



**Cost-benefit analysis of First Voice's
early intervention program**

First Voice

A sound investment

9 January 2017

Glossary

ABS	Australian Bureau of Statistics
AWE	average weekly earnings
BCR	benefit cost ratio
CBA	cost-benefit analysis
DALY	disability adjusted life year
NDIA	National Disability Insurance Agency
NDIS	National Disability Insurance Scheme
VSL	value of a statistical life
VSLY	value of a statistical life year
YLD	years of healthy life lost due to disability
YLL	years of life lost due to premature death

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Executive summary

First Voice is the national voice for member organisations whose primary focus is the provision of listening and spoken language therapy services for children who are deaf or hearing impaired in Australia and New Zealand. First Voice members provide family-centred, multi-disciplinary early childhood intervention services. These intervention services follow a parent-based model of therapy, where one or both parents are taught how to teach their hearing-impaired child to listen and speak.

Deloitte Access Economics was commissioned by First Voice to conduct a cost-benefit analysis of the early intervention services provided by First Voice members. The cost-benefit analysis analysed the costs and benefits of the First Voice early intervention services over a 50 year timeframe. This timeframe takes into account that most of the benefits occur later in life while costs were incurred over the period of the program. The base year for the analysis is 2015, during this year there were approximately 800 children enrolled in a First Voice early intervention program of whom 634 had bilateral hearing losses and were included in the analysis. The comparison group were children who had hearing impairment and had received

an aid or implant but were not enrolled in any early intervention program.

Costs in the analysis were calculated as the cost of providing the services, as well as other economic costs such as transport for appointments, a parent leaving the workforce, childcare for other siblings and deadweight losses. The costs of the program are incurred while the child is enrolled in the program which was assumed to be 4.71 years based on figures provided by First Voice stakeholders.

The benefits attributed to the First Voice early intervention program include the increase in income due to improved employment and educational attainment of participants, improvements in participants' wellbeing, avoided school costs and avoided deadweight losses. Compared to the costs, the benefits of the First Voice early intervention program are realised over a variety of timeframes. Some benefits are realised much later in the child's life, such as the increased income due to improved employment and educational attainment, while other benefits are realised throughout the child's life such as the improvements in wellbeing.

These estimates indicate that First Voice listening and spoken language early childhood intervention programs provide value for money in terms of improving educational outcomes, employment outcomes and wellbeing outcomes for children with hearing loss. Investing additional funding into First Voice programs would represent a sound investment in improving outcomes for children with hearing impairment.

Table i: Lifetime and average annual benefits, costs and BCR, NPV (\$ 2015)

	Lifetime stream (over 50 years)	Average annual stream* (2015 dollars)
Costs	\$215,556	\$4,311
Benefits	\$464,711	\$9,294
Net benefit	\$249,155	\$4,983
BCR	2.2	

Source: Deloitte Access Economics calculations.
Note: Figures are in terms of per child. * Calculated as a simple average i.e. the lifetime stream divided by 50.

1. All prices are in terms of Australian dollars.
2. A BCR between 0 and 1 represents a net cost, while a BCR above 1 represents a net benefit.

The benefits of the First Voice early intervention program to educational attainment and improved employment were reflected in a survey of First Voice graduates who completed the First Voice early intervention program between 1993 and 2002:

- **Education:** First Voice graduates were more likely to have completed year 12 (86%) than both the general population (78%) and those with a moderate or mild disability (73%) (First Voice, 2016c; ABS, 2016b)
- **Employment:** First Voice graduates were more likely to be in regular paid employment (77%) than the disabled or health impaired population (53%) (First Voice, 2016c; ABS, 2016c).

Table i presents the results of the cost-benefit analysis. The total net present value (NPV) cost per child in 2015 dollars was \$215,556¹, while the NPV total benefit per child was \$464,711. The ratio between the two resulted in a benefit-cost ratio (BCR) of 2.2.² Therefore, on average, for every dollar invested in a First Voice early intervention program there is a \$2.20 return in benefits.

A literature review conducted prior to the cost-benefit analysis indicated that there are a number of other benefits of early intervention programs that have not been included in this analysis. For instance, early intervention was found to improve the wellbeing of families with children who are deaf (Liliegren et al, 2012) and to facilitate diagnosis of any additional disabilities (Wiley et al, 2011). Some of these benefits are not able to be quantified so have not been included in the estimated benefits. As a result, the analysis is a conservative estimate of the benefits of the First Voice early intervention program.



1 Background

Deloitte Access Economics was engaged to undertake a cost-benefit analysis of First Voice's early intervention programs. The purpose of the analysis was to estimate the net economic and social benefits of early intervention programs provided by First Voice.

The context for the review is the introduction of a "disability services market" under the new National Disability Insurance Scheme (NDIS) in Australia. An essential prerequisite for any market to succeed is reliable and accessible information. This is required both to enable consumers to make informed decisions and for the funding authority (in this case the Commonwealth Government National Disability Insurance Agency (NDIA)) to ensure that public funding for early intervention programs is directed through eligible NDIS participants to evidence-based providers with proven outcomes.

This cost-benefit analysis will assist First Voice in engaging with federal and state government bodies in Australia and New Zealand, including the NDIA, by identifying the estimated return, in the form of benefits, relative to the investment, in the form of costs, of First Voice services.

