World Health Organization

European Region

Repair, recycle and refurbishment of assistive products

For self-care and mobility products

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Abstract

This document outlines good practices for the repair, refurbishment and recycling of assistive products within the framework of the WHO-GATE 5P model and circular economy principles. It provides practical tools and documentation templates to strengthen referral pathways, inspection and quality assurance procedures, and the management of spare parts and materials across the product lifecycle. Emphasizing sustainability, safety and user-centred service delivery, the document supports health systems and service providers to extend product life, optimize resource use and reduce environmental impact.

Keywords

SELF-HELP DEVICES, EUROPE, HEALTH POLICY, PUBLIC POLICY, PERSONS WITH DISABILITY, AGING

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Abbreviations

OEM original equipment manufacturers

SDG Sustainable Development Goal




1.
Introduction

Ensuring access to assistive technology is fundamental for promoting independence, participation and well-being among people with functional difficulties. As populations age and the prevalence of disability increases, governments face growing demand for effective and sustainable solutions that support individuals in daily life and enable universal health coverage.

Assistive technology is an umbrella term covering assistive products and the systems and services related to their delivery *(1)*. Assistive products maintain or improve an individual's functioning and independence, thereby promoting health and well-being *(1)*. Examples include hearing aids, wheelchairs, walking aids, communication devices, and self-care products such as shower chairs and toilet chairs. Despite being essential, only one in 10 people globally currently have access to the assistive products they need *(2)*. Extending the lifecycle of these products through repair, refurbishment and recycling offers a pathway to improving affordability and availability, reducing waste and supporting national health systems in meeting the needs of their populations *(3,4)*.

Sustainable repair, refurbishment and recycling practices directly support Member States in fulfilling their commitments under the United Nations Convention on the Rights of Persons with Disabilities and advancing the Sustainable Development Goals (SDGs). Among others, these practices support SDG 3 on good health and well-being, SDG 10 on reducing inequalities and SDG 12 on responsible consumption and production. By embedding circular economy principles into national assistive technology systems, Member States can advance an inclusive approach to health and social care that leaves no one behind.

1.1 Purpose

This document supports Member States in developing sustainable repair, refurbishment and recycling programmes for priority assistive products used in self-care and mobility activities. The products specifically addressed in this document include shower chairs, bath chairs, toilet chairs and commodes, walking aids and manual wheelchairs. These products are essential for maintaining independence and promoting health and well-being, particularly among older people, people living with chronic conditions and persons with disabilities. By establishing safe and efficient practices for managing the lifecycle of these assistive products, governments can extend product availability, reduce waste and improve access to quality assistive technology.

The guidance provided in this document covers three inter-related practices: repair, refurbishment and recycling. Sustainable repair, refurbishment and recycling practices align with circular economy principles and reduce overall procurement costs to national health systems. This document provides a practical framework for establishing programmes for each of these three practices at the national, regional or facility level, ensuring that limited resources are used efficiently while minimizing environmental impact and maintaining the highest standards of safety and hygiene.

Member States are not expected to implement repair, refurbishment and recycling programmes simultaneously. Each of these three approaches can be implemented independently and will generate significant benefits for access, cost and sustainability. This document presents all three concepts and demonstrates how they work synergistically within a circular economy framework; however, countries may choose to begin with the approach that best aligns with their current capacity, resources and priorities. Starting with even one of these practices, whether repair to extend product life, refurbishment to enable reuse or recycling to recover materials, represents meaningful progress towards a more sustainable assistive technology ecosystem.

1.2 Objectives

This document aims to support Member States in achieving the following objectives:

- extend the lifecycle of assistive products through sustainable repair and refurbishment practices;
- reduce product-related waste and minimize environmental impact;
- improve access to quality assistive products and support equitable provision;
- reduce overall procurement costs to national health systems;
- establish safe and hygienic practices that protect user health and safety; and
- support the development of circular economy approaches in assistive technology.

1.3 Target audience

This document is designed for multiple stakeholders involved in planning, implementing and managing assistive technology services at national and facility levels. Government ministries and health authorities can use this document to develop policy frameworks and establish national repair, refurbishment and recycling programmes that align with circular economy principles and support equitable access to assistive technology. Health and social care providers, including hospitals, rehabilitation centres and community care organizations, will find practical guidance on integrating repair and refurbishment processes into their service delivery, extending product availability and responsibly managing devices at the end of their usable life.

Equipment suppliers and manufacturers can use this document to understand how repair and refurbishment support market demand and product sustainability, informing their business models and procurement decisions. Maintenance and refurbishment teams can access the technical and operational details needed to safely inspect, repair and refurbish assistive products while adhering to quality and hygiene standards. Disability organizations and user advocates can reference this document when advocating for policies and programmes that improve access to assistive technology through circular economy approaches.

While this document focuses specifically on self-care and mobility products, the principles and processes described may be transferable to other categories of assistive technology, making it relevant for anyone involved in building sustainable assistive technology systems. For those involved in the repair, refurbishment and recycling of products which contain electronic or digital components, or other products not covered within this document, additional considerations may apply beyond those mentioned herein.

1.4 Key concepts

Repair, refurbishment and recycling are distinct but complementary practices that form the foundation of a circular approach to assistive technology. Each serves a specific purpose in the product lifecycle, yet together they create a sustainable ecosystem that reduces waste, extends access and supports resource efficiency.

Repair refers to fixing broken or malfunctioning assistive products to restore their original function. This includes replacing parts, adjusting components or correcting faults. Repair extends product life, reduces waste and maintains user independence by ensuring continuity of access. Repaired products are returned to the original user for continued use, making repair essential for minimizing service disruptions and preventing premature product abandonment.

Refurbishment involves restoring a used assistive product to a safe and usable condition for reissue to a new user. This process includes cleaning, replacing worn parts, testing for safety and function, and in some cases updating the product to meet current standards. Unlike repair, refurbished products enter the

supply chain as available stock, increasing the quantity and variety of devices that can be issued within a country. Refurbishment enables reuse, supports equitable access, and reduces both procurement costs and environmental impact by diverting products from the waste stream.

Recycling encompasses the breakdown of assistive products at the end of their usable life into parts or raw materials for reprocessing. This includes recovering usable components such as wheels, armrests or frames for spare parts, as well as separating materials like metals, plastics and electronics for remanufacturing. Recycling minimizes landfill waste, supports circular economy principles, conserves natural resources and reduces the environmental footprint of assistive technology provision. Effective recycling requires safe disassembly protocols and partnerships with recycling facilities to ensure compliance with health and environmental standards.

