervention and language development in children who are deaf and hard of hearing. Pediatrics 106:E43, 2000

76. Hall DM: Re: Ward, S., 1999 an investigation into the effectiveness of an early intervention method for the delayed language development in young children. International Journal of Language & Communication Disorder, 34, 243-264. Int J Lang Commun Disord 34:445-7, 1999

77. Letts C, Edwards S: Re: Ward, S., 1999 an investigation into the effectiveness of an early intervention method for delayed language development in young children. International Journal of Language & Communication Disorder, 34,243-246. Int J Lang Commun Disord 34:443-5, 1999

78. Yoder P: Re: Ward, S., 1999, an investigation into the effectiveness of an early intervention method for delayed language development in young children. International Journal for Language & Communication Disorder, 34, 243-246. Int J Lang Commun Disord 34:441-3, 1999

79. Ward S: An investigation into the effectiveness of an early intervention method for delayed language development in young children. Int J Lang Commun Disord 34:243-64, 1999

80. Vohr B, Jodoin-Krauzyk J, Tucker R, et al: Expressive vocabulary of children with hearing loss in the first 2 years of life: impact of early intervention. J Perinatol 31:274-80, 2011

81. Yoshinaga-Itano C: Early intervention after universal neonatal hearing screening: impact on outcomes. Ment Retard Dev Disabil Res Rev 9:252-66, 2003

82. Connor CM, Craig HK, Raudenbush SW, et al: The age at which young deaf children receive cochlear implants and their vocabulary and speech-production growth: is there an added value for early implantation? Ear Hear 27:628-44, 2006

83. Wake M, Poulakis Z, Hughes EK, et al: Hearing impairment: a population study of age at diagnosis, severity, and language outcomes at 7-8 years. Arch Dis Child 90:238-44, 2005

84. Das VK, Das RV: Googly from down under: hearing impairment and early intervention. Arch Dis Child 90:221-2, 2005

85. Nicholas JG, Geers AE: Effects of Early Auditory Experience on the Spoken Language of Deaf Children at 3 Years of Age. Ear Hear 27:286-298, 2006

86. Buschmann A, Jooss B, Rupp A, et al: Parent based language intervention for 2-year-old children with specific expressive language delay: a randomised controlled trial. Arch Dis Child 94:110-6, 2009

87. Coste-Zeitoun D, Pinton F, Barondiot C, et al: Specific remedial therapy in a specialist unit: evaluation of 31 children with severe, specific language or reading disorders over one academic year. Rev Neurol (Paris) 161:299-310, 2005

88. Easterbrooks SR, O'Rourke CM, Todd NW: Child and family factors associated with deaf children's success in auditory-verbal therapy. Am J Otol 21:341-4, 2000

89. Lim SY, Simser J: Auditory-verbal therapy for children with hearing impairment. Ann Acad Med Singapore 34:307-12, 2005

90. Yucel E, Derim D, Celik D: The needs of hearing impaired children's parents who attend to auditory verbal therapy-counseling program. Int J Pediatr Otorhinolaryngol 72:1097-111, 2008

91. Bertram B, Pad D: Importance of auditory-verbal education and parents' participation after cochlear implantation of very young children. Ann Otol Rhinol Laryngol Suppl 166:97-100, 1995

92. Pundir M, Nagarkar AN, Panda NK: Intervention strategies in children with cochlear implants having attention deficit hyperactivity disorder. Int J Pediatr Otorhinolaryngol 71:985-8, 2007

93. Yoshinaga-Itano C, Baca RL, Sedey AL: Describing the trajectory of language development in the presence of severe-to-profound hearing loss: a closer look at children with cochlear implants versus hearing aids. Otol Neurotol 31:1268-74, 2010

94. Easterbrooks SR, O'Rourke CM: Gender differences in response to auditory-verbal intervention in children who are deaf or hard of hearing. Am Ann Deaf 146:309-19, 2001