The cost-benefit analysis was preceded by a literature review of reported outcomes from interventions for children with hearing loss. The measureable outcomes of interest in the review were:

- Early development outcomes (communication, speech, language)
- Learning outcomes (school and post-secondary)
- Life-long social and wellbeing outcomes.

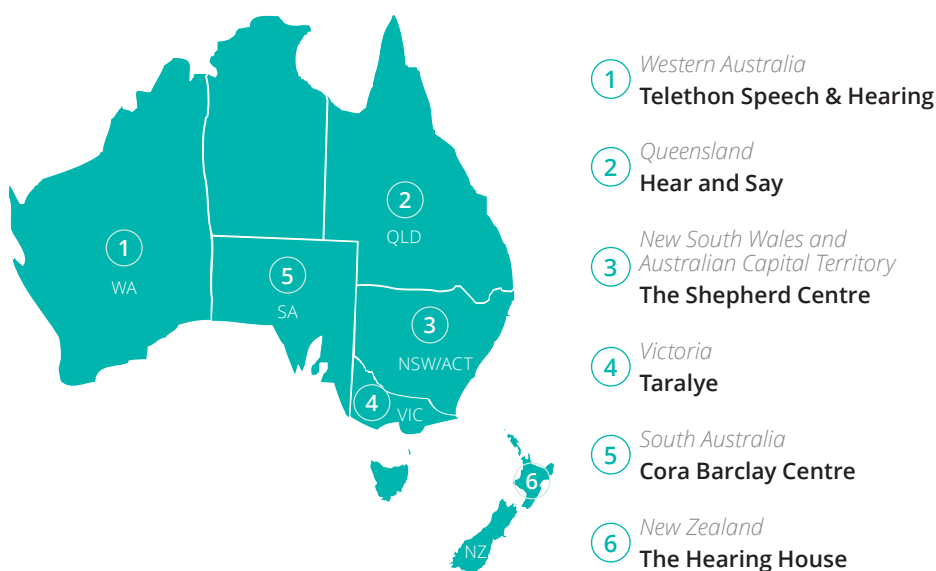
This review identified a number of benefits attributed to early intervention that were used in the cost-benefit analysis such as an increase in educational attainment, improved employment outcomes and increase in wellbeing. A cost-benefit analysis of the First Voice intervention program was originally performed by Econtext (2011), this publication was also used to inform the formulation of the costs and benefits of the First Voice intervention services, although all assumptions and other inputs to the cost-benefit analysis were independently identified and verified by Deloitte Access Economics.

1.1 First Voice

First Voice is the national voice for member organisations whose primary focus is the provision of listening and spoken language therapy services for children who are deaf or hearing impaired in Australia and New Zealand. Member organisations include:

- Cora Barclay Centre, South Australia
- Hear and Say, Queensland
- Taralye, Victoria
- Telethon Speech & Hearing, Western Australia
- The Shepherd Centre, New South Wales and Australian Capital Territory
- The Hearing House, New Zealand.

Figure 1.1: First Voice member centres



Source: First Voice (2015).

Each organisation provides early intervention services to develop listening and spoken language skills in children and infants who are deaf or hearing impaired. This is a family-based, multi-disciplinary model which predominantly utilises auditory-verbal therapy and auditory-oral approaches. First Voice services and programs are provided by multi-disciplinary teams of health and education professionals including auditory-verbal therapists, speech pathologists, paediatric audiologists, teachers of the deaf, psychologists, family counsellors and occupational therapists.

The early childhood intervention service is offered to children with hearing impairment from birth until the child starts compulsory schooling (typically the age of 5 years). It aims to teach parents how to create and use a listening and learning environment at home and elsewhere so their child can develop spoken language using their 'aided' hearing (First Voice, 2016a). Within the intervention services, intensive counselling for the parents is provided, along with education sessions which aim to provide the parents with information about the intervention approach. Both intensive and

comprehensive services are provided to families to ensure the child is supported in their family environment.

In 2015, almost 800 preschool aged children with hearing impairment participated in First Voice member centres' early intervention programs. These children have a range of severity of hearing impairments from children with unilateral hearing loss through to children with bilateral profound loss. Of the almost 800 children in the 2015 cohort, 160 had unilateral hearing loss. Children with unilateral hearing loss attending First Voice member centres typically receive a shorter, less intensive intervention program with a significantly lower cost than the program provided to children with bilateral hearing loss. They are therefore not typical of the intensive intervention program that is analysed in this report and have not been included in this analysis.

As audited data on hearing loss severity for the 2015 cohort were not yet available, the hearing loss severity for the 2015 cohort was calculated to be the average of the hearing loss severities of the First Voice centres' 2014 and 2013 cohorts.

The severity of hearing loss for the 2015 cohort is shown in Table 1.1. Other than unilateral hearing loss, the most common severity of hearing loss in the 2015 cohort was moderate (20%), mild (19%) and profound (16%). Taking into account that those children with unilateral hearing loss do not participate in this early intervention program, the cohort who do take part in the program for 2015 was 634 and this is the cohort used in the analysis.

The First Voice cohort also contains a number of children who have additional needs. According to the First Voice (2016b) Sound Outcomes publication, approximately 25% of the 2014 cohort of children spoke a language other than English and 12% had additional disabilities. First Voice stakeholders also noted that the cohort contains a number of children who come from culturally diverse backgrounds.