Together, these three practices align with the European Union Waste Framework Directive (Fig. 1), which prioritizes prevention, reuse and recycling over disposal. By integrating repair, refurbishment and recycling into national assistive technology systems, Member States can build more resilient, cost-effective and environmentally responsible health and social care services.

Fig. 1. European Union waste hierarchy

Source: European Commission (2026) *(5)*

1.5 WHO-GATE 5P Framework and circular economy approach

The WHO-GATE 5P Framework (Fig. 2) provides a comprehensive approach to strengthening assistive technology access through five interconnected elements: people (users of assistive products; cross-cutting across the remaining four elements); policy (enabling regulatory environments); products (quality and availability); provision (effective service delivery); and personnel (trained workforce).

Repair, refurbishment and recycling programmes consider all five of these dimensions:

- People benefit through improved access and continuity of care.
- Policy frameworks must enable and regulate these practices.
- Products designed for durability and repairability support programme effectiveness.
- Provision systems must integrate repair and refurbishment as core service delivery components *(6)*.
- Personnel require training and competencies in inspection, repair techniques and quality assurance; increased local capacity and knowledge of assistive technology; and training in management/ tracking of assistive product stock.

By embedding circular economy principles into national assistive technology strategies, countries advance the WHO-GATE 5P Framework while simultaneously reducing costs, extending access and supporting environmental sustainability. A circular assistive technology provision model has been explored by researchers, who describe the role of design, local production, provision, repair and maintenance, reuse, and recycling and material recovery (Fig. 3) *(3)*. The approaches described in this document should be understood as integral to comprehensive, person-centred assistive technology systems rather than standalone initiatives.

Fig. 2. WHO-GATE 5P Framework

Source: WHO (2026) *(7)*.

Fig. 3. Circular assistive technology provision model

AT: assistive technology.
Source: Reproduced with permission from Oldfrey et al. (2021) *(3)*.

2.
Referral process and documentation

2.1 Referral for repair and/or refurbishment

Products enter repair or refurbishment pathways through one of three distinct routes, each requiring structured processes to ensure traceability, accountability and appropriate management. Understanding these pathways is essential for establishing effective systems that maximize product recovery and extend availability. Following this section, Box 1 provides a description of the Norwegian assistive technology refurbishment programme, including a description of the pathways assistive products follow.

2.1.1 Routine maintenance and repair

Routine maintenance and repair are an essential part of the assistive product provision process. Products should be checked regularly for loose or worn parts and maintained and repaired as necessary to extend the life of the product and reduce the potential for product breakdown. Intervals for routine maintenance and repair should be established for each product, and products should be reviewed by either clinical or technical teams as part of ongoing follow-up services. Routine maintenance will often lead to small repairs but may prevent breakdown and larger repairs required at a later date.

2.1.2 Referral for repair

Referral for repair occurs when a product is still in active use but has become broken or malfunctioning. Users, caregivers or health and social care providers identify the fault and refer the product for repair while it remains assigned to the user. Referral sources may include individual users, home care providers, hospitals, rehabilitation centres or community care organizations. During the repair period, alternative products should be made available to ensure continuity of care and avoid service disruption. Once repaired, the product is returned to the original user for continued use. In some cases, particularly for non-customized and simple assistive products, it may be more seamless for the user to keep the alternative product, while the repaired product returns to stock as an alternative product. This saves transport, cleaning and restoring of the alternative product after having been used for a short time.

2.1.3 Return for refurbishment

Return for refurbishment occurs when a product is no longer needed by the current user and is returned to the health and social care system for potential reissue. Products may be returned because the user's needs have changed, the user has recovered function or the user has passed away. Returns may be initiated by individual users, health and social care facilities such as hospitals or care homes, or equipment loan programmes. Returned products are assessed to determine whether they are suitable for refurbishment and reissue to a new user. This pathway increases the quantity and variety of available devices, supports equitable access, and reduces procurement costs by enabling products to serve multiple users over their lifespan.

Both repair and refurbishment require a structured referral process supported by clear documentation. Referral forms should capture item type and model, serial number or unique identifier, condition assessment, infection control status and the reason for referral or return. Establishing these processes ensures that products are directed to the appropriate pathway and managed safely, efficiently and in compliance with quality and hygiene standards. The next section provides an example of what may be included in a referral form to support tracking, tracing and documentation standards (Table 1).

2.2 Documentation requirements

Robust documentation is essential for ensuring traceability, accountability and compliance throughout the repair and refurbishment process. Table 1 outlines the key documentation elements that should be captured for each product across the repair and refurbishment process.

Table 1. Key documentation for repair and refurbishment

Element	Purpose	Details
Unique identifier	Enable tracking and identification of individual products	Record serial number, stock keeping unit or barcode number assigned to the product
Referral/intake form	Capture initial product information and condition at receipt	Document product type and model, condition assessment, infection control status, reason for referral or return and referral source
Condition assessment report	Establish baseline condition and document pre-repair/ refurbishment status	Conduct and record pre-repair/ refurbishment inspection using standardized checklist covering structural integrity, functional components, hygiene and safety concerns
Warranty status	Verify coverage for repair or replacement eligibility	Record warranty period, terms, provider contract and expiration date
Repair/refurbishment log	Track all work performed on the product	Record date of service, technician name, parts replaced or adjusted, materials used, time spent and any complications encountered
Quality assurance certificate	Verify that product meets safety and hygiene standards after repair or refurbishment	Document completion of load and stability testing (if applicable), functionality checks and final hygiene inspection with date and technician signature
Tracking and traceability	Enable real-time monitoring and audit trail	Use barcode or QR code system linked to digital database to track product location, status and history throughout the repair/ refurbishment process

Source: authors.

Where available, digital information systems should link these documentation elements to one another to enable efficient record-keeping and enable access by authorized personnel across the health and social care system at facility, regional or national levels.

Box 1. Refurbishment of assistive technology in Norway

Overview

Norway has developed a national, unified system for providing assistive technology to people with permanent functional impairments. All assistive technology products are owned by the state and loaned to users free of charge, ensuring equitable access regardless of geography or socioeconomic status. A key pillar of the system is an extensive refurbishment programme, which maximizes reuse of products, reduces public expenditure and supports environmental sustainability. The refurbishment model is fully integrated into national policy and service delivery structures.

Scope

The programme is implemented nationwide through 14 local Assistive Technology Centres at county level. It covers a broad range of assistive technology products, including manual and powered wheelchairs, hospital beds, walkers, specialized seating and standing systems, and assistive products for hearing and vision impairment. The system serves people of all ages – from children requiring frequent adjustments due to growth, to older adults with progressive mobility needs.