95. Diller G, Graser P, Schmalbrock C: Early natural auditory-verbal education of children with profound hearing impairments in the Federal Republic of Germany: results of a 4 year study. Int J Pediatr Otorhinolaryngol 60:219-26, 2001

96. Bodmer D, Shipp DB, Ostroff JM, et al: A comparison of postcochlear implantation speech scores in an adult population. Laryngoscope 117:1408-11, 2007

97. Chee GH, Goldring JE, Shipp DB, et al: Benefits of cochlear implantation in early-deafened adults: the Toronto experience. J Otolaryngol 33:26-31, 2004

98. Eriks-Brophy A: Outcomes of Auditory-Verbal Therapy: A Review of the Evidence and a Call for Action. The Volta Review, 104:21-35, 2004

99. Rhoades E: Language progress with an auditory-verbal approach for young children with hearing loss International Pediatrics 16:1-7, 2001

100. Rhoades E, Chisholm T: Global language progress with an auditory-verbal therapy approach for children who are deaf or hard of hearing. The Volta Review 102:5-25, 2000

101. Rhoades EA: Research outcomes of Auditory-Verbal intervention: Is the approach justified? Deafness & Education International 8:125-143, 2006

102. Dornan D, Hickson L, Murdoch B, et al: Is Auditory-Verbal Therapy Effective for Children with Hearing Loss? The Volta Review 110:361–387, 2010

103. Heavner K, Griffin BL, El-Kashlan H, et al: The Relationship Between Communication Approach and Spoken Language in Young Cochlear Implant Recipients, Report prepared by the University of Michigan Cochlear Implant Team, 2006

104. O'Donoghue GM, Nikolopoulos TP, Archbold SM: Determinants of speech perception in children after cochlear implantation. Lancet 356:466-8, 2000

105. Archbold SM, Nikolopoulos TP, Tait M, et al: Approach to communication, speech perception and intelligibility after paediatric cochlear implantation. Br J Audiol 34:257-64, 2000

106. Connor CM, Hieber S, Arts HA, et al: Speech, vocabulary, and the education of children using cochlear implants: oral or total communication? J Speech Lang Hear Res 43:1185-204, 2000

107. Cohen SM, Labadie RF, Haynes DS: Primary care approach to hearing loss: the hidden disability. Ear Nose Throat J 84:26, 29-31, 44, 2005

108. Johnson CE, Danhauer JL, Koch LL, et al: Hearing and balance screening and referrals for Medicare patients: a national survey of primary care physicians. J Am Acad Audiol 19:171-90, 2008