It should be noted that whilst this report was restricted to the First Voice early intervention program, some First Voice centres offer other complementary services such as cochlear implantation and school support.

Table 1.1: Severity of hearing loss in the better ear, 2015

Severity	Range	Proportion (%)
Normal (unilateral hearing loss)	-10-20dBHL	20%
Mild	21-40dBHL	19%
Moderate	41-55dBHL	20%
Moderately severe	56-70dBHL	13%
Severe	71-90dBHL	11%
Profound	>90 dBHL	16%

Source: Deloitte Access Economics calculations, First Voice (2016b) and First Voice (2015b)



2 Methodology

A cost-benefit analysis involves the estimation of costs and benefits over a number of years, with future benefits and costs discounted to the present using a discount rate. The costs and benefits of a particular intervention program are compared to determine a net benefit (or cost) along with a benefit-cost ratio (BCR). The BCR is calculated as the ratio of the sum of the discounted benefits of the intervention, relative to the cost of undertaking it. A BCR between 0 and 1 represents a net cost, while a BCR above 1 represents a net benefit.

The benefits estimated are conservative as many of the future benefits of early intervention programs are yet to be realised. For instance, governments benefit from health expenditure avoided, firms save on avoided productivity losses associated with disease and injury, and the rest of society benefits from a reduced demand for informal care from family and friends. Some of these benefits are not able to be quantified so have not been included in the estimated costs and benefits.

The following sections provide details about the parameters used in the analysis, along with the methodology behind calculating the costs and benefits attributed to the First Voice intervention. To support comparison of the results with the previous cost benefit analysis undertaken we continued to adopt the assumptions used in that analysis where we considered them to be reasonable and where there was not a readily available revised assumption that would clearly be more robust.

2.1 Parameters

The comparison group for this analysis were children who had received an aid or implant but were not enrolled in a First Voice intervention or any other early intervention. Benefits attributed to this intervention occur in the future and to take this into account the time frame of 50 years was selected. Sensitivity testing was performed at 25 years and 75 years. To be consistent with the 2011 report, a 3%³ discount rate was used with sensitivity testing being performed at 0% and 6%. In this analysis, costs and benefits of the

First Voice early intervention program have been estimated for the 2015 year. Other assumptions made in the analysis are highlighted in the discussion of each of the benefits and costs. The parameters used for this analysis are shown in Table 2.1.

Participants in the First Voice early intervention program were assumed to go to the First Voice centre 20 times per annum, based on estimates received from First Voice stakeholders. The participants go to the First Voice centre for a variety of appointments including group sessions, paediatric audiologist assessments and one on one auditory-verbal therapy. The 20 visit estimate is therefore a conservative estimate. Each of these appointments and sessions vary in length; however, it was estimated by First Voice stakeholders that appointments for the early intervention program typically run for approximately one hour.

Table 2.1: Parameters used in the analysis

Parameter	Base	Sensitivity testing
Year	2015	
Cohort	634	
Cohort with an additional disability	11.7%*	
Timeframe	50 years	25 years and 75 years
Discount rate	3.0%	0.0% and 6.0%
Comparison group	Children who have received an aid or implant but are not enrolled in any early intervention program	





Note: *This figure was calculated by averaging the proportion of children who have an additional disability from the 2014 and 2013 cohorts.

Source: First Voice stakeholders, First Voice (2016b), First Voice (2015b)

3. Deloitte Access Economics typically uses a 7% discount rate in cost-benefit analyses; however, the 3% discount rate was chosen as it was used in the previous analysis and allowed for comparability.

2.2 Benefits

The literature review performed prior to this cost-benefit analysis informed quantifiable benefits of early childhood auditory-verbal therapy and auditory-oral therapy. Identified benefits include:

-  Improved educational outcomes (year 12 attainment, avoided school costs)
-  Higher employment
-  Improved wellbeing
-  Avoided deadweight losses.

2.2.1 Higher level of educational attainment

The literature review found that early intervention, including auditory-verbal therapy and auditory-oral therapy interventions, leads to improved school and post-secondary outcomes for participants.

A survey of school leavers was undertaken by First Voice whereby children who graduated from a First Voice early intervention program between 1993 and 2002 were invited to participate. Questions covered schooling, tertiary study,

employment and personal relationships. In total, 154 survey responses were received, yielding a response rate of 18%. According to the survey a high proportion of graduates completed year 12 (86%). Other statistics provided by First Voice also stated that of program leavers, 38% had received a Bachelor's degree or higher (First Voice, 2016c).

By comparison, the ABS (2011b) reported that in 2010 78% of Australians aged 20 to 24 years had finished year 12. Of those with a disability or who were restricted by a long term health condition an average of 62% had completed year 12. Those who had a profound or severe disability were far less likely to have completed Year 12 (46%) than those who had a moderate or mild disability (73%).

Numerous studies have analysed how different levels of education impact income (McMahon, 2009; Leigh, 2008; Forbes et al, 2010). A study by Forbes et al (2010) found that completing year 12 led to an average increase of 11.5% in hourly wages compared to not completing year 12. While completing a Bachelor's degree or higher led to an average 37.6% increase in hourly wages compared to Year 12 non-completers. These results are shown in Table 2.2.