Key processes

Returned products follow a standardized process: collection, cleaning, inspection, refurbishment and re-entry into stock. Technicians evaluate whether refurbishment is cost-effective – considering spare-part availability, labour requirements, product lifespan and environmental impact. National procurement agreements ensure high-quality products suitable for long-term reuse and require suppliers to provide spare parts for at least five years after contract expiry. A new national digital assistive technology inventory system supports staff in identifying available refurbished alternatives during service delivery, improving turnaround time and product fit.

Impact

Refurbishment is a highly cost-effective and sustainable component of Norway's assistive technology system. Refurbished products accounted for approximately 30% of total product value, equivalent to €90 million in 2022.

For children, reuse enables frequent adjustments and timely provision of well-fitted equipment, preventing contractures, improving posture, and supporting mobility and participation. For adults with changing needs the ability to replace or adjust equipment quickly is essential to functioning and independence. The programme also significantly reduces waste, extends product lifecycles and lowers the environmental footprint of assistive technology provision.

Challenges and lessons learned

Key challenges include managing outdated product models, ensuring consistent availability of spare parts and determining when refurbishment is cost-effective versus purchasing new equipment. Maintaining a skilled technical workforce is also essential for high-quality repairs.

Lessons learned include the following:

- High product quality reduces long-term costs – procurement frameworks should prioritize durability and refurbishment suitability.
- Spare part availability is critical – long-term supplier agreements enable efficient repairs and reuse.
- A national digital assistive technology system strengthens reuse systems, allowing staff to quickly identify compatible refurbished products and ensure full logistic overview.
- Close collaboration between municipal generalists and Assistive Technology Centre specialists ensures timely equipment return, repair and redistribution.
- Refurbishment is a scalable, transferable model for countries seeking cost-efficient, environmentally sustainable assistive technology systems.

Source: Berit Stølen (Norwegian Labour and Welfare Service), 2026.[1]

[1] Berit Stølen, Norwegian Labour and Welfare Service, personal communication, 2026.

3.
Inspection, repair and spare parts

This section provides practical guidance on assessing product condition, identifying common repairs needed and maintaining an essential spare parts inventory. The inspection checklists, repair examples and spare parts lists presented here are not exhaustive but represent the most common issues encountered with self-care and mobility products in routine practice. Each country should adapt these recommendations to reflect the specific products in use within their health and social care systems, local environmental conditions and available resources. Regular review and updating of these lists based on repair data will ensure they remain relevant and useful for technicians and maintenance teams.

3.1 Inspection checklist

A standardized inspection checklist ensures consistent assessment of product condition and enables systematic identification of repairs needed. The following checklist (Table 2) should be completed when a product is received for repair or refurbishment. Inspections should be conducted by trained personnel in a well-lit environment with appropriate tools and safety equipment. Products should be cleaned before inspection to allow accurate assessment of structural integrity and functional components.

Table 2. Inspection checklist components

Component	What to inspect	Issues to look for
Frame	Overall structural integrity	Cracks, bends, rust, corrosion, loose welds, deformation
Seat/backrest	Surface condition and attachment	Tears, stains, hygiene concerns, loose attachment points, cushioning degradation
Wheels/casters	Mobility and safety	Flat spots, worn treads, worn or damaged pushrims, difficulty rotating, damaged bearings, brake functionality
Armrests/footrests	Stability and attachment	Cracks, bends, loose fasteners, padding condition, secure mounting
Commode pan (if applicable)	Cleanliness and integrity	Cracks, chips, discoloration, corrosion, seal integrity, proper fit
Fasteners and hardware	Secure attachment	Loose bolts, nuts or screws; missing fasteners; rust or corrosion on metal hardware

Source: authors.

Following inspection, documented findings from this checklist should guide decisions about whether the product can be repaired, refurbished for reissue or should proceed to recycling or end-of-life management.

3.2 Common repairs

The following repairs represent the most frequently encountered issues with self-care and mobility products (Table 3). These repairs can typically be performed at local repair centres or health and social care facilities by trained technicians using readily available tools and materials. The examples provided are not exhaustive; technicians should document all repair work performed and adapt this list based on patterns observed in their specific context.

Table 3. Most frequently encountered repairs for self-care and mobility products

Repair type	Description	Frequency	Materials/parts needed
Wheel/caster replacement	Replace worn or non-functional wheels or casters	Very common	Universal wheels, casters or axles compatible with device
Brake and wheel lock adjustment or replacement	Repair or replace brake mechanisms or wheel locks to restore safety and mobility control	Very common	Brake pads, brake cables or complete brake/wheel lock assemblies
Rubber tip or ferrule replacement	Replace worn or missing rubber tips on legs or walker frames	Very common	Rubber tips, ferrules or non-slip pads in various sizes
Fastener tightening or replacement	Tighten or replace loose, missing or corroded bolts, nuts and screws	Very common	Bolts, nuts, screws and washers in standard sizes
Seat cushion or cover replacement	Replace worn, torn or deteriorated cushioning or upholstery	Common	Replacement seat cushions, covers or foam padding
Frame repainting or polishing	Restore finish to improve appearance and prevent corrosion	Occasional	Paint, primer or polishing compounds appropriate for material
Armrest or footrest repair	Tighten attachment, replace padding or adjust positioning	Common	Fasteners, padding materials, replacement armrest or footrest kits
Handle or grip repair	Replace worn, cracked or slippery handles and grips	Occasional	Replacement handles, grips or grip tape
Commode pan cleaning or seal replacement	Thoroughly clean or replace deteriorated seals and gaskets	Common (for commodes)	Cleaning agents, replacement seals, gaskets or pans
Alignment adjustment	Correct misalignment of wheels, frames or moving parts	Occasional	Adjustment tools, shims or replacement components as needed

Source: authors.

Technicians should record details of all repairs performed, including the date, parts used, time invested and any challenges encountered. This data helps identify patterns in product failures and informs procurement and design decisions for future products. A record of parts which could not be repaired, including reasons why and management of the product for recycling/end of life, may also be useful for understanding quality, safety and limitations of use.

3.3 Spare parts inventory

Maintaining an organized, well-stocked spare parts inventory is essential for ensuring timely and cost-effective repairs. The availability of commonly needed parts reduces downtime, extends repair capacity and minimizes the need to discard products that could otherwise be restored to functionality. Countries should establish inventory management systems that track stock levels, expiration dates and usage patterns to ensure efficient procurement and prevent waste. Procurement tenders should, wherever possible, include requirements for the provision of spare parts when the assistive product is purchased.

