Cost-Benefit Analysis of Providing Early Intervention to Children with Autism

Estimation of the net economic benefit of early intervention for a cohort of children with autism

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Executive summary

Autism is a lifelong neurobiological disorder characterised by impairments in social communication, social-relating and stereotypical behaviours and interests. It has a major impact on quality of life, with the majority of adults with autism unable to live independently or participate in the workforce. It is widely recognised that early intervention is critical to improving outcomes for individuals with autism, with studies demonstrating improvements in key child outcome variables such as educational and cognitive skills, as well as adaptive behaviour and autism symptomology.

Cost-benefit analysis plays an important role in policy development and the efficient allocation of resources across programs. The key role of cost-benefit analysis in relation to early intervention is to optimise the allocation of government funding by identifying those programs shown to yield the greatest net economic benefit to society.

This paper presents the framework that has been developed by Synergies Economic Consulting (Synergies) to estimate the net economic benefit of early intervention for a cohort of children with autism. The approach that has been adopted is as follows:

- recognising the spectrum nature of this disorder, the cohort comprises three groups that have been developed in collaboration with AEIOU and the Autism Research Advisory Group (RAG).[1] These groups have been selected to be representative of the population of children with autism that have the potential to benefit from early intervention; and

- the cost-benefit framework developed by Synergies has been applied to estimate the net economic benefit of early intervention for each of the above groups under a base case scenario of lifetime outcomes. Sensitivity analysis was also conducted by specifying a more conservative set of outcomes for each group. The outcomes adopted under these scenarios have been advised by the RAG.

This cost-benefit framework estimates the economic benefit of early intervention focusing on five key areas – education, employment, living independence, healthcare, and quality of life.[2] A conservative approach has been adopted in applying the cost-benefit framework so that the benefits of early intervention are more likely to be understated rather than overstated. Examples of this conservative approach include

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[1] RAG is a scientific collaboration between Autism Early Intervention Outcomes Unit (AEIOU) and individuals from external agencies who have expertise and interest in undertaking research in autism. The representatives of the RAG that provided input into this analysis were Associate Professors James Scott and Honey Heussler. Data on the cost of early intervention was also sourced from AEIOU.

[2] As there are currently no studies that have assessed the impact of early intervention on healthcare outcomes for individuals with autism, no potential benefits have been ascribed to this category under any of the scenarios.

the limited timeframes over which benefits are measured (i.e. employment and quality of life) and the use of the minimum as opposed to the average wage when assessing employment benefits.

The three groups that have been designed, in collaboration with AEIOU and the RAG, to capture the population of children with autism are as follows:

- group 1 – children with severe intellectual impairment – likely to be non-verbal and suffer from significant behavioural issues and anxieties (estimated to account for approximately 20% of the children that would receive early intervention);

- group 2 – children with mild to moderate intellectual impairment – likely to experience difficulties with language and communication, particularly in social settings (estimated to account for approximately 60% of the children that would receive early intervention); and

- group 3 – children with High Functioning Autism – while not suffering from intellectual disabilities, individuals in this group can experience difficulties in other areas that can adversely impact long-term outcomes in key areas (estimated to account for approximately 20% of the children that would receive early intervention).

The cost-benefit framework was applied to the above groups and proportions to estimate the total net economic benefit of early intervention. Percentage estimates were applied to the outcomes under each key area (both with and without early intervention) to recognise that early intervention will not achieve (or be responsible for) positive outcomes for all members of the cohort. The percentages were determined by the RAG. These outcomes and percentages are summarised in the table below.

Outcomes and percentages for base case

Key area outcomes	Group #1		Group #2		Group #3	
	Without EI	With EI	Without EI	With EI	Without EI	With EI
Education						
FT special ed.	n/a[1]	n/a	80%	40%	10%	5%
Mainstream school w/ support	n/a	n/a	20%	60%	70%	30%
Mainstream school w/o support	n/a	n/a	0%	0%	20%	65%
Employment						
FT employ. at min. wage	n/a	n/a	5%	10%	20%	60%
PT employ. at min wage	n/a	n/a	20%	60%	50%	35%

Key area outcomes	Group #1		Group #2		Group #3	
	Without EI	With EI	Without EI	With EI	Without EI	With EI
Unemployed	n/a	n/a	75%	30%	30%	5%
Living independence						
FT care	80%	40%	30%	10%	0%	0%
Shared accom.	20%	60%	65%	65%	30%	10%
Independent/supervised living	n/a	n/a	5%	25%	30%	20%
Independent	n/a	n/a	0%	0%	40%	70%

Note: 'n/a' means the outcome is assumed to be not applicable to a child in this group.
Source: Proportions provided by the RAG.

The application of the cost-benefit framework to these outcomes and percentages resulted in average per person total lifetime benefit estimates of:

- $1.3 million for group #1

- $1.2 million for group #2

- $0.75 million for group #3.

Information on the proportion of individuals accounted for by each group, ABS data on the number of live births in Australia per annum, and autism prevalence data was applied to these estimates to determine the total economic benefit for a cohort of children with autism.

The following table summarises the number of children categorised under each group and the total economic benefit attributable to each group.

Total economic benefit of early intervention for a cohort of children with autism

	Average benefit per child	No. Children	Total economic benefit
Group #1	$1,296,929	237 (20%)	$307,500,000
Group #2	$1,202,474	711 (60%)	$855,200,000
Group #3	$747,175	237 (20%)	$177,100,000
Total	-	**1,185**	**$1,339,800,000**

Source: Synergies modelling.

Subtracting the total cost of providing early intervention to the cohort, which is estimated at $118.5 million ($100,000 multiplied by 1,185 children), results in a total net economic benefit estimate of $1,221.3 million, with a Benefit Cost Ratio (BCR) of 11.3.

Given the significant degree of uncertainty that exists in relation to the long-term impacts of early intervention, sensitivity analysis was conducted on these results. The application of more conservative percentages to the outcomes under early intervention produced a net benefit estimate of $365.7 million for the cohort and a BCR of 4.1. While

these values are significantly lower than the estimates under the base case (70% reduction for the net benefit estimate and 64% for the BCR), this analysis shows that even when applying more conservative improvement percentages, early intervention still results in a significant net economic benefit and a very strong BCR.

The key conclusions to be drawn from the estimated benefits of early intervention for a cohort of children with autism are as follows:

• the avoided carer costs were the most significant benefit from early intervention and are a key driver of the overall result, particularly for the more severely affected children. This is driven by the reduced intensity of long term care requirements and subsequently lower carer costs as a result of early intervention; and

• sensitivity analysis demonstrates that even when very conservative improvement percentages are adopted, the results of the analysis are still very strong and show a significant societal benefit resulting from the provision of early intervention.

While the outcomes of this modelling present strong evidence on the societal benefits achievable through the provision of early intervention to children with autism, the application of this framework to determine an accurate estimate for the population-wide benefit of early intervention is currently constrained by the absence of a robust evidence base on the long-term benefits of early intervention. Research that focuses on building this evidence base will assist in the more robust application of the framework.

The outcomes of this modelling show the significant societal benefits potentially achievable through the provision of early intervention to children with autism. However, this analysis is intended to provide a starting point. The outcomes assumed in this analysis have been postulated based on current available evidence and best practice early intervention strategies. The key issue is how early intervention actually alters the lifetime trajectory for a child with autism, from when they enter school all the way through their adult life. The evidence of this is currently limited. It is therefore imperative to continue to develop robust frameworks for evaluating long term benefits and building this evidence base. As this evidence base builds, more reliable estimates, particularly of the benefits of early intervention for children with autism, will be able to be obtained.

Contents

Figures and Tables

1   Introduction

The purpose of this paper is to apply the cost-benefit framework developed by Synergies Economic Consulting (Synergies) for assessing the economic impact of early intervention for children with developmental disabilities to a cohort of children with autism. In addition to providing an overview of the framework and the approach taken in applying it, the paper presents and discusses the results of the analysis.

The approach that has been adopted is as follows:

- recognising the spectrum nature of this disorder, the cohort comprises three groups that have been developed in collaboration with AEIOU and the Autism Research Advisory Group (RAG).[3] These groups are considered to be representative of the population of children with autism that have the potential to benefit from early intervention based on the current evidence base; and

- the cost-benefit framework developed by Synergies has been applied to estimate the net economic benefit of early intervention for each of the above groups under a base case scenario of lifetime outcomes. Sensitivity analysis was also conducted by specifying a more conservative set of outcomes for each group. The outcomes adopted under these scenarios have been advised by the RAG.

The three groups to which the framework has been applied are designed to be indicative of:

- the characteristics generally exhibited by children with autism that would potentially benefit from early intervention based on current evidence; and

- the outcomes that can be achieved for children in each group as a result of early intervention, based on scientific evidence and the experience of the RAG.

The estimation of the total net benefit of early intervention for a cohort of children with autism required the application of the following:

- proportions to each of the groups, to account for the breakdown of children with autism that would potentially benefit from early intervention;

- percentages to each of the outcomes, both with and without early intervention, to account for the probability of success of early intervention for children in each group; and

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[3]   RAG is a scientific collaboration between Autism Early Intervention Outcomes Unit (AEIOU) and individuals from external agencies who have expertise and interest in undertaking research in autism. The representatives of the RAG that provided input into this analysis were Associate Professors James Scott and Honey Heussler. Data on the cost of early intervention was also sourced from AEIOU.