First Voice graduates were more likely to have completed year 12 (86%) than both the general population (78%) and those with a moderate or mild disability (73%).⁴

It was assumed that participants in a First Voice early intervention program who did not have an additional learning disability would have higher educational attainment compared to the comparison group. This assumption recognised that individuals with an additional learning disability would still face difficulties with obtaining higher educational attainment while those without an additional learning disability would be capable of obtaining a higher level of education. It was assumed that 38% of First Voice participants would complete a Bachelor degree or higher and the remaining participants (62%) would complete Year 12, this assumption is based on the First Voice school leavers survey results.

Table 2.2 : Average marginal effect of education on hourly wages compared to Year 12 non-completers

	Men	Women	Average
Bachelor's or higher	38.4%	36.7%	37.6%
Year 12	12.8%	10.1%	11.5%

Source: Forbes et al (2010)

4. The 95% confidence interval for First Voice graduates who have completed year 12 is (81.7%, 92.3%), the 95% confidence interval for the general population is (77.7%, 78.3%) and the 95% confidence interval for those with a moderate or mild disability is (72.7%, 73.3%). First Voice stakeholders state that the outcomes for the current First Voice cohort will be better than those reported in the school leavers survey. This is due to the current cohort being diagnosed with hearing loss earlier than the cohort of First Voice participants surveyed in the school leavers survey. Those surveyed in the school leavers survey were diagnosed with hearing loss prior to the implementation of the universal newborn hearing screening which screens babies for hearing loss and detects hearing loss when someone is young. Universal screening was introduced nationally by the end of 2010 according to Department of Health (2013) publication. As a result, some of those surveyed in the school leavers survey might not have had their hearing loss diagnosed until later in life. Early diagnosis has been found to improve learning and language outcomes for people with hearing loss (Allied Health Evidence, 2007).

Using these proportions and the averages presented in Table 2.2, the average increase in income was estimated to be 21.4% per year per participant. This was calculated by multiplying the proportion of First Voice participants who were assumed to complete a Bachelor degree or higher by the average marginal effect on wages for completing a Bachelor degree or higher and adding to the result of multiplying the proportion of First Voice participants assumed to complete year 12 by the average increase in income from completing year 12.

It was assumed that First Voice participants would work from age 18 years to 75 years and retire at 76 years; however, for the base case these benefits were forecasted to 50 years. To calculate the average income earned each year by a First Voice participant the average weekly earnings (AWE) for each age bracket (ABS, 2016b) were multiplied by average employment rates (ABS, 2011a) and then by the weeks in the year. Multiplying by the average employment rate takes into account the probability of an individual being employed. The income earned by the First Voice participant each year was then multiplied by 21.4% to calculate the increase in income due to the increase in educational attainment. The average per year increase in income for all First Voice participants was estimated to be **\$9,076 per child per year.⁵ This converts to a lifetime benefit with a NPV of \$103,091 in 2015 dollars over the 50 year modelling horizon.**

2.2.2 Improved employment

Hearing loss itself can have a significant impact on an individual's ability to work. This may include a reduced chance of

employment. A recent publication by the Australian Human Rights Commission (AHRC, 2016) found that people with a disability face ongoing and systemic discrimination in the work place. Discrimination faced by people with a disability includes inaccessible recruitment practice such as an interview being held over the phone, and inaccessible workplaces due to building design or technology.

Having a disability can lead to premature retirement; a greater number of sick days than average; and even a diminished capacity to be productive at work due to impaired ability or psychological stresses. As such, hearing loss may hinder the employability or productivity of someone with hearing loss (AHRC, 2016).

The literature review found that early intervention could improve employment outcomes for participants through improving language skills of children. This is also supported in the First Voice survey of school leavers which showed that 77% of survey respondents (119) had been in regular paid employment for a period of greater than 6 months (First Voice, 2016c). By comparison, the 2015 Survey of Disability, Ageing and Carers reported the labour participation rate for those with a disability aged 15 to 64 years was 53% (ABS, 2016c).

It was assumed that the First Voice early intervention program would improve employment outcomes of children with hearing loss due to their improved ability to communicate. To quantify the improvement in employment outcomes of First Voice participants, the difference between the First Voice graduates' employment rate

First Voice graduates were more likely to be in regular paid employment (77%) than the disabled or health impaired population (53%).⁶

(77%) and the disabled or health impaired population regular employment rate (53%) was used. The difference between the First Voice employment rate and the labour force participation rate for people with a disability was approximately 24%. It was assumed that half of this difference was attributed to the First Voice intervention. This reflects that it may be too optimistic to attribute all of this effect to the First Voice intervention given there may be confounding factors. Factors such as the age of detection of hearing loss and age of implantation have been found to impact children's outcomes (Centre for Allied Health Evidence, 2007).

Assuming that the First Voice intervention increases income by 12% each year, the initial increase in income was estimated to be \$855 in the first year. This was projected for years 18 to 75⁷ and was applied to the First Voice cohort who did not have an additional learning disability. Those that had an additional learning disability were assumed not to have an increase in income. The average per year increase in income was calculated to be **\$5,097 per child per year.⁸ This converts to a lifetime benefit with a NPV of \$57,894 in 2015 dollars over the 50 year modelling horizon.**

5. This is the average increase in income over years 18 to 50 inclusive.

6. The 95% confidence interval for First Voice graduates is (70.4% and 83.6%) and the 95% confidence interval for the disabled or health impaired population is (52.6%, 53.4%).

