TIDAL N+
Transformative Innovation in the Design of Assisted Living products and services

Repair of Assistive Products in the UK:

Wheelchairs

Outcomes of a 1-day workshop exploring this topic from user, community and provision system perspectives

Ben M. Oldfrey [a], Vikranth H. Nagaraja [b], Arhym Hoonchamlong [a], Laurence P.J. Kenney [b]

[a] *Global Disability Innovation Hub (GDI Hub), University College London, London*

[b] *Centre for Health Sciences Research, University of Salford, Salford, UK*

products in the UK, with a particular focus on wheelchairs.

Global Disability Innovation Hub · Engineering and Physical Sciences Research Council · Nottingham Trent University · University of Salford Manchester · University of Strathclyde Glasgow · Loughborough University

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Introduction

Massive scale, highly automated manufacture has brought huge rises in quality of life globally, but the associated throw-away culture has engulfed high-income societies. Driven by the climate crisis, a tipping point has clearly been reached, and although recycling processes are patchy at best, the concept is widely accepted in our economy. However, recycling of raw materials, while an essential part of a circular economy, also loses the value that is added to products through design and manufacture – at huge cost, both financially and environmentally.

The importance of repair across all products globally has seen a phenomenally rapid rise in attention in recent times, with a range of initiatives, actions and changes in practice occurring. These changes have taken place at the enthusiast and community level, within the larger economy as a whole, and at the policy level, with the Right to Repair being implemented in a growing number of countries.

However, assistive products (APs) present industry, commissioners and users with a range of challenging problems when addressing repair. The regulatory environment encourages a risk averse approach, the devices are often used in the home environment, where observation on use patterns is very difficult, and the clinical services which provide the devices are heterogeneous in nature and over-stretched. Users may not know who to contact in the event of a repair and, particularly if the AP is associated with supporting mobility - transport of the broken device to a centre for repair is problematic. This problem of inadequate repair strategies is not only environmental – rather it represents a huge barrier to the optimisation of assistive product provision.

Products can be, and very often are, disconnected from the system that produced them as soon as they are purchased/provided. Critical to recognise is that repair is intrinsically a system activity. It cannot be separated from the system around it – if it is, it is likely not possible. This makes it a very complex issue to address effectively.

No one actor can achieve what is needed, and we need to map the actions needed and the value of repair across different parts of the system.

Before we can theorise on solutions, the current status quo must be better understood, and this was the driver for our workshops. The workshops built on an emerging body of work in this area. For instance, studies from the USA[1], Ireland[2] and low resource settings[3] have begun to document the frequency of repairs in wheelchair services. The team were unaware of published work from the UK which had addressed the impact that the need for (frequent) repair and/or access to repair services has on users and their carers/families. The wheelchair workshop offered an opportunity to bring a range of stakeholders together, to both discuss the challenges and share ongoing work in the space.

Short Talks Session

We began with short talks from a range of perspectives on this topic – we wanted to understand what repair meant to different people. We wanted to collaboratively build a clearer picture of how these perspectives intersect, and what the value of repair is to each stakeholder. We also wanted to identify what future directions could be taken to improve its place in the system with a range of stakeholders, and invited:

- Users of assistive technology
- Clinicians, health professionals and other service providers
- Manufacturers
- Designers / Engineers

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2. Gowran, R. J., Clifford, A., Gallagher, A., McKee, J., O'Regan, B., & McKay, E. A. (2020). Wheelchair and seating assistive technology provision: a gateway to freedom. *Disability and Rehabilitation*, *44*(3), 370–381. https://doi.org/10.1080/09638288.2020.1768303
3. Oldfrey, B., Holloway, C., Walker, J., McCormack, S., Deere, B., Kenney, L., … Miodownik, M. (2023). Repair strategies for assistive technology in low resource settings. *Disability and Rehabilitation: Assistive Technology*, *19*(5), 1945–1955. https://doi.org/10.1080/17483107.2023.2236142

- Start-Ups interesting in incorporating repair-focused strategies

The talks and the rich Q&A/Discussion that ensued from these are summarised below:

Keoke King and Abdoul Hayyou (Participant Assistive Products)

From Participant Assistive Products, Keoke and Abdoul began the session by discussing several key aspects of wheelchair design, with a focus on durability and usability in LMICs. One of their primary goals is to create products with a lifespan of 15-20 years. They emphasised the importance of sourcing tyres locally to reduce manufacturing costs and improve accessibility. Standardising wheel size is also a key strategy for lowering costs.