- data on the number of births in Australia per annum and the prevalence rate of autism in order to determine an estimate for the total net benefit.

The proportions and percentages were provided by AEIOU and the RAG based on the best available evidence.

In addition to presenting the results of this analysis, this paper also includes an overview of the scientific base that is currently available on the benefits of early intervention for children with autism.

The rest of this report is structured as follows:

- section 2 includes background information on autism and early intervention and the role of cost-benefit analysis;

- section 3 sets out the methodology adopted in applying the cost-benefit framework to estimate the net economic benefit of early intervention for a cohort of children with autism;

- section 4 describes the process of modelling the benefits of early intervention for the cohort and presents the results; and

- section 5 presents a summary of the key outcomes from the modelling.

The report also includes two attachments:

- a table providing a detailed overview of the approach followed in estimating the individual benefits of early intervention; and

- the results of modelling performed to demonstrate the aspirational benefits of early intervention for children with autism (that is, stronger improvements than the assumptions made in the base case) under various scenarios.

2 Background

2.1 Autism and early intervention

Autism is a neurobiological disorder characterised by impairments in social communication, social-relating, and stereotypical behaviours and interests (APA, 2000). Recent epidemiological reports indicate the number of children diagnosed with Autistic Disorder and Autism Spectrum Disorders (ASDs) in general is rising and it has been estimated that ASD affects approximately 1 in 160 children in Australia aged between six and 12 years.[4] More recent international data suggests rates may be as high as 1 in 100.[5] This makes ASD more common than visual impairments, hearing impairments, cerebral palsy and leukaemia combined.

Autism is a lifelong disorder, having a major impact on quality of life, with the majority of adults with autism unable to live independently or participate in the workforce (e.g. Howlin, 2003). It is widely recognised that early intervention is critical to improving outcomes for individuals with autism and over the past three decades, significant data has emerged suggesting that programs beginning in the toddler years have the potential to affect key outcomes for children with autism.[6]

Although no medical or drug therapy has been shown to improve the core symptoms of autism, early intervention based on educational and behavioural models has demonstrated efficacy in improving key child outcome variables.[7] Such research has led to the development of best practice guidelines for ASD interventions in Australia.[8]

The long-term outcomes including education, employment, mental health and social ability are poor with few adults able to live independently or participate in the workforce.[9] Lifetime costs of caring for individuals with autism are consequently high, estimated in the United States at US$3.2 million per person.[10] Synergies has previously

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[4]   MacDermott, S., Williams, K., Ridley, G., Glasson, E. & Wray, J. (2007). The prevalence of autism in Australia. Can it be established from existing data? Report for the Australian Advisory Board on Autism Spectrum Disorders.

[5]   Paynter, J., Scott, J., Beamish, W., Duhig, M. & Heussler, H. (2012). A Pilot Study of the Effects of an Australian Centre-Based Early Intervention Program for Children with Autism. The Open Pediatric Medicine Journal, 6, p 7-14.

[6]   Prior, M. & Roberts, J. (2006). Early Intervention for Children with Autism Spectrum Disorders: Guidelines for Best Practice.

[7]   Eikeseth, S. (2008). Outcome of comprehensive psycho-educational interventions for young children with autism, Res Dev Disalb.

[8]   Prior & Roberts (2006).

[9]   Levy, A. & Perry, A. (2011). Outcomes in adolescents and adults with autism: A review of the literature. Research in Autism Spectrum Disorders, 5(4), pp 1271-1282.

[10]   Ganz, M.L. (2007). The Lifetime Distribution of the Incremental Societal Costs of Autism, Archives of Pediatrics & Adolescent Medicine, 161(4), pp 343-349.

undertaken a study to estimate the economic cost of ASD in Australia. This study was first conducted in 2007 and was then updated in April 2011. This updated study produced a mid-point cost estimate of $9.7 billion per annum (in December 2010 dollars).[11] This report is summarised in the box below.

Box 1   Estimating the economic cost of ASD in Australia

The purpose of this report was to produce an updated estimate of the annual economic cost of ASD in Australia, including the burden of disease. The methodology employed in undertaking this study is similar to the methodologies employed in 'cost of illness' studies. Overall, a conservative approach was taken to the analysis, which meant that the probability that the costs are understated is higher than the probability that they are overstated. This meant that where reasonable data could not be sourced to estimate a particular cost, it was not included in the estimates.

The costs that were included in the study are as follows:

•   Direct costs – healthcare, social services and education

•   Other tangible costs – employment and informal care

•   Intangible impacts – quality of life (typically referred to in other studies as the 'burden of disease').

The total direct and indirect costs (excluding burden of disease) were estimated at between $4.2 billion (low prevalence) and $7.3 billion (high prevalence) per annum, with a mid-point of $5.8 billion. The estimated cost of reduced quality of life is an additional $3.9 billion. All cost estimates are in December 2010 dollars.

Overall, this suggests annual total costs, including burden of disease, of between $8.1 billion (low prevalence) and $11.2 billion (high prevalence), with a mid-point of $9.7 billion. This equates to an average annual cost of approximately $87,000 per person with ASD.

This shows that the most significant cost component is the burden of disease. Employment is the next most significant cost category, followed by the costs of informal care. Direct costs, being healthcare, social services and education, comprise around 12% of the total costs.

A number of costs were not included in this study due to a lack of data. These include the cost of other conditions on the autism spectrum, such as PDD-NOS, the cost of alternative therapies and early intervention programs, the cost associated with comorbid conditions, other costs of unemployment and the costs of underemployment, the cost of additional living support services, and the costs of family breakdown.

Data source: Synergies Economic Consulting (2011). Economic Costs of Autism Spectrum Disorders in Australia – Updated Study.

In addition, autism not only affects children, but also families and the wider community. For example, parents of children with autism experience higher rates of stress than parents of typically developing children, or those with other disabilities.[12] Thus, due to both the nature of the impairment arising from autism, as well as the

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[11]   Synergies Economic Consulting (2011). Economic Costs of Autism Spectrum Disorder in Australia – Updated Study.

[12]   See Pisula, E. (2007). A Comparative Study of Stress Profiles in Mothers of Children with Autism and those of Children with Down's Syndrome. Journal of Applied Research in Intellectual Disabilities, 20(3), pp 274-278; and Schieve, L.A., Blumberg, S.J., Rice, C., Visser, S.N. & Boyle, C. (2007). The Relationship Between Autism and Parenting Stress. Pediatrics, 119 (Supp 1), pp S114-S121.

significant social and economic costs, early intervention for autism has been internationally recognised as a health priority.[13]

2.2 Best practice early intervention

As autism is a heterogeneous syndrome, no one intervention is suitable for all children. The Best Practice early interventions have been extensively reviewed by Prior and Roberts (2006). There are a wide variety of interventions that have been proposed as suitable for providing early intervention for children with autism. Prior and Roberts reported that there is a lack of evidence supporting many of these interventions. However, they concluded that there were some key elements that were essential to any effective early intervention programme:

• autism-specific curriculum content focusing on attention, compliance, imitation, language, and social skills;

• highly supportive teaching environments which deal with the need for predictability and routine, and with challenging behaviour, obsessions, and ritual behaviours;

• support for children in their transition from the preschool classroom; and

• support for family members including partnership with professionals involved in treatments.

They also concluded that:[14]

> **…no one program will suit all children with autism and their families.** There are benefits from early, intensive, family-based treatment programs, so long as these are adapted to the child's pattern of strengths and weaknesses and take account of family circumstances. [emphasis added]

The table below outlines the types of early intervention strategies applied for children with autism.

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[13] Charman, T. & Howlin, P. (2003). Research into early intervention for children with autism and related disorders: Methodological and design issues. Autism, 7(2), pp 217-225;

[14] Prior & Roberts (2006).

Table 1   Overview of types of EI for children with autism

Type of early intervention	Description	Examples
Behavioural	• Focus on application of learning theory and skill development • Use of Applied Behaviour Analysis (ABA)	Early Intensive Behavioural Interventions such as the Lovaas Program
Developmental	• Focus on building relationships and development of social emotional capacities	Relationship Development Intervention (RDI)
Therapy-based	• Focus on communication and social development or sensory motor development • Usually designed for use with other interventions	Picture Exchange Communication System (PECS), Auditory Integration Training (AIT)
Family-based	• Focus on working with families to develop skills in working with their children	The Hanen Program
Combined	• Incorporate behavioural and developmental strategies – often include sensory issues • Focus on working with and managing the characteristics of autism	Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH)
Other	• Other types of early intervention	Music Intervention Therapy

2.3   Evidence of benefits of early intervention

Educationally-based autism-specific early intervention programs typically do not subscribe to a single program, philosophy, or theoretical approach, but instead aim to be comprehensive and offer a range of teaching strategies such as Picture Exchange Communication Systems,[15] activities drawn from the Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH)[16] and positive behaviour support.[17] Examples of programs which have received attention are special nursery placement,[18] autism-specific nursery,[19] eclectic autism-specific preschools,[20] eclectic-developmental autism-specific preschools[21] and autism-specific primary

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[15]   Frost, L.A. & Bondy, A.S. (1994). The Picture Exchange Communication System Training Manual. Cherry Hill, NJ: PECs, Inc.