109. Danhauer JL, Celani KE, Johnson CE: Use of a hearing and balance screening survey with local primary care physicians. Am J Audiol 17:3-13, 2008
110. Wallhagen MI, Pettengill E: Hearing impairment: significant but underassessed in primary care settings. J Gerontol Nurs 34:36-42, 2008
111. Carron JD, Moore RB, Dhaliwal AS: Perceptions of pediatric primary care physicians on congenital hearing loss and cochlear implantation. J Miss State Med Assoc 47:35-41, 2006
112. Wall TC, Senicz E, Evans HH, et al: Hearing screening practices among a national sample of primary care pediatricians. Clin Pediatr (Phila) 45:559-66, 2006
113. Cheng AK, Rubin HR, Powe NR, et al: Cost-utility analysis of the cochlear implant in children. JAMA 284:850-6, 2000
114. Keren R, Helfand M, Homer C, et al: Projected cost-effectiveness of statewide universal newborn hearing screening. Pediatrics 110:855-64, 2002
115. Young NM, Reilly BK, Burke L: Limitations of Universal Newborn Hearing Screening in Early Identification of Pediatric Cochlear Implant Candidates. Arch Otolaryngol Head Neck Surg 137:230-234, 2011
116. Hear and Say Centre: Hear and Say 2010 Annual Report, http://www.hearandsaycentre.com.au/userfiles/file/2009_10%20annual%20report.pdf. 2010
117. The Shepherd Centre: Annual Report. 2009
118. Taralye: Annual Report. Blackburn, Victoria, The Advisory Council for Children with Impaired Hearing (Victoria), 2010
119. British Association of Teachers of the Deaf: Deaf children and teachers of the deaf: Survey Report 2003., 2004
120. Australian Bureau of Statistics: Report 4102.0 - Australian Social Trends, Mar 2011 2011
121. Warren McCann: Review of the Cora Barclay Centre, Confidential Report to the Minister for Education in South Australia, 2011
122. Aussie Deaf Kids, Cora Barclay, Deafness Forum Australia, et al: Hearing Loss Early Intervention Support Package, Funding Proposal for Children with Hearing Loss, 2 July 2010
123. Australian Bureau of Statistics: Report 6202.0 - Labour Force, Australia, Mar 2011. 2011
124. Australian Bureau of Statistics: Report 4102.0 - Australian Social Trends, 2007 2007
125. Gordon M, Rosenman L, Cuskelly M: Constrained labour: Maternal employment when children have disabilities. Journal of Applied Research In Intellectual Disabilities 20:236-246, 2007
126. Hyde M, Punch R, Komesaroff L: A comparison of the anticipated benefits and received outcomes of pediatric cochlear implantation: parental perspectives. Am Ann Deaf 155:322-38, 2010
127. Australian Bureau of Statistics: Report 1350.0 - Australian Economic Indicators, May 2011 2011
128. ACIL Tasman: The cost of managing lung cancer in NSW, Report prepared for the Cancer Institute NSW, 2008
129. Cancer Institute NSW: Accommodation Guide, Cancer Institute NSW, 2005

130. Hear and Say Centre: Cochlear Implant Program for Overseas Patients (12 month plan), 2011
131. AudioClinic: Hearing Aid Prices, http://www.audioclinic.com.au/hearing-aids/hearing-aid-prices, accessed on 4 May 2011, 2011
132. Hyde M, Punch R, Komesaroff L: Coming to a decision about cochlear implantation: parents making choices for their deaf children. J Deaf Stud Deaf Educ 15:162-78, 2010
133. Hansen S, Anthonsen K, Stangerup SE, et al: Unexpected findings and surgical complications in 505 consecutive cochlear implantations: a proposal for reporting consensus. Acta Otolaryngol 130:540-9, 2010
134. Ovesen T, Johansen LV: Post-operative problems and complications in 313 consecutive cochlear implantations. J Laryngol Otol 123:492-6, 2009
135. Kraai T, Brown C, Neeff M, et al: Complications of bone-anchored hearing aids in pediatric patients. Int J Pediatr Otorhinolaryngol, 2011
136. Badran K, Arya AK, Bunstone D, et al: Long-term complications of bone-anchored hearing aids: a 14-year experience. J Laryngol Otol 123:170-6, 2009
137. Gillett D, Fairley JW, Chandrashaker TS, et al: Bone-anchored hearing aids: results of the first eight years of a programme in a district general hospital, assessed by the Glasgow benefit inventory. J Laryngol Otol 120:537-42, 2006
138. Kohan D, Sorin A, Marra S, et al: Surgical management of complications after hearing aid fitting. Laryngoscope 114:317-22, 2004
139. ACIL Tasman: Ear telehealth in the Pilbara: Costs and Benefits, 2009
140. Leigh I, Marcus A, Dobosh P, et al: Deaf/hearing cultural identity paradigms: modification of the deaf identity development scale. J Deaf Stud Deaf Educ 3:329-38, 1998
141. Gurney JG, Tersak JM, Ness KK, et al: Hearing loss, quality of life, and academic problems in long-term neuroblastoma survivors: a report from the Children's Oncology Group. Pediatrics 120:e1229-36, 2007
142. Hinderink JB, Krabbe PF, Van Den Broek P: Development and application of a health-related quality-of-life instrument for adults with cochlear implants: the Nijmegen cochlear implant questionnaire. Otolaryngol Head Neck Surg 123:756-65, 2000
143. Persson J, Hellbom G: Balancing societal costs and users' quality of life--priority setting of interventions for the hard-of-hearing. Int J Audiol 42 Suppl 1:S9-12, 2003
144. Viscusi W, Aldy J: The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World. The Journal of Risk and Uncertainty 27:5–76,, 2003
145. Mathers C, Vos T, Stevenson C: The burden of disease and injury in Australia, Australian Institute of Health and Welfare, AIHW Cat. No PHE 17, Canberra., 1999
146. Hogan A, Shipley M, Strazdins L, et al: Risks to mental health among children with hearing loss – a preliminary study, Final Draft. Submitted for publication in the A&NZ Journal of Public Health, 2011
147. Mathers C, Bernard C, Iburg KM, et al: Global Burden of Disease in 2002: data sources, methods and results, Global Programme on Evidence for Health Policy Discussion Paper No. 54, 2004
148. Wake M, Hughes EK, Poulakis Z, et al: Outcomes of children with mild-profound congenital hearing loss at 7 to 8 years: a population study. Ear Hear 25:1-8, 2004
149. Winn SL: Employment Outcomes for People in Australia Who Are Congenitally Deaf: Has Anything Changed? American Annals of the Deaf 152:382-390, 2007

