REVEALING REALITY

frontier economics

THE VALUE OF A WHEELCHAIR

DECEMBER 2023

WWW.FRONTIER-ECONOMICS.COM

This research has been commissioned by the Wheelchair Alliance and funded by the Motability Foundation. The Motability Foundation fund, support, research and innovate so that all disabled people can make the journeys they choose.

Contents

frontier economics

frontier economics

1 Acknowledgements

We are grateful for input and expertise provided by a range of stakeholders throughout this project.

Errors and omissions remain the responsibility of the authors alone.[1]

[1] Frontier Economics, Revealing Reality

2 Executive summary

2.1 Background and methodology

Wheelchairs profoundly impact the quality of life of thousands of disabled adults, children and carers. Wheelchairs and associated seating are fundamental to access to education and work and safely facilitating independent living and social inclusion.

There is currently a lack of up-to-date mixed methods research which considers the value of an appropriate wheelchair to the wheelchair user and society more broadly. Previous work has provided a compelling articulation of unevenness of NHS wheelchair service provision and the negative consequences of poor provision. However, much of this evidence fails to meaningfully incorporate the voices of wheelchair users or is not based on granular quantitative analysis. This piece of work has addressed these gaps by: (1) examining the value of appropriate wheelchair provision holistically; and (2) adopting a mixed-methods approach, blending high quality quantitative analysis with in-depth engagement with wheelchair users.

Figure 1 Summary of methodology

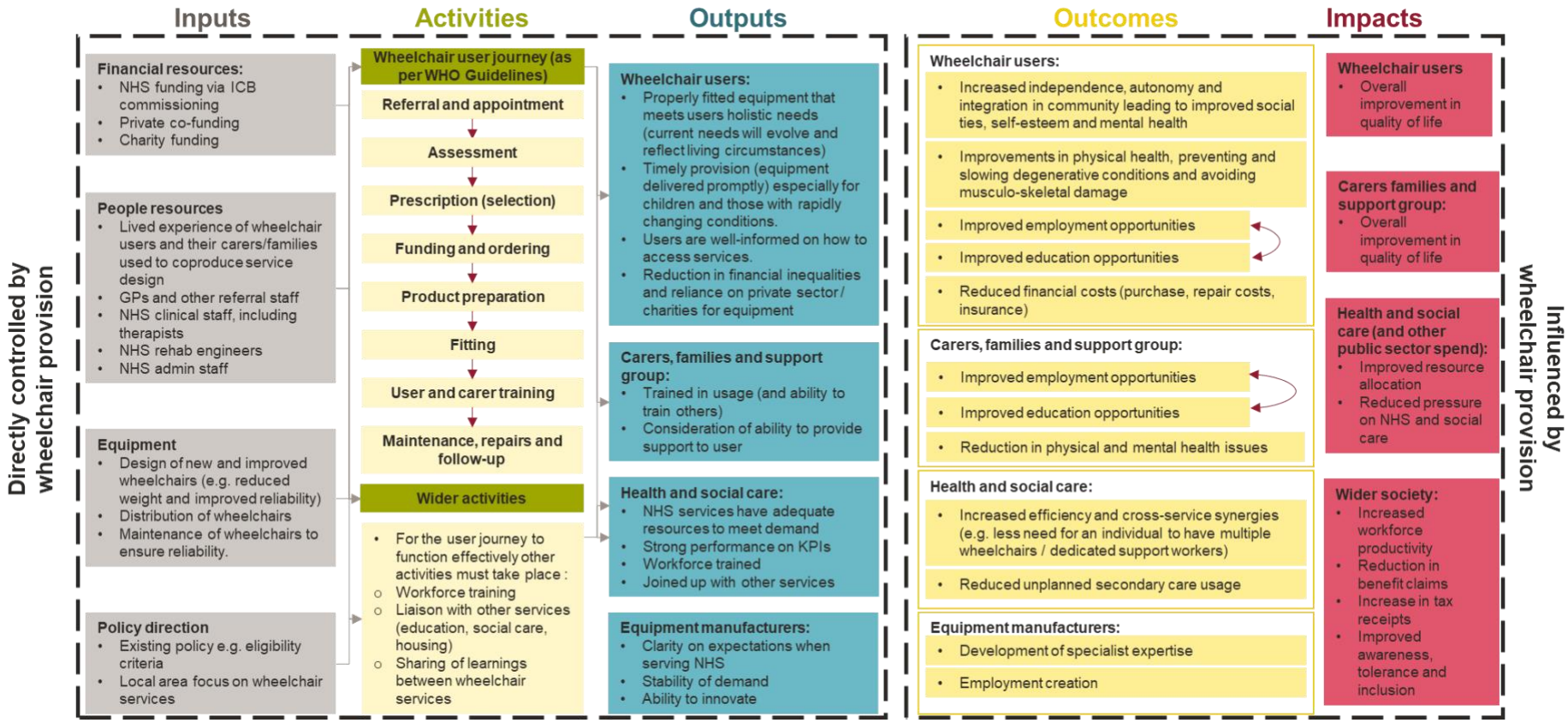
Throughout the work we have adopted a Social Return on Investment (SROI) approach. SROI builds on a traditional cost-benefit analysis and explicitly includes the wider social impacts an intervention or initiative (in this case provision of appropriate wheelchairs) can have.[2] This approach enabled us to blend quantitative modelling of economic benefits with qualitative understanding, from repeated detailed engagement with wheelchair users, of aspects which are less suited to financial modelling.

2.2 Conceptual framework

We used a logic model to inform the engagement we carried out with users and also structure our quantitative model. Our logic model is based on a desk review of relevant literature and engagement with experts from the Wheelchair Alliance. We are interested in the causal impact of high quality wheelchair provision. The outcomes and impacts on the right hand side of the logic model that we have included are all heavily influenced by wheelchair provision but will also be a function of numerous other factors (e.g. broader societal attitudes and inclusion).

[2] https://socialvalueuk.org/resources/a-guide-to-social-return-on-investment-2012/

Figure 2 Full logic model



Source: Frontier based on review of evidence and stakeholder engagement

2.3 Overall results

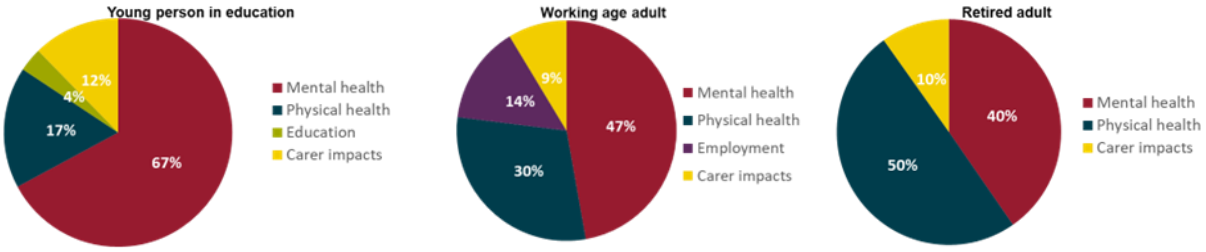
We model the value per user, per year that could be unlocked if we moved from a relatively uneven standard of NHS wheelchair provision (which is the case currently) to a universal high quality offering (that is currently delivered by some but not all NHS wheelchair services). This allowed us to understand the difference in outcomes that we might expect for an individual who has access to the right equipment and associated support services versus the same individual who does not have access to the right equipment. Existing evidence shows that the quality of current NHS provision of wheelchair services can vary significantly both over time and across different geographical areas.[3] Wheelchair users (users) in some areas receive an excellent service whereas users in other areas may experience significant delays, inappropriately tailored equipment, a lack of training and/or slow response to breakdowns.

Our analysis unambiguously shows that provision of high-quality wheelchairs can have a significant positive impact on people's lives and also lead to meaningful financial benefits for the NHS and society.

Our central estimates suggest that the annual benefits of appropriate wheelchair provision for young wheelchair users, relative to poor or uneven provision, are approximately £10,700 per user, per year. The equivalent figures for working age adults is £15,200 and for retired adults is £13,400.

Below we have provided a high-level breakdown of total benefits into the five benefit categories for each wheelchair user type.

Figure 3 Breakdown of total benefits by benefit category for each user type



Source: Frontier modelling

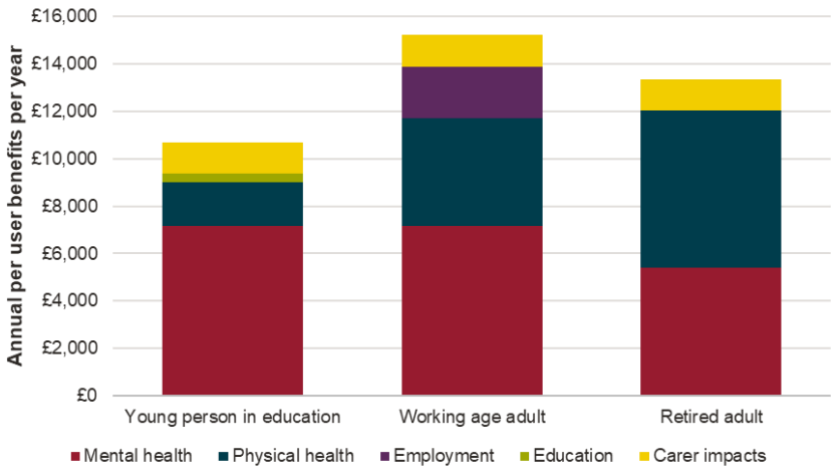
For young wheelchair users in full-time education mental health impacts account for two-thirds of total benefits. Mental health impacts are followed by physical health impacts (17%), impacts on carers (12%) and education impacts (4%) respectively. This was also seconded by the qualitative interviews, with interviewees stressing the importance of feeling like they were the same as other young people in their school or university, and could enjoy the same hobbies and opportunities.

[3] e.g. https://wheelchair-alliance.co.uk/app/uploads/2022/10/wheelchair-economic-study-final-report-screen-reader.pdf

For working age wheelchair users the distribution is different and employment impacts are the third largest category (14%). Again, mental health impacts are the largest driver of benefits for this group. Many interviewees in the qualitative interviews spoke of the mental health benefits of having an appropriate wheelchair, not just in enabling their day-to-day lives, but also in allowing them to engage with work and feeling more fulfilled. People generally felt that the right wheelchairs allowed them to feel much more independent, more purposeful, and in some cases, even be able to give back to others with similar disabilities through their work.

Finally, amongst retirement age wheelchair users' physical health impacts are the largest source of benefits and account for 50% of total benefits.

Figure 4 Annual benefit estimates by user group and benefit category



Source: Frontier based on user engagement and secondary evidence

2.4 Potential return on investment associated with additional NHS investment in wheelchair equipment

For the purposes of illustration we have considered the potential costs and benefits associated with a rise in NHS spending on wheelchair equipment. We have considered the costs and potential benefits associated with increasing the equipment spend in Integrated Care Boards (ICBs) that currently report below average total spending per registered wheelchair patient.

The cost of increasing equipment spending to the average level amongst ICBs who currently report below average levels of per patient spending is approximately **£22 million** per year. Even if these patients collectively realised only an **additional 1%** of total annual benefits of high-quality wheelchair provision the societal return would be over **£60 million**. Even under this very conservative assumption the additional benefits would outstrip the additional costs by a ratio of almost 3:1. If patients registered with these ICBs collectively realised an additional 5% of total annual benefits of high quality wheelchair provision the societal return would be

approximately £315 million. In this case the additional benefits would outstrip the additional costs by a ratio of 14:1.

The NHS would also experience significant cost savings as a result of improved wheelchair service provision. Wheelchair users and their carers would experience fewer physical and mental health issues which would otherwise require costly treatment and unplanned secondary care.

2.5 Policy recommendations

2.5.1 Importance of simplifying NHS provision for users and their families

Policy recommendation #1

NHS England (NHSE) to play a more active role in ensuring that all ICBs prioritise wheelchair services and dedicate sufficient resources to effectively deliver the service. For example, this could be done by mandating that all ICBs adopt the Quality Framework for Wheelchair Provision along with the Model Service Specification when commissioning wheelchair services. This would help to minimise inequality across different services and ensure consistent delivery of a good quality service and provision.

There are clear advantages to locally led provision of NHS wheelchair services. In particular commissioners can provide a service which is tailored to local needs. However, it has also led to variation in the standard of care provided and accountability. This variation has been highlighted in previous studies and our direct detailed engagement with wheelchair users reemphasises this unevenness. Users told us they were often left to navigate the system themselves and had to rely on their own experience and knowledge to access support.

2.5.2 Importance of adequate levels of wheelchair funding

Policy recommendation #2

The Department of Health and Social Care (DHSC) and NHS England should explore the possibility of increasing current spending on NHS wheelchair services to help ensure more benefits are realised and the NHS can unlock significant cost savings.

Our analysis shows that a relatively small increase in equipment spending (approximately £22 million per year) would make a meaningful difference to the total equipment budgets in half of ICBs. The positive impacts of this spend would comfortably outweigh the costs even if patients registered with these ICBs collectively only realised an additional 1% of total annual benefits of high quality wheelchair provision.

2.5.3 Importance of flexibility in regards to wheelchair funding

Policy recommendation #3

Local wheelchair services and commissioners should continue to share best practice and explore opportunities to pool budgets between wheelchair services and other local services. NHS England should consider what support and processes are required to encourage and facilitate greater joined up working and frictionless pooling of budgets.

There is also a clear need to ensure that current budgets are utilised in the best way possible. This should involve greater dissemination of best practice and the benefits of moving towards frictionless pooled funded models for both statutory bodies and wheelchair users, their families and carers.

3 Background and context

In this section we provide a summary of the objectives of our work and the ordering of remaining report sections. We also provide a glossary of key terms used throughout the report.

3.1 Role of Wheelchair Alliance

The Wheelchair Alliance champion national accountability for wheelchair users and their carers.[4]

Wheelchair Alliance vision

To transform the experience for wheelchair users in England through improved access, quality and effectiveness

The Wheelchair Alliance work in partnership with other organisations to influence decision makers and ensure that wheelchair users can lead independent lives. At the heart of this objective is ensuring that wheelchair users are listened to and have confidence that every NHS wheelchair service across England provides appropriate choice. The Wheelchair Alliance strategy is composed of three complementary pillars:

- To champion national accountability for wheelchair users. The Wheelchair Alliance will publicly support and champion services and processes that demonstrate best practice for wheelchair users and, where appropriate, their primary carers. The Wheelchair Alliance will also challenge services that do not provide equitable care in an acceptable timeframe.
- To communicate with wheelchair users. The Wheelchair Alliance aim to provide accessible information relating to wheelchairs, with a commitment to the use of simple, jargon free and easily navigated forms of communication.
- To innovate for the benefit of wheelchair users. The Wheelchair Alliance will work in partnership with wheelchair users, manufacturers, policy makers, NHS England, local commissioners and service providers to improve services and equipment that best support independent living.

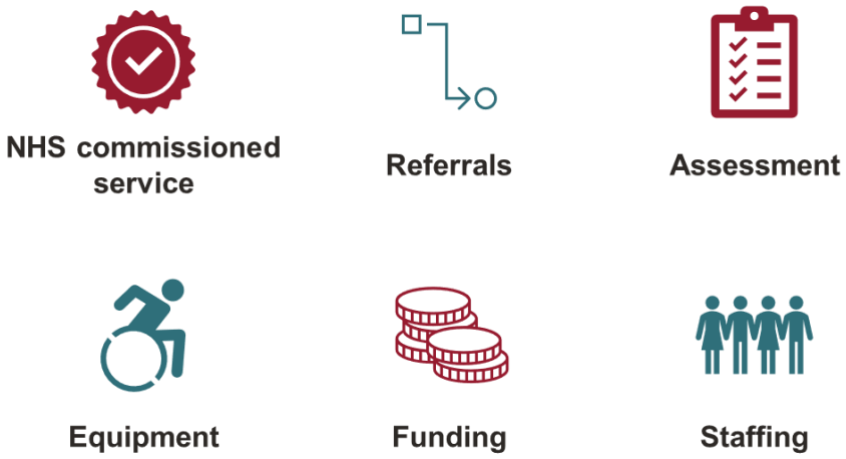
3.1.1 Wheelchair Charter

The Wheelchair Alliance has also developed a Wheelchair Charter which articulates a set of principles which collectively guarantee that everyone who needs a wheelchair in England gets one, and no one is left without the equipment they need because of where they live.[5]

[4] https://wheelchair-alliance.co.uk/

[5] The Wheelchair Charter applies to: NHS provided and commissioned wheelchair services (specialist professionals who provide wheelchairs via NHS referral) and private and independent suppliers of wheelchair services.

Figure 5 Wheelchair Charter



Source: Wheelchair Alliance

The six principles relate to:

1. A **NHS commissioned** service that provides equity of access and provision for all, irrespective of age or postcode. NHS services should work in partnership with wheelchair users and their family/carers, including with design, innovation and service change.
2. **Referrals** in the context of wheelchair services should be carried out by an appropriately skilled professional. Referrals should also enable assessment and wheelchair provision within the NHS constitutional right of 18 weeks.
3. **Assessment**: wheelchair and postural support assessment should consider all aspects of individual current and future needs, including those of carers, with a prescription to maximise independence, health and well-being. Clinicians should work with appropriate services to achieve goals agreed between the wheelchair user, carers and wheelchair provider. This includes access to home, school, work and leisure activities.
4. **Equipment** should be delivered, maintained and regularly reviewed as per nationally agreed timescales. Individual reviews should be based on recognised outcome measures. Services should be delivered across geographical boundaries where needed and emergency backup provision should be facilitated.
5. **Funding**: budgets should be flexible and innovative. This includes Personal Wheelchair Budgets[6] and collaboration with different services and alternate funders to facilitate agreed outcomes.
6. **Staffing**: NHS services should be staffed with specialist professionals who will be appropriately qualified and will receive ongoing training and development. Staff should have a broad knowledge of wheelchair and postural support options. Staff should work

[6] https://www.england.nhs.uk/personalisedcare/personal-health-budgets/personal-wheelchair-budgets/

with manufacturers and independent organisations to develop innovative and affordable products for the future.

3.2 Rationale for this work

There is currently a lack of up-to-date mixed methods research which considers the value of an appropriate wheelchair to the wheelchair user and society more broadly. Previous work has provided a compelling articulation of unevenness of service provision nationally and the negative consequences of poor provision. However, much of the current evidence is qualitative in nature.[7] Quantitative work exists but previous research tends to adopt a relatively narrow focus or is now out-of-date. For example, work by the Red Cross in 2015 measured the value of short term wheelchair loans only.[8] Likewise academic studies have considered the value of wheelchairs amongst a specific population (e.g. those who have had a stroke)[9] and previous policy research has looked at the returns attributable to a specific wheelchair charity.[10]

In addition, research on this topic in the past has too often failed to meaningfully incorporate the voices of wheelchair users. This piece of work has addressed these gaps by:

- examining the value of appropriate wheelchair provision holistically; and
- adopting a mixed-methods approach by blending high quality qualitative and quantitative analysis including repeated in-depth engagement with wheelchair users which formed the cornerstone of our work.