[16]   Schopler, E.A. (1994). A statewide program for the treatment and education of autistic and related communication handicapped children (TEACCH). Psychoses and Pervasive Developmental Disorders, 3, pp 91-103.

[17]   Horner, R.H. (2000). Positive behaviour supports. Focus on Autism and Other Developmental Disabilities, 15, pp 97-105.

[18]   Reed, P., Osborne, L.A. & Corness, M. (2007). The real-world effectiveness of early teaching interventions for children with autism spectrum disorder. Exceptional Children, 73, 417(17); and Reed, P., Osborne, L.A. & Corness, M. (2010). Effectiveness of special nursery provision for children with autism spectrum disorders. Autism, 14, pp 67-82.

[19]   Magiati, I., Charman, T. & Howlin, P. (2007). A two-year prospective follow-up study of community-based early intensive behavioural intervention and specialist nursery provision for children with autism spectrum disorders. Journal of Child Psychology and Psychiatry, 48, pp 803-12.

[20]   Zachor, D.A., Ben-Itzchak, E. (2010). Treatment approach, autism severity and intervention outcomes in young children. Research in Autism Spectrum Disorders, 4, pp 425-32.

[21]   Zachor, D.A., Ben-Itzchak, E., Rabinovich, A-L,. & Lahat, E. (2007). Change in autism core symptoms with intervention. Research in Autism Spectrum Disorders, 1, pp 304-17.

schools or units for children under six years.[22] These programs share in common an autism-specific focus, structuring their teaching in nursery, preschool, or kindergarten classrooms, and incorporate elements of educational programs such as circle time, individual education plans and a positive approach to challenging behaviour. These programs tend to be delivered by multidisciplinary teams in which teachers coordinate classroom activities and intervention is actively supported by speech pathologists, psychologists and/or occupational therapists.

Key outcomes investigated across studies have included educational and cognitive skills, as well as adaptive behaviour and autism symptomotology (see Table 2).[23] This body of research has found some evidence of gains over time for children in terms of educational and cognitive skills, adaptive behaviour and autism symptoms. These outcome studies suggest that intervention of this kind may lead to improvements in these areas. However, there is clearly a need for further research into specific programs.

Table 2   Outcomes of previous studies of autism-specific early learning programs

Domain	Measure[a]	Studies	Results (pre/post within groups comparison)
Educational skills	PEP-R	Reed et al Reed et al	• Significant improvement for "special nursery placement" on gross motor, cognitive and verbal subscales • Significant improvement for "Autism-specific special nursery" on the overall PEP-R score
Cognitive skills	BAS-II	Reed et al	• Significant improvement for "special nursery placement" on picture matching, naming and early number skills subscales
	MSEL	Zacor & Ben-Itzchak	• Significant raw scores gains across all four domains for an "eclectic-developmental" autism-specific preschool program • Gains were significant in standard scores on receptive language only
Adaptive behaviour	VABS-Screener	Charman et al	• Significant changes over time on the VABS Screener on domain age-equivalent scores but no significant difference in the overall adaptive behaviour composite score
	VABS	Reed et al	• Children attending an "Autism-specific special nursery" school significantly improved on composite score
		Magiati et al	• Significant increases in mean age-equivalent scores on the VABS for "Autism-specific special nursery" group

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[22] Charman, T., Howlin, P., Berry, B. & Prince, E. (2004). Measuring Developmental Progress of Children with Autism Spectrum Disorder on School Entry Using Parent Report. Autism, 8, pp 89-100.

[23] Paynter, J., Scott, J., Duhig, M., Beamish, W. & Heussler, H. (Under Review). A Pilot Study of the Effects of an Australian Centre-Based Early Intervention Program for Children with Autism. The Open Pediatrics Medicine Journal.

Domain	Measure[a]	Studies	Results (pre/post within groups comparison)
		Zachor & Ben-Itzchak	• Significant gains in each of the four raw domain scores of adaptive behaviour
			• Significant communication and socialisation adaptive behaviour subscale standard scores
			• Significant decrease of motor skills standard scores
Autism symptoms	ADOS	Zachor et al	• Significant gains on the social interaction domain score for the "eclectic-developmental" intervention group
	SCQ	Charman et al	• No significant changes over time for the measure of autism symptoms on the Social Communication Questionnaire

a PEP-R: Psychoeducational profile – revised; BAS-II: British Abilities Scale-II; MSEL: Mullen Scales of Early Learning; VABS: Vineland Adaptive Behaviour Scale; ADOS: Autism Diagnostic Observation Scale; SCQ: Social Communication Questionnaire.

Source: Paynter, J., Scott, J., Duhig, M., Beamish, W. & Heussler, H. (2012). A Pilot Study of the Effects of an Australian Centre-Based Early Intervention Program for Children with Autism. The Open Pediatrics Medicine Journal, 6, pp 7-14.

It is important to recognise that the current evidence base on the benefits of early intervention for children with autism is limited to the short-term impacts of early intervention. There is currently no evidence on the longer term impacts of early intervention on key life outcomes for these individuals. This paper uses the current evidence base to hypothesise lifetime outcomes, both with and without early intervention, to enable Synergies' cost-benefit framework to be applied to estimate the net economic impact of providing best practice early intervention to a cohort of children with autism.

2.4   Role of cost-benefit analysis

Economic evaluation tools such as cost-benefit analysis play an important role in policy development and the efficient allocation of resources across programs. The key role of cost-benefit analysis in relation to early intervention (and the disability sector more generally) is to maximise the efficiency of government funding by identifying those programs and early intervention therapies that can be shown to yield the greatest net economic benefit to society (i.e. the benefits to society outweigh the costs associated with delivering the early intervention program to the maximum extent across the various options).

There are significant practical challenges associated with conducting cost-benefit analysis in the social policy context, particularly in relation to early intervention. The most significant of these are as follows:

• impacts are inherently difficult to quantify (e.g. improvements in quality of life);

- considerable discretion must be exercised when assessing and quantifying potential impacts; and

- analysis must be conducted over a long time horizon in order to take into account the full economic benefits from early intervention.

In addition to these issues, conducting a cost-benefit analysis on early intervention for children with autism poses an additional challenge due to the spectrum nature of the disorder and the individual differences in terms of each child's response to early intervention. These characteristics result in significant variability of the overall outcomes as a result of early intervention across the population and complicate the task of quantifying the benefits from early intervention. Whilst these challenges must be acknowledged, it is important to note that their impact will relate to the precision of the benefit estimates that are produced and not to the validity of the framework that has been developed or the existence of the benefits themselves.

One of the key requirements for conducting a robust cost-benefit analysis on early intervention for children with autism is evidence on the lifetime outcomes achieved by individuals with autism that received early intervention compared to a control group that did not receive early intervention. This evidence is not currently available.

The Productivity Commission's (PC) Final Report on Disability Care and Support recommends the building of an evidence base for early intervention strategies, as well as undertaking economic analysis such as cost-benefit analysis. The PC did however, recognise the issues in developing a robust evidence base for early intervention, in particular, the challenges in conducting longitudinal studies for children who have received early intervention that track outcomes into adult life.[24] It is important to note that there are practical difficulties associated with isolating the incremental impacts of early intervention over long time horizons. This is one of the fundamental challenges of conducting cost-benefit studies on early intervention.

Given the lack of robust long-term evidence on the impact of early intervention, it is only possible at this point to set out the framework for undertaking a cost-benefit analysis and to apply conservative assumptions regarding the outcomes that can be achieved from early intervention and the percentage of individuals who will achieve these outcomes, in order to produce a conservative estimate of the net economic impact of early intervention. The greater the quality of the scientific evidence that can be obtained on the long-term impacts of early intervention, the more robust the outcomes of the application of this cost-benefit framework.

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[24] Productivity Commission (2011). Inquiry Report: Disability Care and Support, Volume 1, p 84.

The approach taken in developing the cost-benefit framework is described in the following section.

3   Methodology

A two-step approach was followed to estimate the net impact of providing early intervention to a cohort of children with autism:

- development of a cost-benefit framework to be applied to the provision of early intervention to children with developmental disabilities; and

- application of this framework to a cohort of children with autism (in addition to outcomes and percentages based on the scientific evidence base).

3.1   Framework for cost-benefit analysis of early intervention

Establishing a framework for undertaking a cost-benefit analysis of early intervention for children with autism enables a comparison of the benefits and costs, to produce an estimate of the net benefit to society resulting from early intervention. For an early intervention program to be regarded as a positive investment in Net Present Value (NPV) terms, the estimated benefits must exceed the costs. The results of cost-benefit analyses are typically reported in terms of their Benefit Cost Ratio (BCR). If the BCR exceeds one, this indicates that the investment will yield a net economic benefit to society.

The benefits of early intervention are identified as reduced or avoided costs associated with autism and increased economic output resulting from the improvement in productivity of the individual (and potentially caregivers). The starting point for estimating these benefits is therefore the lifetime trajectory for a person with autism who does not receive any early intervention. In designing this cost-benefit framework, the focus has been on how early intervention could potentially alter outcomes for individuals with autism in five key areas, based on the evidence that is currently available:

- education

- employment

- living independence

- healthcare

- quality of life.

There is also considerable evidence suggesting that caring for a child with autism has a significant impact on the family. There is currently no accepted methodology available for estimating these costs and consequently a conservative approach has been adopted

and they have not been included in this study. However, it is considered reasonable to assume that early intervention has the potential to generate significant and positive benefits for families.