Their next steps involve engaging with users to better understand the drawbacks of 559mm wheels, such as their taller profile, which can create practical challenges like not fitting under most tables and causing higher seats and longer frames.

Discussion Highlights

Tyre size and repair rate

Whether tyre size affects the rate of repair and degradation was discussed, with speculation that it probably does not, with a lack of specific research on this issue.

Use of wheelchair-specific vs. bike tyres

In higher-income regions like the US, Europe, and Japan, wheelchair-specific tyres are popular due to perceived benefits (e.g., maintenance and flat tyre repairs), though there may be a profit motive. In LMICs, however, using locally available, multi-purpose tyres is more practical, and e-bikes could offer a better model for future design.

Interchangeability between wheel sizes

It was highlighted that differences in wheel size can impact seat and caster angles, affecting performance. Another participant noted the psychological benefits for users when sitting higher in wheelchairs, as well as improved biomechanics for pushing. Adjustable axle slots on some wheelchairs, like those accommodating both 507mm and 559mm wheels, were mentioned as a potential solution.

Tubeless vs. regular bike tyres

Participant's focus was on tube-based tyres, as tubeless tyres are not common in low-resource settings, however, it was discussed that other tyres could bring benefits.

Dr Selvakumar Ramachandran, (co-founder Kerckhoffs Ltd (UK))

For the second talk, Dr Selvakumar Ramachandran shared his personal experiences as a wheelchair user, highlighting that a wheelchair is not just a mobility tool but also a professional one. For instance, he attaches a camera to his wheelchair to document his surroundings. Dr Ramachandran described his early years in India, where he did not use a wheelchair and instead had to crawl. His first experience using a wheelchair, though inconvenient at first, gave him a sense of dignity by allowing him to interact with others at a height of three feet.

He recounted using a tricycle to get to university in India and then crawling to class. In Italy, his wheelchair could not be repaired through the medical system, so he had to take it to a car mechanic. He shared that he usually ignores minor wheelchair issues to avoid delays, with his wife learning to fix these problems. He also expressed fear of travelling with his battery-powered wheelchair due to the risk of damage, suggesting that airports should provide repair services for minor wheelchair issues.

Discussion Highlights

Environmental challenges

Dr. Ramachandran emphasised the difficulty of navigating uneven pavements, especially cobblestones, which cause his wheels to bend every few months. Other participants suggested that manufacturers should receive feedback on such issues and that users might benefit from having more than one wheelchair, similar to how people have different types of shoes for various activities.

Open-source design

Open-sourcing components were proposed for items prone to breaking, allowing them to be easily replaced or fixed at nearby repair shops. The idea is to design a part that breaks under stress but can be easily replaced, avoiding damage to the entire wheelchair.

Travel concerns

Dr. Ramachandran raised concerns about travelling with a battery-powered wheelchair. Airport staff frequently check the battery, raising fears it might not meet regulatory requirements. He mentioned that American Airlines allows two wheelchairs per traveller.

The Big Repair Project, Prof Mark Miodownik (UCL)

In the next talk, Prof Mark Miodownik talked about ‘The Big Repair Project’, with the discussion focused on the need for system-wide changes to make product repair more accessible and sustainable. The current landscape involves a variety of stakeholders—policy makers, producers, waste processors, repair professionals, educators, and citizens—all of whom play a role in ensuring the durability and repairability of products.

A key issue raised was that modern products are often not designed to be repaired, leading to situations where repair is more expensive than replacement, resulting in premature disposal. In contrast to older repair manuals that proudly detail how to fix

products, today's manuals are filled with warnings against opening devices, often voiding warranties. This trend forces consumers into a wasteful cycle, replacing rather than repairing, and contributing to the waste economy.

There was a strong emphasis on the psychological benefit of having the agency to repair items oneself. Platforms like YouTube, where users share repair tutorials, and initiatives like the Big Repair Project in the UK encourage local repair efforts. These local activities have numerous advantages, including shorter product loops and reduced shipping and repair times.

A striking example was shared regarding washing machine manufacturers, who make more profit from repairs (£30 per machine) than from selling new units (£10 per machine). Beyond functionality, access to repair fosters a sense of community and empowerment for individuals. The conversation concluded by stating that while globalisation isn't the enemy, products should be adaptable to local environments, allowing them to have longer, more sustainable lifecycles.