Table 4 outlines essential spare parts that should be maintained by repair and refurbishment centres. Inventory levels should be adjusted based on the volume of repairs performed, local product types in use and storage capacity.

Table 4. Essential spare parts

Category	Specific items	Storage notes
Wheels and casters	Universal wheels (various sizes), casters, axles, bearings	Store in dry location, protect from dust
Brakes, wheel locks and components	Brake pads, brake cables, brake levers, complete brake and wheel lock assemblies	Keep dry and clean; avoid rust and corrosion
Rubber and foam components	Rubber tips, ferrules, non-slip pads, foam padding, cushioning material	Store away from direct sunlight to prevent degradation
Fasteners and hardware	Bolts, nuts, screws, washers (stainless steel preferred for corrosion resistance)	Organize by size; use labelled bins or containers
Seat components	Replacement seat cushions and backrests, seat covers, upholstery material, padding	Store in clean, dry location; protect from moisture
Armrest and footrest kits	Complete armrest units, footrest units, attachment hardware	Keep with original packaging when possible
Commode-specific parts	Commode buckets/pans, seals, gaskets, hinges	Keep sealed; check for cracks or deterioration
Handles and grips	Replacement handles, grip covers, grip tape, mounting hardware	Store in accessible location for quick access
Tools and consumables	Lubricants, cleaning supplies, disinfectants, sandpaper, paint/primer, replacement fuses	According to material safety data sheet documentation

Source: authors.

3.3.1 Inventory management best practices

The following should be considered best practices in inventory management.

- Establish a tracking system (digital or paper-based) recording part type, quantity received, date received, quantity used and current stock level.
- Conduct regular inventory audits (monthly or quarterly) to verify stock accuracy and identify parts that require reordering.
- Set reorder thresholds for commonly used parts to ensure continuous availability.
- Source parts from reliable suppliers; establish relationships with original equipment manufacturers (OEM) when possible, to ensure quality and compatibility. Include spare parts in procurement tenders.
- Consider bulk purchasing agreements to reduce costs while maintaining adequate stock.
- Store parts in organized, labelled bins or containers in a clean, dry, secure location.
- Protect sensitive components (electronics, rubber, foam) from environmental damage through appropriate storage conditions.
- Document any obsolete or damaged parts and remove them from inventory to prevent use in repairs.




4.

Repair and/or refurbishment process

This section outlines the step-by-step process for repairing and refurbishing assistive products to restore them to a safe, functional and hygienic condition. The process described here applies to products undergoing either repair (for return to the original user) or refurbishment (for reissue to a new user). While the core steps are similar, refurbishment requires more comprehensive assessment and documentation due to the change in user. A detailed process map or decision tree is provided in Annex 1 to guide technicians and facility managers through key decision points and pathway choices. Countries should adapt this process to align with their available resources, facility infrastructure and national standards for quality assurance and infection control.

Note that while the process below may be commonly used regardless of who is providing services, the provider conducting the repair may differ depending on the national context or the specific product pathway. For example, where products have been provided with a warranty, products may be returned to the supplier within the warranty period for repair or replacement. In some contexts, repair and refurbishment may be managed by a contracted repair and refurbishment supplier, while in others, these processes may be managed and completed by in-house teams. An example of how refurbishment is being used in Romania to bring high-quality donated wheelchairs into use is provided in Box 2.

Box 2. Recycled wheelchair supply via international partnerships in Romania

Motivation Romania Foundation has leveraged donated pre-owned wheelchairs from a Swedish partner since 2012 to improve mobility access for people with disabilities in Bulgaria, Romania and Ukraine. These high-quality recycled units undergo technical assessment, and refurbishment in Bucharest workshops, ensuring safe distribution at a subsidized cost (covering transport from Sweden, warehousing, parts and administration) far below new market prices plus destination shipping.

Key features at a glance:

- Assistive technology focus: standard, supportive and specialized wheelchairs (up to 200/month available);
- Key processes: import, workshop refurbishment, regional distribution;
- Economic benefit: donated stock reduces costs while meeting diverse user needs; and
- Impact: supports independent living, rehabilitation and inclusion for underserved regions.

This model shows how cross-border recycling and local expertise can deliver affordable, sustainable assistive technology solutions in resource-limited settings.

Source: Cristian Ispas (Motivation Romania) and Emma Tebbutt (WHO), 2026.[2]

[2] Cristian Ispas, Motivation Romania and Emma Tebbutt, WHO; personal communication; 2026.

4.1 Cleaning and disinfection

Thorough cleaning and disinfection are critical first steps in both repair and refurbishment processes. These steps eliminate pathogens, remove visible contamination and prepare the product for detailed inspection and component replacement. Cleaning and disinfection are particularly important for products that may have been used by multiple users or in high-risk settings such as hospitals.

4.1.1 Cleaning process

The following steps are key in the cleaning process.

- Pre-cleaning – remove gross contamination (soil, organic matter, body fluids) using warm water, mild detergent and a soft brush or cloth. Pay special attention to seams, crevices and areas where dirt accumulates.
- Rinsing – thoroughly rinse all surfaces with clean water to remove soap and debris. Ensure all crevices and recessed areas are rinsed completely.
- Drying – allow the product to air dry completely in a clean environment or use clean towels to dry surfaces. Ensure no moisture remains, as this can promote rust and corrosion or create an environment for microbial growth.

4.1.2 Disinfection process

The following considerations should be applied in the disinfection process.

- Use hospital-grade disinfectants appropriate for the product materials (metal, plastic, rubber, fabric). Follow manufacturer instructions for contact time, dilution and safety precautions.
- Apply disinfectant using methods appropriate to the product type (spraying, wiping, soaking or immersion depending on the product and disinfectant used).
- Ensure all surfaces, including crevices and hard-to-reach areas, come into contact with the disinfectant for the recommended contact time.
- Pay particular attention to areas that contact skin, such as seats, backrests, armrests and handles.
- For products with removable components (cushions, covers, pans), remove and disinfect separately if possible.

4.1.3 Infection control considerations

Infection control should take account of the following considerations.

- Follow national and facility-level infection control protocols and guidelines.
- Use personal protective equipment (gloves, eye protection, respiratory protection if indicated) as appropriate for the disinfectant being used.
- Ensure adequate ventilation in the cleaning and disinfection area to minimize exposure to chemical vapours.
- Document the date of disinfection, disinfectant used and staff member responsible for quality assurance purposes.
- Establish a quarantine period (if applicable per local guidelines) before the product proceeds to the next stage of repair or refurbishment.
- Do not proceed to inspection (see 3.1), repair or refurbishment of products until cleaning and disinfection are complete and documented.