Under the framework, the potential benefits of early intervention in relation to each of these key areas are assessed under the base case for individuals with autism (i.e. no early intervention) and the current evidence on the impacts of early intervention. The framework has been designed as an incremental analysis, meaning that it is restricted to those benefits and costs that are directly attributable to early intervention.

3.2   Applying the framework to a cohort of children

The spectrum nature of autism was a fundamental consideration in applying the framework for measuring the benefits of early intervention, with the cohort of children being categorised into three groups. These groups, which were defined with input from AEIOU and the RAG, have been designed so as to capture the different characteristics of the population of a cohort of children with autism that could potentially benefit from early intervention. It is also important to acknowledge that the impact of early intervention varies greatly across individuals and that the desired outcomes will not be achieved in all children relevant to the identified groups.[25]

While the lack of a robust long-term evidence base makes it difficult to apply the cost-benefit framework to produce an accurate estimate of the overall net benefit of early intervention, it is possible to postulate outcomes based on the current available evidence to produce an estimate of the likely benefits of early intervention for a cohort of children with autism. This is the approach that has been followed in this paper, with conservative improvements in outcomes applied to a cohort of children with autism (based on the groups and proportions advised by AEIOU and the RAG) and Synergies' cost-benefit framework applied to estimate the total net economic benefit.

A consistent approach was adopted to assess the potential benefits of early intervention for children with autism across each of the five key areas:

- assessment of the base case (i.e. no early intervention), based on information provided by AEIOU and the RAG;

- conclusions were made with regard to the potential impact of early intervention on children in each group, based on input from AEIOU and the RAG; and

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[25]   Furthermore, while the desired outcomes may be achieved for some children, this cannot be attributed to the impact of early intervention in every case.

- identification and application of the method to be used to derive an estimate of the potential benefit (e.g. avoided expenditure on special education).

The measurement timeframes that have been used to determine the benefits are conservative. For example, the economic benefit associated with an individual gaining employment has been estimated based on the minimum wage, as opposed to the average wage. Quality of life benefits have been measured over 40 years of adult life.

The benefits have been measured over these limited timeframes so that benefits are more likely to be understated rather than overstated. A table has been included in Appendix 5A which details the approach followed in estimating the potential benefits of early intervention for each of the key areas. The approach is summarised in the flow diagram below.

Figure 1   Approach followed in applying the cost-benefit framework to an autism cohort
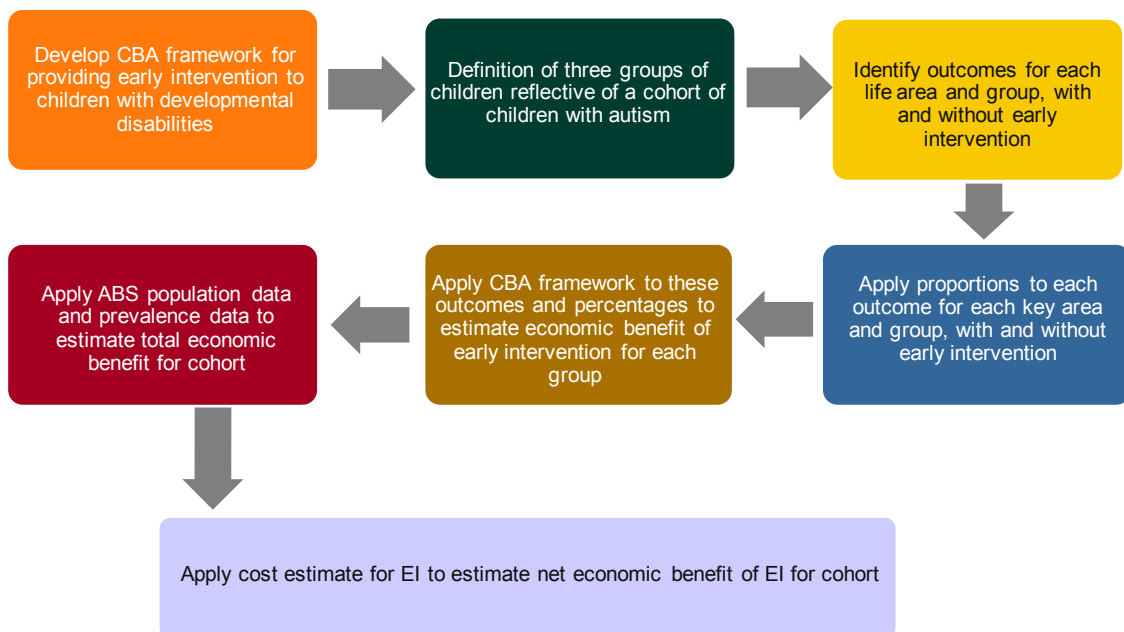
The following section sets out the characteristics of the three groups that make up the cohort of children with autism in addition to detailing the process followed in estimating the net economic impact of early intervention.

4 Estimating population-wide benefits

The evidence presented in Table 2 demonstrates that best practice early intervention has the potential to achieve significant improvements in terms of educational and cognitive skills, adaptive behaviour and autism symptoms. While it is acknowledged that there is an important gap in the evidence in terms of how these improvements are likely to translate to improved lifetime outcomes, it is considered that the existing evidence base is of sufficient quality to enable improvements in certain key life areas resulting from early intervention to be hypothesised. By applying probabilities of success to these outcomes it is possible to estimate the net economic benefit of early intervention for a cohort of children with autism.

Three groups of children have been defined based on input received from AEIOU and the RAG. Benefit estimates and BCRs can then be calculated for these groups to provide an estimate of the potential benefits of early intervention for the entire cohort. A conservative approach has been taken in estimating the total net economic benefit of early intervention.

Based on the current scientific evidence, the RAG has attributed percentages to outcomes for the key life areas under each of the three groups, both with and without early intervention. The following sections include tables with these percentages in addition to the calculation of the economic benefit of early intervention (on an average per child basis).

Groups within cohort of children with autism

Group #1

This group accounts for those children with severe cognitive impairments. Individuals in this group are likely to be non-verbal and suffer from significant behavioural issues and anxieties. They are also unlikely to be able to self-care (i.e. unable to perform tasks such as showering, dressing, toileting, and food preparation without assistance).

Some of the common characteristics of children in this group include:

- impaired communication (often non-verbal)

- significant behavioural outbursts

- significant sensory limitations.

Without early intervention, the outcomes for individuals in this group are very poor, with significant supported living and supervision requirements (i.e. an individual in

this group is likely to require individual housing with 1-2 carers at all times for safety reasons and full-time supervision). These children require significant support from special education services, have very limited employment opportunities and have a very poor quality of life.

AEIOU and the RAG have estimated that this group accounts for approximately 20% of the children with autism that would benefit from early intervention.[26]

The following table sets out the outcomes and percentages to be used to estimate the economic benefit of early intervention for individuals in this group.

Table 3 Outcomes and percentages with and without early intervention in group #1

Key area outcomes	Probability	
	Without early intervention	With early intervention
Education		
No change	NA	NA
Employment		
No change	NA	NA
Living independence		
Full-time care in a dedicated facility (2-3 carers per person)	80%	40%
Shared accommodation (2-3 people per carer)	20%	60%

Source: Proportions provided by the RAG.

As can be seen in Table 3, the only key area in which there is an improvement in the outcomes for severely impaired individuals with autism is in relation to living independence. Based on advice provided by the RAG, it is a reasonable expectation that the proportion of individuals in this group that require intensive full-time care from multiple carers into adulthood would fall from 80% to 40% as a result of early intervention. Instead of requiring full-time intensive care, outcomes for these individuals will be improved to the extent that they are able to live in shared accommodation. The cost impacts of early intervention for this group are therefore:

* a fall in the cost of providing intensive full-time care as 40% less individuals (across the population in this group) will require this level of care after early intervention; and

* a rise in the cost of shared accommodation, as the aforementioned 40% of individuals will now require access to shared accommodation services.

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[26] Early intervention is considered appropriate for a child where the characteristics of that child are such that the available scientific evidence indicates that the child receiving intensive early intervention treatment is likely to produce a net economic benefit.

The Present Value (PV) of the lifetime cost of intensive full-time care (2.5 full-time carers per person) in a dedicated accommodation facility is estimated at approximately $3.25 million (discount rate of 3% over a 40 year period). A 40% reduction in the number of individuals in this group requiring this level of care therefore results in an average avoided cost of approximately $1.3 million per person (in PV terms).

The PV of the lifetime cost of shared accommodation is approximately $842,500. A 40% increase in the number of individuals in this group requiring access to shared accommodation services results in an additional cost of approximately $337,000 per person (in PV terms).

Therefore, the PV of the avoided cost associated with the reduction in care requirements for individuals in this group is equal to $963,000 per person ($1.3 million less $337,000). Added to this is an estimate of the benefit associated with an improvement in the quality of life for these individuals. A conservative approach has been taken in estimating this impact, with a reduction of 0.05 applied to the autism disability weighting (for each group). Given this conservative approach, it is considered appropriate to apply this benefit uniformly across the entire population (i.e. no percentages applied). This results in a cost reduction of approximately $334,000 per person (in PV terms).

The result for group #1 is an average per person benefit of $1,296,929 in PV terms.