3.3 Purpose of this report

This project has been carried out jointly by Frontier Economics[11] and Revealing Reality.[12] Each stage of the work has been overseen by the Wheelchair Alliance (the Alliance). This type of research aligns with the Alliance's core priorities to collect evidence on the standard of wheelchair provision, shine a light on current best practice and highlight the implications associated with not meeting the requisite standards as highlighted in Alliance's Charter.[13]

[7] e.g. https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

[8] https://www.redcross.org.uk/-/media/documents/about-us/research-publications/health-and-social-care/brc-wheels-in-motion-july-2015.pdf

[9] https://pubmed.ncbi.nlm.nih.gov/17937056/

[10] https://www.pmguk.co.uk/data/page_files/publications%20and%20reports/2011/R.Whizz-KidzFrontierEconomicsReport2011.pdf

[11] https://www.frontier-economics.com/uk/en/home/

[12] https://revealingreality.co.uk/

[13] https://wheelchair-alliance.co.uk/the-wheelchair-charter/

We have gathered robust qualitative and quantitative data on the value of high quality wheelchair provision. This report summarises all the work we have undertaken on this project. The conclusions reflect the independent views of Frontier Economics and Revealing Reality.

3.4 Structure of this report

The remainder of the report is structured as follows:

- In Section 3 we outline the methodology that we have employed throughout this work;
- In Section 4 we provide a brief overview of current wheelchair provision in England;
- In Section 5 we outline our conceptual framework for the work;
- In Section 6 we present the results of our qualitative analysis;
- In Section 7 we set out our overall quantitative analysis;
- In Section 8 we set out to provide further detail on the components of our quantitative analysis; and
- Finally, in Section 9 we set out our policy recommendations and conclusions.

3.5 Glossary of key terms and acronyms

In the table below we have provided a glossary and key terms, acronyms and other relevant jargon related to the value of wheelchairs to help with interpretation of this report.

Table 1 Glossary

Term	Explanation
Block contracts	A fixed payment made to a provider to deliver a specific, usually broadly-defined, service
Clinical Commissioning Group (CCG)	CCGs were clinically-led statutory NHS bodies responsible for the planning and commissioning of health care services for their local area. They were dissolved in July 2022 and their duties taken on by the new integrated care systems (ICSs)
Counterfactual	Alternative assumed state of the word used for modelling purposes. For example, considering the difference in outcomes that we might expect for an individual who has access to the right wheelchair equipment versus the same individual who does not have access to the right equipment.
Integrated Care Board (ICB)	An integrated care board (or ICB) is a statutory NHS organisation which is responsible for developing a plan for meeting the health needs of the population, managing the NHS budget and arranging for the provision of health services in a

Term	Explanation
	geographical area. ICBs are a component of a wider Integrated Cared System (alongside Integrated Care Partnerships). There are 42 ICBs and ICSs across England.
Logic Model	Visual illustration of theory of change
Mixed-methods approach	Collecting and analysing both quantitative and qualitative data
Motability Foundation	The Motability Foundation fund, support, research and innovate so that all disabled people can make the journeys they choose.
National Wheelchair Dataset	In 2015/16, NHS England introduced the first centralised national wheelchair dataset about wheelchair services. It was designed to improve transparency and benchmarking.
Personal Wheelchair Budgets	A personal wheelchair budget is a resource available to support people's choice of wheelchair, either within NHS commissioned services or outside NHS commissioned services. Personal wheelchair budgets enable postural and mobility needs to be included in wider care planning and can support people to access a wider choice of wheelchair.
Social Return on Investment (SROI) analysis	Social Return on Investment (SROI) is a systematic way of incorporating social, environmental, economic and other values into decision-making processes.
Theory of Change (ToC)	A theory of change is a method that explains how a given intervention, or set of interventions, is expected to lead to impacts and intermediate outcomes.
Wheelchair Alliance	The Wheelchair Alliance[14] champion national accountability for wheelchair users and their carers. Their vision is to transform the experience for wheelchair users in England through improved access, quality and effectiveness. The Alliance is a Community Interest Company run solely by volunteers

Source: Frontier based on review of evidence

[14] https://wheelchair-alliance.co.uk/

4 Methodology

This section sets out the approach that we have used to explore the economic value of a wheelchair. Frontier Economics carried out the quantitative side of the project, creating modelling to assess the socioeconomic impacts of the benefits of having appropriate wheelchair provision. Revealing Reality conducted the qualitative side of the research, recruiting and interviewing 20 wheelchair users to capture the realities of their experiences and sense-check the assumptions from the quantitative modelling.

4.1 Overview

We have delivered this work through a series of activities and consultations, summarised below.

Figure 6 Overview of methodology

Source: Frontier and Revealing Reality

Throughout the work we have adopted a Social Return on Investment (SROI) approach. SROI builds on a traditional cost-benefit analysis and explicitly includes the wider social impacts an intervention or initiative (in this case provision of appropriate wheelchairs) can have.[15]

This approach enabled us to blend robust quantitative modelling of economic benefits with an in-depth qualitative understanding of aspects which are less suited to financial modelling. SROI requires strong input from stakeholders which aligned with our focus on incorporating the voices of wheelchair users (and other stakeholders) throughout.

In keeping with best practice and SROI principles set out by the Cabinet Office[16] we have based our work on a robust conceptual framework that underpins all of our analyses. This framework provided a structure for data collection and analysis including both qualitative engagement with wheelchair users and secondary evidence gathering. We then analysed and synthesised this information before testing conclusions with wheelchair users and summarising our findings in this report. Throughout this work we met regularly with

[15] https://socialvalueuk.org/resources/a-guide-to-social-return-on-investment-2012/

[16] (1) Involve stakeholders (2) Understand what changes (3) Value the things that matter (4) Only include what is material (5) Do not over-claim (6) Be transparent (7) Verify the result.

representatives from the Wheelchair Alliance who shared relevant documentation with us and provided feedback on draft outputs.

Further detail on each stage of work is provided below.

4.2 Stage 1

4.2.1 Logic model development

To inform all subsequent work we firstly developed a Theory of Change (ToC) which conceptually illustrates a comprehensive set of the causal pathways by which wheelchair provision leads to outputs (such as properly fitted equipment), which in turn lead to outcomes (such as improved employment prospects) and ultimately impacts (such as improved wellbeing and economic growth).

This approach is fully in keeping with best practice. The UK Government's Magenta Book recommends that a key first step of an evaluation is developing a ToC.[17] The ToC captures the theory of how the intervention is expected to work, setting out the steps involved in achieving the desired outcomes, the assumptions made and wider contextual factors.

We have visualised our ToC using a logic model framework. This is based on an extensive review of documents we identified via online searches or provided by the Wheelchair Alliance team and other stakeholders. These documents included NHS policy papers, existing academic work and previous work carried out by Frontier Economics and Revealing Reality. A full list of sources is included in our Bibliography (Section 9).[18]

We drafted an initial logic model following a detailed review of the secondary evidence described above. We then refined our framework following a workshop session with Wheelchair Alliance team members. The logic model was then finalised after engaging with wheelchair users (see below for details).

4.2.2 Sampling of wheelchair users and preparation of materials

We recruited a sample of 20 people to speak about their experience of wheelchair usage, as outlined below. The research consisted of two strands of engagement: 20 initial, in-depth ethnographic interviews conducted in wheelchair users' homes, and 10 follow-up remote interviews with half of the sample (see below for further details).

To assist us in our research, we used discussion guides and other research materials to aid researchers answer the key questions relating to the experience of wheelchair users and the

[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879438/HMT_Magenta_Book.pdf

[18] See Section 8 for a full list of sources used

impact of current and past provision. These materials were used flexibly by researchers to explore these topic areas in more detail during interviews but also understand each person's unique experience and probe around other points raised by respondents. These discussion guides were used in particular to:

- Gather relevant contextual and observational information to formulate a wider understanding of people's lives and behaviours
- Collect information relevant to wheelchair usage, as well as the challenges and benefits individuals experienced in their wheelchair use.

The core criteria in the sampling frame were (1) whether the user had an appropriately fit wheelchair, and (2) manual versus powered current wheelchair. We weighted the sample towards those who did not have an appropriate wheelchair and manual wheelchairs, to gather evidence more thoroughly on the impacts of inappropriate wheelchairs. Engaging with people who had an appropriate wheelchair fit enabled us to demonstrate the economic benefits of provision and highlight best practice. Without engaging with this group, we would have been entirely focused on what systems were currently not providing, which could have limited the impact of our outputs.

Additional sampling criteria included: (1) age (2) congenital disability vs. acquired injury (3) socio-economic group (4) region, and (5) carer/family arrangements. We relied on the Wheelchair Alliance's extensive network for recruitment of potential participants. Those who were not selected for an interview were notified and thanked for their time. All potential participants completed a written form outlining in brief their experiences. The insights from these written inputs were included in our findings.

4.3 Stage 2

4.3.1 Initial engagement

Objectives

1. Gain insight into the lived experience of wheelchair users to better understand the impacts of access to an appropriate wheelchair and highlight opportunity areas for providing better access to appropriate wheelchairs.
2. Explore the causal pathways by which wheelchair provision leads to social and economic impacts, and which of these have the greatest social and economic impacts.
3. Robustly illustrate the benefits associated with provision of the right wheelchair at the right time and make the case for greater investment in NHS wheelchair services, based on SROI analysis.

Format

We conducted 2–3-hour ethnographic interviews with wheelchair users and carers where relevant. These interviews took place in-person, within the participants' homes and the areas

where they lived, and involved a combination of interviewing and observation. Conducting interviews in person enabled researchers to establish a strong rapport with participants, and observation played a crucial role in enriching the evidence about how a person's wheelchair worked for them or did not, within the context of everyday life.

These interviews explored various topics, mapping out the positive or negative impact of accessing appropriate or inappropriate wheelchairs, including:

- Initial wheelchair acquisition and any changes, along with associated challenges.
- Current wheelchair experiences and changes over time, including carer perspectives where relevant.
- Assessment of appropriate or inappropriate aspects, compared to other wheelchair experiences.
- Impact on their lives, both positively and negatively, and how it changed over time.
- What the user and carer (where relevant) feel could be improved in their lives if aspects of their wheelchairs were more appropriate for them.

Engagement with other stakeholders

In addition to the detailed engagement with wheelchair users described above we also carried out a small number of scoping interviews with other stakeholders including representatives from NHS wheelchair services and other experts in this field. The goals of this engagement were to verify our understanding of the policy landscape and understand in more detail what the most pressing evidence gaps were and how this work could help fill those gaps.

The final focus and scope of our analysis reflects the insights we collected during these conversations.

4.3.2 Initial modelling

We started to develop our quantitative model structure in parallel with the initial programme of qualitative engagement. Our quantitative model mirrors our conceptual logic model in terms of structure and focus on the most impactful causal pathways that can be feasibly modelled.

We designed the model to maximise flexibility so that it can produce societal benefit estimates for different types of wheelchair user and different beneficiary groups (e.g. NHS vs. individual wheelchair users).

Wheelchair user types

Our engagement with wheelchair users and our review of existing evidence highlighted that the specific ways in which appropriate wheelchair provision can add value for an individual user depends on their individual lifestyle and requirements. We wanted to reflect this in our quantitative modelling. In order to make the analysis tractable we defined three archetype wheelchair users each of whom is at a different life stage:

- young wheelchair user who is in full time education;
- working age adult wheelchair user; and
- older adult wheelchair user who is of retirement age.

We have gathered evidence and presented results for these three groups separately (see Section 7 for more details).

Counterfactual

During this stage of work, we also developed our counterfactuals which describe the impact of adequate provision (e.g. understanding the difference in outcomes that we might expect for an individual who has access to the right equipment versus the same individual who does not have access to the right equipment).

Existing evidence shows that the quality of current NHS provision of wheelchair services can vary significantly both over time and across different geographical areas.[19] Users in some areas receive an excellent service whereas users in other areas may experience significant delays, inappropriately tailored equipment, a lack of training and/or slow response to breakdowns. We model the value per user, per year that could be unlocked if we moved from a relatively uneven standard of NHS wheelchair provision (which is the case currently) to a universal high quality offering that is currently delivered by some but not all NHS wheelchair services.[20]

Our quantified benefits do not cover the entire value of wheelchairs but the additional value that could be unlocked in England if we moved from current uneven provision to a universal high standard of care. The entire added value of high quality wheelchair provision would be far higher. This further emphasises the conservative nature of our results.

4.4 Stage 3

In line with best practice we want to ensure that all of our outputs are co-produced and people with lived experience of using wheelchairs can meaningfully input throughout. Therefore, during this stage of our work we used findings from the first wave of interviews, the outline quantitative model and interim quantitative results as the basis for a final round of virtual re-engagement with wheelchair users.

[19] e.g. https://wheelchair-alliance.co.uk/app/uploads/2022/10/wheelchair-economic-study-final-report-screen-reader.pdf

[20] High quality in this context means provision is in line with WHO guidance and the Wheelchair Alliance's own Charter https://www.who.int/publications-detail-redirect/9789240074521

4.4.1 Re-engagement with wheelchair users

Objectives

During this stage, we utilized the draft quantitative model outline we had developed as the foundation for a final round of virtual re-engagement with wheelchair users and key audience stakeholders. The objectives of this concluding engagement phase were to:

1. Fill quantitative evidence gaps with qualitative insights from those with lived experience.
2. Verify and refine proposed counterfactuals.
3. Highlight additional sources of evidence not previously considered.
4. Gather insights on presenting findings for maximum impact.

In follow-up interviews, we asked questions specifically around the main pathways assessed in the logic model (such as impacts on physical or mental health, access to work/education, and any applicable carer support), to gather more detail on these key areas of their life and understand how they were affected by the standard of provision they had received.

Logistics

We revisited 10 of our initial respondents to delve deeper into areas related to the key pathways identified in the quantitative modelling and findings from the initial round of interviews. Additionally, we tested the assumptions made during the initial modelling phase. These key pathways included:

- The impact of provision on wheelchair users' physical health.
- The impact of provision on wheelchair users' mental health.
- The impact of provision on wheelchair users' access to and experiences in education and employment.
- The impact of provision on the level of formal and informal care needed for wheelchair users.

4.4.2 Finalisation of modelling

Following the second round of engagement with wheelchair users we were able to refine our modelling assumptions and produce final results. This involved calculation of the economic and social benefits of appropriate wheelchair provision for the user groups we have described above.

Throughout this modelling we followed HM Treasury (HMT) best practice in terms of projecting future benefits.[21] We have also included our key assumptions in the Annex.

[21] e.g. https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020

All the quantitative modelling work was subject to detailed quality assurance (in line with HMT's best practice Aqua Book) by experienced Frontier modellers who were not directly involved in designing and developing the model.

4.5 Limitations

As noted in previous work there are significant information gaps which exist in relation to the current scale of challenges in the provision of wheelchair services in England.[22] For example, there are issues in relation to the National Wheelchair Dataset and evidence that certain ICBs are interpreting questions and definitions in different ways. This has limited our ability to use and interpret this dataset.

We have made every reasonable effort to identify and use data from a variety of sources when producing our estimates. Key assumptions and parameter values have been tested with wheelchair users and experts from the Wheelchair Alliance.

The model draws on a range of evidence sources including both existing studies and primary data gathered from the interviews with wheelchair users (a full list of sources is provided in the Annex). Individual monetised estimates are subject to uncertainty (due to variation in effects by subpopulation, changes over time, confounders, and statistical variation).

Therefore, when developing the model framework we also explicitly accounted for uncertainty via upper and lower bounds. These ranges are reflected in our results (see Section 7 for further details).

[22] https://wheelchair-alliance.co.uk/app/uploads/2022/10/wheelchair-economic-study-final-report-screen-reader.pdf

5 Current provision of wheelchairs in England

In this section we describe the current landscape for wheelchair provision in England and summarise some of the existing work that has been carried out on this topic. This provides context for our qualitative and quantitative findings which we have presented in the next sections of this report.

Our previous report *An Economic Assessment of Wheelchair Provision in England* provides a more detailed description of the current wheelchair market.[23] This work highlighted a range of market characteristics including (1) uncertainty over the number of wheelchair users in the country (2) inconsistent user experience (3) the need for greater support of NHS wheelchair services.

5.1 Types of provision

Following referral and assessment, a user has four different options for receiving wheelchair equipment:

- direct NHS provision which involves a dedicated NHS wheelchair service prescribing and providing wheelchair equipment that suit the lifestyle and clinical needs of the user in a cost effective manner;
- NHS provision through Personal Wheelchair Budgets[24] which are a resource to support people's choice of wheelchair either within NHS commissioned services or outside NHS commissioned services;
- charity funding, there are a number of different charities in England who are able to help get funding for wheelchairs; and
- private purchase, wheelchair users can privately purchase their wheelchair or contribute to the cost when accessing NHS Personal Wheelchair Budgets or charity funding.

5.1.1 Focus for this study

Our primary focus in this work is on NHS England wheelchair services. Clearly wheelchairs provided via charitable funding or private funding can also create significant value and enable users to lead fulfilled independent lives. However, NHS England wheelchair services should provide a high quality service for everyone who needs a wheelchair and many people may not have a viable alternative option.

In addition, existing evidence shows that there is considerable room for improvement in relation to NHS provision (see below for further details) and therefore the potential social and

[23] https://www.motabilityfoundation.org.uk/media/zsjnh4un/wheelchair-economic-study-final.pdf

[24] https://www.england.nhs.uk/personalisedcare/personal-health-budgets/personal-wheelchair-budgets/

economic benefits associated with universal high quality NHS provision are not being fully captured.

5.2 Policy context

Commissioning of NHS Wheelchair services should aim to provide an efficient, cost effective service that is person-centred and supports individuals, their families and carers to achieve improved quality of life and independence through timely provision of the right wheelchair and associated equipment at the right time.[25] Over the last 10 years NHS England has implemented a number of initiatives in order to commission more effective, higher-quality wheelchair services. The specific initiatives include:

- Establishing a national wheelchair dataset about expenditure on and access to wheelchair services. This dataset was designed to improve transparency and benchmarking and provides regular information at the CCG (now ICB) level on a range of indicators.[26]
- Developing a national wheelchair tariff.[27] This currency model was designed to help improve commissioning and provision of wheelchair services. It provides information on what is included in each currency. This included defining different categories of need (low, medium, high) to help classify different complexities of wheelchair services.
- Publishing a model wheelchair specification[28] to tackle the issue of variation in quality of services. The specification outlines the provision of standard and specialised wheelchair and posture services. It describes the role, function and responsibilities of these services. The specification also acknowledges that CCGs (now ICBs) need to be able to commission services that meet the needs of their own local population.[29]
- Introducing personal wheelchair budgets (PWBs) as a resource available to increase people's choice and control of wheelchair provision, either within NHS commissioned services or outside of NHS commissioned services. Since April 2017, all CCGs (now ICBs) have been expected to start developing plans to offer personal wheelchair budgets to replace the wheelchair voucher system. To date, not all wheelchair services are offering PWBs.

[25] https://www.england.nhs.uk/wp-content/uploads/2017/07/wheelchairs-model-service-specification.pdf

[26] Indicators include the number of users registered with each wheelchair service, , the number of new referrals within the period in question, each CCG's success in meeting waiting times targets for equipment handover; and current spending by each CCG on their wheelchair service. This data is analysed as part of our market study

[27] https://www.england.nhs.uk/publication/guidance-for-using-wheelchair-currency/

[28] https://www.england.nhs.uk/wp-content/uploads/2017/07/wheelchairs-model-service-specification.pdf

[29] This specification was last reviewed in 2017 and may now need to be updated and ratified.