7. For the base case these benefits were forecasted to 50 years, the 75 year timeframe is used in the sensitivity testing.

8. This is the average for years 18 to 50 inclusive.

2.2.3 Avoided school costs

Children with hearing impairment may receive additional support in school to aid them in their learning environment. Access Economics (2006) noted there are no national data on the cost of school education for deaf and hearing impaired students. This is due in part to state/territory funding and coordination of education which has resulted in an inconsistent approach to educating children with hearing impairment (Department for Education and Child Development, 2016).

The previous cost-benefit analysis reported that the 'extra' education costs for children with hearing loss were \$5,603 per child per year in 2005, which was based on Access Economics (2006). Inflating using consumer price index (CPI) inflation rates (ABS 2016a) resulted in a 2015 cost of \$7,271 per year for each child that did not have an additional learning disability. It was assumed that all children in the First Voice cohort who did not have an additional disability would no longer require additional schooling support as a result of the First Voice intervention. Therefore, avoided school costs averaged out over the entire population of First Voice children was calculated to be \$6,421 per child per year. This benefit stream was projected from years 6 to up to year 18 when the individual is assumed to start work. **This converts to a lifetime benefit with a NPV of \$60,676 in 2015 dollars.**

2.2.4 Wellbeing

'Loss of wellbeing' methodology has been adopted to quantify the impact of hearing loss on quality of life, and improved quality of life arising from the First Voice intervention. This methodology is used to calculate non-financial costs and instead assesses reduced health and premature mortality in terms of **disability adjusted life years (DALYs)**. The DALY approach has been adopted and applied in Australia

by the Australian Institute of Health and Welfare (AIHW) (e.g. Mathers et al, 1999). DALYs have two components – premature mortality, measured in years of life lost due to premature death (YLL), and morbidity, measured in years of healthy life lost due to disability (YLD) where:



YLDs are calculated using disability weights, where the disability weight of a health condition reflects a relative health state. A weight of 0 represents a perfect year of health and a weight of 1 represents death. For example, the disability weight for mild hearing loss is 0.01, which represents losing 1% of a year of healthy life due to hearing impairment. Disability weights are applied to the population who has the condition to estimate YLDs.

It was assumed that there were no premature deaths due to hearing impairment. This results in the value of YLLs being 0 and the DALY calculation only relying on YLDs.

The loss of wellbeing as measured in DALYs can be converted into a dollar figure using an estimate of the **value of a statistical life year (VSLY)**. The Department of Prime Minister and Cabinet (2014) estimated the value of the VSLY to be \$182,000 in 2014. This was inflated to 2015 dollars using CPI (ABS, 2016a) resulting in the **value of the VSLY in 2015 dollars to be \$183,833.**

To calculate the wellbeing benefits attributed to the First Voice intervention, disability weights from the most recent AIHW (2016) publication on the burden of disease in Australia were obtained. To estimate the YLDs for the comparison group, the disability weights for hearing loss by severity (shown in Table 2.3) were applied to the First Voice program participants.

Table 2.3: Disability weight for hearing loss by severity

Severity	Disability weight
Normal (unilateral hearing loss)	0.000
Mild	0.010
Moderate	0.027
Severe	0.158
Profound	0.204

Source: AIHW (2016).

Information on First Voice participants and the severity of their hearing loss is shown in **Table 1.1**. Information on First Voice participants had an additional level of severity; moderately severe. The children who fell into this category were evenly split into moderate and severe.

To calculate the benefit attributed to an increase in wellbeing due to the early intervention, it was assumed that the First Voice intervention would improve wellbeing such that the disability weight for each severity would be reduced by one step. For example, those children with moderate hearing loss would no longer have a disability weight of 0.027, instead they would have a disability weight of 0.010, the mild hearing loss disability weight.

The difference between the comparison group YLDs and the intervention YLDs was then calculated and used to obtain an estimate of improved wellbeing for the First Voice cohort. Improved wellbeing was calculated to be **\$8,402 per child per year** and to be a benefit received by participants every year. However, this benefit was only partly received in the first year due to the assumption that the child does not start the early intervention program immediately after birth, instead this figure was multiplied by 0.71 in the first year to reflect First Voice data showing that children spend on average 4.71 years

in early intervention. **This converts to a lifetime benefit with a NPV of \$220,236 in 2015 dollars over the 50 year modelling horizon.**

2.2.5 Avoided deadweight losses

Transfer payments (government payments and taxes) are not a net cost to society, as they represent a shift of consumption power from one group of individuals to another. If the act of taxation did not create distortions and inefficiencies in the economy, then transfers could be made without a net cost to society. However, these distortions do impose an efficiency loss on the economy.

In a practical sense, this distortion reveals itself as a loss of efficiency in the economy, which means that raising \$100 of revenue requires consumers and producers to give up more than \$100 of value. In order to calculate the size of this additional inefficiency which is needed to raise the \$100 of tax revenue, Deloitte Access

Economics' standard methodology is to apply rates used by the Productivity Commission in its study of distortions in the pharmaceutical industry (Productivity Commission, 2003). These rates are \$0.275 per \$1 of tax revenue raised, plus \$0.0125 per \$1 of tax revenue raised for Australian Taxation Office administration, i.e. 28.75% of the value of the transfers in total.