Group #2

Individuals in this group suffer from mild to moderate intellectual impairment and experience difficulties with language and communication, particularly in social settings. There is significant variance in the functioning of children in this group, subject to cognitive levels and behavioural symptoms. Children in this group are likely to suffer from comorbidities such as fine motor or tone problems and are unlikely to cope in mainstream schooling without support.

Some of the common characteristics of children in this group include:

- frustration and anxiety associated with communication difficulties
- self-esteem and ongoing behavioural difficulties
- poor educational outcomes and disillusionment with school.

The outcomes for individuals in this group range from full-time supportive care with close supervision to being able to live in supported care with limited supervision and work in a level of employment suited to their interests.

AEIOU and the RAG have estimated that this group accounts for approximately 60% of the children with autism that would benefit from early intervention.

The following table sets out the outcomes and percentages to be used to estimate the economic benefit of early intervention for individuals in this group.

Table 4   Outcomes and percentages with and without early intervention in group #2

Key area outcomes	Probability	
	Without early intervention	**With early intervention**
Education		
Full-time special education	80%	40%
Mainstream schooling with support	20%	60%
Employment		
Full-time employment at the minimum wage	5%	10%
Part-time employment at the minimum wage	20%	60%
Unemployed	75%	30%
Living independence		
Full-time care in a dedicated facility (2-3 carers per person)	30%	10%
Shared accommodation (2-3 people per carer)	65%	65%
Independent/supervised living	5%	25%

Source: Proportions provided by the RAG.

Individuals in group #2 have the potential to achieve improvements in all three key areas (in addition to quality of life). These improvements are shown in the following diagram.

Figure 2 Improvements from early intervention for group #2
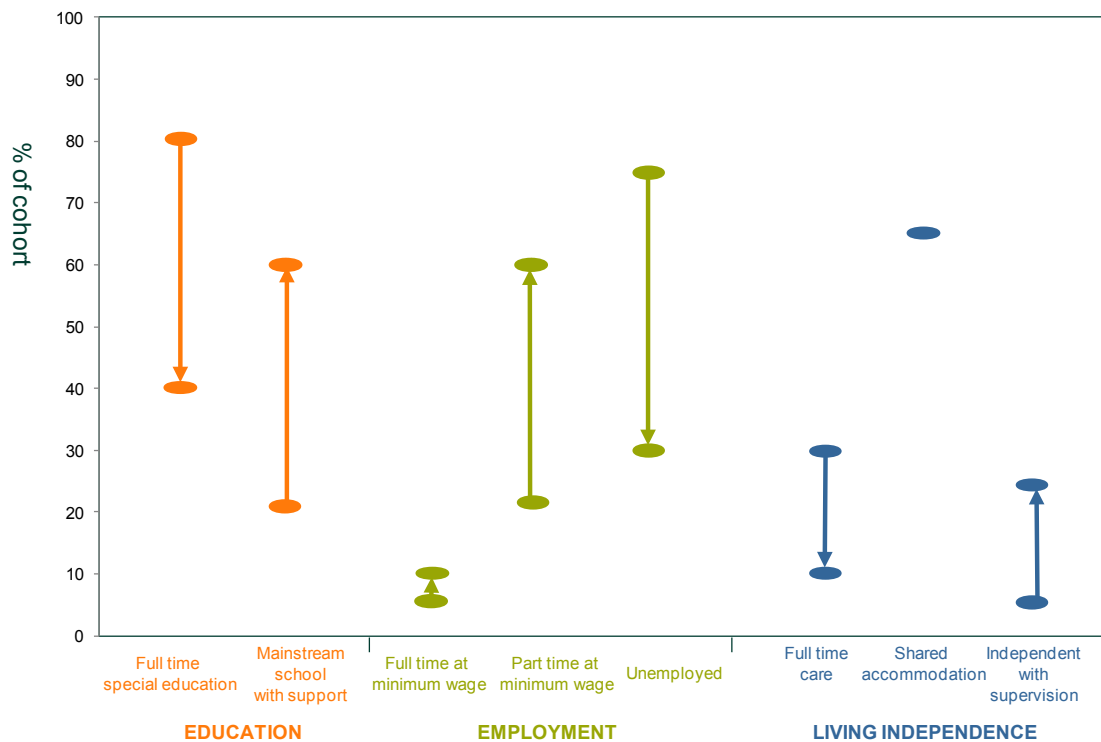
The cost savings that are achieved as a result of the improvements resulting from early intervention are summarised in the following table (on an average per child basis).

**Table 5 Outcomes from early intervention and cost implications for group #2**

Key area outcomes	Cost (PV terms)	% change from early intervention	Avoided cost from early intervention
Education			
Full-time special education	$152,968	40% decrease	$61,187
Mainstream schooling with support	$76,484	40% increase	-$30,594
Employment[a]			
Part-time at the minimum wage	$411,545	40% increase	$164,618
Full-time at the minimum wage	$658,454	5% increase	$32,923
Living independence			
Full-time care in a dedicated facility	$3,249,937	20% decrease	$649,987
Independent living with limited supervision	$48,079	20% increase	-$9,616
Quality of life			
0.05 reduction to disability weight	NA	0.05 reduction for all	$333,968
Total avoided cost from early intervention			**$1,202,474**

Source: Proportions provided by the RAG.

a The 'cost' of the employment outcomes is foregone productivity had the person been able to be employed part-time at the minimum wage. It is assumed that the person's contribution to productivity equates to their wage rate.

The above table shows that early intervention results in an estimated benefit of approximately $1.2 million (in PV terms) when averaged over all individuals in group #2. The largest cost saving for this group relates to carer costs, due to the 20% reduction in the number of individuals requiring intensive full-time care from multiple carers (accounting for over 50% of the total avoided cost). The following graph presents a breakdown of the dollar benefits of early intervention for this group across the four key areas.

Figure 3   Breakdown of benefits of early intervention for group #2
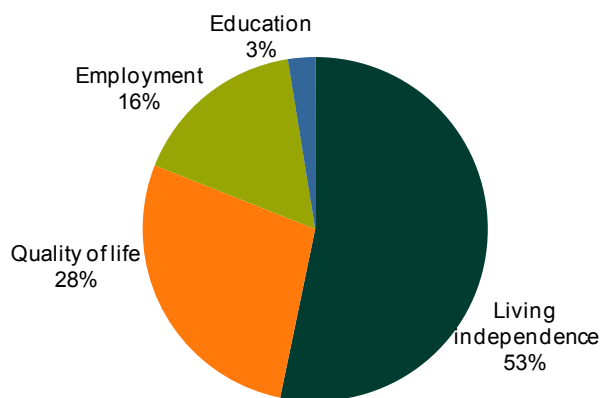
Data source: Synergies modelling.

It is important to note that the estimate for the total avoided cost in this group is conservative, given the conservative percentage improvements that have been applied to the key outcome areas and also the conservative outcomes upon which the avoided cost estimates are based (this includes the benefit estimated for the improvement in quality of life, for which only a 0.05 reduction was applied to the disability weighting for autism).

Group #3

While the children in this group do not suffer from intellectual disabilities, they do experience difficulties in other areas (behavioural, communication and social) that can adversely impact their long-term outcomes with respect to education, employment, living independence and quality of life. Individuals with HFA typically have difficulty communicating social responses and emotions and often have obsessions or rigidities that hinder their learning and development and cause significant anxiety. However, individuals with HFA are also likely to have specific strengths that are well above average in certain areas.

Some of the common characteristics of children in this group include:

- communication difficulties, particularly in social settings

- significant sensory needs

- difficulties adapting to expectations in educational settings

- anxiety issues.

The outcomes for individuals in this group range from being functional members of the community who contribute to the workforce to those that are socially isolated, struggle to live independently and suffer from long-term unemployment. As with outcomes, the quality of life for individuals in this group also varies significantly.

AEIOU and the RAG have estimated that this group accounts for approximately 20% of the children with autism that would benefit from early intervention.

The following table sets out the outcomes and percentages to be used to estimate the economic benefit of early intervention for individuals in this group.

Table 6   Outcomes and percentages with and without early intervention in group #3

Key area outcomes	Probability	
	Without early intervention	With early intervention
Education		
Full-time special education	10%	5%
Mainstream schooling with support	70%	30%
Mainstream schooling without support	20%	65%
Employment		
Full-time employment at the minimum wage	20%	60%
Part-time employment at the minimum wage	50%	35%
Unemployed	30%	5%
Living independence		
Shared accommodation (2-3 people per carer)	30%	10%
Independent/supervised living	30%	20%
Independent	40%	70%

Source: Proportions provided by the RAG.

Individuals in group #3 also have the potential to achieve improvements in all three key areas (in addition to quality of life). These improvements are shown in the following diagram.