4.2 Component replacement

Component replacement addresses wear, damage or obsolescence identified during inspection. Strategic replacement of worn or damaged parts restores product functionality, extends useful life and ensures user safety. Component replacement decisions should balance cost-effectiveness with quality and durability.

4.2.1 Component replacement principles

The following principles are key in component replacement.

- Use OEM parts when available – OEM parts are designed and tested for compatibility and performance with the specific product model. They carry manufacturer warranty and quality assurance.
- Consider certified compatible parts – when OEM parts are unavailable, expensive or difficult to source, certified alternative parts meeting relevant safety and quality standards may be used. Ensure compatibility before installation and document part substitution.
- Replace all instances of a worn component – if a product has multiple wheels, casters or similar components and some are worn, replace all rather than only the damaged ones to ensure balanced function and extend product life.
- Upgrade components where appropriate – when replacing worn or damaged components, consider upgrading to safer or more durable alternatives if cost permits. For example, replacing standard casters with sealed, maintenance-free casters may reduce future maintenance needs.
- Document all replacements – record each component replaced, including part number, OEM or supplier information, date of replacement and technician name.

4.2.2 Quality and safety considerations

The following quality and safety considerations should be taken on board.

- Ensure replaced components are properly installed and securely fastened according to manufacturer specifications.
- Test component function before proceeding to quality assurance testing.
- Replace components only as needed to address identified defects; avoid unnecessary replacement that increases cost and waste.
- For products assigned to specific users, discuss component replacement options with the user or their caregiver when feasible, particularly if upgrades increase comfort or safety.

4.3 Quality assurance

Quality assurance testing verifies that repaired or refurbished products are safe, functional and ready for use. While comprehensive testing in specialized facilities is ideal, most countries lack access to standardized laboratory testing equipment. This section provides practical quality assurance protocols that can be implemented using basic equipment and materials available in typical repair centres, health and social care facilities or community-based services.

4.3.1 Basic functionality testing

Basic functionality testing comprises the following elements.

- Mobility and movement – manually operate all moving parts (wheels, casters, locks, hinges, adjustable components) to verify smooth operation without grinding sounds, resistance or misalignment.
- Stability and weight-bearing – apply downward pressure to seats and armrests to verify structural integrity and stability; ensure no creaking, movement or instability is detected.
- Brake or wheel lock function – engage and disengage brakes or wheel locks multiple times to ensure they hold securely and release freely without resistance.
- Seat and support surfaces – check that cushioning is firm and supportive; test for sagging, flattening or areas of excessive wear.

4.3.2 Structural integrity testing

The following elements are essential to structural integrity testing.

- Visual inspection – examine frame, welds, fasteners and attachment points for visible cracks, breaks, rust or deformation.
- Physical stress testing – apply manual pressure to frame and joints to identify any unusual movement, creaking or instability; tap on metal components with a tool to listen for hollow sounds that might indicate cracks.
- Fastener verification – check that all bolts, nuts, screws and fasteners are tight and secure; tighten as needed.

4.3.3 Hygiene and cleanliness inspection

Hygiene and cleanliness inspection should take account of the following factors.

- Visual cleanliness – inspect all surfaces, seams, crevices and hard-to-reach areas to confirm complete removal of visible dirt, stains or contaminants.
- Odour assessment – note any unusual or unpleasant odours that might indicate incomplete disinfection or hidden contamination.
- Surface condition – verify that cushioning, covers and padding show no signs of mould, mildew or deterioration.

4.3.4 Documentation and sign-off

The following steps are key to documentation and sign-off.

- Complete a quality assurance checklist documenting the date, technician name, results of all tests performed and any concerns identified.
- Record the product's readiness status: approved for use, approved with limitations or requires additional work.
- For products approved for reissue (refurbishment), issue a certificate of quality assurance with date and technician signature.
- For products with identified limitations, document restrictions clearly (e.g. "maximum user weight 100 kg" or "armrest padding worn but functional").

4.3.5 Safety considerations

Safety considerations should include the following.

- Products with safety concerns (cracked frames, non-functioning brakes, unstable structures) must not be approved for use and should be directed to recycling or end-of-life management.
- When in doubt about product safety, consult with supervisory staff or equipment specialists before approving the product for use.
- Products should be re-tested if there is any reason to question the integrity of previous testing.

While this approach uses readily available resources, countries with capacity to access standardized testing facilities or develop partnerships with research institutions or manufacturers should consider periodic comprehensive testing of sample products to validate the effectiveness of basic quality assurance protocols.

5.

Recycling and end-of-life management

While repair and refurbishment extend product life and enable reuse, recycling addresses the end-of-life stage when products can no longer be safely used or refurbished. Recycling serves two complementary purposes: first, it recovers valuable spare parts and materials from devices at the end of their useful life, which can support ongoing repair and refurbishment efforts; second, it ensures safe disassembly and processing of products to minimize environmental impact and recover raw materials *(3)*. Effective recycling requires clear protocols for product assessment, safe disassembly and material separation, and partnerships with certified recycling facilities. This section provides guidance for establishing recycling systems as part of a comprehensive circular economy approach to assistive technology.

5.1 Material separation

Separating the constituent materials of assistive products is the foundation of effective recycling. Proper material separation enables each material stream to be directed to appropriate recycling pathways, maximizes the recovery of valuable materials and ensures hazardous components are managed safely. Material separation should be performed by trained staff following clear protocols and using appropriate safety equipment (Table 5).

5.1.1 Spare parts recovery

Before complete disassembly and material separation, identify usable components that can be recovered as spare parts for future repairs or refurbishment. Common spare parts recovered from end-of-life products include wheels, casters, armrests, footrests, handles, cushions and fasteners. Store recovered spare parts with existing inventory, following standard inventory management practices.