The final benefit accrued from the First Voice intervention is the increase in participants' taxable income from the perspective of the government and the avoided school costs to government. The avoided deadweight loss refers to the additional income that the First Voice participants gain through increased educational attainment and through improved employment. In addition, the government will no longer need to pay school support costs for graduates of the First Voice early intervention program who do not have an additional learning disability. The benefit from avoided

deadweight losses was calculated to be on average, **\$1,571 per child per year.⁹ This converts to a lifetime benefit with a NPV of \$22,815 in 2015 dollars over the 50 year modelling horizon.**

2.2.6 Other benefits not included in this study

There are other benefits attributed to the First Voice early intervention program which have not been quantified in this report. Some other benefits include:

- Benefits to carers over the long term – both financial benefits as well as improved wellbeing due to knowing their child also has improved wellbeing
- Savings for employers
- Lower support costs in the voluntary sector.

These benefits were not quantified primarily because of insufficient data or proxies that could be used to quantify them.



9. This is the average over years 6 to 50 inclusive.

2.3 Costs

This section provides a methodological overview for the cost side of the cost-benefit analysis. Costs primarily relate to the estimated financial cost of the First Voice intervention and draw on program cost data provided by First Voice stakeholders. In addition to these costs there are other indirect costs that are attributed to the First Voice intervention.

The costs analysed are incurred while the child is in the program, the program takes children from birth until the child goes to compulsory schooling (typically age 5). According to First Voice stakeholders the average time spent in the early intervention program is 4.71 years. As a result, costs were calculated on a per year basis and assumed to be incurred for years 1 to 5; however, to take into account that children might not go immediately into early intervention after being born, the first year of costs was multiplied by 0.71. This then aligns with the First Voice data that the average time spent in the early intervention program was 4.71 years.

2.3.1 Operational costs and rent

Operational costs and rent for the early intervention program were provided by The Shepherd Centre and validated by the Cora Barclay Centre. According to The Shepherd Centre, the average cost per child of the early intervention program was \$18,000 per year. This cost includes the income of staff who run the service, fuel costs when therapists travel to the home of an intervention participant, materials used in the intervention and rent. Total operational costs and rent costs were \$18,000 per child per year. **This converts to a lifetime cost with a NPV of \$79,688 in 2015 dollars.**

2.3.2 Productivity losses

According to First Voice representatives it is likely that one or both parents alter their work arrangements after their child is identified as hearing impaired and enrolls in the First Voice early intervention program. It was assumed that compared to the comparison group, the mother in a family that has a child enrolled in a First Voice program will stop paid employment.

To calculate productivity losses the labour force participation rate of a mother that has a child with a hearing impairment must first be estimated. No figures were found that estimated the labour force participation rate of a mother that has a child with hearing impairment; instead, the labour force participation rate of a mother of a child that has a disability was used. A study by Zhu (2016) estimated that the employment gap between a mother with a child who has a disability and a mother who has a child with no disability 24 months after giving birth was between 14% and 17%. ABS (2015a) data suggest that the labour force participation rate of a mother with a child aged 0 to 4 years is 61% and the employment rate (for those in the labour force) of a mother with children aged 0 to 4 years is 96%.

Multiplying the labour force participation rate by the employment rate of those participating, then subtracting 14% implies that the proportion of mothers of a child with a disability who are working was 44% before commencing First Voice. By multiplying the females average yearly wage (ABS, 2016b) by the working rate (44%) the productivity loss was estimated to be **\$21,129 per child per year. This converts to a lifetime cost with a NPV of \$93,542 in 2015 dollars.**

2.3.3 Transport costs

Transport costs come from two sources; the cost of fuel that is used when travelling to and from First Voice appointments and an opportunity cost for the parent who takes their child to the appointments. This section discusses the methodology behind calculating these costs.

2.3.3.1 Fuel costs

There are transport and possibly accommodation costs for parents attending First Voice appointments. Travel costs were based on the median distance travelled by families to the Cora Barclay Centre appointments. Of the families partaking in the Centre's early intervention program, a median distance of 33 kilometres return was travelled. Applying the Australian Taxation Office's 66 cents per km (2015-16) and that the family makes 20 trips to the First Voice centre per year, it was estimated that fuels costs were **\$436 per child per year. This converts to a lifetime cost with a NPV of \$1,928 in 2015 dollars.**

Accommodation costs have not been considered owing to the increasing use of video conferencing facilities. For example, approximately 15% of The Shepherd Centre appointments are conducted by video link (The Shepherd Centre, 2016). This is also common for Hear and Say families in Queensland. It was assumed this technology enables regional families to participate in the First Voice early intervention program from their home.



2.3.3.2 Reduction of leisure time

Travelling to First Voice centres means that parents must forfeit time that could have been spent on undertaking leisure activities which represents a cost to the parent. As identified, early intervention participants go to the First Voice centre on average 20 times per annum and an appointment runs for about an hour. It was assumed the time cost component for the parent was 2 hours in total, which includes the travel and appointment time.