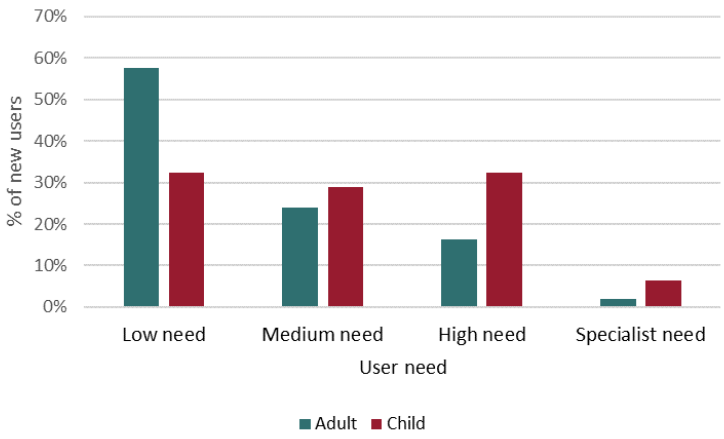
5.3 NHS provision

5.3.1 Number of registered users

There were 640,000 wheelchair users registered with ICB wheelchair services in the most recent wave of the National Wheelchair Dataset (Quarter 4 2022/23). The vast majority of these users are adults (576,000, 90%), while the remainder are children (64,000, 10%).[30]

Below we have illustrated the breakdown of new users (whose episode of care was closed during the reporting period) by the level of need and age.[31] Overall, 55% of new patients whose episode of care was closed in the reporting period were classified as low need, 25% as medium need and 18% as high need. Low need is by far the most common category amongst adults ("occasional wheelchair users with relatively simple needs"). The distribution of children across low and high need groups is more even, with almost the same proportion of low, medium (daily users of wheelchairs with some postural and/or seating needs) and high need (permanent users who are dependent on a wheelchair for all mobility) users.

Figure 7 Breakdown of new users whose episode of care was closed in Quarter 4 of 2022/23 by user needs and age



Source: Frontier Economics analysis of the National Wheelchair dataset

[30] One ICB did not submit data to this wave: NHS Northamptonshire

[31] From this data we cannot establish exactly why each episode of care was closed. The guidance for using Wheelchair Currency defines different types of needs as follows:

- Low Need: Occasional users of wheelchair with relatively simple needs that can be readily met. Do not have postural or special seating needs. Physical condition is stable, or not expected to change significantly.
- Medium Need: Daily users of wheelchair or use for significant periods most days. Have some postural or seating needs. Physical condition may be expected to change.

High Need: Permanent users who are fully dependent on their wheelchair for all mobility needs. Physical condition may be expected to change / degenerate over time.

Available at: https://www.england.nhs.uk/wp-content/uploads/2017/03/guidance-using-wheelchair-currency.pdf

Note: We have excluded the "No equipment provided" category

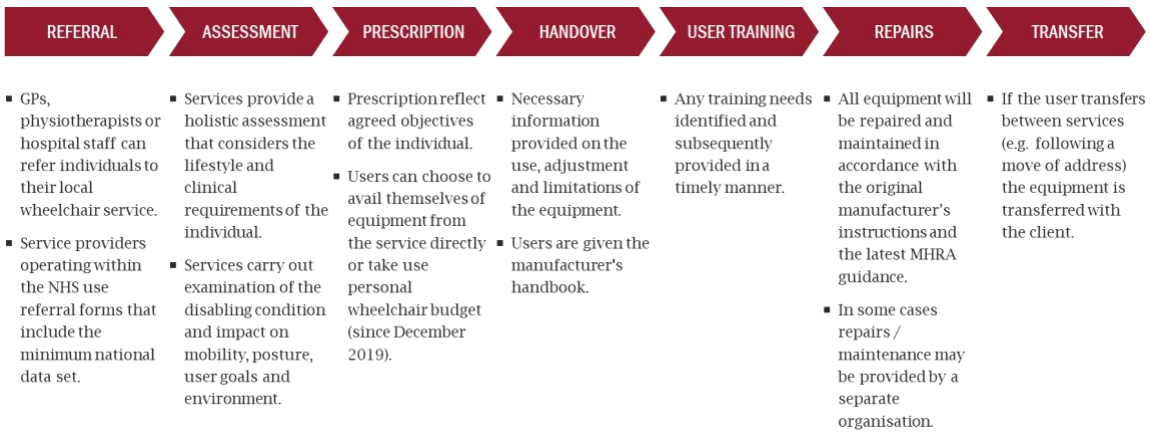
We know that there are a significant number of wheelchair users in England who are not captured by these NHS figures. Our previous work on this topic highlighted that private spending on wheelchairs has risen significantly over the last decade.[32] We analysed the evolution over time of total annual turnover for the ***Retail sale of medical and orthopaedic goods*** in specialised stores.[33] The data shows that annual turnover has seen a 69% real increase from 2012 to 2021, going from £640 million to £1,100 million.[34] This retail category is broad and includes more than wheelchairs, but the observed increase in turnover suggests a substantial and growing increase in demand for privately purchased wheelchair equipment over the last ten years.

5.3.2 User pathways

The 'Model Service Specification for Wheelchair and Posture Services' ('Model Service Specification'), published in 2017, describes the role, function and responsibilities of wheelchair services.[35] However, it is important to note that this guidance is non-mandatory. As a result, the provision of care across ICBs may deviate from that defined by the Model Service Specification.

There are multiple stages of service provision along the wheelchair user journey, from referral, to receiving equipment and any repairs or service transfers. We have illustrated these below.

Figure 8 NHS wheelchair user journey



Source: Frontier Economics based on the Operating Model for NHS Commissioned Wheelchair Services and the Model Service Specification for Wheelchair and Posture Services

[32] https://wheelchair-alliance.co.uk/app/uploads/2022/10/wheelchair-economic-study-final-report-screen-reader.pdf

[33] This category of retail products is based on the 2007 revision of the Standard Industrial Classification (UK SIC 2007). The UK SIC 2007 is a major revision of UK SIC 2003 which changes at all levels of the SIC. This is the most granular category, and there is not a SIC code that relates to wheelchairs specifically.

[34] In 2021 prices

[35] https://www.england.nhs.uk/publication/model-service-specification-for-wheelchair-and-posture-services/

Note: For many users, in particularly those with progressive conditions, this journey will not be linear i.e., there will be periods of reassessment and new equipment issued

5.3.3 Variation in NHS provision model

The Model Service Specification does not prescribe a particular configuration of wheelchair services in terms of how the delivery of service is discharged. As a result, a variety of different models of wheelchair service provision exist across England. These models can be characterized across a number of key dimensions:

- Whether services are provided by **a NHS provider or private provider, or a combination of both**. Local NHS wheelchair services may configure their offering in different ways, using a combination of NHS in-house provision, public sector involvement or other bodies (such as the charity sector or social enterprises). Some services are fully delivered in-house across all the user facing elements of the wheelchair user journey (all services will purchase equipment from private manufacturers).[36] Services may be partially contracted out. For example, repair and maintenance services could be tendered to a private provider, but with assessment services provided within the NHS. And finally, services may be full contracted out to a provider through a block contract to a private provider of wheelchair services.
- **The payment model used for commissioning services**. There are at least three payment models currently used for NHS England wheelchair services.
  - full block contract models for both assessment of potential wheelchair users and for wheelchair equipment;
  - a combination of block contracts and pay per item, such as block contract for assessment and pay per item for equipment.
- Whether wheelchair services are **'bundled' with other services**. wheelchair services could be procured as a singular service or as part of a wider package of services. For example, wheelchair assessment services may be procured alongside equipment services, community services, and static seating.

5.3.4 Variation in quality metrics

Significant variation in the quality of care provided by NHS wheelchair services in different parts of the country has been a repeated conclusion of previous work. Geographic variation in outcomes is still visible in the most recent wave of the National Wheelchair Dataset.

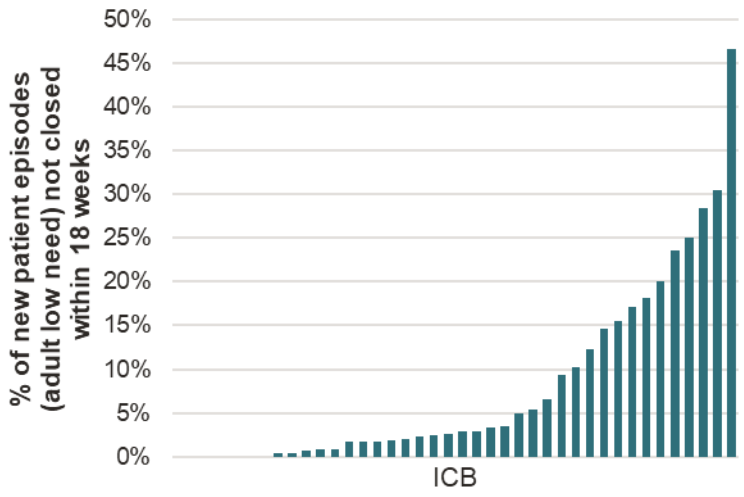
We have examined the proportion of new patients whose episode of care was **not** closed in the most recent reporting period within the 18 week target window. In the figure below we have illustrated this proportion for each ICB (higher percentages imply more episodes of care that do not meet the 18 week target).

[36] Some NHS wheelchair services may only purchase equipment from a defined formulary which can limit users' choice.

We can see that multiple ICBs met the 18 week target for all new low need adult patients in the relevant reporting period (indicated by the bars at 0% below). At the other end of the spectrum some ICBs fail to close over 20% of new patient episodes of care within 18 weeks. For simplicity we have focused exclusively on low need adults for this part of the analysis (as they are the biggest single group). However, a similar pattern is evident for those with medium and high needs.

Some of this variation may be due to differences in case mix and average patient complexity in different areas of the country. However, in and of itself, this cannot explain the magnitude of variation we see in waiting times. Also differences in demographic factors across areas should also be reflected in local funding allocations. Therefore, it is reasonable to infer that some services are providing a higher quality offering than others which may be due to variation in the level of funding provided and/or differences in the extent to which wheelchair services are seen as a local priority relative to other locally commissioned NHS services.

Figure 9 Proportion of low need adult patients with episode of care exceeding 18 weeks by ICB



Source: Frontier Economics analysis of the National Wheelchair dataset
Note: This relates to "low need" adult patients only. 40 of the 42 ICBs reported information on wait times.

6 Conceptual framework

In this section we describe the logic model which forms the foundation for the remainder of our work.

6.1 Role of logic model

A logic model is a visual representation of the theory of change of an intervention. It presents the logical connection between:

- the resources used in delivering an intervention (inputs);
- the activities undertaken using those resources;
- the outputs resulting from those activities; and
- the resultant outcomes and longer-term impacts.

We have used our logic model to inform the engagement we carried out with users (see Section 6 for more details) and also structure our quantitative model (see Section 7 for more details).

6.2 Development of logic model

Our logic model is based on a desk review of relevant literature (see Section 9) and engagement with experts from the Wheelchair Alliance. Our logic model was refined further following interviews with wheelchair users.

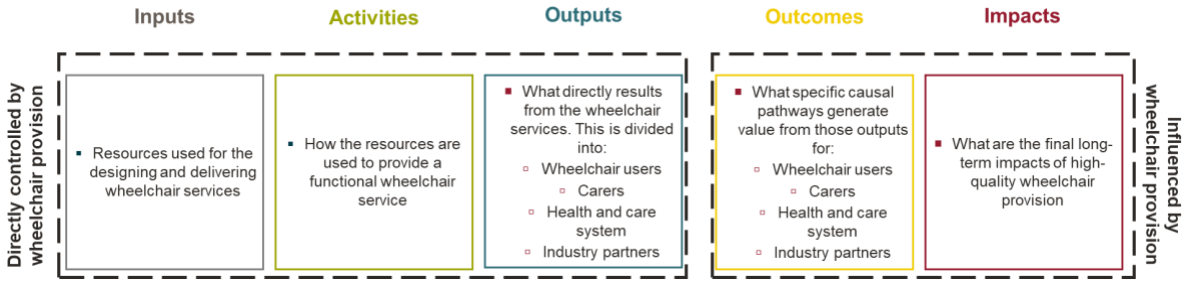
6.3 Structure of the logic model

This logic model illustrates conceptually how high quality wheelchair provision (and associated ancillary services) can lead to economic and societal value. Our logic model articulates how wheelchair services can create value in an idealised context where services work effectively and users' needs are met.

Our qualitative engagement (see Section 6) has highlighted examples of where this occurs (examples of best practice) and where this does not occur. Our quantitative modelling (see Section 7) shows the monetised impact of moving towards universal best practice for individuals and society.

Our logic model is composed of five categories which are illustrated below.

Figure 10 Logic model structure



Source: Frontier

We are interested in the causal impact of high quality wheelchair provision. The outcomes and impacts on the right hand side of the logic model that we have included are all heavily influenced by wheelchair provision but will also be a function of numerous other factors (e.g. broader societal attitudes and inclusion). We have where possibly controlled for these other factors in our quantitative modelling.

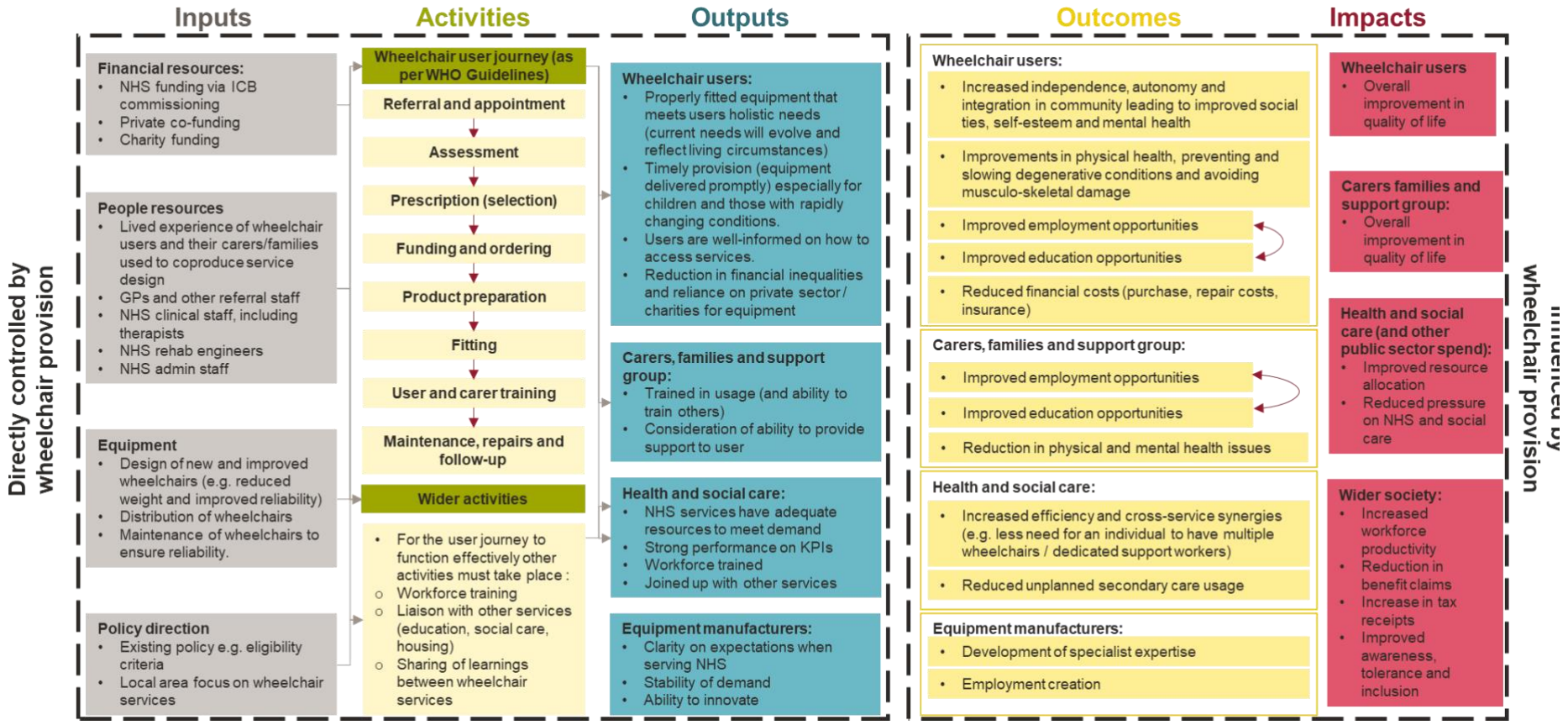
6.4 Logic model

We have illustrated the full logic model below.

This shows how resources such as staff, equipment and budgets facilitate key activities including referral, assessment, prescription and maintenance of wheelchairs. These activities in turn create a range of outputs for wheelchair users (e.g. timely provision of well-fitted equipment), their carers (e.g. training in how to support the wheelchair user), the wider health and social care system (e.g. training of workforce) and equipment manufacturers (e.g. stability of demand).

These outputs contribute to positive outcomes for those groups and final impacts on society more broadly which are listed below.

Figure 11 Full logic model



Source: Frontier based on review of evidence and stakeholder engagement

6.4.1 Enablers and barriers

We have also considered the external factors which will contribute to the ability of NHS Wheelchair Services to generate the final impacts we have listed above but may not be in their direct control. These include:

- Inputs
  - National funding envelope for health and care
  - Availability of raw materials and functioning of supply chains
  - Availability of skilled workforce
  - Effective commissioning and local prioritisation of wheelchair services
  - Effective regulation and oversight
- Activities and outputs
  - Wheelchair users awareness of their rights and eligibility
  - Increased choice within NHS processes
  - Consistently applied eligibility criteria which allows for wheelchair users' needs to be met
  - Integration between health services and other services (e.g. social care, education)
- Outcomes and impacts
  - Societal attitudes and stigma
  - Willingness of employers and education providers to design inclusive environments
  - Competitiveness of market for wheelchair manufacture and distribution

As noted previously our quantitative modelling has sought where possible to isolate the impact of high quality wheelchair provision holding other factors (such as those listed above) constant. Our final conclusions and recommendations (see Section 8) also touch on some of the factors listed above.

7 Summary of insight from the face-to-face interviews

This section presents the key findings from the ethnographic-style interviews with wheelchair users. These insights are derived from synthesising information drawn from all the interviews. Case studies from individual interviews are in Section 8.

7.1 Clinical assessment carried out by NHS services did not always reflect wheelchair users' wider needs

Many of the interviewees felt there was sometimes a reluctance by NHS wheelchair services to offer a greater level of provision even if this might have unlocked significantly greater independence, such as the ability to travel independently or maintain work. For example, respondents reported that if they were able to walk with aids or to use a manual wheelchair, they were not offered a powered wheelchair or a wheelchair with a power pack[37].

Most of the research participants recognised that this reluctance may have stemmed from a desire to help them retain their mobility or fitness. However, they felt this way of thinking did not always take into account the unique context of their lives and aspirations or their holistic needs.