Table 5. Material separation pathways and considerations

Material type	Examples in assistive products	Recycling pathway	Special considerations
Metals	Frames (aluminium, steel, stainless steel), fasteners, springs, hinges, wheels, axles	Metal recycling facilities; scrap metal dealers	Remove any plastic or rubber components before sending to metal recycling
Plastics	Seats, handles, grips, wheel covers, armrest padding covers, commode pans, buckets	Plastic recycling facilities	Identify plastic type if possible (e.g. polypropylene, polyvinyl chloride, polyurethane); remove metal fasteners before recycling
Rubber and foam	Wheel treads, cushioning, cushions, padding, handles, grips, seals, gaskets	Specialized rubber recyclers; foam recycling facilities	May have limited recycling options in some regions; contact local recycling facilities to confirm acceptance and requirements
Fabric and upholstery	Seat covers, backrest covers, arm padding covers	Textile recycling facilities	Remove metal fasteners; confirm acceptance with facilities before sending
Electronics (if present)	Control panels, sensors, batteries, circuit boards, LED displays	Specialized electronics recyclers (e-waste facilities)	Handle separately using appropriate e-waste recycling protocols; ensure data security protocols are followed; remove batteries before general recycling
Glass or mirrors (if present)	Reflective surfaces, display covers	Glass recycling facilities	Handle carefully to prevent breakage; confirm acceptance with recycling facilities

Source: authors.

5.1.2 Material separation process

The material separation process should include the following elements.

- Assessment – evaluate the product to identify all material components before beginning disassembly.
- Safety preparation – use appropriate personal protective equipment (gloves, eye protection, respiratory protection if needed) and ensure an adequate workspace.
- Disassembly – carefully disassemble the product using appropriate tools, following manufacturer specifications or technical drawings when available.
- Component sorting – sort disassembled components by material type into designated containers or storage areas.
- Fastener removal – remove bolts, screws, metal fasteners and springs from plastic, rubber or fabric components before directing to recycling.
- Contamination management – remove any residual contamination (dirt, grease, biological material) from components before recycling; clean as needed following infection control protocols.
- Documentation – record the date, product type, materials separated, approximate quantities and staff member responsible.

5.1.3 Safety and environmental considerations

The following safety and environmental considerations are key in the material separation process.

- Use appropriate personal protective equipment to protect staff from sharp edges, chemical residues or other hazards.
- Ensure adequate ventilation when disassembling products with adhesives, foam or other materials that may release fumes.
- Do not attempt to disassemble products containing hazardous materials (asbestos, lead paint, polychlorinated biphenyls) without specialized training and equipment; contact appropriate authorities or specialized waste handlers.
- Store separated materials in secure, organized locations preventing cross-contamination.
- Never mix material streams (e.g. metal with plastic) as this contamination reduces recycling value and may render entire batches unrecyclable.

5.2 Recycling partners

Establishing partnerships with recycling facilities ensures safe and compliant processing of separated materials. Many countries lack in-house recycling capacity and must work with external partners.

5.2.1 Identifying partners

The following elements should be considered in identifying partners.

- Contact local or regional metal, plastic, rubber, electronics and textile recyclers.
- Consult national or local waste management authorities for guidance on approved facilities.
- Ensure partners comply with national environmental regulations and hold appropriate licences or certifications.

5.2.2 Partnership agreements

In creating partnership agreements, the following are essential.

- Clarify types and quantities of materials accepted, preparation requirements, logistics, pricing and compliance standards.
- Request certificates of recycling or disposal to verify responsible management.
- Maintain contact information and backup partners as a contingency.

5.3 Disposal protocol

Products that cannot be repaired, refurbished or recycled must be safely disposed of in accordance with national and European Union waste management regulations. Clear protocols ensure responsible end-of-life management and maintain audit trails.

5.3.1 Disposal steps

The following steps comprise good disposal protocol.

- Assessment – determine that the product cannot be safely repaired, refurbished or meaningfully recycled.
- Safe disassembly – carefully disassemble products to recover any hazardous components (batteries, electronics, chemicals) that require special handling.
- Hazardous component management – dispose of hazardous materials according to national guidelines; consult waste management authorities for guidance on batteries, electronics or chemical residues.
- General waste disposal – direct non-hazardous components to appropriate waste streams (landfill, incineration, waste-to-energy) in compliance with local regulations.
- Documentation – record the date, product description, disposal method, facility used and staff member responsible.
- Audit trail – maintain disposal records to demonstrate compliance and enable tracking of waste volumes.

Products should only proceed to disposal after repair, refurbishment and recycling pathways have been exhausted.

6.
Incentives and culture of sustainability

Building sustainable repair, refurbishment and recycling programmes requires more than technical capacity and infrastructure, it requires a shift in organizational and societal culture. Many countries lack established practices and attitudes supporting circular economy approaches to assistive technology. Creating a culture of sustainability involves educating stakeholders about environmental and economic benefits, building awareness of available services, training staff, and implementing incentive structures that encourage participation. This section provides practical considerations for promoting a mindset that values product longevity, resource efficiency and responsible end-of-life management across health and social care systems and among assistive technology users.

6.1 Promoting a recycling-friendly mindset

Creating awareness of and buy-in for repair, refurbishment and recycling requires clear communication about environmental, social and economic benefits. Educational initiatives should target both health and social care professionals and assistive technology users, tailoring messaging to local values and priorities. Approaches may include displaying informational posters and signage in health and social care facilities and community settings highlighting the environmental impact of product waste; sharing regular updates on programme outcomes such as quantity of products repaired, devices refurbished and reissued or waste diverted from landfills; and communicating success stories from individual users or facilities demonstrating tangible benefits.

Framing circular economy principles within existing national sustainability commitments or health and social care system values may be more powerful than standalone environmental messaging. However, cultural attitudes towards waste, reuse and product lifecycle vary significantly across regions, and what motivates behaviour change in one context may be ineffective in another. Strategies should be developed collaboratively with local stakeholders to ensure they align with cultural norms, values and communication preferences.

6.2 Training and awareness

Building workforce capacity and professional awareness is essential for successful implementation of repair, refurbishment and recycling programmes *(8)*. Training initiatives should be tailored to different roles: technicians and maintenance staff require hands-on instruction in inspection, repair techniques, material separation and quality assurance; health and social care providers need awareness of referral pathways and how to communicate repair and refurbishment options to users; and administrative staff require understanding of documentation, inventory management and partnership coordination.

Training programmes may be delivered through formal workshops, online modules, mentorship arrangements or integration into existing professional development frameworks *(7–9)*. User engagement is equally important; educating assistive technology users about product maintenance, appropriate use and the importance of returning devices when no longer needed can significantly increase programme participation. The specific format, content and delivery method of training should reflect local capacity, resources and educational infrastructure available within each country.

6.3 Incentives for recovery

Incentive programmes can motivate users, caregivers and facilities to return products for repair, refurbishment or recycling. Potential incentive approaches include offering user discounts, credits or financial reimbursement for returning used products; providing facilities with recognition programmes acknowledging high participation rates; or creating partnerships with community organizations to facilitate convenient product collection points.