Discussion Highlights

Extended warranties and liability

When asked about who takes liability for repairs under extended warranties, it was emphasised that user repairs are often not ideal. Instead, professional repairers in local hubs are needed to assess and handle repairs. In the UK and EU, regulations are moving toward holding repairers liable for their work. Companies like Johnson & Johnson assess which products are profitable to repair and focus only on those. Additionally, a new waste tax is expected to encourage a shift toward repair over disposal.

The Right to Repair Medical Devices, Richard Stubbs (IPEM)

Next, Richard Stubbs outlined the history and evolution of guidelines for managing medical equipment, from the 1963/1969 HTM 8 to the current 2021 regulations.

Initially, medical devices were simple, long-lasting, and commonly repaired in-house, but as technology advanced, unscheduled maintenance and repairs became more formally addressed in later guidelines. The speaker compares medical devices with other highly regulated sectors, like aviation and automotive, where standardised spare parts and repair credentialing systems are well-established.

Currently, the UK Medical Device Regulations are under revision, providing a key opportunity to integrate the right to repair, sustainability, and medical device management. There is a growing need to simplify access to repair information, spare parts, and tools, which has historically been restricted by manufacturers. Examples from the agriculture sector and consumer products show where more decentralised repair systems are working, especially in countries with specific right-to-repair legislation.

Distributed digital manufacturing, such as 3D printing, was also discussed as a future approach to making repairs more accessible. However, challenges like part standardisation and ensuring qualified personnel handle repairs remain. With ongoing updates to UK medical regulations and international efforts, the speaker advocates for regulations that support both safety and sustainability while promoting repairability.

Richard emphasised collaboration between stakeholders to ensure repair-friendly systems and suggests that aligning these goals with sustainability, especially in achieving net-zero targets, will help drive the right-to-repair movement forward.

IPEM has established a ‘task and finish’ group that is gathering evidence, engaging with stakeholders, and ultimately hoping to influence MHRA’s Medical Devices regulatory authoring group.

GS1, Juliette New

Juliette was next from GS1 UK, a non-profit standards organisation that develops and maintains standards for the unique identification of every person, product, and place, spoke about the role of GS1 in enabling end-to-end traceability from manufacturer to patient. GS1 UK aims to standardise data across the healthcare sector and works closely with NHS England and the Department of Health and Social Care (DHSC) to support the "Scan4Safety" programme. This initiative, introduced by the DHSC, enhances patient safety, operational efficiency, and supply chain management in hospitals through barcode scanning technology, ensuring better traceability and visibility of people, products, and locations throughout the healthcare system.

Juliette emphasised how GS1 standards can help organisations improve patient safety, supply chain efficiency, and overall traceability. She highlighted the critical role GS1 standards play in product recalls, tracking medical devices, and managing assets within hospitals. Juliette also discussed the potential application of GS1 standards in improving transparency, accountability, and efficiency in wheelchair repair processes. She noted that delays in wheelchair repairs are often due to inefficient tracking systems, and using GS1 standards could help reduce waiting times, improve repair timelines, and lead to better patient outcomes.

Discussion Highlights

Linking identifiers to people

In hospitals, patients have unique NHS numbers that can be linked to their medical records. However, many community members lack such identifiers, and efforts are still underway to integrate these individuals. Currently, health records are being scanned for traceability.

Tracking at Home

Another question focused on tracking wheelchair repairs at home, and solutions like GPS and digital passports could help monitor assets. However, there are privacy concerns regarding the sharing of data, especially around GLNs (Global Location Numbers) and GPS tracking of APs borrowed from the NHS.

Manufacturing and Asset Tracking

How GS1 can assist manufacturers was discussed, in creating a unified system to track products from procurement to repair ensued, highlighting the possibility of using barcode scanning technology.

Open-Source Medical Devices, Pranay Kumar (RMIT University)

Pranay led the next session, sharing his insights from his research on open-source medical devices, focusing on how open-source design could impact wheelchair repairs. Open-source medical devices allow design documentation to be shared globally, enabling localised production and modification to suit specific contexts. He illustrated how countries like India could benefit by using readily available bicycle components for wheelchairs, while others might use automotive parts. The open-source approach aims to reduce environmental impact and accelerate innovation by decentralizing design and production. However, challenges remain, such as the lack of regulatory protocols for open-source devices, reliance on outdated software, and difficulties in maintaining long-term design accessibility. The speaker encouraged the application of these practices to wheelchair design to enhance repairability and customisation.