For example, one of the interviewees, Charlie, no longer had use of his legs or abdominal muscles following a bike accident but he could use his upper body. At his initial assessment by his local NHS wheelchair service, he was denied a powered wheelchair and told that using a manual wheelchair would enable him to remain physically fit. However, rather than improving his strength, Charlie developed several wrist and shoulder injuries over the years due to pushing a manual wheelchair.

"*It really frustrates me, because there's this* ***wheelchair exercise*** *belief they promote that using a manual wheelchair is an exercise technique. If it was a viable technique for exercise, you would see fake wheelchairs at the gym! This has never been a good thing*."

When Charlie subsequently got a powered wheelchair, it transformed his ability to work, engage in social activities and hobbies, and maintain his physical health. He uses weights at home and does exercises for his upper body, maintaining a far higher level of physical health than he ever did using his manual wheelchairs. In Charlie's opinion, the belief that manual wheelchairs keep users in his situation "active" and healthy is often misguided, and they are the wrong means to maintain exercise and health.

In addition, it is possible that this observed behaviour is partially driven by the fact that NHS wheelchair services spending is being limited due to budget constraints. However, in the long run, as this research illustrates, there are strong arguments for equipping people with more

[37] A lightweight manual wheelchair with a power pack can be a better option than a powered wheelchair for some users

effective, and albeit more expensive provision in the short-term, to enable them to be happier and more economically productive in the long-term.

7.2 Wheelchair users felt NHS wheelchair services did not always consider their need to lead full lives – or the benefit to wider society

Wheelchair users said their ability to work, study and contribute to society more broadly was not always given a high priority by NHS wheelchair services. The respondents emphasised the value of independence and the positive contribution that working, volunteering and studying had on their mental wellbeing.

For example, Jane, 53, who has multiple sclerosis, was denied a powered wheelchair because she could walk with an aid in her own home. However, Jane struggled with fatigue, and could not sustain walking around her home for long periods of time. She retired from her work as a cardiac nurse and lecturer on medical grounds, and was not able to exert herself to do other work or volunteer without a powered wheelchair.

"Instead of making them [wheelchair users] wait until they are that poorly that they can no longer walk at home and then allowing them to have one [powered wheelchair] when they are less able, why not give them one now while they're able to get out and be part of society? … Surely that's the time that they need that wheelchair, not the time when they can literally no longer walk in the house."

The most challenging moments and periods of low mood for the wheelchair users interviewed were often times when they felt unable to work or study as they once had, or as they wanted to. Delays to NHS assessment, the provision of equipment or repairs and adjustments could exacerbate and lengthen these challenging periods.

Users also reported that physical injury or pain directly or indirectly caused by the use of an inappropriate wheelchair (e.g. musculoskeletal pain, falls, or pressure ulcers) could lead to additional disruption to their working lives.

Interviewees Duncan and Esme had both missed out on significant periods of education and study as a result of ill-fitting or malfunctioning wheelchairs. In Esme's case, she felt this had also affected her future career progression.

"It really does add up, the amount of times I've had to miss uni or work because my wheelchair doesn't work. I miss my job less now because I can work from home and I have a desk chair, but I miss out on going into the office. When my wheelchair malfunctions, I can't go into the office. So financially it doesn't have that impact, but I miss out on collab days and career progression from just being there and being seen and being around people."

Duncan missed a large amount of school due to injuries caused by his manual wheelchair. Although it was technically 'clinically appropriate' for him, it weighed 22kg, and as a result he dislocated his thumbs trying to push himself around. During year 8, rarely able to get to the

classrooms where his classmates and teachers were, he had to work downstairs through worksheets on his own.

7.3 Adaptations that provided flexibility were deemed to be the most beneficial to personal independence

Interviewees felt that having a wheelchair with appropriate adaptations such as adjustable seating or technology to enable driving, was supremely important.

Simple additions to wheelchairs that made them adaptable to different circumstances, for example a Tri-ride or additional batteries to extend life, often made an enormous difference to peoples' opportunities and independence.[38]

Simon, 62, described the numerous benefits of being able to raise the height of his wheelchair when stationary – he could be at eye level with people he was talking to, which made conducting business easier and more effective, and it made him feel much more confident and comfortable socially too.

"[Before getting the raising feature] I felt a bit left out and estranged and not welcome. A nuisance, more or less, because people trip over you and have to walk around you and you couldn't go up to someone and do some business with him or her. But as soon as I got my up and down wheelchair, apart from the fact people found it interesting and therefore come and ask me about it, I could do it, move up and down in front of the person I wanted to speak to about some business and then we could do the business."

The raising function on Simon's wheelchair also gives him access to a greater range of spaces. By moving up and down, he can reach lights more easily, as well as being able to use his computer for work. His wheelchair is also able to slide forward 10 inches from a stationary position independent of the wheels, which means he is able to reach the door handle or slide under tables more easily. These small adaptations to his wheelchair make the world around him much more accessible, and able to conduct his day-to-day life far more effectively and happily as a result.

7.4 Wheelchair users felt access to funding was fragmented

Respondents felt that the availability of funding and support was inflexible and not always optimally allocated – money might be available for things that would make minimal difference to their quality of life but not for things that would be life-changing.

[38] A Tri-Ride is a motorised device that can be attached to the frame of a manual wheelchair, transforming the wheelchair into a three-wheeled power assisted device. These add-ons are not currently provided by the NHS. There are, however, other add-ons that the NHS provide that convert a manual wheelchair to a power assisted wheelchair such as power packs and motorised wheels, in addition to fully powered chairs.

In particular, the interviewees felt early investment in wheelchair provision that could give them greater independence, access, ease and happiness, could unlock lasting benefits not only for themselves, but for their primary carers and society more widely through the contribution they could make.

This inefficiency of resource allocation was apparent in the fact that nearly all the research participants had had multiple wheelchairs, which may have been cheaper than a fully appropriate wheelchair, but some of which were rarely or never used because they lacked the required flexibility or functionality for their lifestyle needs.

Lucy, 41, had three wheelchairs at home, including a powered wheelchair provided by the NHS. She found this wheelchair too bulky to use inside her bungalow and was unable to transport it in her car. For this reason, Lucy decided to pay for her own wheelchair – an active manual wheelchair, which is lightweight and foldable – and she rarely used her powered wheelchair except to go to the local shops. Similarly Jane, 53, who has multiple sclerosis, and was allocated a manual wheelchair by the NHS, decided to purchase a mobility scooter to help her manage day-to-day activities. Her manual wheelchair remained mostly unused at home.

All the interviewees said they found it challenging to navigate the system to access appropriate support. Wheelchair users and their families felt they needed a lot of determination and knowledge to do so effectively. For example, Claire, 72, who has spinal muscular atrophy, was only made aware by her physiotherapist that she was eligible for a power-assisted wheelchair after struggling with a manual wheelchair for 12 years.

8 Overall quantitative findings

In this section we outline the headline results of our quantitative analysis.

8.1 Approach used

As we described in Section 2 we have adopted a Social Return on Investment (SROI) type approach for our modelling. SROI builds on a traditional cost-benefit analysis and explicitly includes the wider social impacts an intervention can have.[39]

8.1.1 Modelling principles

In line with best practice, we have followed a set of underlying SROI principles.[40]

Figure 12 SROI principles

Source: Cabinet Office

Throughout this work we have engaged stakeholders and used the expertise and insights of wheelchair users to guide our modelling. This engagement allowed us to understand how high quality wheelchair provision can lead to meaningful changes in people's lives. We could then focus our modelling on those material factors. Throughout we have been conservative in our assumptions and been realistic about attributing impacts to wheelchair provision specifically. We have also provided transparent detail on how we have operationalised the specific modelling pathways in the remainder of this section. Finally, prior to finalising the quantitative modelling we re-engaged with wheelchair users to verify the appropriateness of our analysis and refine certain parameters and assumptions.

8.1.2 Benefit categories

We have focused on the benefit pathways that were included in our conceptual logic model. In line with the principles that we have described above we quantitatively modelled areas which users suggested were most important. Benefits can be divided in five sub-categories:

- **Mental health impacts**: Mental health impacts relate to the increased independence, societal integration and wellbeing benefits associated with provision of appropriate

[39] https://socialvalueuk.org/resources/a-guide-to-social-return-on-investment-2012/

[40] (1) Involve stakeholders (2) Understand what changes (3) Value the things that matter (4) Only include what is material (5) Do not over-claim (6) Be transparent (7) Verify the result.

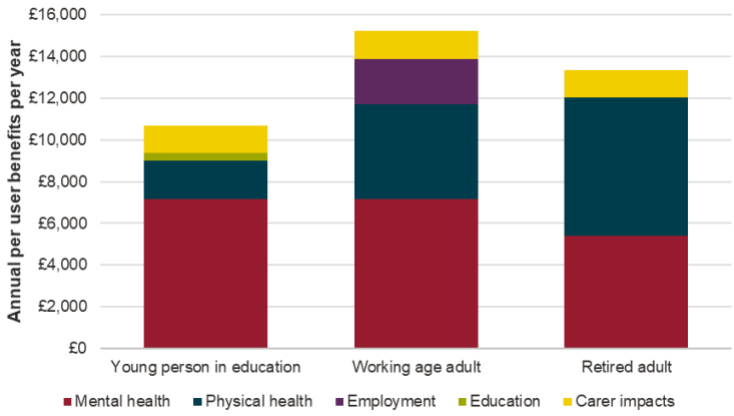
wheelchairs to users. These benefits are relevant for all groups of wheelchair users. However, the magnitude of these benefits varies by user type.

- **Physical health impacts**: Physical health impacts relate to reduced likelihood of falls, reduced likelihood of musculoskeletal problems e.g. back pain and reduced incidence of pressure ulcers for wheelchair users who have access to appropriate equipment and follow-up care. These benefits are relevant for all groups of wheelchair users. However, the magnitude of these benefits varies by user type.
- **Employment impacts**: Employment impacts relate to improved likelihood of an individual being in work and being able to work longer hours when provided with an appropriate wheelchair. This benefit is most relevant for working age adults. However, it is also important to acknowledge that retired wheelchair users may want to engage in unpaid work or volunteering. This form of valuable social participation may in some cases also be facilitated by having access to the right equipment and support. Employment impacts for carers are discussed below.
- **Education impacts**: Education impacts relate to the increased likelihood of improved educational attainment when wheelchair users can access the right wheelchair at the right time. This quantitative benefit applies to young wheelchair users only and impacts their future employment prospects. In some cases, older wheelchair users may also want to re-train or take part in additional formal education. It is important to acknowledge the potential for these impacts even if we have not modelled their magnitude specifically.
- **Carer impacts**: Carer impacts cover both (1) reduction in physical health issues for carers when wheelchair users have the right equipment and carers are given appropriate training (2) increased opportunities for labour market participation for carers when users have the right equipment and are therefore more independent. Both of these channels could also have knock-on effects on carers' mental health. Like wheelchair users themselves carers will also include individuals who are relatively younger and relatively older. We have modelled average carer impacts rather than attempting to split out separate impacts for carers of different ages.

8.2 Overall results

Our analysis shows that provision of high quality wheelchairs can have a significant positive impact on people's lives and also lead to financial benefits for the NHS and society.

Figure 13 Annual benefit estimates by user group and benefit category



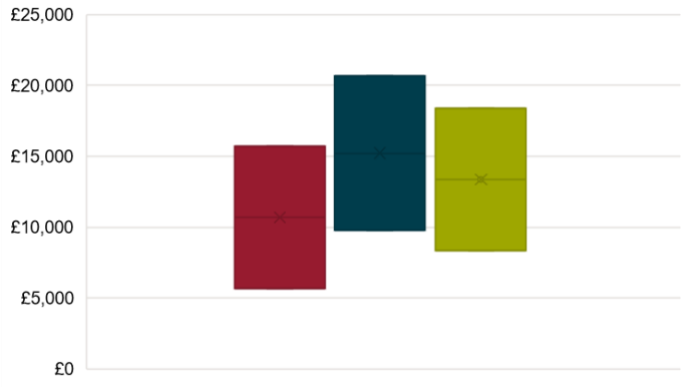
Source: Frontier based on user engagement and secondary evidence

Our central estimates suggest that the annual benefits of appropriate wheelchair provision for young wheelchair users, relative to poor or uneven provision, are approximately **£10,700** per user, per year. The equivalent figures for working age adults is **£15,200** and for retired adults is **£13,400**. We have illustrated these results above.

Our central estimates are the midpoints of upper and lower bounds for each of our user groups. These ranges reflect underlying uncertainty in certain modelling parameters. For example, we have drawn on multiple external sources to inform specific modelling parameters. Some of these sources report higher/lower impacts than others (which may be driven by slight differences between the metrics used or the sample population for example). We have used ranges to reflect this.

As we have illustrated below the range of potential annual benefits for a young wheelchair user in education from appropriate provision is £6,000-16,000. The equivalent ranges for working age adults and retired adults are £10,000-21,000 and £8-18,000 respectively.

Figure 14 Upper and lower bound annual benefit estimates by user group



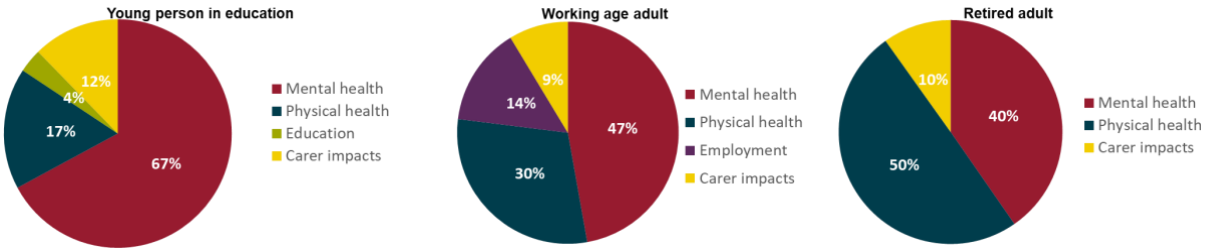
Source: Frontier based on user engagement and secondary evidence

We present the results for each sub-category of benefits in the following sub-sections.

8.3 High level breakdown by category

In Section 8 we provide granular detail on the approaches we have used to estimate benefits across each category and detailed results for each category. Below we have provided a high level breakdown of how total benefit results can be broken down into the relevant benefit categories for each wheelchair user type.

Figure 15 Breakdown of total benefits by benefit category for each user type



Source: Frontier modelling

We can see that for young wheelchair users in full time education mental health impacts are the largest source of benefits and account for two-thirds of total benefits. Mental health impacts are followed by physical health impacts (17%), impacts on carers (12%) and education impacts (4%) respectively. For working age wheelchair users the distribution is different and employment impacts are the third largest category (14%). Again, mental health impacts are the largest driver of benefits for this group. Finally, amongst retirement age wheelchair users physical health impacts are the largest source of benefits and accounts for 50% of total benefits.

8.4 Cost comparison

To help put our annual benefit estimates into context we have examined the current average level of NHS spending per patient registered with NHS wheelchair services using the National Wheelchair Data Collection data covering January – March 2023.[41]

Below we have illustrated annual spending per patient across each ICB. It is clear that per patient spending varies hugely in different parts of the country. To some extent this is to be expected. Different ICBs will serve different local populations which will lead to a variation in

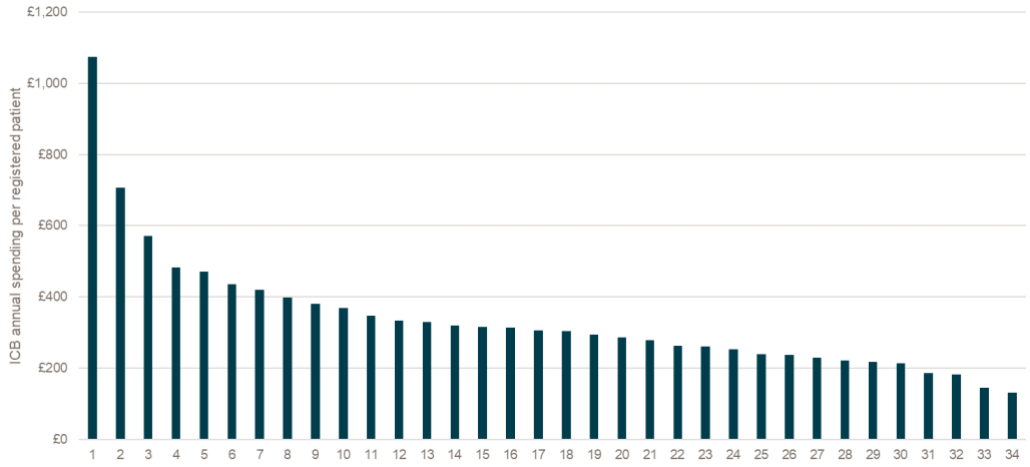
[41] https://www.england.nhs.uk/statistics/statistical-work-areas/national-wheelchair/national-wheelchair-data-collection-quarterly-publication-files-2022-23/

case mix that could justify some differences in per patient spending. However, it does not seem reasonable that this factor alone can explain all of the observed variation.

In addition, there seems to be some reporting issues and it is possible that some ICBs are not accurately recording their total per patient level of spending (several areas report implausibly low average per patient spend). If we exclude these outlier values median spending per patient per year is approximately £300.

Not all of this budget will be spent on equipment. A significant proportion of this £300 per year average spend on each patient will be accounted for by staffing and other non-equipment costs. Best estimates currently suggest that equipment may account for approximately a third of total NHS wheelchair budgets.

Figure 16 Variation in ICB spending per registered patient (2023 Q1 data)



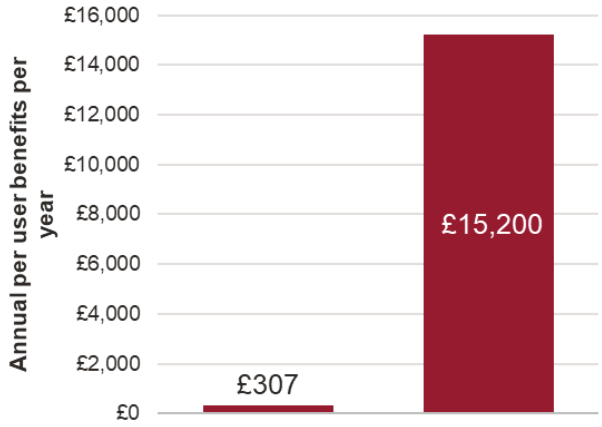
Source: *Frontier analysis of National Wheelchair Data Collection*

Note: *A small number of ICBs did not report budget data. Reporting issues are likely to be affecting a small number of ICBs who did provide figures*

As we outlined in Section 3 there is additional spending on wheelchair equipment and services outside of these figures via private purchase and charitable funding. However, NHS wheelchair services remain by far the single most important source of investment in wheelchair provision across England. To help put our annual benefit estimates into context we have illustrated below the difference between the current average level of NHS spending per user and our estimate of annual benefits on a per user basis.[42]

[42] For the purposes of this illustration we have focused on a single user type (working age adults) and used our midpoint benefit estimate.