Some countries have integrated incentives into health insurance schemes or public procurement systems, making repair and refurbishment services free or subsidized for eligible users. However, the effectiveness and appropriateness of incentive mechanisms depend heavily on local economic conditions, existing social protection systems and community preferences.

In some contexts, emphasis on environmental stewardship or social responsibility may be more motivating than financial incentives, while in others, direct economic benefit may be the primary driver of participation. Incentive strategies should be designed through consultation with target populations and tested at pilot scale before broader implementation to ensure they are acceptable, achievable and generate meaningful behaviour change within the specific cultural and economic setting.

6.4 User education and preventative maintenance

Training assistive technology users in basic care, maintenance and early problem identification can significantly extend product lifespan and prevent the need for major repairs *(8).* Preventative maintenance empowers users to take ownership of their equipment and reduces the burden on formal repair services by catching small problems before they become critical. User education should be integrated into the initial provision process and reinforced through follow-up contact.

Content may include basic cleaning and hygiene practices appropriate to the product type; identifying early signs of wear or malfunction and how to report them; safe use practices that minimize premature damage; storage and environmental considerations; and simple adjustments or minor maintenance that users can safely perform themselves. In addition to training, users may also be provided with a basic tool kit for preventative maintenance and repair. Training should be delivered in accessible, user-friendly formats adapted to individual literacy levels and learning preferences, including demonstrations, written or pictorial instructions, videos or peer-to-peer learning *(11)*.

Caregivers and family members supporting users should also receive training, as they often identify problems and facilitate maintenance activities. While not all users will have the capacity for or interest in learning maintenance skills, providing this information ensures that those who wish to participate can contribute to extending product life. Regular check-ins or follow-up appointments provide opportunities to reinforce maintenance education, troubleshoot emerging problems and refer products for formal repair before they become unusable.




7.

Principles underpinning effective repair, refurbishment and recycling

The success of repair, refurbishment and recycling programmes depends on consideration of several foundational principles that extend beyond individual processes. These principles address the quality and design of assistive products themselves, the information systems that enable tracking and coordination, and the infrastructure that supports efficient collection, storage and distribution of repaired and refurbished devices.

This section outlines three interconnected principles that national health and social care systems should prioritize when establishing or strengthening circular economy approaches to assistive technology. While the previous sections have focused on operational processes, this section considers the systemic enablers that make those processes sustainable, scalable and effective over time.

7.1 Quality assistive products

The quality and design of assistive products determine their suitability for repair, refurbishment and recycling. High-quality products are more likely to have longer initial lifespans, withstand daily use without premature failure and remain functional through multiple repair cycles. Products designed with repairability in mind – featuring modular components, accessible fasteners, standardized fittings and straightforward assembly – can be serviced more efficiently and cost-effectively, reducing downtime and extending useful life. Durable materials and finishes resist corrosion and environmental degradation, maintaining product functionality and appearance over extended periods. Additionally, products designed to facilitate eventual disassembly and material separation support effective recycling and spare parts recovery at end of life.

When procuring assistive products, national health and social care systems should prioritize quality specifications that support repairability and recyclability, including consideration for availability of spare parts in the local area, even if initial purchase costs are higher *(11,13).* This long-term investment perspective recognizes that total cost of ownership, including repair, refurbishment and eventual recycling, is significantly lower for durable, high-quality products compared to lower-cost alternatives requiring frequent replacement. Engaging manufacturers and suppliers in dialogue about product design features supporting circular economy principles can gradually shift market practices towards more sustainable products *(14).*

7.2 Data and information systems

Effective repair, refurbishment and recycling programmes require robust data and information systems that enable tracking, coordination and decision-making across the assistive technology supply chain. Information systems should capture product-level data including unique identifiers, ownership history, maintenance and repair records, refurbishment status and current location. This traceability enables accountability, supports quality assurance and provides evidence of programme outcomes. Information systems must be accessible to multiple stakeholders, which may include assistive technology users, technicians, facility managers, health system administrators, policy-makers and suppliers, at appropriate levels of detail. Countries may choose to implement centralized national databases enabling real-time visibility of product location and status, while others may develop regional or facility-level systems with periodic data consolidation. Regardless of type, systems should capture consistent data elements using standardized definitions to enable aggregation and analysis. Box 3 provides an example of how data was used in Iceland to guide decisions regarding sustainable refurbishment of assistive products.

Box 3. Using data to guide sustainable refurbishment in Iceland

Iceland's national health system explored refurbishment of rollators (wheeled walking aids) as a means to reduce waste and support circular use of assistive technology. Detailed cost and process data revealed, however, that under local conditions, where there are high labour and logistics costs, strict quality requirements and limited recycling value, the refurbishment costs exceeded the purchase price of a new rollator walker. Intensive cleaning with chemicals also offset potential environmental gains.

Key features at a glance:

- Assistive technology category: ISO 120606 – Rollators.
- Decision factor: evidence from cost and process data showed refurbishment was not viable.
- Outcome: activity discontinued; focus shifted to refurbishment for higher value assistive technology.

Key insights

- Reliable lifecycle tracking and data analysis are essential to identify which assistive products deliver true economic and environmental benefit when refurbished.
- Health systems should invest in comprehensive data management systems for equipment logging and condition monitoring.

This case demonstrates how robust data and lifecycle information can empower sustainable decision-making. By combining environmental goals with clear evidence, health systems can design recycling and refurbishment strategies that are both responsible and economically sound.

Source: Páll Sigvaldason (Iceland Health Assistive Technology Service), 2026.[3]

Data analysis capabilities support programme optimization by identifying patterns in product failures, guiding procurement decisions, revealing bottlenecks in repair or refurbishment processes, and demonstrating programme impact through metrics such as products repaired, devices refurbished and reissued, users served, costs saved or waste diverted. Digital systems offer efficiency advantages but require investment in infrastructure, training and maintenance. Countries with limited digital capacity can implement effective tracking using paper-based systems with periodic manual compilation, though this requires more labour and is more prone to data loss. The appropriate level of system sophistication should be determined based on local context, available resources and programme scale.

7.3 Storage and distribution

Efficient storage and distribution networks are essential infrastructure supporting repair, refurbishment and recycling programmes. Strategic placement of storage facilities and repair centres determines accessibility for users, facilities and technicians, directly affecting programme utilization and effectiveness. Countries should consider establishing a network of repair and refurbishment centres distributed geographically to minimize transport distances and reduce service delays. These centres may be located within existing health and social care facilities, rehabilitation centres, community care organizations or dedicated repair workshops depending on local context and capacity *(15)*. Storage facilities must provide clean, secure, organized environments – protecting products from environmental damage, contamination or theft. Climate control, maintaining appropriate temperature and humidity levels, helps preserve product condition, particularly for materials susceptible to rust, deterioration or mould. Clear organization and inventory systems enable efficient location and retrieval of products and spare parts.