AWE for females was taken from the ABS (2016b) and multiplied by 33% (Cadilhac et al, 2009)¹⁰, this provided an estimate for the cost of leisure time. The AWE was broken down to an hourly rate and multiplied by the number of visits to the First Voice centre and the average time spent travelling and at the appointment. The cost of leisure time was calculated to be **\$301 per child per year. This converts to a lifetime cost with a NPV of \$1,335 in 2015 dollars.**

2.3.4 Childcare for siblings

For some children attending First Voice program appointments who have siblings, it is likely that some of these children will require care while the First Voice participant attends a session at the First Voice centre. First Voice stakeholders estimated that about 20% of families attending the early intervention program bring siblings. The ABS (2011a) estimates that of all couples with children, approximately 21% had more than 3 children. This is similar to the estimates provided by First Voice.

It is likely that the majority of families with more than three children would need to arrange care for pre-school aged siblings.

It was assumed that the child would have to spend approximately 3 hours in child care, this takes into account the travel time to and from the centre, the appointment time and extra time spent travelling to and from the child care centre. The cost of childcare varies considerably according to location and the type of care offered. According to ABS (2015b) in 2014 the mean cost of formal childcare was \$6.87 per hour per child. This figure was inflated using CPI (ABS, 2016a) then multiplied by the length of care required (3 hours) and number of siblings (2). It was found that childcare costs were **\$181 per child per year. This converts to a lifetime cost with a NPV of \$802 in 2015 dollars.**

It is noted that some care for siblings would be provided by other family members and would not impose a financial cost on families. While informal carers are not paid for providing this care, informal care is not free in an economic sense. Time spent caring involves forfeiting time that could have been spent on paid work or undertaking leisure activities. As such, informal care can be valued as the opportunity cost associated with the loss of economic resources (labour) and the loss in leisure time valued by the carer.

2.3.5 Deadweight losses

Deadweight losses attributed to the First Voice program come from two sources; government payments to First Voice centres for the early intervention program and forgone taxation due to reduced employment from the parent who is no longer in the labour force.

Government funding received by First Voice centres was taken from the financial statements of each centre. These figures

were then multiplied by 28.75% to estimate the distortion in economy as a result of the government funding. Total deadweight losses from government funding were **\$7,853 per child per year. This converts to a lifetime cost with a NPV of \$34,766 in 2015 dollars.**

The deadweight loss attributed to the loss of taxable income from the parent dropping out of the labour force was calculated by multiplying the lost income by the average personal income tax rate and the indirect tax rate. The average personal income tax rate (22.80%) was calculated using Deloitte Access Economics modelling as well as the average indirect tax rate (13.00%). This was then multiplied by 28.75% to give a cost of **\$790 per child per year. This converts to a lifetime cost with a NPV of \$3,496 in 2015 dollars.**

2.3.6 Other costs not included in this study

There are a variety of other costs attributed to the First Voice early intervention program that were not included in this analysis. Costs such as additional psychotherapeutic intervention, complications with aids or implants, upgrading of aids or implants and follow up costs were not included in this analysis as they were deemed to not be directly attributed to the early intervention program.

10. Leisure time is valued differently from time spent at work. Academic literature commonly uses the AWE multiplied by one third to represent the value of leisure time.

3 Results

This section presents the results of the cost-benefit analysis. Overall, the First Voice service is estimated to provide substantial benefits relative to the costs of providing the intervention.

3.1 Base case

The total benefit per child in 2015 dollars was calculated to be \$464,711. The biggest benefit stream was the increase in participant's wellbeing (\$220,236), followed by the increase in income due to an increase in educational attainment and improved employment (\$160,985). The benefits of the First Voice service are summarised in Table 3.1.

The total cost per child in 2015 dollars of the First Voice intervention program was \$215,556. The biggest cost stream attributed to the First Voice intervention was productivity losses from the parent leaving the workforce (\$93,542), followed by the operational costs and rent that the First Voice centre incurs (\$79,688). The costs of the First Voice program are summarised in Table 3.2.

A comparison of the costs and benefits yields a BCR of 2.2. The BCR calculation is shown in Table 3.3.

In total, the net benefit per child from First Voice early intervention programs was \$249,155, and the BCR was estimated to be 2.2. This means that on average, every dollar invested in the intervention returns \$2.20 in benefits, which includes wellbeing and economic gains as well as financial benefits.

Table 3.1: Summary of lifetime benefits per child, 2015

Benefit stream	NPV (2015 dollars)	Annual stream* (2015 dollars)
Wellbeing	220,236	8,402
Improved employment	57,894	5,097
Higher level of educational attainment	103,091	9,076
Avoided school costs	60,676	6,421
Avoided deadweight losses	22,815	1,571
Total	464,711	30,567

Source: Deloitte Access Economics calculations.

* These benefits are in terms of per child per year and are a simple average over the period that the participant begins to receive the benefit to a maximum of 50 years, apart from avoided school costs which occur in years 6 to 18.

Table 3.2: Summary of lifetime costs per child, 2015

Cost stream	NPV (2015 dollars)	Annual stream* (2015 dollars)
Operational costs and rent	79,688	18,000
Productivity losses	93,542	21,129
Transport costs	3,263	737
Childcare for siblings	802	181
Deadweight losses	38,262	8,643
Total	215,556	48,690

Source: Deloitte Access Economics calculations.

*These costs are in terms of per child per year. They were assumed to be incurred for years 1 to 5 inclusive with the first year multiplied by 0.71 to reflect that a child will not enter an early intervention program immediately after birth.