Discussion Highlights

Regulatory Concerns

A participant asked about liability and regulatory standards for open-source hardware. The speaker explained that while open-source software is being

developed, hardware is still subject to traditional regulatory frameworks, making it the manufacturer's responsibility to ensure safety.

Collaboration Platforms

Another question raised the idea of aggregating knowledge and challenges from global designers. Pranay mentioned platforms like Ubora, an online repository, that helps translate open-source designs into actual medical products, addressing some of these challenges, but acknowledged the difficulties in coordinating globally.

Software Incompatibility

Constant software updates and changes make it difficult to maintain compatibility. Old GitHub repositories, for example, may become unusable over time due to new software requirements.

Reimbursement Strategies

Securing financial support or reimbursement for open-source devices remains a significant challenge.

DEMAND, Design and Manufacture for Disability, Charlie Chalmers

Charlie from Demand spoke next, a UK-based charity that designs and manufactures custom equipment for people with disabilities. Established in 1980, DEMAND's mission is to help disabled individuals live more independently by creating bespoke solutions tailored to their specific needs. Originally focused on one-off designs for hospitals and occupational therapists, Demand has shifted to a more data-driven approach, responding to repeated inquiries from users. He shared insights from their previous experience refurbishing wheelchairs and mobility equipment, which stopped due to a market shift toward disposable products. Currently, the organisation is reviewing years of data to identify recurring product needs, to inform their new focal areas. He emphasised the importance of emotional

attachment to products to encourage repair rather than disposal and the challenges of sustaining a repair business model in the current economic landscape but expressed hope for reviving repair practices in the future.

Discussion Highlights

Economic Viability

A participant asked why repair services for mobility devices have dwindled. Charlie explained that the rise of disposable products and the economic inefficiencies of repair led to the decline of this part of Demand's operations.

Customisation and Repair

Another question focused on the importance of emotional attachment to products. Charlie emphasised that users who assemble or customise their devices tend to value them more, which fosters a repair culture rather than disposal.

Wheelchair Repair in South Africa: Church of Jesus Christ of Latter Day Saints Program, Eric and David Wunderlich

Eric and David from the Church of Jesus Christ of Latter Day Saints presented their wheelchair repair initiative in South Africa, which works with provincial health departments to improve the quality and accessibility of wheelchair services. They have trained therapists, technicians, and volunteers in wheelchair repair and provided toolkits and parts. Their network of repair locations has enabled the refurbishment of 16,600 wheelchairs and 8,400 mobility devices in 2023 alone. This effort has reduced waiting lists and costs, especially for users in rural areas, by enabling home visits and on-the-spot repairs.

Discussion Highlights

Economic Decision-Making

A participant asked how they decide whether to refurbish or scrap a wheelchair. David explained that it's an economic decision based on the cost of repair versus purchasing new parts.

Wear and Tear Assessment

Another question focused on assessing the wear and tear of parts. David shared that experience plays a key role in identifying parts that need replacing, particularly bearings and brakes, which are the most common issues.

Data Collection

A participant inquired about whether they collect data on the most frequently repaired parts. The team confirmed that they do, and this data helps inform the supply of spare parts and toolkits provided to repair sites.

Topical Session Outcomes

Data and Repair

Data Gaps and the Need for a Shift in Value

The session highlighted several critical issues and potential pathways forward regarding the role of data in improving service delivery and product management. A key theme was the lack of available data on wheelchair repairs. This gap stems from the fact that repair activities are often not integrated into the broader product lifecycle, with limited funding allocated for repairs and data on repairs typically not valued or reflected upon. Participants pointed out that current systems prioritise capital expenditure—buying and paying for products—over the ongoing value of

repairs. To address this, the logic around data collection must shift to recognise repair data as valuable. There was a suggestion to link data to payment and exchange systems, for example, through deposit schemes to ensure the return of products and to integrate data collection into the overall process so it can be used and appreciated.

Challenges in Data Quality and Collection

Concern was raised about the quality of the data currently gathered, with much of it considered ‘garbage.’ Databases often do not communicate, and finding useful data requires sorting through irrelevant information. AI was suggested as a potential solution to help sift through this data and identify useful patterns. A further suggestion was to standardise which data should be required and which should be optional, allowing for more focused and purposeful data collection.

At the service delivery level, differentiating between emergency and opportunistic repairs could provide valuable insights. User-led data was acknowledged as important but also problematic due to the competition between third-party repair services and the NHS. Another issue raised was how to collect anonymous data in a way that builds trust among users, ensuring they are comfortable participating in the process.