Figure 4   Improvements from early intervention for group #3
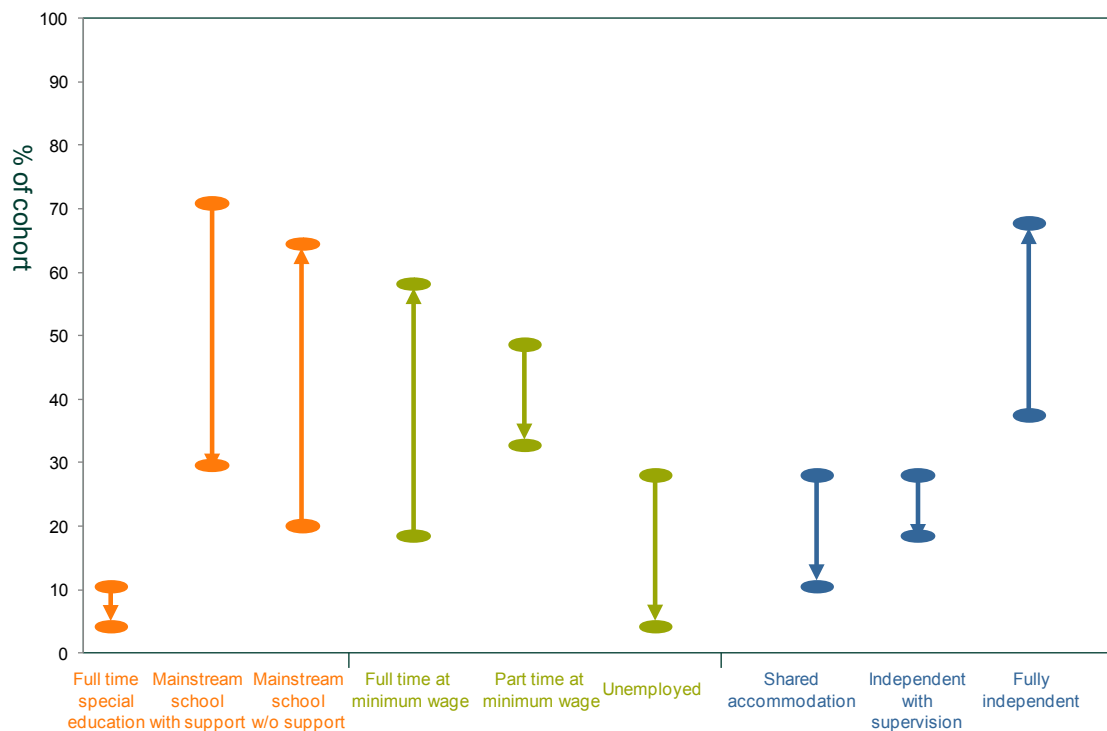
The cost savings that are achieved as a result of the improvements resulting from early intervention for group #3 are summarised in the following table (on an average per child basis).

Table 7   Outcomes from early intervention and cost implications for group #3

| Key area outcomes	Cost (PV terms)	% change from early intervention	Avoided cost from early intervention
Education			
Full-time special education	$152,968	5% decrease	$7,648
Mainstream schooling with support	$76,484	40% decrease	$30,594
Employment[a]			
Part-time at the minimum wage	$411,545	15% decrease	-$61,732
Full-time at the minimum wage	$658,454	40% increase	$263,382
Living independence			
Shared accommodation	$842,533	20% decrease	$168,507
Independent living with limited supervision	$48,079	10% decrease	$4,808
Quality of life			
0.05 reduction to disability weight	NA	NA	$333,968
Total avoided cost from early intervention			**$747,175**

Source: Proportions provided by the RAG.

a The 'cost' of the employment outcomes is foregone productivity had the person been able to be employed part-time at the minimum wage. It is assumed that the person's contribution to productivity equates to their wage rate.

As shown in the above table, early intervention results in an estimated benefit of approximately $0.75 million (in PV terms) when averaged over all individuals in group #3. Unlike for groups #1 and #2, the most prominent benefit of early intervention for individuals with HFA (aside from improved quality of life) is the increased ability to gain full-time employment.

Improved outcomes in relation to living independence, which accounted for the majority of the avoided costs in groups #1 and #2, accounted for a smaller proportion of the total avoided cost for this group. This is due to the individuals in this group having less costly care requirements without early intervention (relative to individuals with autism and severe or mild to moderate intellectual impairments). The following graph presents a breakdown of the dollar benefits of early intervention for group #3 across the four key areas.

Figure 5   Breakdown of benefits of early intervention for group #3
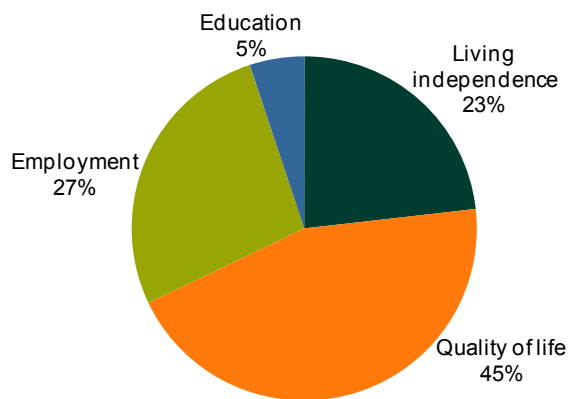
Data source: Synergies modelling.

Again, it is important to note the conservative nature of the benefit estimates reported in the table.

Estimating the net economic benefit of early intervention

The preceding sections detailed the process that was followed to determine the average economic benefit attributable to early intervention for an individual in each of the three groups (i.e. the economic benefit that is expected, on average, for an individual in each group). As previously noted, the improvements in outcomes applied to these groups, and therefore the resulting benefit estimates, represent conservative estimates.

Estimating the total economic benefit of early intervention for a cohort of children with autism requires an estimate for the number of children in each group. As previously stated, AEIOU and the RAG have advised that the population of children with autism

that have the potential to benefit from early intervention can be distributed across the groups based on the following proportions:

- 20% to group #1

- 60% to group #2

- 20% to group #3.

These proportions are to be applied to determine the number of individuals in each group. A prevalence rate of 39.3 per 10,000 live births has been used to determine the number of children born with autism each year. This is the estimated prevalence rate of childhood autism as reported in a 2011 Western Australian-based study titled 'A comparison of autism prevalence trends in Denmark and Western Australia'.[27]

The ABS reported that there were 301,617 live births in Australia in 2011.[28] Applying this total to the above prevalence rate produces an estimate of 1,185 children being born with autism each year. This estimate has been applied as the total population of a cohort of children with autism – in other words, the cohort can be seen to comprise all of the children born with autism in Australia in a particular year. Applying the proportions determined by AEIOU and the RAG to this total results in estimates of 237 children in groups #1 and #3 and 711 children in group #2.

The following table provides a summary of the estimates for the number of children in each group and the total economic benefit attributable to each group.

Table 8   Total economic benefit of early intervention for a cohort of children with autism

	Average benefit per child	No. Children	Total economic benefit
Group #1	$1,296,929	237 (20%)	$307,500,000
Group #2	$1,202,474	711 (60%)	$855,200,000
Group #3	$747,175	237 (20%)	$177,100,000
Total	-	**1,185**	**$1,339,800,000**

Source: Synergies modelling.

The table above shows that the estimate for the total economic benefit of early intervention for the cohort is estimated at $1,339.8 million.

To determine an estimate of the net economic benefit of early intervention, it is necessary to compare this estimate to the total cost of providing early intervention services to the cohort of children. AEIOU has advised that the annual cost of providing

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[27]   Parner, E.T., et al (2011). 'A comparison of autism prevalence trends in Denmark and Western Australia.' Journal of Autism and Developmental Disorders, 41(12), pp 1601-8.

[28]   ABS (2012). Births, Australia, 2011. Publication No. 3301.0.

early intervention services to a child with autism is approximately $50,000. As each child receives two years of early intervention treatment, the total cost per child is $100,000. Applying this figure to the estimate for the number of children in the cohort produces a total cost estimate of $118.54 million. This is then subtracted from the total economic benefit estimate to calculate the net economic benefit - $1,221.3 million. This translates to a BCR of 11.3.

Sensitivity analysis

As noted above, the percentages provided by the RAG to estimate the net economic benefit of early intervention for a cohort of children with autism are based on current scientific evidence and are considered conservative. However, given the significant degree of uncertainty that exists in relation to the long-term outcomes of early intervention for children with autism, it is important to conduct sensitivity analysis by adopting percentages that are even more conservative in terms of the improvements from early intervention.

The table below summarises the percentages that have been applied under this conservative scenario to estimate the net economic benefit of early intervention.

Table 9   Outcomes and percentages for sensitivity analysis

Key area outcomes	Group #1		Group #2		Group #3	
	Without EI	With EI	Without EI	With EI	Without EI	With EI
Education						
FT special ed.	n/a	n/a	80%	60%	10%	5%
Mainstream school w/ support	n/a	n/a	20%	40%	70%	55%
Mainstream school w/o support	n/a	n/a	0%	0%	20%	40%
Employment						
FT employ. at min. wage	n/a	n/a	5%	10%	20%	35%
PT employ. at min wage	n/a	n/a	20%	40%	50%	45%
Unemployed	n/a	n/a	75%	50%	30%	20%
Living independence						
FT care	80%	65%	30%	20%	-	-
Shared accom.	20%	35%	65%	60%	30%	20%
Independent/supervised living	0%	0%	5%	20%	30%	20%
Independent	0%	0%	0%	0%	40%	60%

Source: Proportions provided by the RAG.

More conservative inputs have also been applied for other modelling parameters:

- a discount rate of 5% as opposed to the standard social discount rate of 3% (the higher discount rate results in lower present values); and

- a reduction in the improvement in quality of life by 50% (i.e. effectively an average reduction in the disability weight of 0.025 as opposed to 0.05 per person).

The previously described framework was then applied to estimate the economic benefit of early intervention under this conservative scenario. The table below summarises the results of the sensitivity analysis and compares them to the base case.