Table 3.3: Benefits, costs and BCR, 2015

Costs	\$215,556
Benefits	\$464,711
Net benefit	\$249,155
BCR	2.2

Source: Deloitte Access Economics calculations.

3.2 Sensitivity testing

NPV calculations are sensitive to both changes in the timeframe and the discount rate. This section provides the results of testing performed on changes to these parameters. The benefit streams are expected to occur a number of years after the cost streams which occur in the first 5 years. As a result, the benefit streams will be more sensitive to changes in the discount rate and the timeframe.

3.2.1 Discount rate

Chart 3.1 presents the results when the discount rate is changed from the base case of 3% to 0% and 6%. As was expected, the NPV benefit per child was highly sensitive to changes in the discount

rates. Under the 0% discount rate the NPV benefit per child in 2015 dollars was \$1.0 million while under the 6% discount rate it was reduced to \$258,881, the difference between the two was \$753,492. The NPV cost per child had significantly less variation. Under the 0% discount rate the NPV cost per child in 2015 dollars was \$229,331, while under the 6% discount rate it was \$203,287, the difference between the two was \$26,044. The BCR under the 0% discount rate was 4.4, while under the 6% discount rate the BCR was 1.3.

3.2.2 Timeframe

Chart 3.2 presents results from changing the timeframe from 50 years to 25 years and 75 years. Due to all costs being

incurred in years 1 to 5 there were no changes to the total NPV cost per child when the timeframe was changed. The NPV benefit per child was highly sensitive to changes in the timeframe and when costs and benefits were assessed over a period of 25 years, the total NPV benefits in 2015 dollars per child were estimated to be approximately \$55,745 more than the total NPV cost per child (\$269,302 total benefit compared to \$215,556 total cost). This is due to two benefit streams – the improved employment stream and the educational attainment stream – only being realised for a few years. The BCR under the 25 year timeframe was 1.3, while under the 75 year timeframe it was 3.5.

Chart 3.1: Sensitivity testing: discount rate

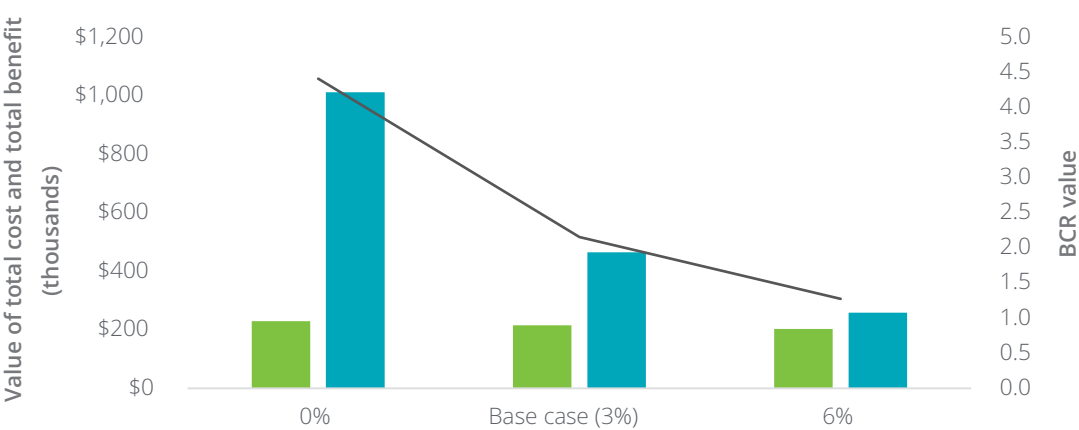
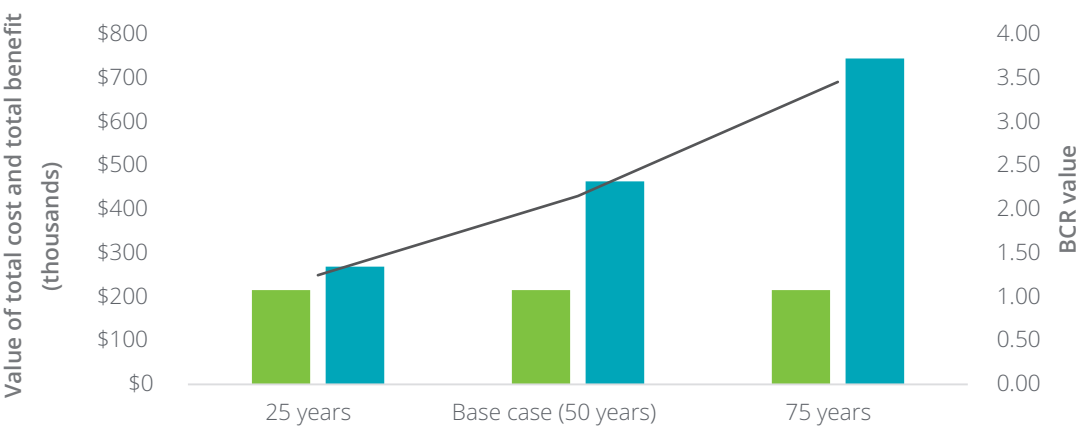


Chart 3.2: Sensitivity testing: timeframe



Source: Deloitte Access Economics calculations.



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