Solutions and Barriers Moving Forward

One potential solution discussed was to create a “profile” for each wheelchair that would follow the device through its lifecycle, from manufacturing to the user and beyond. This would not only decentralise the repair process, encouraging users to seek repairs, but also help gather data that could predict future issues. AI could detect patterns in the data to prevent breakdowns and improve both manufacturing and service efficiency.

Barriers to good data collection were also explored. Funding remains a significant challenge, along with the perception that data collection is “boring” or irrelevant.

However, it was argued that once data gains credibility and is seen for its true value, people will be more inclined to contribute. A key concern is that current systems often focus on negative drivers, such as cost and loss, whereas a positive approach could highlight the number of successful repairs and emphasise the NHS goal to reach net-zero by 2040.

Additionally, participants noted that some users hesitate to provide honest feedback due to fear that their AT could be taken away. To address this, data should be collected throughout the device's lifecycle, from manufacturing to the user experience and beyond.

Challenges remain in balancing the value of data collection with the effort required to convince people to share their data and overcome cultural barriers. Moving forward, the group emphasised the need to understand and capture data at the intersection of the device and the user experience to enact meaningful change in the system.

Methods of Repair

Current Routes to Repair

The NHS holds the contract for assessing and supplying wheelchairs and contacting users by phone for repairs. However, the records kept are often minimal, providing little detail about the specific wheelchair model or the nature of the problem. This makes it challenging for service providers to identify issues and the correct parts needed, particularly given the increasing variety of wheelchair models. Participants discussed whether video technology could help alleviate these issues by allowing users to visually show problems, reducing the chances of engineers arriving with the wrong parts. With parts being sourced from various companies, this is a significant problem.

The NHS supplies wheelchairs for long-term users, but for short-term use, users must either purchase a wheelchair themselves or seek assistance from

organisations like the Red Cross. The NHS also relies on users being able to handle simple repairs themselves, such as adjusting brakes or pumping tyres. Ideas for repair training were raised, with Google and local bike shops mentioned as potential resources. A suggestion was made for a contact centre to assist when issues arise.

Different methods of obtaining a wheelchair influence who pays for repairs. The NHS covers repair costs for NHS-loaned wheelchairs, while users with personal wheelchair budgets must cover their own repair expenses.

Key Problems Faced by Users and Service Providers

Data Quality and Access

Poor data recording and management complicates the repair process, as providers often lack detailed product information. The variety of wheelchairs and parts adds to this difficulty, especially with third-party, low-quality spare parts.

Quality of Reporting from Users/Carers

Many users and caregivers struggle to explain the details of their wheelchair's issues or identify specific parts. A suggestion was made to use colour coding to indicate parts that should not be touched to simplify this process.

Variety of Parts

While the diversity of wheelchairs is necessary to accommodate different conditions, it makes repair more complicated. Providers must balance having enough variety to meet user needs while ensuring a manageable selection for repairs.

Potential Solutions for Facilitating Better Repairs

Several ideas were proposed to address these challenges:

Blockchain Technology

Blockchain could be used to track repair data, although this would require significant computational resources.

Improved User Information and Training

The idea of an information manual to help users maintain and repair their wheelchairs was discussed, but it was noted that manuals tend to be too complex and lack practical repair instructions. A keyword-accessible video resource was suggested as an alternative.

Better Availability and Communication of Information

A "digital passport" was proposed, which would store key information about each wheelchair, helping users and service providers communicate more effectively about the specific needs and history of the device.

In summary, improving data quality, enhancing user training, and better managing the variety of parts is critical to facilitating better wheelchair repairs. Embracing digital tools like video support, blockchain, and digital passports could streamline the repair process and ensure better outcomes for users.

Impact of Repair

User Experiences with Wheelchair Repair

One user shared his personal journey with wheelchair repairs, describing the stress and challenges he faces when sending his wheelchair in for repairs. He mentioned how he waits until the last possible moment to send it in because it disrupts his daily life, often attempting to fix smaller issues with the help of his wife before resorting to the manufacturer. While he appreciated the good service, which included not only repairing the broken part but also servicing the wheelchair, he noted that the wheelchair had to be sent away as the service provider was not local, adding to his concerns.

The conversation also touched on different user experiences with the NHS. One individual shared the difficulty of receiving only two wheelchair mounts through the NHS and having to self-fund additional mounts, adjusting them for every new wheelchair. In another case, a user who had self-funded a wheelchair found that the NHS would not provide any modifications, as it was purchased outside of the NHS system.