Table 10 Total economic benefit of early intervention for a cohort of children with autism

	Total economic benefit (base case)	Reduction in benefits under conservative scenario	Total economic benefit (conservative scenario)
Group #1	$307,500,000	69.8%	$92,900,000
Group #2	$855,200,000	61.6%	$328,100,000
Group #3	$177,100,000	64.3%	$63,200,000
Total	**$1,339,800,000**	**63.9%**	**$484,200,000**

Source: Synergies modelling.

As is shown in the above table, the economic benefits estimated under the conservative scenario represent a significant reduction compared to the benefits estimated under the base case, both for each group and the entire cohort. The following graph presents a comparison of the total economic benefit for each group of individuals under the base and conservative scenarios.

Figure 6 Comparison of total economic benefits under the base and conservative scenarios
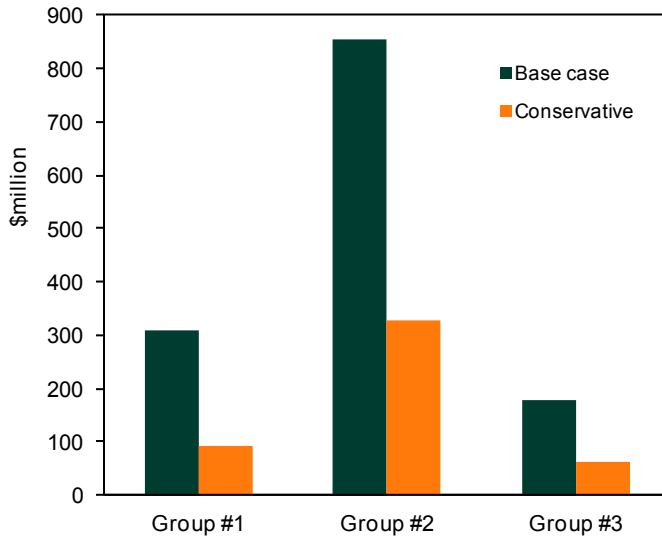
While the benefits estimated under each of the key areas were lower under the conservative scenario, the most significant reductions occur in the avoided carer costs. For example, for group #1, these savings fell by over 72%, from approximately $963,000 to $268,000 per person. For group #2, carer cost savings were approximately $640,000 per person under the base case, compared to only $246,500 under the conservative scenario (a reduction of over 61%).

Despite the significant reduction in the total economic benefits estimated under the conservative scenario, the comparison of these benefits to the cost of early intervention still produces a positive outcome, with the net economic benefit equal to $365.7 million for the cohort, with a BCR of 4.1. While these values are significantly lower than the estimates under the base case (69% and 63% respectively), this analysis shows that even when applying more conservative values, early intervention still results in a significant net economic benefit and a very strong BCR.

5   Summary

This paper presents the results of the application of a cost-benefit framework to estimate the net economic benefit of early intervention for a cohort of children with autism, which was separated into three groups considered to be representative of the population of children with autism that would benefit from early intervention. The RAG provided data on the percentage of individuals that would achieve improvements as a result of early intervention for each key life area for each group. The benefits estimated for each group were then applied to population and prevalence data to determine an estimate of the net economic benefit of early intervention for the cohort. Sensitivity analysis was performed on these results using more conservative percentages and parameters.

The results of this modelling demonstrate that the population-wide net economic benefit of providing early intervention to children with autism is significant. The total economic benefit estimate for a cohort of individuals with autism is estimated at $1,339.8 million, based on:

- the average per person benefit estimates modelled for each group

- ABS data on the number of births in Australia in 2011

- data on the prevalence of autism.

Comparing this estimate to the total cost of providing early intervention to this cohort ($118.5 million), results in a total net economic benefit of $1,221.3 million and a BCR of 11.3. The avoided carer costs were the most significant benefit from early intervention and are a key driver of this positive result.

Given the magnitude of these estimates and taking into account the significant degree of uncertainty associated with the long-term outcomes of early intervention, sensitivity analysis was performed on these results using even more conservative parameters (percentages indicating a lower level of improvement from early intervention and a discount rate of 5% as opposed to the social discount rate of 3%). This resulted in a 64% reduction in the estimate for the total economic benefit of early intervention ($484.2 million), resulting in a net economic benefit estimate of $365.7 million and a BCR of 4.1.

It is important to note that while these estimates are significantly lower than those calculated under the base case, the results under the conservative scenario are still very strong and show a significant societal benefit resulting from the provision of early intervention. This sensitivity analysis demonstrates that even applying conservative assumptions, early intervention produces a very significant net economic benefit for society.

Future research directions

The variability and uncertainty associated with the benefits of early intervention is a common theme in studies that have examined its efficacy for children with autism (noting that the horizon of these studies tends to be short term). Reducing this uncertainty and gaining a further understanding of this variability must be one of the key objectives of the next generation of early intervention research. This includes developing an understanding of which early intervention strategies work best for which children and under what circumstances.

Past research has focussed on substantiating the existence of the benefits of early intervention. As noted earlier in this document, the existence of these benefits is no longer in dispute and therefore this objective is no longer as crucial. It is however, important that research continues to focus on building a robust evidence base on the long-term benefits of early intervention, noting the challenges associated with this task and subsequently the need to set reasonable expectations.

This paper has presented a framework that can be used to conduct a cost-benefit analysis of early intervention for children with autism, in addition to applying this framework (using data and information provided by AEIOU and the RAG) to estimate the potential benefits of early intervention for children with autism. This analysis has involved using proportions and assumptions provided by the RAG based on current scientific evidence.

The outcomes of this modelling show the significant societal benefits potentially achievable through the provision of early intervention to children with autism. However, this analysis is intended to provide a starting point. The outcomes assumed in this analysis have been postulated based on current available evidence and best practice early intervention strategies. The key issue is how early intervention actually alters the lifetime trajectory for a child with autism, from when they enter school all the way through their adult life. The evidence of this is currently limited. It is therefore imperative to continue to develop robust frameworks for evaluating long term benefits and building this evidence base. As this evidence base builds, more reliable estimates, particularly of the benefits of early intervention for children with autism, will be able to be obtained.

A Estimating the benefits of early intervention under the Synergies framework

Overview of approach followed to estimate indicative benefits of early intervention

Key area	Base case	Impacts to be captured	Potential outcomes/scenarios	Potential benefits	Limitations of approach
Education	• Additional cost of providing education to students with disabilities estimated at $15,367[a] per student pa – based on difference between cost of standard education and cost of providing special education services to children with disabilities	• Reduced special education support required for children with autism as a result of EI • Not measuring impacts such as improved educational performance	• In the absence of EI, a child with autism would have needed to attend a special school and EI results in an improvement in outcomes to the point where the child can attend a mainstream school with or w/o support • In the absence of EI, a child with autism would have needed to attend a mainstream school with support and EI results in an improvement in outcomes to the point where the child can attend a mainstream school without support	• If entire cost is avoided over 12 years, total benefit in PV terms is estimated at $153,000 • Actual benefits are between $0 and $153,000 – rather than completely negating need for special education, EI may reduce the intensity of special education services required	• While it is considered reasonable to assume that successful outcomes achieved in an EI program will increase the likelihood that a child will be able to attend a mainstream school, it is recognised that cognitive functioning may not be the only determinant of whether the child will require special education services • There may be other benefits for the child of attending a mainstream school that have not been captured (e.g. improved social skills)
Employment	• Research indicates that individuals with autism have a very low chance of obtaining competitive employment	• Outcomes of EI may have positive impacts on levels of unemployment, underemployment and presenteeism (i.e. where a person with a disability is employed but has trouble being fully productive at work) • Impacts can be inferred from improved educational achievements and improvements in cognitive functioning. Social and communication skills also impact on employment outcomes	• An individual that would otherwise have been unemployed could obtain part/full-time employment at the minimum or average wage (as a result of EI) • An individual that would otherwise have been employed part-time could obtain full-time employment (as a result of EI) • An individual that would otherwise have been employed at the minimum wage could obtain employment at the average wage (as a result of EI)	• At minimum, if a person obtains competitive employment as a consequence of EI, this could increase economic productivity by $412,000 over their working lifetime (working life estimated at 35 years) • More optimistic assumption would be that the person obtains full-time employment at the average wage, which would result in a benefit estimate of $1.14 million	• While results on EI programs are positive in terms of the short-term impacts on cognitive functioning, there is currently no evidence that confirms that these benefits are maintained into adult life and actually translate to an improved chance of obtaining competitive employment • Under the approach used to estimate employment benefits associated with EI, the assumption has been adopted that the increase in productivity is equivalent to the increase in the individual's wage rate
Living independence	• Evidence indicates that in most cases individuals with autism do require informal or formal care (significant variation across the spectrum) • Cost incurred by a	• Improved capacity of individuals with autism to live independently (i.e. with reduced reliance on formal care services and informal carers) in their adult lives as a result of the positive outcomes of EI	• Reduction in the cost associated with formal services provided (accommodation support, community access and support, respite care) • Either small, moderate or significant reductions in informal care required (5, 15 and 30 hours per week respectively)	• Potential benefits of up to $1.55 million over a 40 year period as a result of avoided formal care services provided due to EI • Small reduction (5 hrs) in informal care requirements as a result of EI produces a	• The lack of long-term studies presents difficulties in terms of drawing conclusions with regards to the impact of EI on an individual's quality of life in adulthood