150. Coates H, Vijayasekaran S, Mackendrick A, et al: Aboriginal Ear Health Manual. Perth, 2008
151. Australian Bureau of Statistics: Report 6302.0 - Average Weekly Earnings, Australia, Nov 2010, 2011
152. Winn S: Is there a link between hearing aid use, employment, and income? Am Ann Deaf 151:434-40, 2006
153. Leigh A, Ryan C: Estimating Returns to Education Using Different Natural Experiment Techniques. Economics of Education Review 27:149-160, 2008
154. Leigh A: Returns to education in Australia. Economic Papers 27:233-249, 2008
155. Teasdale TW, Sorensen MH: Hearing loss in relation to educational attainment and cognitive abilities: a population study. Int J Audiol 46:172-5, 2007
156. Bourgeois J, Treubig K: A nuts and bolts guide to College success for deaf and hard of hearing students, downloaded from http://sunsite.utk.edu/cod/pec/products/nutsandbolts.doc, The University of Tennessee, Knoxville, 1997
157. Williams JM: Do Health-Care Providers Have to Pay for Assistive Tech? http://www.businessweek.com/bwdaily/dnflash/may2000/nf00505c.htm, Business Week, 2000
158. Byrd RS, Weitzman ML: Predictors of early grade retention among children in the United States. Pediatrics 93:481-7, 1994
159. Woodcock K, Pole JD: Educational attainment, labour force status and injury: a comparison of Canadians with and without deafness and hearing loss. Int J Rehabil Res 31:297-304, 2008
160. Mann JR, Zhou L, McKee M, et al: Children with hearing loss and increased risk of injury. Ann Fam Med 5:528-33, 2007
161. Kidsafe: Twelve facts about child injury in Australia, Report downloaded from http://www.gtp.com.au/kidsafesa/inewsfiles/4986%2012%20facts%20about%20child%20injury%20FS%20V2proof.pdf, 2010
162. AIHW: Australia's Health 2010, downloaded from http://www.aihw.gov.au/publication-detail/?id=6442468376&tab=2, 2010
163. Moller J: Estimated cost of injury ($millions) by all causes Australia 1995–96, downloaded from www.nisu.flinders.edu.au/pubs/injcost/allcause.html. 1998
164. Marshak L, Prezant F: Married with special needs children, Woodbine House, 2007
165. Standing Committee on Legal and Constitutional Affairs: To have and to hold: Strategies to strengthen marriage and relationships, House of Representatives, Commonwealth of Australia, 1998
166. Australian Bureau of Statistics: Report 3307.0.55.001 - Divorces, Australia, 2007. 2008
167. Bratti M, Miranda A: Non-pecuniary returns to higher education: the effect on smoking intensity in the UK. Health Econ 19:906-20, 2010

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