Inequities in Wheelchair Access and Repair

The group discussed various inequities in wheelchair access. Some users who are assessed as not needing a wheelchair—because only their mobility inside the home is considered—are denied support from the NHS, which seemed unfair to many participants. The NHS Wheelchair Budget was highlighted as a way for users to customise their wheelchairs through a voucher system, but it was noted that repairs and maintenance are not covered under this program. Instead, users must directly contact the manufacturer and bear the responsibility for repairs themselves.

One participant shared the story of a man whose friends had bought him an electric wheelchair, but the NHS refused to provide any assistance with modifications or repairs, as they deemed him capable of lifting his arms, thus not requiring further support. Additionally, some areas reported repair wait times as long as 6-8 months, highlighting a significant gap in services.

Solutions and Support for Wheelchair Users

Several potential solutions to repair challenges were discussed. A notable example was the story of a woman whose wheelchair was damaged during a flight from the UK to Nepal. Unable to use the toilet without her wheelchair, she did not eat for the duration of the journey. Despite the hardship, she eventually managed to get her wheelchair repaired and is still using the replaced component.

To address the common fear of wheelchairs breaking down, participants discussed solutions like creating wheelchair hubs at airports to reduce anxiety and facilitate quick repairs. Another suggestion was the development of an open-source portal offering guidance on quick fixes or workarounds for minor repairs. A list of 18 low-risk parts, such as tube caps and armrests, was proposed for inclusion in such a system, but questions remained about liability for repairs to load-bearing components.

System Issues and Policy

Systemic Barriers to a Wheelchair Repair Strategy in the UK

The breakout session focused on the complexities within existing systems that are holding back the development of a cohesive repair strategy for wheelchairs in the UK. Participants highlighted that, unlike in low-resource settings where new roles and processes are embraced, the UK tends to approach repair and maintenance on an ad-hoc basis. Systematic change is seen as problematic due to resistance to change, often driven by risk aversion and a lack of incentives.

One major issue is the economic devaluation of AT, such as wheelchairs, which leads to a "don't care to repair" mindset. This is compounded by the fact that many AT devices are not owned by the users themselves, meaning they lack attachment or responsibility for repair. A potential solution suggested was to foster user attachment by offering customisation, personalisation, or even naming options for AT, making it more desirable and valued.

The Potential of Personalisation and Second-Hand Wheelchairs

The group discussed whether personalisation could incentivise the use of second-hand wheelchairs, similar to how glasses can be customised with accessories. The lack of mass customisation options for AT was noted as surprising, given the possibilities in other markets. It was suggested that the issue might not lie in market

size but rather in the procurement process. Norway's refurbishment system was mentioned as a successful example of how such a strategy could work, but participants observed that the NHS in the UK remains highly risk averse. This risk aversion is compounded by the absence of user cases or data to verify the safety and reliability of refurbished wheelchairs.

Children's wheelchairs were proposed as a potential area to test the idea of a refurbishment system, as children often outgrow their wheelchairs and need new ones. While risk concerns were raised, participants pointed out that there is little data to substantiate these worries.

Barriers to User Buy-In and Systemic Change

The session also examined the lack of user buy-in when it comes to repairing or using second-hand wheelchairs. Several barriers were identified:

- Lack of certification for refurbished products
- Limited personalisation or customisation options
- The perception that used items are not desirable
- The stigma around using second-hand equipment
- Failure to account for environmental costs and long-term sustainability in the overall economic assessment
- A culture of disposal, where items are discarded rather than repaired
- NHS risk aversion and reluctance to embrace new approaches
- Political and systemic barriers, such as the absence of clear records or data to support repair initiatives
- Ambiguity over who holds responsibility for repair and maintenance.

In conclusion, the group recognised that fostering a culture of repair will require addressing these systemic issues, reducing risk aversion, and improving both user engagement and the economic evaluation of repair strategies.

International Connections

The breakout discussion explored the potential for improving the UK's wheelchair repair system by learning from international communities and leveraging global connections. Participants highlighted valuable opportunities to collaborate with other countries, particularly in lower—and middle-income countries (LMICs), where community-driven repair initiatives are born out of necessity.

One participant shared an experience from visiting disabled people's organisations (DPOs) abroad, noting that local communities often have indigenous methods for repairing all types of wheelchairs. While not widely advertised, these informal systems provide confidence that wheelchair repairs can be managed effectively in those settings, reducing concerns about travelling with a wheelchair.