[3] Páll Sigvaldason, Iceland Health Assistive Technology Service, personal communication, 2026.

Distribution systems must reliably transport repaired products back to users and refurbished devices to facilities or users needing them. Reverse logistics systems that collect end-of-life products for recycling complete the cycle *(16)*. The configuration of storage and distribution networks should balance efficiency, accessibility and cost considerations. Rural or remote areas may require different approaches than urban settings. Where centralized facilities are impractical, countries might develop partnerships with existing logistics networks or community organizations to extend reach. Regular evaluation of storage and distribution effectiveness, including measurement of delivery times, transportation costs, product condition on arrival and user satisfaction, enables continuous improvement of network performance.

8.
Conclusion

Repair, refurbishment and recycling represent powerful strategies for extending access to assistive technology, reducing costs and minimizing environmental impact within national health and social care systems. These practices align with circular economy principles and support Member States in meeting commitments under the United Nations Convention on the Rights of Persons with Disabilities and the SDGs. Establishing effective programmes requires attention to operational processes, including standardized inspection, cleaning, repair and recycling procedures, as well as systemic enablers such as quality product procurement, robust information systems and efficient storage and distribution networks.

Implementation does not require comprehensive adoption of all elements simultaneously. Countries should begin with approaches that align with current capacity and priorities, whether starting with repair to extend product life, refurbishment to increase availability or recycling to recover materials. Even partial implementation generates significant benefits. Success depends on building organizational culture and workforce capacity that value product longevity and resource efficiency, supported by clear policies, adequate financing and incentive structures encouraging participation. Sustained engagement with users, facilities, manufacturers and recycling partners strengthens programmes over time.

Member States are encouraged to adapt the guidance in this document to local contexts, learn from peer countries' experiences, and pursue technical support from WHO and partner organizations as they develop or strengthen repair, refurbishment and recycling programmes. Through coordinated action, countries can build more resilient, equitable and sustainable assistive technology systems that serve all people with functional difficulties.

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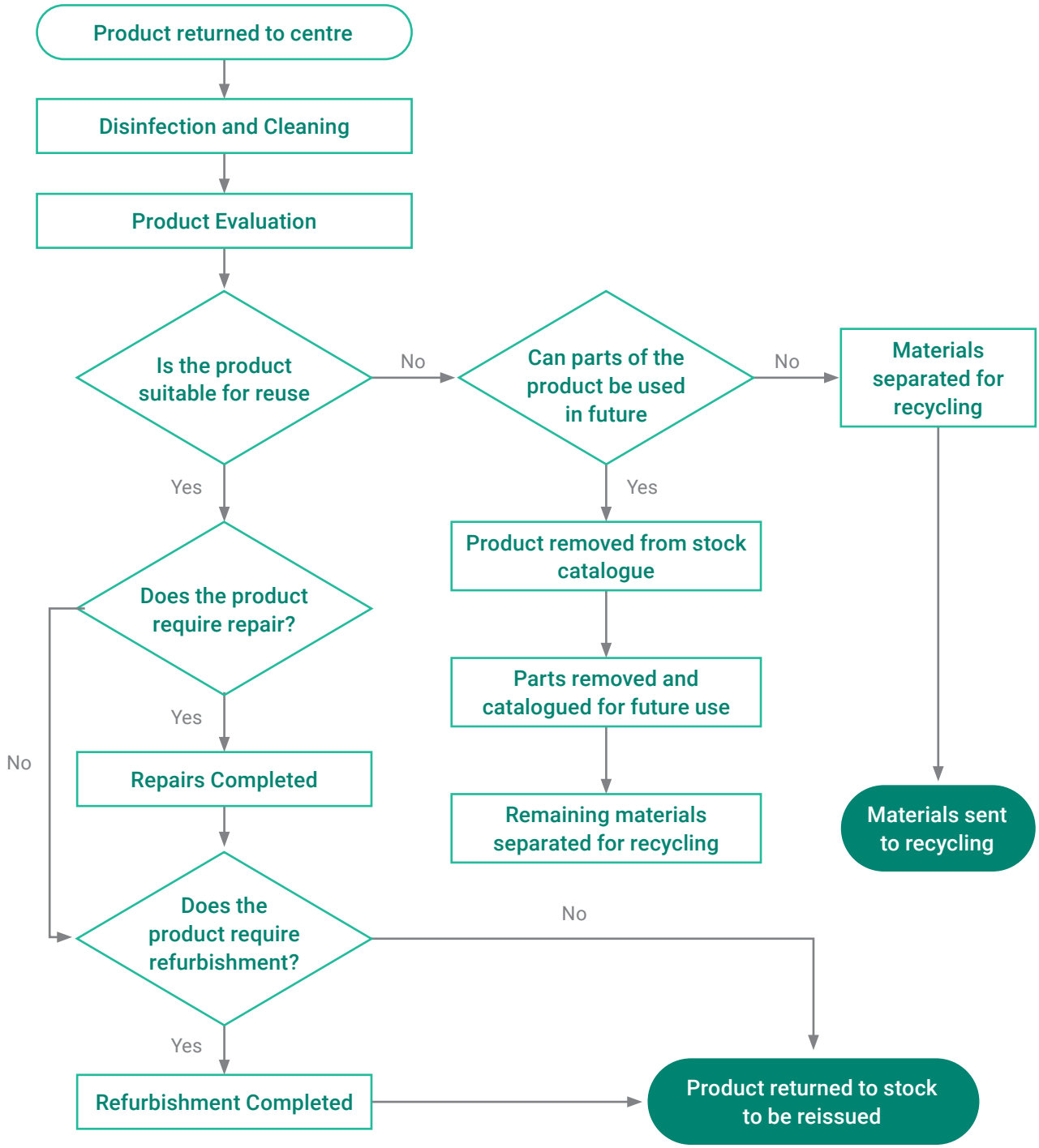
Annex 1. Sample decision tree

This decision tree is used to guide technicians and facility managers through key decision points and pathway choices in the assistive technology reuse, repair and/or refurbishment process. Countries should adapt this process to align with their available resources, facility infrastructure and national standards for quality assurance and infection control.

Fig. A1.1. Sample decision tree



Source: authors

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