Key area	Base case	Impacts to be captured	Potential outcomes/scenarios	Potential benefits	Limitations of approach
	• consistent user of formal care services as high as $1.55 million[b]			benefit of $177,700 (based on a 35 year working life for the informal carer) • Significant reduction (30 hrs) in informal care requirements as a result of EI produces a benefit of up to $1,066 million	
Healthcare	• Incremental cost of healthcare services provided to individuals with autism estimated at $12,202 per annum[c]	• Reduced healthcare expenditure for children with disabilities	• No studies conducted to date have assessed the impact of EI of health outcomes – insufficient evidence base to hypothesise outcomes	• No potential benefits have been ascribed to this category	• Evidence is needed to enable a link to be established between EI and improved healthcare outcomes – availability of this evidence is extremely limited • There is also a high level of difficulty associated with identifying the costs that relate specifically to autism and those that relate to comorbid conditions such as epilepsy
Quality of life	• Disability weighting for autism is 0.55[d] – when applied to estimate of Value of a Life Year of $288,965, produces an estimated annual cost of $158,931 – represents base case cost of reduction in quality of life[e]	• Improved outcomes as a result of EI results in a reduction in Years of Life Lost due to a Disability (YLD) – the equivalent years of healthy life lost due to autism (measure of morbidity) • Modelled based on a reduction to the disability weighting	• Hypothetical scenarios of either conservative (0.02), median (0.05), or significant (0.1) reductions to the disability weighting	• Based on a 40-year period,, lifetime benefit from an improvement in quality of life as a result of EI could range from $367,400 to $1.102 million (depending on extent of reduction to disability weighting)	• Analysis limited to YLD – Years of Life Lost (YLL) not considered. It is difficult to incorporate the impact of a possible reduction in the risk of premature mortality when estimating indicative benefits on a per person basis. This would also require robust evidence linking EI with a reduced probability of premature mortality, which is not available • There is also a high degree of subjectivity in terms of establishing a value to be applied to a life year and also the disability weightings that are to be applied to estimate the quality of life impact under the base case • The reductions to these weightings as a result of EI are purely hypothetical and have not been derived from any assumed changes in specific factors that underpin the calculation of the disability weights

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a Queensland Government (2011). Service Delivery Statement (State Budget Paper 5), Department of Education and Training.

b Australian Institute of Health and Welfare (2011). Disability support services 2009-10. Report on services provided under the National Disability Agreement.

c Synergies (2011). Economic Costs of Autism Spectrum Disorder in Australia – Updated Study.

d Years of Life Lost due to a Disability (YLD) is measured based on disability weights. These weights range from 0 (which means living in a state of good or ideal health) to 1 (which is equivalent to death).The weighting is seen to proxy the impact of the disability on a person's quality of life.

e Mathers, C., Vos, T. & Stevenson, C. (1999). The Burden of Disease and Injury in Australia. Australian Institute of Health and Welfare.

Note: All benefit estimates were produced using a discount rate of 3%. The purpose of a discount rate is to determine the present value of benefits and costs which are to be incurred in the future, thereby allowing policy makers to compare cash flows across different time horizons. A discount rate of 3% is consistent with the rate used by the Australian Institute of Health and Welfare.

Source: Synergies (2012). The Economic Benefits of Early Intervention for Children with Disabilities. A Report for the Not for Profit Children's Lobby Group.

B   Aspirational benefits of early intervention

This attachment presents the results of a modelling exercise conducted to estimate the potential or aspirational benefits of early intervention for individual children with autism in each of the three groups. By 'aspirational', this means the benefits that practitioners would like to see and are considered feasible if all eligible children could access best practice early intervention services (or in other words, the optimistic case). These reflect a stronger level of improvement than the base case scenario.

Potential impacts of early intervention

Based on input provided by members of AEIOU and the RAG, the potential impacts of early intervention across the previously identified key areas for a child in each of the groups have been hypothesised.

Potential outcomes from early intervention

Group	Education	Employment	Living independence	Quality of life
#1	No expected benefit	No expected benefit	As opposed to requiring two to three full-time carers and dedicated residential facility, child is able to live in shared accommodation with one carer on a part-time basis (25 hrs/week)	Significant improvement in quality of life through improved behaviour and communication skills, increased functional abilities and reduction in aggressive behaviour
#2	As opposed to requiring full special education, the child is able to attend mainstream school with access to special education services	Able to obtain full-time employment at the minimum wage (as opposed to being unable to obtain employment without EI)	Reduction in informal care required by 15 hrs/week	Significant improvement in quality of life as a result of improved behaviour and communication skills, increased living independence and ability to obtain employment
#3	Child is able to attend mainstream school and no longer requires access to special education services	Able to obtain full-time employment at or above the minimum wage (as opposed to being unable to obtain employment without EI)	Individual is able to live independently, resulting in a reduction in the level of informal care required by 15 hrs/week	Significant improvement in quality of life as a result of alleviation of limitations associated with behavioural problems and communication skills and improved outcomes

It is important to note that these impacts are considered aspirational and have not been applied across the entire population of children under each of the groups.

Modelling the benefits of early intervention

Having established the outcomes from early intervention that are considered achievable for children in each of the groups, the next step is to apply the methodology set out in Synergies' report on the Benefits of Early Intervention to estimate the potential benefits attributable to early intervention for a child in each group. The

process for estimating the benefits for each group has been summarised in the table below. All lifetime benefit estimates have been generated based on a discount rate of 3%,[29] and BCRs have been estimated by dividing the total benefit estimate by the cost of providing early intervention services. A cost estimate of $100,000 has been used based on information provided by AEIOU (annual cost of $50,000 for the provision of early intervention services over a two-year period).[30]

It is important to note that the benefit estimates and BCRs that have been calculated in the table below relate to a child with autism that has the characteristics defined for each of the three groups. In relation to any application of these benefit estimates across the population of children with autism, it is important to note the following:

• the outcomes modelling would only be achieved for a proportion of the children in each group; and

• the base cases (i.e. outcomes achieved without early intervention) will vary for children in each group, with a proportion of children achieving the desired outcomes regardless of whether they are provided with access to best practice early intervention.

Estimates of the potential benefits of early intervention

Group	Education	Employment	Living independence	Quality of life	Total lifetime benefit
#1	• No expected benefit	• No expected benefit	• Annual cost of $140,600 under base case (without EI) ($125,000 for 2.5 full-time carers and $15,600 for accommodation) • EI reduces care requirements to one carer for 25 hours per week – annual cost of $31,250 • Accommodation cost reduced to $5,200 to account for ability to share accommodation • Total annual avoided cost of $104,150 – lifetime benefit of $2,407,404 (based on	• 0.05 reduction in disability weighting to account for improvement in quality of life – annual benefit of $14,448 • Translates to a lifetime benefit of $333,968 (based on 40yr adult lifetime)	• Total lifetime benefit of **$2,741,372** • Translates to a Benefit Cost Ratio of **27.4**

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[29] The purpose of a discount rate is to determine the present value of benefits and costs which are to be incurred in the future, thereby allowing policy makers to compare cash flows across different time horizons. A discount rate of 3% is consistent with the rate used by the Australian Institute of Health and Welfare.

[30] The cost estimate for the early intervention program has not been discounted. This is considered to be a conservative approach as discounting the second year of costs would result in a lower overall cost estimate. The majority of these costs (approx. 80%) are attributable to salaries for speech pathologists, occupational therapists, behavioural therapists , and other staff

Group	Education	Employment	Living independence	Quality of life	Total lifetime benefit
			40yr adult lifetime)		
#2	• Benefit of reduction in special education services required estimated by reducing cost of special education under the base case ($152,968) by 50% • Total benefit estimated at $76,484 in PV terms	• Ability to obtain full-time employment at the minimum wage translates to an annual benefit of $30,644 • Based on working life of 35yrs, equates to a lifetime benefit of $658,454	• Reduction in care costs by 15hrs/week results in an annual benefit of $27,750 • Translates to a lifetime benefit of $641,434 (assuming 40yr adult lifetime)	• 0.05 reduction in disability weighting to account for improvement in quality of life – annual benefit of $14,448 • Translates to a lifetime benefit of $333,968 (based on 40yr adult lifetime)	• Total lifetime benefit of **$1,710,340** • Translates to a Benefit Cost Ratio of **17.1**
#3	• Special education services no longer required – full cost of special education is avoided – total PV benefit of $152,968	• Ability to obtain full-time employment at the minimum wage translates to an annual benefit of $30,644 • Based on working life of 35yrs, equates to a lifetime benefit of $658,454	• Reduction in care costs by 15hrs/week results in an annual benefit of $27,750 • Translates to a lifetime benefit of $641,434 (assuming 40yr adult lifetime)	• 0.05 reduction in disability weighting to account for improvement in quality of life – annual benefit of $14,448 • Translates to a lifetime benefit of $333,968 (based on 40yr adult lifetime)	• Total lifetime benefit of **$1,786,824** • Translates to a Benefit Cost Ratio of **17.9**

Note: Benefit Cost Ratios have been calculated based on an estimate for the total cost of early intervention of $100,000. This cost estimate was provided by AEIOU. AEIOU also provided the carer cost estimate under group #1.

Source: Synergies modelling with cost estimates provided by AEIOU and the RAG.