Challenges in International Collaboration

Several challenges were discussed, particularly the need for better connectivity between teams in different countries. One major issue identified was the underdeveloped hardware ecosystem in places like Istanbul, which hinders collaboration on advanced technologies such as robotics. Additionally, participants noted that communication and collaboration across borders is often difficult. Conferences and workshops were seen as the most effective ways to build trust and foster teamwork.

Another challenge lies in navigating the bureaucratic structures in high-income countries like the UK, which can slow down the implementation of international best practices. On the other hand, LMICs tend to be less risk-averse, with fewer concerns around litigation, making them more flexible and innovative in finding repair solutions. There is potential for the UK to adopt and adapt some of these low-risk, community-driven approaches.

Learning from International Examples

Participants emphasised the importance of learning from decentralised repair systems in LMICs. In these settings, community-based rehabilitation efforts are often highly effective, driven by necessity rather than formal structures. For example, if a product sourced from China is available in the UK, repairs could be carried out at local repair shops, drawing from community knowledge. The UK, with its more centralised system, could benefit from adopting elements of these decentralised approaches.

There are also lessons to be learned from high-income countries like Norway, which has developed a strong reuse and repair system for wheelchairs. Norway's system could serve as a model for how to integrate sustainability and reuse into the UK's repair strategy.

The UK wheelchair repair system is not isolated. Much of the production and innovation in the field is already international, meaning there are numerous opportunities for collaboration in areas like education, academia, and development. By engaging more with international communities, the UK can learn from both high-income countries with well-established systems and LMICs with innovative, community-driven solutions.

Some Key Challenges and Opportunities

Bureaucracy in High-Income Countries

The complex bureaucratic processes in countries like the UK can hinder the adoption of innovative repair strategies.

Risk Aversion in the UK

LMICs may offer more flexible, low-risk approaches to repair that could inspire less risk-averse policies in the UK.

Learning from Norway

Norway's reuse and repair systems offer valuable insights for the UK in terms of sustainability and long-term repair strategies.

Community-Driven Initiatives

LMICs demonstrate how local, resourceful repair initiatives can be more innovative and effective than centralised, "by-the-book" approaches, providing a valuable learning opportunity for the UK.

NHS Clinical Challenges

The breakout session highlighted the complexities and challenges faced by the NHS in balancing the diverse needs of wheelchair users with the operational constraints of repair services. One of the primary issues discussed was the tension between offering a wide range of wheelchair models to meet various user needs and maintaining a concise, efficient repair process. Due to these challenges, boundaries are set, and some users may not qualify for a wheelchair. The NHS offers around a dozen core wheelchair models with a few sub-models, while leftover parts are used for repairs.

Stock Management and Repair Challenges

A key point raised was the need for a well-managed stock system and competent staff to run it. The "just-in-time" model was discussed as a possible solution, allowing the NHS to maintain a diverse inventory of parts while controlling stock levels to avoid shortages or overstock. When a wheelchair experiences catastrophic failure, it

was noted that, in most cases, the solution is to swap the wheelchair rather than repair it.

In an average wheelchair service, there are typically a few dozen wheelchairs in stock, with only 1-3 power chairs available. Factors affecting stock levels include the collection and decontamination process, the variety of wheelchair sizes needed, and whether the wheelchair is self-propelling. Stock often doesn't meet users' specific needs, and in such cases, a "stop-gap" wheelchair—one that is good enough for the time being—is provided.

User Expectations and Repair Priorities

User expectations regarding repair services vary, and appointments are prioritised based on individual circumstances. Vulnerable users or those living alone are given higher priority. The NHS provides for a huge number of users, and while self-modifications to wheelchairs are allowed, alterations to the structure void the NHS warranty. To prevent the system from becoming overwhelmed, users are encouraged to seek out alternative repair services, such as bike shops or assistance from family members, for minor issues.

It was mentioned that only some user manuals provide troubleshooting guidance, leaving room for improvement in educating users. The appointment system is triggered by priority, considering factors such as living arrangements, location, and past repair history. Some users, referred to as "frequent flyers," frequently need repairs due to using their indoor wheelchairs outside. When addressing repairs, it's often beneficial to talk to the user to understand if there is a deeper issue beyond the immediate repair.