Figure 17 Estimated annual benefits per user vs. average NHS spend per user



Source: Frontier modelling and analysis of National Wheelchair Data Collection

We can see that the annual NHS spend per registered user is dwarfed by our estimated per user annual benefits which could be unlocked if NHS services were universally high standard. We know from this work and from previous work that NHS services are not universally achieving a high standard of provision and therefore significant amounts of the potential benefits from wheelchair provision are not being realised.

Taking both of the above points into account suggests that there is scope for increasing current spending and/or utilising existing spending in a more efficient or flexible way to help ensure that more of these benefits are realised in practice.

8.5 Potential return on investment associated with additional NHS investment in wheelchair equipment

For the purposes of illustration we have considered the potential costs and benefits associated with a rise in NHS spending on wheelchair equipment. As we outline in detail in the following section there are very well run NHS wheelchair services across the country currently and pockets of very high quality provision. However, there is also considerable evidence of unevenness in provision.

We have therefore considered the costs and potential benefits associated with increasing the equipment spend in ICBs that currently report below average total spending per registered wheelchair patient.

This analysis is illustrative in nature. There may also be more investment required in services run by other ICBs excluded from our analysis who currently report spending above average amounts per patient. Also, some of the ICBs who spend below average amounts per patient may actually be achieving positive patient outcomes due to particularly efficient processes or

a relatively simple case mix. However, it is sensible to first examine the group of ICBs who are spending less than other ICBs on average per patient.

The National Wheelchair Dataset does not provide a breakdown in total spending into categories such as equipment. We have therefore:

1. explored the increase in budget required to increase total per patient spending to the median level seen across the country for all those ICBs who currently report below average levels of per patient spending; and
2. applied a scaler (of 33%) to these additional costs to focus on equipment costs only.

According to this methodology the cost of increasing **equipment spending** to the average level amongst ICBs who currently report below average levels of per patient spending (the bottom 50% of ICBs) is approximately **£22 million** per year. This represents a 14% increase in our estimate of **current total annual NHS spending** on wheelchair services (including both equipment costs and non-equipment costs). Under this illustrative scenario there are approximately 450,000 patients who are registered with ICBs that would increase per patient spending.

Even if these patients collectively realised an **additional 1%** of total annual benefits of high quality wheelchair provision (estimated to be £10,700 per year for young wheelchair users in full time education, £15,200 per year for adult wheelchair users of working age and £13,400 per year for retired wheelchair users) the societal return would be almost **£60 million**. Even under this very conservative assumption the additional benefits would outstrip the additional costs by a ratio of almost 3:1. If patients registered in the relevant ICBs experience an additional 5% of total annual benefits of high quality wheelchair provision the societal return would be over 10 times higher than the costs.

It therefore seems sensible to explore opportunities to expand investment into NHS wheelchair services on the basis of the potential societal returns. The NHS itself would also experience significant cashable cost savings as a result of improved wheelchair service provision. In particular (which is captured in our social value calculations), wheelchair users themselves and their carers would experience fewer physical and mental health issues which would in some cases require costly treatment and unplanned secondary care. Therefore, there is a clear financial case for investment by the NHS as well as a wider societal case.

9 Detailed quantitative results by benefit pathway

In this section we provide a detailed breakdown of the specific method by which we quantified each of the benefit categories as well as quantitative results and qualitative case studies across the categories:

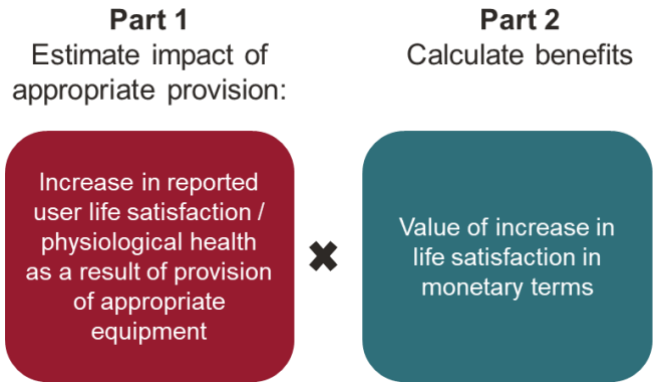
- mental health impacts;
- physical health impacts;
- employment impacts;
- education impacts; and
- impacts on carers.

9.1 Mental health impacts

Our estimation of mental benefits associated with improved wheelchair provision is based on existing evidence which shows that wheelchair users who have access to appropriate equipment are able to live more independent lives which results in higher levels of wellbeing.[43] Appropriate wheelchair provision has been shown to be an essential "lifeline", and the consequences of poor provision on quality of life are significant.[44] This wheelchair specific evidence is supported by a wider body of literature which finds that an individual's mobility, access to their community, and social integration all enhance health-related quality of life.

We can monetise the improvement in mental health which is linked to higher quality wheelchair provision using established benchmarks which assess the value of personal wellbeing.[45]

Figure 18 Causal pathway: mental health



Source: Frontier based on stakeholder engagement and review of secondary evidence

[43] e.g. Quiñones-Uriostegui et al., 2023 https://pubmed.ncbi.nlm.nih.gov/37036293/, Winkler, 2008 https://journals.lww.com/topicsingeriatricrehabilitation/fulltext/2008/07000/relationship_between_quality_of_wheelchair_and.8.aspx

[44] https://www.mdpi.com/1660-4601/18/7/3338

[45] https://www.economicsbydesign.com/the-economic-value-of-personal-wellbeing/

The underlying secondary evidence is not sufficiently granular to allow us to identify a difference in the magnitude of these impacts by user type. However, our primary engagement with wheelchair users indicated that the life satisfaction benefits of independence associated with appropriate provision may be higher for young wheelchair users and working age wheelchair users relative to wheelchair users of retirement age. We have built this age gradient into our modelling.

Our central estimates for annual mental health benefits for young wheelchair users, working age wheelchair users and retirement age wheelchair users are £7,200, £7,200 and £5,400 respectively. This benefit category is the largest category for each of these user types. Mental health accounts for over 40% of total benefits across each group.

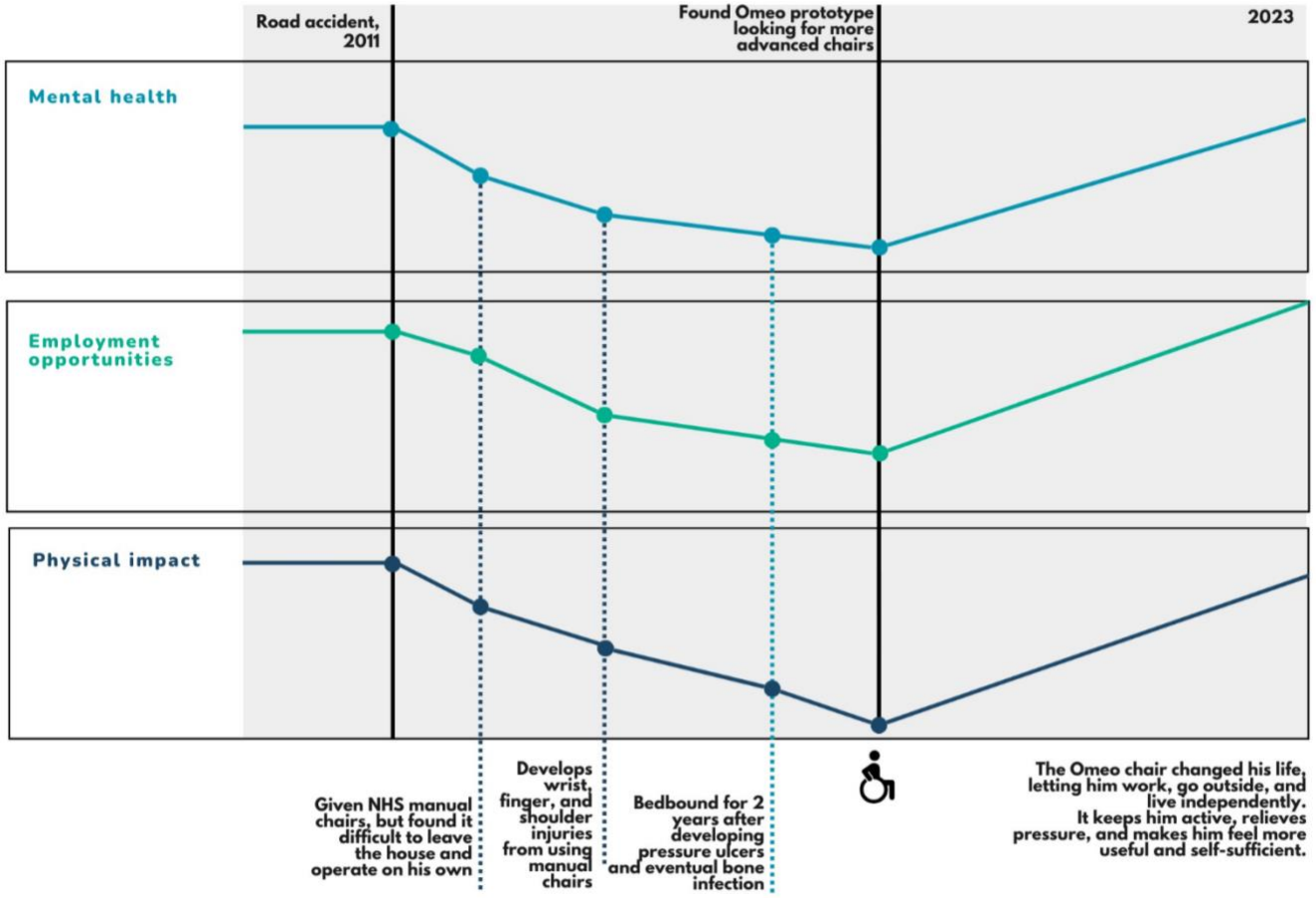
9.1.1 Case study: Mental health – Charlie's transformative chair has inspired him to help others

"Able-bodied people see that the dog needs to be walked and might think 'Oh, I can't be bothered.' To me now, I'm thinking, 'Wow, I can walk the dog!'"

The first time Charlie, now 33, sat in his new powered wheelchair, his world felt instantly bigger. His mind raced thinking about all the places he could now take his dog for a walk and even mundane tasks like mowing the lawn sparked a sense of excitement. Charlie felt "useful" for the first time since his accident.

It had been a long time since Charlie had felt so happy. At the age of 15 he was made homeless, and he bounced between jobs and accommodation until he was 20. The following year when cycling to work, Charlie got hit by a car and was paralysed from the waist down.

Figure 19 Charlie's journey



Source: Qualitative engagement

Over time, Charlie began to adapt to life in a wheelchair – excelling at sports like wheelchair tennis – before he was diagnosed with pressure ulcers and bedbound for two years. Pressure ulcers occur when the skin is damaged from prolonged periods of restricted movement so wheelchair users, especially those with spinal injuries, are more prone to them than able-bodied people. During those two years, a nurse visited him twice a day to change his dressing, but the bone became infected and he had a series of medical interventions until eventually the ulcers healed. Although he had physically recovered, his mental wellbeing had deteriorated as a consequence of his isolation and dependence. Unsure of what his future would look like, he started to lose hope.

"I was just thinking, this is my life now. I wasn't ready for it. I spent maybe a month or two in a depressive state, eating a lot and I gained a lot of weight."

Finding that using a manual chair was hurting his shoulders and hands, Charlie began searching for alternative options online, specifically a powered chair. By chance, he came across the Omeo wheelchair in prototype form. The Omeo is a hands-free powered wheelchair that is designed for all forms of terrain and allows the user to control its movement and direction by shifting their body weight. At that time, only one Omeo had been created, crafted by the founder for a friend. Despite the distance from New Zealand, where the founder was based, Charlie contacted him and requested one, to which he agreed. To afford it, Charlie sold many of his personal belongings, finally obtaining the means to purchase his own Omeo – an expensive leap of faith.

The risk paid off, and Charlie's new wheelchair changed his life. From significant milestones, such as playing badminton with his son for the first time, to seemingly trivial tasks like carrying a cup of coffee between rooms, Charlie discovered a new appreciation for life.

"I'm doing things that normal people do. Like gesticulating in conversation. That's what it's all about, isn't it? To make you feel more human."

Driven by the desire to let other wheelchair users share the same joy, Charlie joined Omeo, founding and heading up its UK arm. "It's really heartwarming and it's cool just being able to help others." After years of struggles and setbacks, being able to inspire others brought Charlie a deep fulfilment.

Charlie's extraordinary story highlights how transformative the right wheelchair can be. His decision to buy his own chair was expensive – and risky – but Charlie's wheelchair has enabled him to participate in work, reconnect with his family and friends, and most of all, enjoy life's little pleasures, such as taking his dog for a walk, or tending to the garden. Crucially, his Omeo has given him back the agency to make decisions without having to consider whether his wheelchair will be accommodated.

"It's no longer about 'Can we go here?' or 'Can we do this?' It's more like, 'Let's go do this,' or 'Do you want to come with me?'"

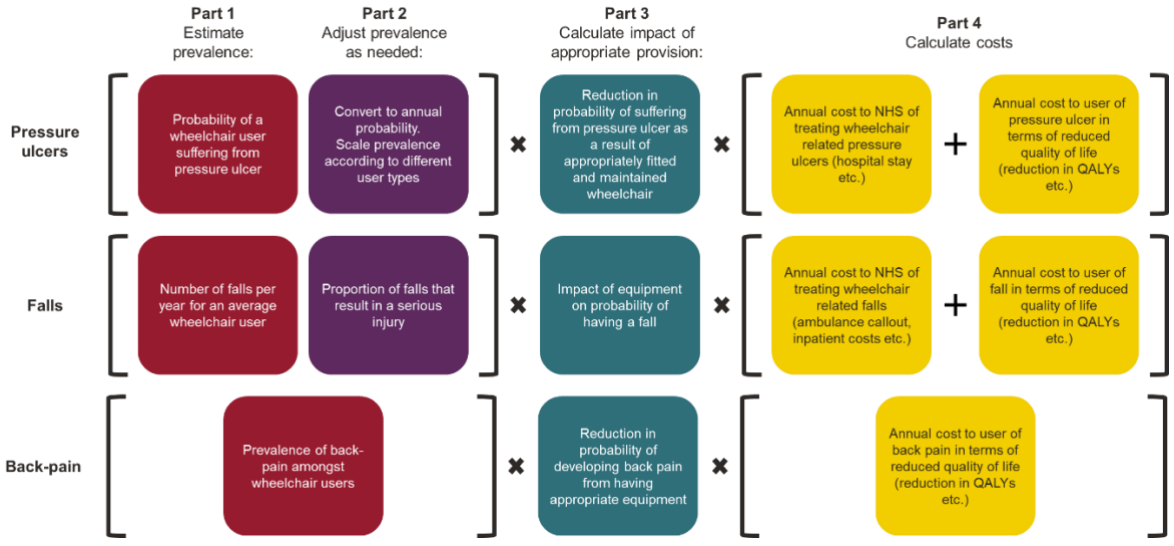
9.2 Physical health impacts

A wheelchair can impact a users' physical health in a number of different ways. Previous work has highlighted how an ill-fitting wheelchair or ill-equipped wheelchairs can directly cause users harm or contribute to the deterioration of a users' physical condition over time.[46] Our engagement with wheelchair users and review of existing evidence highlighted three material physical health impacts of high quality wheelchair provision which could be feasibly modelled:

- reduction in the prevalence of pressure ulcers;
- reduction in the likelihood of falling from a wheelchair; and
- reduction in the likelihood of a user developing musculoskeletal issues (e.g. back pain).

In all three cases we collected evidence on the likelihood of a wheelchair user experiencing a specific physical health issue.[47] For example, previous work suggests that up to half of all people who use a wheelchair will develop a pressure ulcer at some point during their life, which is caused, in part, by ill-fitting or ill-equipped wheelchairs (e.g. a wheelchair with an incorrect pressure relieving cushion). We then calculated the impact that appropriate wheelchair provision could have on reducing this relative-risk for different types of wheelchair user.[48] Finally, we estimated the costs per user (both in terms of personal costs to wellbeing and costs to the NHS) if they experience a specific physical health issue and calculated the magnitude of potential cost savings associated with the reduction in risk.

Figure 20 Causal pathway: physical health



Source: Frontier based on stakeholder engagement and review of secondary evidence

[46] https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

[47] e.g. OHID Guidance on Pressure Ulcers https://www.gov.uk/guidance/pressure-ulcers-applying-all-our-health

[48] e.g. Bui et al. (2017) & Breinza et al. (2010) report a 40-50% reduction in the risk of developing a pressure ulcer when wheelchair users are provided with high quality wheelchairs with tailored fit and appropriate cushioning.

Our central estimates for annual physical health benefits for young wheelchair users, working age wheelchair users and retirement age wheelchair users are £1,800, £4,500 and £6,650 respectively.

The potential benefits are larger for older adults because their baseline risk of developing a pressure ulcer or experiencing a fall for example are higher (holding the quality of wheelchair provision constant). Therefore, any reduction in risk associated with higher quality wheelchair provision leads to a bigger financial impact in absolute terms.

Physical health benefits accounts for 17% of total benefits for young wheelchair users, 30% for working age wheelchair users and 50% for retirement age wheelchair users.

9.2.1 Case Study: Physical health – Simon's functional powered wheelchair keeps him healthy and working for important causes

"With the new chair, there's nothing I can't do that other people could do."

Simon, 62, is a proud husband and father to four sons. Over the years, he has loved watching his sons play sport, socialising with his friends, going to Twickenham to watch the rugby, and throwing himself into many areas of work.

He is now a professor at a leading university in the south of England, and does a variety of other paid and voluntary roles, some of which focus on improving experiences for people with disabilities and health. For much of his career he was chief executive of a company with 1,400 employees, 10% of whom had disabilities, which is the achievement he is most proud of.

But Simon's achievements have been hard won. At age 20 in 1981, he broke his neck playing rugby at university, and has not had movement from the neck down ever since. He was forced

to abandon his degree in medicine, but has always been career-driven, and has worked remotely throughout his career.

Over the decades since his injury, he has used a variety of powered wheelchairs, only some of which have been suitable for him. When he is stuck in an uncomfortable position, his body spasms. He needs a wheelchair that has adaptations to prevent this, but for many years they weren't available.

Because Simon's physical mobility is so limited, he also needs a wheelchair that can recline in various directions, to shift the pressure onto different parts of his body. Again, these have not always been available. As a result, in 2006, Simon was bedbound for three months because of pressure ulcers. The physical discomfort that he was in and the cost of his care because of his inadequate provision was very significant. His care increased 15 hours a week, and his wife had to reduce her work by 10 hours a week, all to provide the care that he needed whilst bedbound.

Being confined to his bedroom for weeks on end not only affected Simon's physical health, this period of inactivity had a dramatic impact on his mental health, and he became depressed. The experience also left Simon at greater risk of developing further skin issues in the future.

"The kids were youngsters, so they were playing rugby and football and cricket at the weekends and I couldn't go to watch them. They always like their dad to go and watch them doing things."