Equipment Standardisation and Technological Integration

It was suggested that framework contracts be used to standardise parts across a range of products to improve the repair process. The limited availability of electric wheelchairs, which are typically reserved for users with limited dexterity, is driven by the high cost of technology. However, there is potential to integrate mainstream technology into AT, particularly for preventative maintenance, to avoid accidents and breakdowns.

Challenges and Potential Solutions

Challenges:

- Matching the best equipment for each patient, linked to spare parts and lead times.
- Managing and organising space for spare parts.
- Troubleshooting and adaptive maintenance issues.

Solutions:

- Encourage patients to take more responsibility for their own repairs when feasible.
- Use adaptive maintenance with diagnostic tools to detect and prevent problems.
- Provide comprehensive troubleshooting guides to empower users to address minor repairs on their own.

In conclusion, the session emphasised the need for improved stock management, user education, and the integration of preventative technology to streamline wheelchair repair services and enhance patient satisfaction.

Conclusion

This one-day workshop explored the complexities and significance of repair within the assistive technology landscape, revealing diverse perspectives from various stakeholders. Current practices often fail to integrate repair into the product lifecycle, causing inefficiencies and contributing to environmental waste. Repair strategies are hindered by a lack of data, inconsistent policies, and fragmented services, making it difficult for users to access timely and effective repairs. However, there are some potential pathways forward, particularly the integration of better data collection systems to track repairs and predict breakdowns, and increasing the autonomy that users are allowed to have over their own devices and the repair of them.

International examples, particularly from low-resource settings, demonstrate the value of community-driven repair initiatives. These initiatives offer more flexible, integrated solutions that could inform practices in high-income countries like the UK. Learnings and evidence from these decentralised models could help overcome bureaucratic hurdles and risk aversion that often impede repair efforts in the UK.

Moving forward, a shift in policy to support the "Right to Repair" is crucial, along with greater collaboration between major stakeholders - manufacturers, healthcare providers, and users. Open-source designs, improving stock management, and fostering repair-friendly regulations are potential avenues to bringing more sustainable, efficient, and user-centred wheelchair repair services. As well as improving provision for users, these could also contribute to broader sustainability goals in the future. We thank all involved and hope that the efforts put into this event will contribute a small step in the right direction and that the emerging momentum can be kept up.

Workshop Contributor List

Abbie Williams, DEMAND Design & Manufacture For Disability

Alex Dickinson, University of Southampton

Alshimaa Elbahrawy, Deafgain

Amdalat, Jinadu, La Latch

Amelie De Vazelhes, GDI Hub

Andreas Polydorides, UCL

Arhym Hoonchamlong, UCL

Arjan Buis, Strathclyde University

Ben Oldfrey, UCL

Cassandra Adomako, UCL

Catriona Eldridge, Springboard Pro Ltd

Celine Mouzannar, UCL

Charlie Chalmers, DEMAND: Design and Manufacture for Disability

Danielle Purkiss, UCL

Dave Long, The Wheelchair Alliance

Eleanor Crommentuijn-Marsh, UCL

Grainne Hennessy, An Mheitheal Rothar

Elena Guss Tarazona, Springboard Pro Ltd

Isabella Trujillo Cortes

Jess Winkworth, DEMAND

Josh Hosking, KCH

Juliette New, GS1 Not for profit

Lesley Davidson, University of Salford

Los Kenney, Salford University

Lucy Gates, MRC LEC, University of Southampton

Mahbuba Tabassum, Salford University

Mark Miodownik, UCL

Mikko Koria, Loughborough University London

Nicola Holbrook, NHS

Ogbonna Nnamuchi Chukwuemeka Odumegwu Ojukwu University, Uli

Peter Carr

Portia Watson, SGH

Pranay Arun Kumar, RMIT University, Australia

Ram Chandra Thapa, GDI Hub

Rebecca Churn, DEMAND Design and Manufacture for Disability

Richard Stubbs, Aneurin Bevan University Health Board

Richard Bibb, Nottingham Trent University

Runbei Cheng, University of Oxford/University of Salford

Salva Mottaghizadh, BIUNIQ

Sarah Sheldon, ATscale

Selvakumar Ramachandran, Kerckhoffs Ltd

Soikat Ghosh Moulic, Betsy Cadwaladr University Health Board (NHS Wales)

Vahid Ahmadipour, BIUNIQ

Victoria Moody, DEMAND Design and Manufacture for Disability

Vikranth Harthikote Nagaraja, School of Health and Society / University of Salford

Zeinab Ghannam Omdena