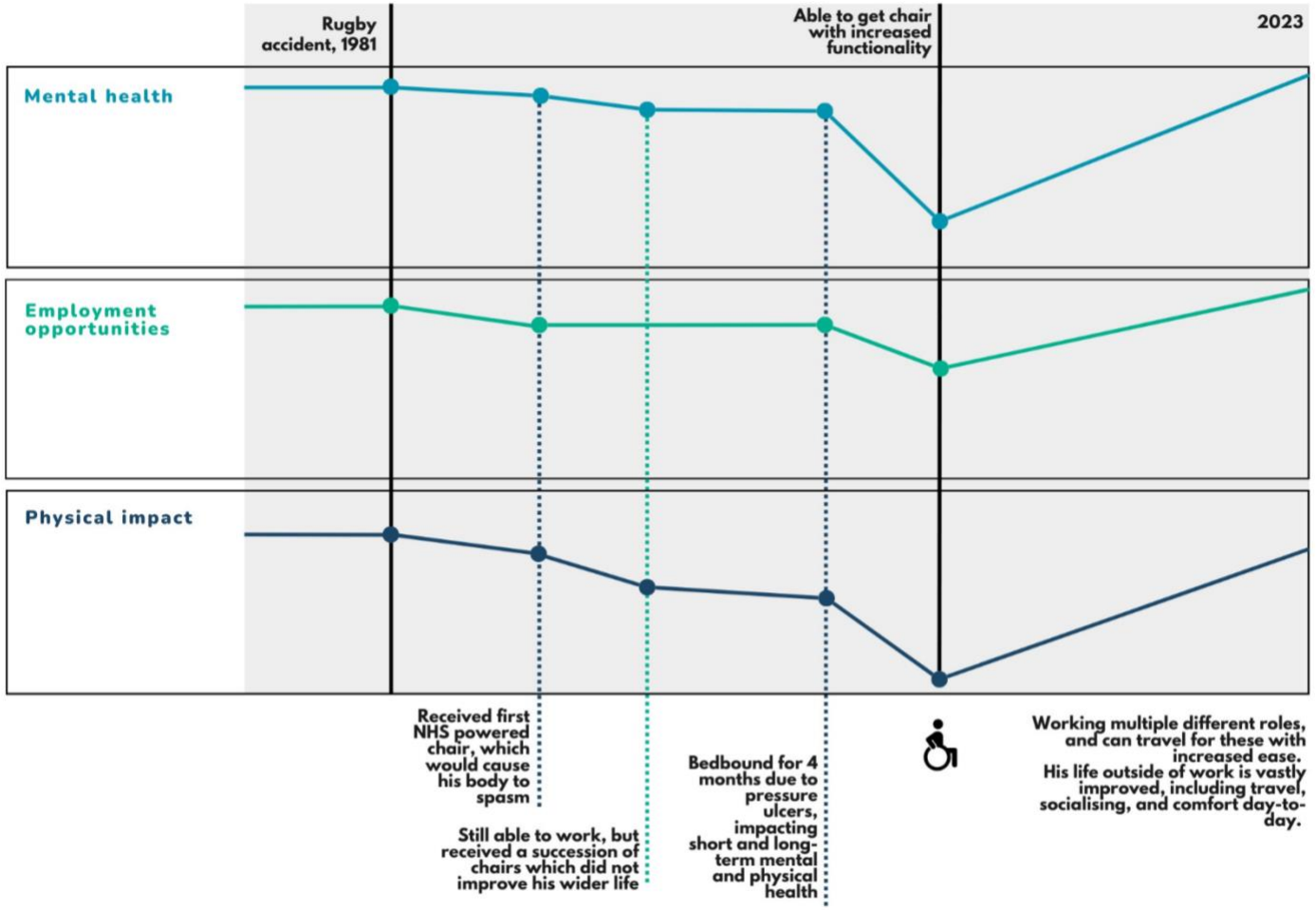
Thankfully, Simon recovered and has been able to buy a wheelchair that meets all his needs. Using a combination of an NHS voucher, personal investment, and additional charitable funding, Simon has been able to buy a wheelchair that fully reclines, rises and lowers, moves back and forth on the spot, and relieves pressure to avoid the risk of pressure sores. And he is living life to the fullest.

"There's a pure sense of personal satisfaction that I get out of it. I've always had this mission since my accident to make the world a better place for disabled people, and if I stopped in 2006 and thought that was it, that's the end and that's as much as I can do, then that would have been a huge disappointment, and perhaps many other people I've touched during that journey wouldn't be doing what they're doing now."

By his own admission, the improvement in Simon's life is down to his confidence and experience navigating the system, a detailed knowledge of exactly what he needs, and the financial fortune to be able to invest in a wheelchair as expensive as his.

"I've got a PhD and I'm a qualified doctor, and it's hard for me to work out how to do it. How other people with mild learning difficulties or they've got a family who aren't literate, or whatever it might be, can work out how to do it and manage the system is beyond me"

Figure 21 Simon's journey



Source: Qualitative engagement

9.3 Impact on employment

Currently, wheelchair users of working age participate in the labour market at lower rates than the rest of the population.[49] This is driven by a range of factors including employer bias, lack of workplace adaptation, inadequate infrastructure, as well as **inappropriate wheelchair equipment**. Poor quality wheelchair provision limits the ability of users to commute to work and participate fully in certain workplace activities. Previous work has noted that wheelchair quality impacts users' ability to find and keep employment.[50]

9.3.1 Case Study: Employment – George's unsuitable chair has diminished his life and restricted his employment opportunities

"I feel like I don't have any power anymore."

George, 58, lives in a renovated cottage just off the Yorkshire coastline with his wife and two dogs. For much of his life, George travelled and worked across the country as a community development and housing consultant. He loved exploring new places, which usually ended with him at the pub with the locals. When at home, he devoted his time to caring for his wife, who has been a wheelchair user since she was diagnosed with muscular dystrophy.

In the past few years, George's health has suffered a series of blows, including a stroke which has inhibited his ability to move the right side of his body. After several stays in hospital, including a coma lasting three weeks, George was given a manual wheelchair by the NHS that was not tailored for him and which he did not anticipate using long-term. But a year later he remains in this 'interim' wheelchair. The lack of strength in his right arm leaves him unable

[49] https://academic.oup.com/esr/article/37/5/818/6190466

[50] https://www.tandfonline.com/doi/abs/10.1080/17483107.2020.1754928

to push himself around his home, so he tends to spend most of his days at his dining room table.

George struggles to look after his wife the way he wants to, and he is no longer able to work or do routine tasks without extreme difficulty. All this has taken a huge toll on his mental health. He feels trapped in his home and "useless".

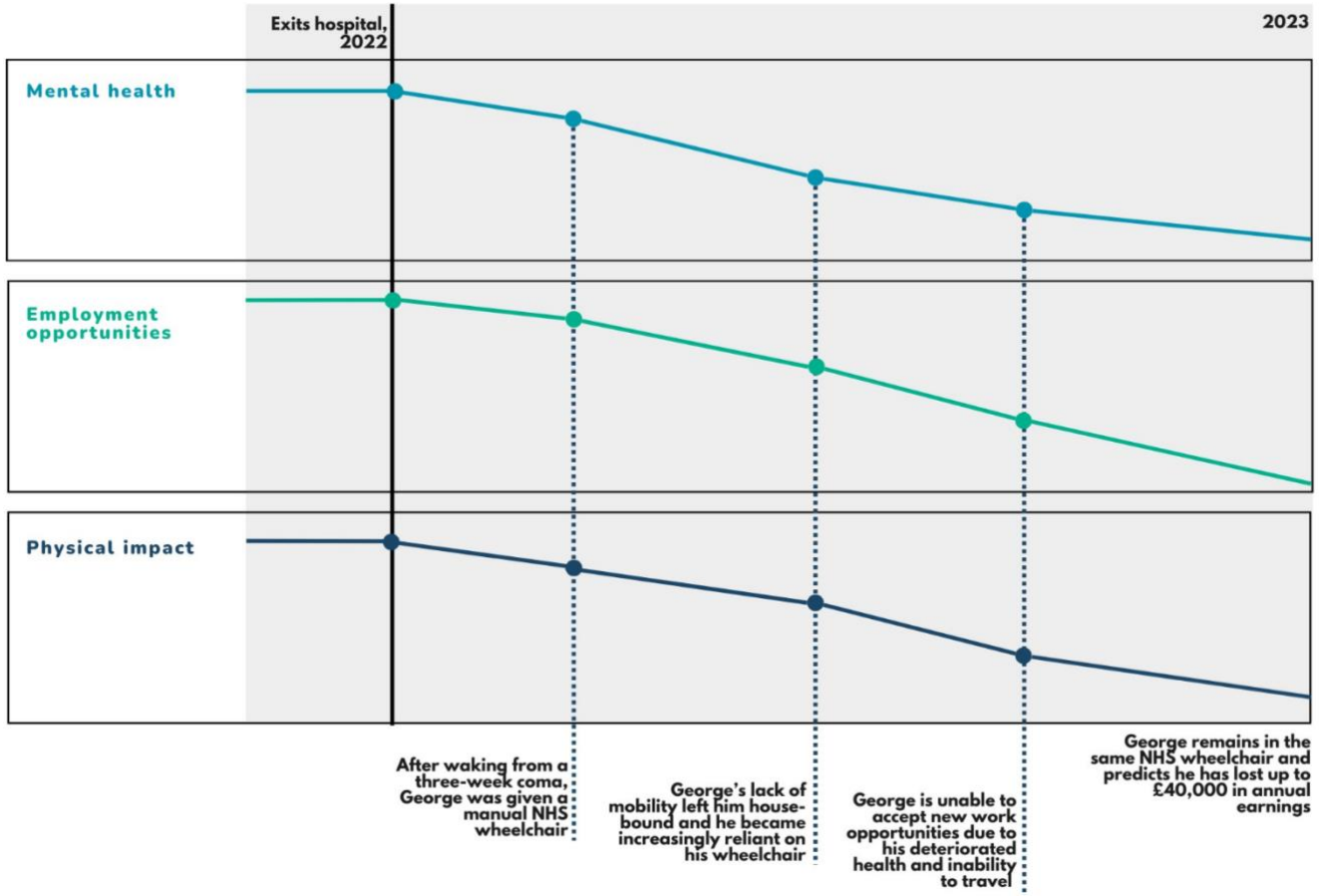
"I miss a lot of things. I'd like to be able to look after my wife more than I can now. I'd like to be able to enjoy cooking again. I loved cooking. Now I'm just cooking for subsistence. I don't eat that much now, I just wasn't up to cooking it."

Furthermore, George's job was an integral part of his identity, and he misses the buzz of running a multi-million-pound housing project. For almost two years, George has been unable to accept new work opportunities, and predicts he has lost up to £40,000 in annual earnings. He and his wife are not eligible for a wheelchair accessible vehicle (WAV), and they are not in a financial position to pay for their own.

"If I had an income, I would have money to get better equipment. I've lost the choice. I feel like I don't have any power anymore."

In comparison, George has witnessed first-hand the benefits a comfortable and adapted wheelchair has brought his wife, who has been able to continue her successful career as an accountant. When his wife became a permanent wheelchair user in her forties, the adjustment to working in a wheelchair from home was substantially eased by having a powered wheelchair that caters to her needs. Seeing his wife continue to do the work that she loves has given George hope that he can do the same, but with the assistance that he is currently being given, this seems a long way away.

Figure 22 George's journey

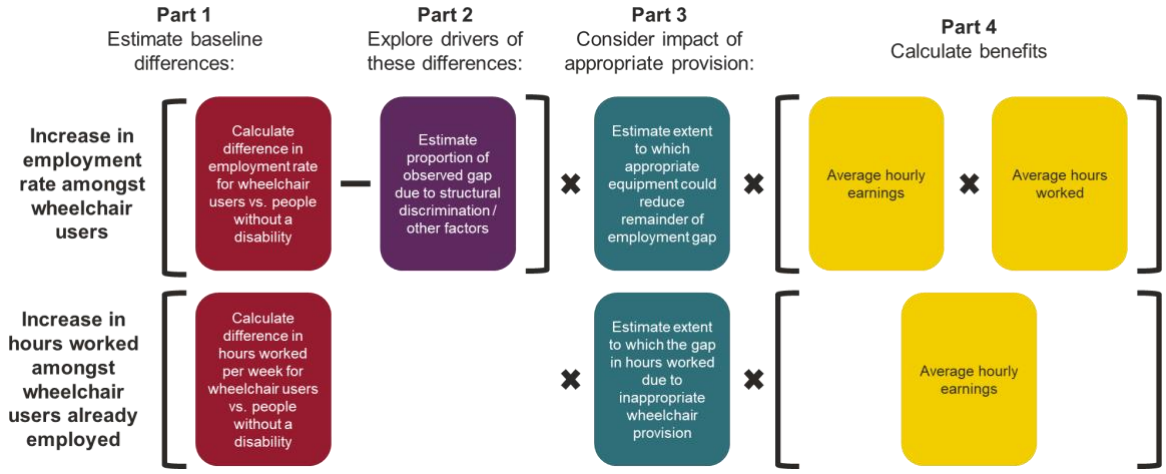


Source: Qualitative engagement

9.3.2 Quantitative modelling

To help quantify the average employment impacts associated with high quality wheelchair provision we explored two specific benefit pathways.

Figure 23 Causal pathway: employment



Source: Frontier based on stakeholder engagement and review of secondary evidence

- Increase in average employment rates (likelihood of having a job) amongst working age wheelchair users who have access to appropriate equipment versus users who do not have access to appropriate equipment. To monetise this benefit pathway we firstly calculate the overall difference in employment rates between those using a wheelchair and the rest of the population using detailed survey data.[51] We then estimate the proportion of this gap that could be addressed by enhanced wheelchair provision by stripping out the impact of other structural factors.[52] Once we have a proportion of the employment gap that could be impacted by higher quality wheelchair provision we calculate the resulting value using average annual earnings using ONS employment statistics.[53]
- Increase in the number of hours worked per week amongst employed wheelchair users who have access to appropriate equipment versus employed users who do not have access to appropriate equipment. For this benefit pathway we start by calculating the average difference in hours worked between those who are employed and use a wheelchair and the rest of the working population.[54] As above we then estimate the

[51] https://www.scope.org.uk/media/disability-facts-figures/#:~:text=The%20disability%20employment%20gap%20is,that%20of%20non%2Ddisabled%20people.

[52] e.g. impact of discrimination

[53] https://www.gov.uk/government/statistics/the-employment-of-disabled-people-2021

[54] https://www.gov.uk/government/statistics/the-employment-of-disabled-people-2021

proportion of this gap that wheelchair provision could feasibly impact.[55] Our central estimates for annual employment benefits for each working age wheelchair user are £2,200. For working age wheelchair users we estimate that employment effects account for 14% of total benefits.

We have not produced quantified benefit employment estimates for younger wheelchair users or older retired wheelchair users. However, our qualitative engagement did highlight that older wheelchair users who are not be in formal employment may want to make valuable contributions to society via volunteering or charity work. Inappropriate wheelchair provision may limit the ability of this group of users to make these contributions.

9.3.3 Case Study: Employment – Sally's chair has meant she can share her love of swimming through teaching

"I am no longer isolated from the world."

Growing up, Sally had a passion for swimming. She started working at her local pool when she was 16 and her goal was to compete in long distance open-water swimming competitions. But during her second year at university in 2010, Sally was struck by a car while riding her bike. While her injuries were not immediately severe, they developed into complex regional pain syndrome (CRPS) and fibromyalgia. She had to take a year out of university and finish

[55] In this case we assume that 30% of the observed gap in average working hours per week could be eliminated via provision of appropriate wheelchairs. This is a very conservative estimate and supported by our primary engagement with wheelchair users themselves as well as existing evidence which shows that a significant proportion of wheelchair users report missing work due to a breakdown in their wheelchair.

her degree part time. She still worked at a leisure centre but open-water swimming became a distant memory.

As Sally's condition worsened, so did her mobility – and her confidence. She went from a once-active lifestyle to one where every movement became a struggle. At first, Sally was reluctant to use a wheelchair, but upon borrowing one she recognised the benefits and made the decision to source one for herself.

Sally bought her first wheelchair privately. Her second wheelchair was from an NHS wheelchair service. They were both heavy, which made self-propelling difficult. Along with her chronic pain and fatigue, working as a swimming teacher at the local pool became too exhausting and she had to quit her job in 2014.

"Working just seemed so far-fetched, to be honest. It's what I wanted to do, but I just couldn't do it physically – I was too exhausted."

When Sally was due a new wheelchair from her NHS wheelchair service, she went to a disability roadshow to see what options existed. Discovering the variety in wheels – some suitable for rural, off-road terrain – and the Tri-ride was a decisive moment for Sally. She realised the possibility of independently accessing open-water swimming was not out of reach as a wheelchair user.

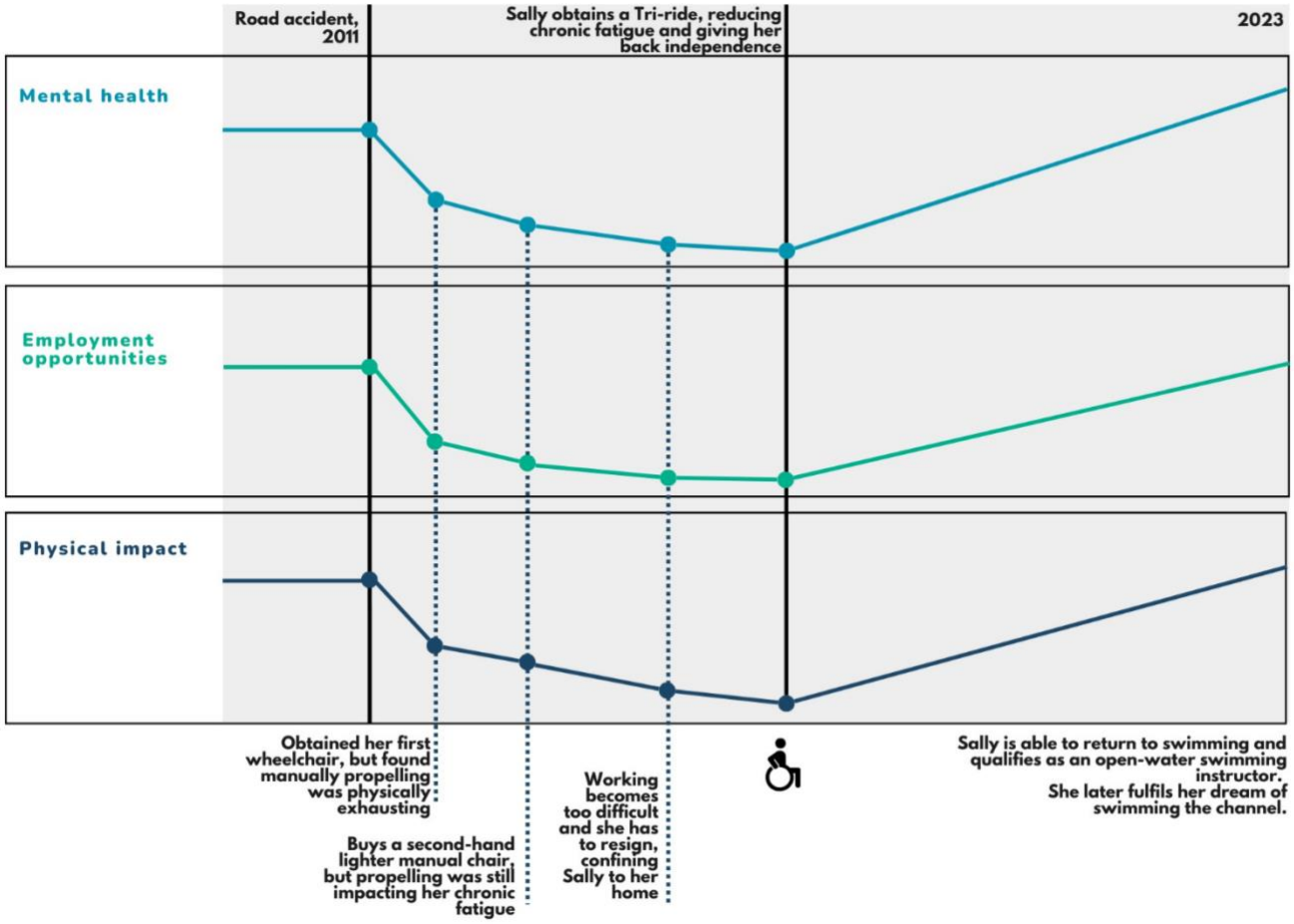
"It was through the confidence that the Tri-ride gave me, I could get to places and was no longer isolated from the world."

Sally's life underwent a profound transformation when she successfully fundraised for the Tri-ride. With a speed limit of 15mph, it replaced her need for a car in her local area, granting her easy access to and around places like her local swimming pool. This newfound mobility not only gave her the confidence to pursue her open water swimming qualification, but it also enabled her to teach both one-on-one and group open water swimming lessons in situ.

"One of my main aims has always been to get back into work. And now that I've got the right chair and the confidence with it, I feel like I can put myself out there a bit more."

Sally is now making her own money and is no longer confined to her home. This has had a profound impact on her wellbeing.

Figure 24 Sally's journey



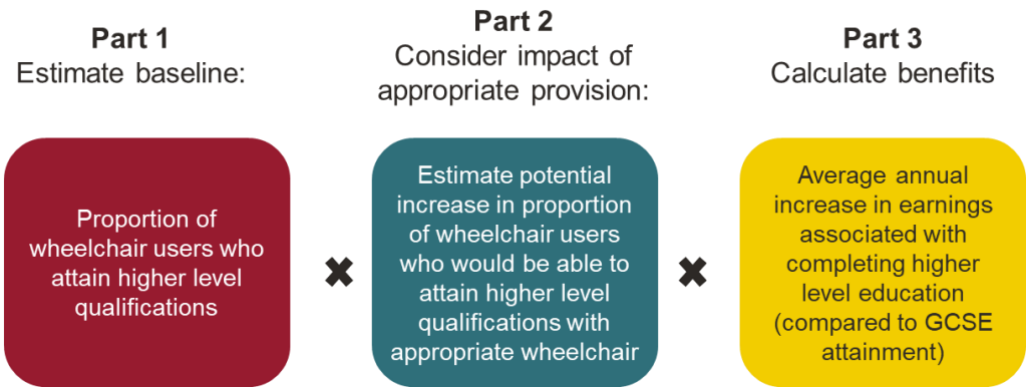
Source: Qualitative engagement

9.4 Impact on education

Previous work has highlighted that early provision of an appropriate wheelchair helps support a young person's educational experience.[56] Specifically, untimely follow-up, maintenance and repair services, particularly when the wheelchair breaks down, have been shown to have a negative impact on educational participation and attainment.[57]

We have included an estimate of these benefits in our quantitative modelling. Any reduction in educational outcomes during early life can have significant impacts on an individual's life time earnings potential (which is a proxy for their future productivity). To make this modelling pathway tractable we focus on the difference in the proportion of wheelchair users who attain a higher level qualification relative to the proportion of the general population. Currently this gap is approximately 20% points.[58] In line with the approach we used to measure potential employment impacts, we estimated the share of this differential that could be attributed to appropriate wheelchair provision.[59] Then, we convert the potential impact of wheelchair provision on attaining higher level qualifications to a monetised impact by using existing evidence on the average increase in annual earnings associated with completing higher level education (relative to having GCSE level qualifications).[60]

Figure 25 Causal pathway: education



[56] https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

[57] https://www.mdpi.com/1660-4601/18/7/3338

[58] https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/disability/articles/outcomesfordisabledpeopleintheuk/2021#:~:text=3.-,Education,%25%20of%20non%2Ddisabled%20people.

[59] In this case we assume that approximately 30% of the observed gap in higher level qualification attainment could be eliminated via provision of appropriate wheelchairs. This is a very conservative estimate and supported by our primary engagement with wheelchair users themselves as well as existing evidence which shows that a significant proportion of wheelchair users report missing education due to a breakdown in their chair.

[60] This insurance is approximately 20% https://ifs.org.uk/sites/default/files/output_url_files/R167-The-impact-of-undergraduate-degrees-on-lifetime-earnings.pdf

Source: Frontier based on stakeholder engagement and review of secondary evidence

Our central estimate for annual education benefits for young wheelchair users are £360. We have focused our quantitative modelling of this pathway on young wheelchair users only. However, our engagement with wheelchair users did suggest that there may also be some education benefits of high quality provision for adult wheelchair users who may wish to retrain at some point in their lives. These impacts have not been included in our modelling which means our education estimates are conservative and represent a lower bound.

9.4.1 Case Study: Impact on Education – Duncan's Tri-ride attachment has allowed him to excel in school and explore the world

"The Tri-ride has enabled me to go to places I wasn't able to go."

Duncan, like most 18-year-olds, values time with his friends, outings to the pub and making the most of his growing independence. Living with his parents and younger brother in a rural village near Plymouth means he appreciates his newfound ability to drive and uses his car to go to college, where he is in his second and final year of studying health and social care.

Looking to the future, Duncan is working towards getting the grades to study law or occupational therapy at university; a goal that at one point seemed entirely unattainable. At the age of 10, after collapsing on a family holiday to Blackpool, Duncan received the diagnosis of Ehlers-Danlos Syndrome (EDS). EDS is an invisible disability that affects the body's connective tissue, causing a variety of symptoms such as chronic pain, fatigue, dizziness and digestive problems. Paired with a later diagnosis of POTS (Postural Tachycardia Syndrome – a condition that causes rapid increase in heart rate after sitting up or lying down) and chronic fatigue, Duncan experiences debilitating exhaustion if he exerts himself for too long, and now spends most of his time in a wheelchair.

For as long as he can remember, Duncan has been "sports mad", meaning the diagnoses triggered a significant lifestyle change for him.

"Every single weekday in the evening there was sports. Football, hockey, cricket, swimming, you name it, I gave it a go."

No longer being able to take part in such activities, and instead having to observe his friends play from the sidelines, was a challenging adjustment. EDS has affected Duncan's life in more ways than just physically. Being the only person at school in a wheelchair exacerbated feelings of anxiety, and adjusting to peers towering above him in conversation took time. This, paired with poor wheelchair provision, impacted both his experience of education and more widely, his experience of childhood.

"My old chair looked more blocky, more clinical, more NHS… when I first used my wheelchair I really didn't want to use it. You're then the only person in a wheelchair in your school, automatically people look at you. You're more conscious of that."

Over the years, Duncan has been supplied with two inappropriate wheelchairs from the NHS. Given his ability to walk, the NHS deemed him to only require standard manual wheelchairs with minimal adaptations, according to their criteria of what is considered 'clinically appropriate'. His first wheelchair was built using the wrong measurements, and had to be sent back immediately, meaning that Duncan was left waiting for his incorrectly sized wheelchair, but also the replacement for it.

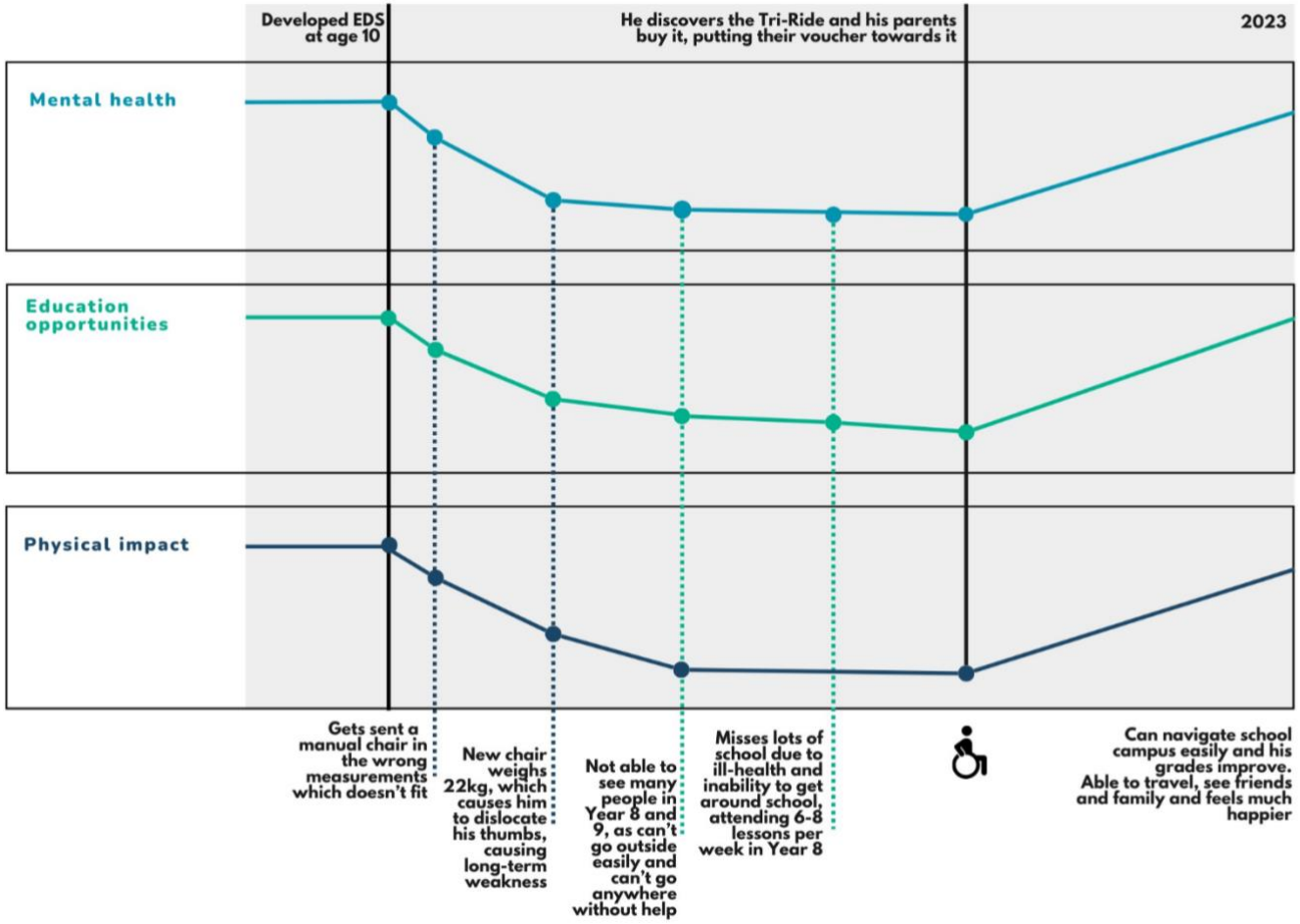
The second wheelchair weighed 22kg, which, paired with his chronic fatigue, meant that self-propelling required a significant amount of effort. In this time, Duncan dislocated his thumbs through pushing the weight of the wheelchair, and they remain weaker to this day.

Throughout Year 8, he was unable to push himself to his lessons because the wheelchair was too heavy, so he had to work separately from his classmates and remain on the ground floor. Working independently without interaction from teaching staff and classmates was detrimental for Duncan and it was only with support from his family that he was able to catch-up.

Duncan's family were also impacted by the poorly fitting wheelchair. His mum suffered a back injury after attempting to lift the wheelchair into the car, putting her out of work and consequently, less able to care for Duncan at home and help with school. As a result, Duncan's dad had to give up his full-time job and become self-employed with fewer hours in order to provide more care. The consequences of Duncan's 'clinically appropriate' wheelchair were far-reaching, affecting not just Duncan's physical comfort and health, but also his educational attainment, social integration, and his family's wellbeing.

"I've been apprehensive every time I've gone to wheelchair services, because it always feels like a battle. Or you need to come with everything prepared – the whole list of why you need a chair, what you need it for, what the benefits are. It can make it an unpleasant experience."

Figure 26 Duncan's journey



Source: Qualitative engagement

It was at this point that his parents lost faith in the NHS system and decided to take matters into their own hands, buying a wheelchair (via the voucher system) that was more suited to Duncan's needs. The wheelchair has a lighter frame which reduced the amount of fatigue he had experienced.

The most transformative attachment for Duncan was the addition of the Tri-ride. Using this attachment, he has been able to make the most of experiences with his friends and family that he wouldn't have been able to otherwise. Duncan can go on long walks around the countryside by himself, even up and down steep hills in his local area.

"We went to Iceland, and there's not many places I wasn't able to go with it… We've been to Disneyland as well, and the Tri-ride has enabled me to do a full day there, whereas previously we went for a few hours, and then had to go back to the hotel to rest."

Getting around his school campuses has been far easier, and looking to the future he has also been able to consider prospective campuses in the knowledge he will be able to manoeuvre around these campuses more easily.

9.5 Carer impacts

Currently wheelchair provision in England does not always adequately take the needs of carers into account. For example, we know that 75% of carers of wheelchair users have no training in how to reduce harm to their own health.[61] A high quality wheelchair service would: (1) provide the correct equipment to users which in turn would increase user independence and therefore reduce informal care requirements; and (2) consider carers' needs holistically as part of the assessment process and provide clear instructions on how best to support the wheelchair user in a safe way

We have therefore included two categories of carer impacts in our quantitative modelling:

- **Reduction in likelihood of carers developing musculoskeletal issues as a result of more appropriate wheelchair provision**. To model this we start with the proportion of carers who develop back issues (72%).[62] We then calculate the monetised value of these back issues by estimating the negative impact that moderate back pain has on quality of life (measured using Quality Adjusted Life Years).[63] Finally, we use a user validated assumption to gauge the potential impact of appropriate wheelchair provision on the risk of carers developing back pain.
- **Ability of carers to increase their employment rate if there is a reduction in the amount of assistance required as a result of improved wheelchair provision**. We

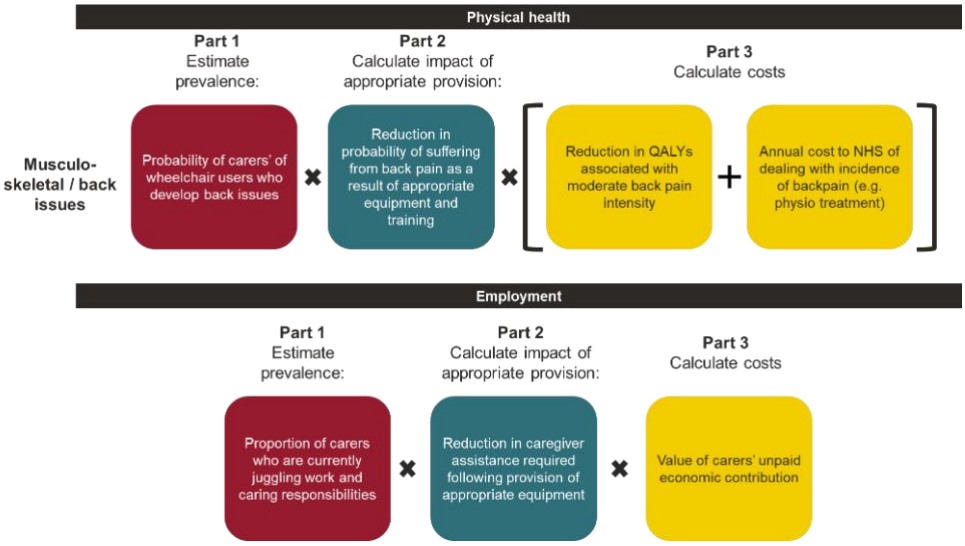
[61] https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

[62] https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

[63] https://pubmed.ncbi.nlm.nih.gov/20347225/

firstly focused on the proportion of carers who are currently juggling unpaid caring and formal employment (as this is the group most likely to increase their volume of formal work in response to a decrease in caring requirements).[64] We then examined evidence on the reduction in volume of caregiver assistance required when more appropriate equipment is provided.[65] We finally converted this to a monetised impact by using the current annual value of carers unpaid economic contribution.[66]

Figure 27 Causal pathway: carer impacts



Source: Frontier based on stakeholder engagement and review of secondary evidence

Our central estimates for carer benefits for all user types are £1,381 per year. These carer benefits account for 12% of total benefits for young wheelchair users, 9% for working age wheelchair users and 10% for retirement age wheelchair users.

[64] Evidence from Carers UK suggests that 1/7 carers are also juggling formal work https://www.carersuk.org/policy-and-research/key-facts-and-figures/

[65] Existing research suggests a reduction of approximately 12% https://bmchealthservres.biomedcentral.com/articles/10.1186/1472-6963-14-309

[66] https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/My-Wheelchair-My-Life-eDigest.pdf

9.5.1 Case Study: Impact on carers – Claire's inappropriate wheelchair has put constraints on Gary's livelihood and has been detrimental to his health

"Gary used to be a big walker – he can't do that anymore."

Claire (72) and her husband Gary (73) have been together since she was 20 years old. They have two children together. At the age of 47, Claire was diagnosed with Spinal Muscular Atrophy – a genetic disease that causes muscle deterioration and leads to a gradual decline in mobility. At the time, she taught at a local college, and Gary worked as a builder.

Gary and Claire wanted a change of scene in their fifties and moved to York (from Hull) to set up a clothes shop. They ran the shop for five years before Claire's mobility began to decline. At 60 she became a full-time wheelchair user, meaning that running a shop was no longer feasible. They returned to Hull. Gary, now Claire's primary caregiver, could not return to his previous role and instead took on a part-time retail role. Gary had to later turn down the offer of a full-time position as Claire's care needs increased.

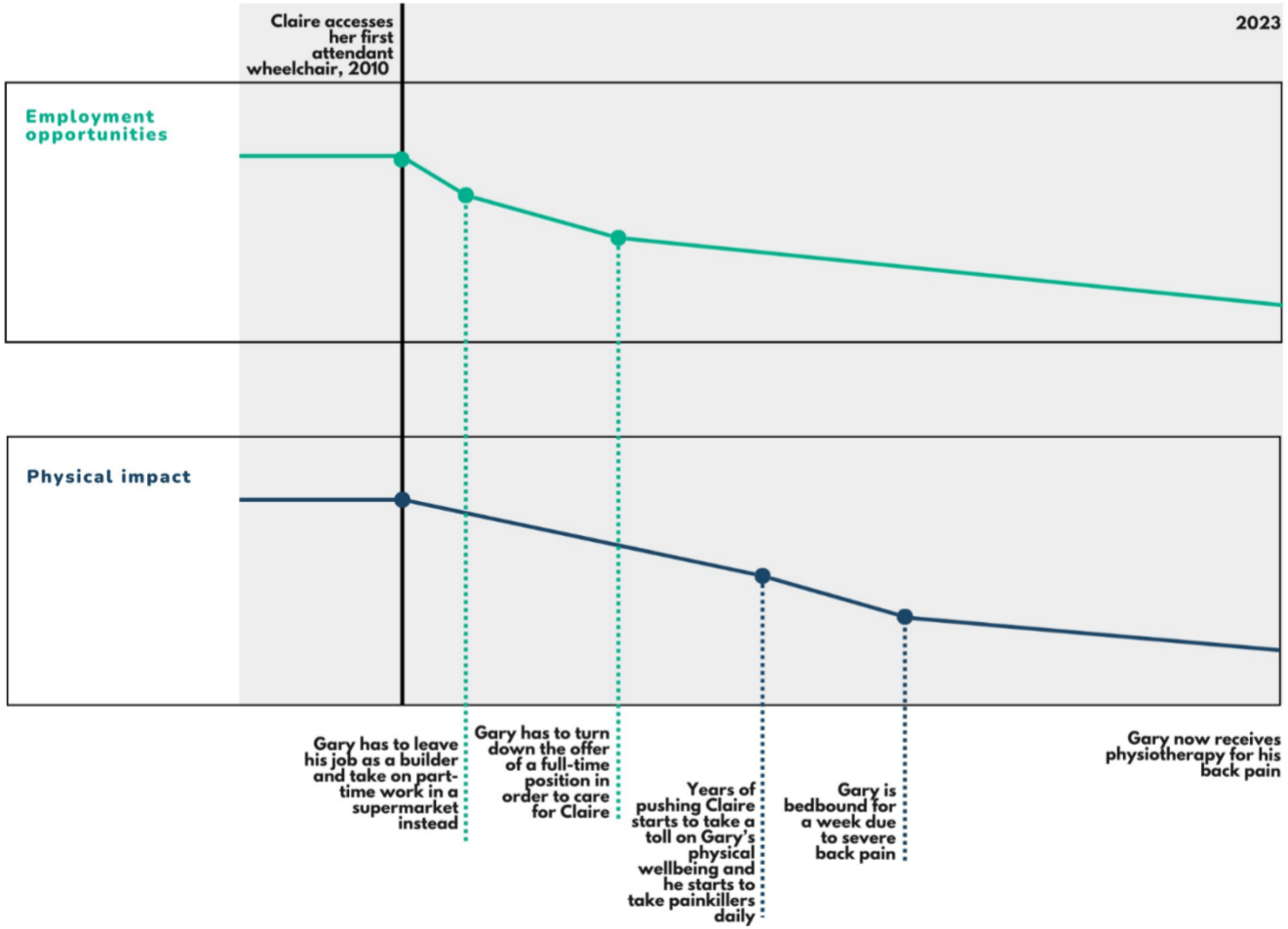
Caring for Claire was made more physically and emotionally strenuous for Gary in the absence of a self-propel wheelchair. NHS wheelchair services provided an attendant wheelchair – a wheelchair designed to be pushed by someone else – which they used for one year, but the wheelchair was heavy and awkward to lift. In the absence of self-propelling features, the wheelchair meant that Claire was totally reliant on Gary to leave the house. Her reliance on him impacted Gary's social life as well.

Claire was prescribed a manual self-propelling wheelchair one year after obtaining her attendant wheelchair, but osteoarthritis in her shoulders was accelerated by the effort and weight of self-propelling. Claire's stamina for propelling herself became limited, with Gary resorting to pushing her thereafter. Lack of awareness or knowledge about the possibility of a powered wheelchair or adaptation meant that Claire went 11 years with this manual wheelchair.

Pushing Claire for such an extended period of time has had serious health implications for Gary. Lower back pain developed after five years, worsening over time. He now receives physiotherapy and takes daily medication for the pain. The severity of Gary's back pain has put a stop to his favourite hobby – walking.

"Gary used to be a big walker, before the back pain. He would go to the Lake District or Yorkshire Dales, climbing hills and sometimes mountains. He can't do that anymore."

Figure 28 Gary's journey



Source: Qualitative engagement

10 Policy implications and next steps

In this section we provide a recap of key results from our work and consider the implications of these findings for policymakers.

10.1 Importance of simplifying NHS provision for users and their families

Policy recommendation #1

NHS England (NHSE) to play a more active role in ensuring that all ICBs prioritise wheelchair services and dedicate sufficient resources to effectively deliver the service. For example, this could be done by mandating that all ICBs adopt the Quality Framework for Wheelchair Provision along with the Model Service Specification when commissioning wheelchair services. This would help to minimise inequality across different services and ensure consistent delivery of a good quality service and provision.

NHS wheelchair services provide a vital service for millions of people across the country. While there is provision of wheelchair equipment outside of the NHS, those alternative options are not available to all wheelchair users.

There are clear advantages to locally led provision of NHS wheelchair services. In particular, commissioners can provide a service which is tailored to local needs. However, it has also led to variation in the standard of care provided and user experience. This variation has been highlighted in previous studies and our direct detailed engagement with wheelchair users reemphasises this unevenness. There would be a huge benefit associated with eliminating variation in outcomes and ensuring all NHS wheelchair services could reach the same performance levels as the top ICBs.

In particular, users told us they were often left to navigate the system themselves and had to rely on their own experience and knowledge to access the right support. Commissioners and providers of NHS wheelchair services should be given sufficient support and guidance from NHS England so that they can provide streamlined access and holistic care to all users.

10.2 Importance of adequate levels of wheelchair funding

Policy recommendation #2

The Department of Health and Social Care (DHSC) and NHS England should explore the possibility of increasing current spending on NHS wheelchair services to help ensure more benefits are realised and the NHS can unlock significant cost savings.

We have shown that reported levels of per patient spending by different ICBs varies significantly around the country. Overall wheelchair services account for a very small proportion of total NHS budgets (and spend on equipment will be an even smaller proportion). However, our analysis highlights that the potential benefits that high quality wheelchair provision could facilitate are large.

The cost of increasing equipment spending to the average level amongst ICBs who currently report below average levels of per patient spending is approximately £22 million per year. If patients registered with these ICBs collectively realised an additional 1% of total annual benefits of high quality wheelchair provision the societal return would be approximately £60 million. Even under this very conservative assumption the additional benefits would outstrip the additional costs by a ratio of almost 3:1. If patients registered with these ICBs collectively realised an additional 5% of total annual benefits of high quality wheelchair provision the societal return would be approximately £315 million. In this case the additional benefits would outstrip the additional costs by a ratio of 14:1.

10.3 Importance of flexibility in regards to wheelchair funding

Policy recommendation #3

Local wheelchair services and commissioners should continue to share best practice and explore opportunities to pool budgets between wheelchair services and other local services. NHS England should consider what support and processes are required to encourage and facilitate greater joined up working and frictionless pooling of budgets.

In addition, exploring increased spending on NHS wheelchair provision there is also a clear need to ensure that current budgets are utilised in the best way possible. This should involve greater dissemination of best practice and consideration of pooled funded models.

Previous work has noted how wheelchair service commissioners experience positive effects of being able to pool funding with local services, such as education and housing services. These benefits can enable wheelchair services to provide better equipment than they would otherwise and to create a more efficient allocation of resources. As a result, services can offer equipment catering for users' holistic needs.

10.4 Follow-on research

This study has started to fill an important evidence gap on the value that could be unlocked if NHS wheelchair services operated at a universally high level (which some services consistently achieve).

However, there is further work which could be usefully undertaken in this context:

- Exploration of the actual gap between current spending on equipment by NHS wheelchair services and the level of spending that would be consistent with universal high-quality provision.
- Exploration into the approach taken by wheelchair services towards manual vs. powered chairs, and understanding the benefits and drawbacks of each approach on wheelchair users' physical health and wider lives
- Drawing on international benchmarking and experience to inform further direction of NHS England wheelchair services.
- Deep-dive into specific high quality wheelchair services to understand lessons that could be shared with other providers.
- Carry out detailed observational research of a wheelchair user as they go through the patient pathway in real time and collect insights before, during and after this process.
- Understanding the approach taken by wheelchair services and therapists to clinical assessment, and the impact these assessments have on wheelchair users' wider lives
- Understanding the impact of good provision on wheelchair users' access to work, and the benefits this has for their overall lifestyle

11 Bibliography

Abou, L. and Rice, L.A., 2022. Risk factors associated with falls and fall-related injuries among wheelchair users with spinal cord injury. Archives of rehabilitation research and clinical translation, 4(2), p.100195.

Achterberg, T.J., Wind, H., De Boer, A.G.E.M. and Frings-Dresen, M.H.W., 2009. Factors that promote or hinder young disabled people in work participation: a systematic review. Journal of occupational rehabilitation, 19, pp.129-141.

Bennett, G., Dealey, C. and Posnett, J., 2004. The cost of pressure ulcers in the UK. Age and ageing, 33(3), pp.230-235.

Bjørnshagen, V. and Ugreninov, E., 2021. Disability disadvantage: experimental evidence of hiring discrimination against wheelchair users. European Sociological Review, 37(5), pp.818-833.

Brienza, D., Kelsey, S., Karg, P., Allegretti, A., Olson, M., Schmeler, M., Zanca, J., Geyer, M.J., Kusturiss, M. and Holm, M., 2010. A randomized clinical trial on preventing pressure ulcers with wheelchair seat cushions. Journal of the American Geriatrics Society, 58(12), pp.2308-2314.

Brienza, D.M., Karg, P.E., Bertolet, M., Schmeler, M., Poojary-Mazzotta, P., Vlachos, H. and Wilkinson, D., 2018. A randomized clinical trial of wheeled mobility for pressure injury prevention and better function. Journal of the American Geriatrics Society, 66(9), pp.1752-1759.

British Red Cross, 2023. Why wheelchairs matter for mental health https://www.redcross.org.uk/stories/health-and-social-care/social-care/why-wheelchairs-matter-for-mental-health

Britton, J., Dearden, L., van der Erve, L. and Waltmann, B., 2020. The impact of undergraduate degrees on lifetime earnings (No. R167). IFS Report.

DWP, 2022. The employment of disabled people 2021 https://www.gov.uk/government/statistics/the-employment-of-disabled-people-2021/the-employment-of-disabled-people-2021

Farrar, M.A., Carey, K.A., Paguinto, S.G., Chambers, G. and Kasparian, N.A., 2018. Financial, opportunity and psychosocial costs of spinal muscular atrophy: an exploratory qualitative analysis of Australian carer perspectives. BMJ open, 8(5), p.e020907.

Ferretti, E.C., Suzumura, E., Rozman, L.M., Cooper, R.A. and de Soárez, P.C., 2021. Economic evaluation of wheelchairs interventions: a systematic review. Disability and Rehabilitation: Assistive Technology, pp.1-12.

Ferretti, E.C., Curi, H.T., Andrade, L.F., Cooper, R.A. and Soárez, P.C.D., 2022. Conceptual mapping proposed to comprehend the effect of wheelchair mobility on social participation and quality of life: a systematic review. Disability and Rehabilitation: Assistive Technology, pp.1-17.

French, M.T., Popovici, I. and Timming, A.R., 2020. Analysing the effect of commuting time on earnings among young adults. Applied economics, 52(48), pp.5282-5297.

Frontier Economics, 2022. An Economic Assessment of Wheelchair Provision in England https://wheelchair-alliance.co.uk/app/uploads/2022/10/wheelchair-economic-study-final-report-screen-reader.pdf

Ganesh, S., Hayter, A., Kim, J., Sanford, J., Sprigle, S. and Hoenig, H., 2007. Wheelchair use by veterans newly prescribed a manual wheelchair. Archives of physical medicine and rehabilitation, 88(4), pp.434-439.

Gavin-Dreschnack, D., 2004. Effects of wheelchair posture on patient safety. Rehabilitation nursing, 29(6), p.221.

Gavin-Dreschnack, D., Nelson, A., Fitzgerald, S., Harrow, J., Sanchez-Anguiano, A., Ahmed, S. and Powell-Cope, G., 2005. Wheelchair-related falls: current evidence and directions for improved quality care. Journal of nursing care quality, 20(2), pp.119-127.

Gebrosky, B., Bridge, A., O'Donnell, S., Grindle, G.G., Cooper, R. and Cooper, R.A., 2022. Comparing the performance of ultralight folding manual wheelchairs using standardized tests. Disability and Rehabilitation: Assistive Technology, 17(1), pp.40-49.

Gowran, R.J., Bray, N., Goldberg, M., Rushton, P., Barhouche Abou Saab, M., Constantine, D., Ghosh, R. and Pearlman, J., 2021. Understanding the global challenges to accessing appropriate wheelchairs: Position paper. International Journal of Environmental Research and Public Health, 18(7), p.3338.

Gudgeon, S. and Kirk, S., 2015. Living with a powered wheelchair: exploring children's and young people's experiences. Disability and Rehabilitation: Assistive Technology, 10(2), pp.118-125.

Hogaboom, N.S., Worobey, L.A., Houlihan, B.V., Heinemann, A.W. and Boninger, M.L., 2018. Wheelchair breakdowns are associated with pain, pressure injuries, rehospitalization, and self-perceived health in full-time wheelchair users with spinal cord injury. Archives of physical medicine and rehabilitation, 99(10), pp.1949-1956.

Kamaraj, D., Bray, N., Jonathan Pearlman, J.P., Rispin, K.R., Borg, J. and Kankipati, P., 2017. A conceptual framework to assess effectiveness in wheelchair provision. African Journal of Disability, 6(1), pp.1-5.

Majmudar, I.K., Mihalopoulos, C., Brijnath, B., Lim, M.H., Hall, N.Y. and Engel, L., 2022. The impact of loneliness and social isolation on health state utility values: a systematic literature review. Quality of Life Research, 31(7), pp.1977-1997.

May, C., 2012. An investigation of attitude change in inclusive college classes including young adults with an intellectual disability. Journal of Policy and Practice in Intellectual Disabilities, 9(4), pp.240-246.

McDaid, D., Bauer, A. and Park, A.L., 2017. Making the economic case for investing in actions to prevent and/or tackle loneliness: a systematic review. London: London School of Economics and Political Science.

Nelson, A.L., Groer, S., Palacios, P., Mitchell, D., Sabharwal, S., Kirby, R.L., Gavin-Dreschnack, D. and Powell-Cope, G., 2010. Wheelchair-related falls in veterans with spinal cord injury residing in the community: a prospective cohort study. Archives of physical medicine and rehabilitation, 91(8), pp.1166-1173.

NHS England, 2017. Model services specification for wheelchair and posture services.

ONS, 2019. Disability and education, UK: 2019 https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/disability/bulletins/disabilityandeducationuk/2019

ONS, 2022. Earnings and hours worked, occupation by two-digit SOC: ASHE Table 2 https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/occupation2digitsocashetable2

Oyster, M.L., Karmarkar, A.M., Patrick, M., Read, M.S., Nicolini, L. and Boninger, M.L., 2011. Investigation of factors associated with manual wheelchair mobility in persons with spinal cord injury. Archives of physical medicine and rehabilitation, 92(3), pp.484-490.

Pettersson, I., Hagberg, L., Fredriksson, C. and Hermansson, L.N., 2016. The effect of powered scooters on activity, participation and quality of life in elderly users. Disability and Rehabilitation: Assistive Technology, 11(7), pp.558-563.

Poojary-Mazzotta, P., 2017. WHEELCHAIR RELATED FALL RISK AND FUNCTION IN NURSING HOME RESIDENTS: FACTORS RELATED TO WHEELCHAIR FIT (Doctoral dissertation, University of Pittsburgh).

Renner, J.S., Barth, M., Ferro, B.H., Birk, M.R., Manfio, E.F., Sanfelice, G.R. and Zwirtes, T.L., 2023. Pressure injuries, care and prevention: the case of wheelchair users. CONTRIBUCIONES A LAS CIENCIAS SOCIALES, 16(3), pp.1244-1258.

Roberts, J., Young, H., Andrew, K., McAlpine, A. and Hogg, J., 2012. The needs of carers who push wheelchairs. Journal of Integrated Care, 20(1), pp.23-34.

Rousseau-Harrison, K. and Rochette, A., 2013. Impacts of wheelchair acquisition on children from a person-occupation-environment interactional perspective. Disability and Rehabilitation: Assistive Technology, 8(1), pp.1-10.

Sapey, B., Stewart, J. and Donaldson, G., 2005. Increases in wheelchair use and perceptions of disablement. Disability & Society, 20(5), pp.489-505.

Scuffham, P., Chaplin, S. and Legood, R., 2003. Incidence and costs of unintentional falls in older people in the United Kingdom. Journal of Epidemiology & Community Health, 57(9), pp.740-744.

Shore, S. and Juillerat, S., 2012. The impact of a low cost wheelchair on the quality of life of the disabled in the developing world. Medical science monitor: international medical journal of experimental and clinical research, 18(9), p.CR533.

Singh, H., Scovil, C.Y., Yoshida, K., Oosman, S., Kaiser, A., Craven, C., Jaglal, S. and Musselman, K.E., 2020. Factors that influence the risk of falling after spinal cord injury: a qualitative photo-elicitation study with individuals that use a wheelchair as their primary means of mobility. BMJ open, 10(2), p.e034279.

Singh, H., Scovil, C.Y., Bostick, G., Kaiser, A., Craven, B.C., Jaglal, S.B. and Musselman, K.E., 2020. Perspectives of wheelchair users with spinal cord injury on fall circumstances and fall prevention: a mixed methods approach using photovoice. PloS one, 15(8), p.e0238116.

Skora, T., Rüger, H. and Stawarz, N., 2020. Commuting and the motherhood wage gap: Evidence from Germany. Sustainability, 12(14), p.5692.

Smith, E.M., Sakakibara, B.M. and Miller, W.C., 2016. A review of factors influencing participation in social and community activities for wheelchair users. Disability and Rehabilitation: Assistive Technology, 11(5), pp.361-374.

Štefanac, S.Š., Grabovac, I.G. and Fristedt, S.F., 2018. Wheelchair users' satisfaction with the prescribed wheelchairs and wheelchair services in Croatia. Collegium antropologicum, 42(3), pp.199-210.

Suka, M. and Yoshida, K., 2008. Low back pain deprives the Japanese adult population of their quality of life: a questionnaire survey at five healthcare facilities in Japan. Environmental health and preventive medicine, 13, pp.109-115.

Suka, M. and Yoshida, K., 2009. The national burden of musculoskeletal pain in Japan: Projections to the year 2055. The Clinical journal of pain, 25(4), pp.313-319.

Ville, I. and Winance, M., 2006. To work or not to work? The occupational trajectories of wheelchair users. Disability and rehabilitation, 28(7), pp.423-436.

Visagie, S., Scheffler, E., Mlambo, T., Nhunzvi, C., Van der Veen, J. and Tigere, D., 2016. Impact of structured wheelchair services on satisfaction and function of wheelchair users in Zimbabwe. African Journal of Disability, 5(1), pp.1-11.

Winkler, S.L.H., Fitzgerald, S.G., Boninger, M.L. and Cooper, R.A., 2008. Relationship between quality of wheelchair and quality of life. Topics in Geriatric Rehabilitation, 24(3), pp.264-278.

frontier economics

REVEALING REALITY

WWW.FRONTIER-ECONOMICS.COM