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Global report on assistive technology

ATscale
GLOBAL PARTNERSHIP FOR ASSISTIVE TECHNOLOGY

AT2030

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World Health Organization

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Foreword

Access to Assistive Technology deserves greater attention now than ever before. In fact, access to appropriate, quality assistive technology can mean the difference between enabling or denying education for a child, participation in the workforce for an adult, or the opportunity to maintain independence and age with dignity for an older person. Access to assistive technology empowers and enables individuals and communities and is a key pre-condition for realization of the UN *Convention on the Rights of Persons with Disabilities* and achievement of the Sustainable Development Goals. Put simply, assistive technology is a life changer.

This *Global Report on Assistive Technology* captures for the first time a global snapshot illustrating the need, access to and the preparedness of countries to support assistive technology. More than 2.5 billion people require one or more assistive products, and this is expected to grow to over 3.5 billion by 2050 as the global population ages. The Report also features many stories illustrating the profound impact that assistive products such as spectacles, hearing aids, communication devices and wheelchairs can have on people's lives. There is also evidence of the economic and social return on investment in assistive technology. And yet, despite the benefits, many people do not have access to assistive technology, with the gaps greatest in low- and middle-income countries. This global inequity requires urgent collective attention and action.

WHO and UNICEF believe strongly that for the many barriers impacting access to assistive technology, an equal number of solutions exist. The *Global Report on Assistive Technology* offers a way forward through ten key recommendations that call for people-centered, collaborative and multisectoral actions to make access to assistive technology a reality for all those in need. This includes integration of assistive technology throughout health systems, as well as ensuring access points in education, social welfare and other sectors; strengthening the assistive technology workforce; and investment in research, innovation, and accessible environments that support the effective use of assistive technology.

Through this *Global Report on Assistive Technology*, we appeal to decision-makers in health, education, social welfare and other relevant stakeholders including civil society to take up the recommendations, towards ensuring that quality, affordable assistive products are available for everyone who needs them.

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UNICEF Executive Director

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Abbreviations

CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
HDI	Human Development Index
ICF	International Classification of Functioning, Disability and Health
ISO	International Organization for Standardization
NGO	nongovernmental organization
rATA	rapid assistive technology assessment
SDG	Sustainable Development Goal
UN	United Nations
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Executive summary

Recalling that a majority of those who need assistive technology do not have access to it, and that this has a significant impact on the education, livelihood, health and well-being of individuals, and on families, communities and societies, Member States adopted a resolution on *Improving access to assistive technology* during the 71st World Health Assembly in May 2018. Among other mandates, Member States requested the Director-General of the World Health Organization (WHO) to prepare a global report on effective access to assistive technology in the context of an integrated approach, based on the best available scientific evidence and international experience, with the participation of all levels within the organization and in collaboration with all relevant stakeholders.

In fulfilling this commitment, aiming to improve access to assistive technology, this global report:

- presents the first comprehensive dataset of its kind and analysis of current assistive technology access;
- draws the attention of governments and civil societies to the need for, and benefits of, assistive technology, including its return on investment;
- makes recommendations for concrete actions that will improve access;
- supports implementation of the UN *Convention on the Rights of Persons with Disabilities*; and
- contributes towards achieving the Sustainable Development Goals, especially in making universal health coverage (UHC) inclusive – leaving no one behind.

The global report explores assistive technology from a variety of perspectives.

Understanding assistive technology

Assistive technology is an umbrella term for assistive products and their related systems and services. Assistive technology enables and promotes the inclusion, participation and engagement of persons with disabilities, ageing populations and people living with chronic conditions in the family, community and all areas of society, including the political, economic and social spheres.

Assistive products can enhance performance in all key functional domains such as cognition, communication, hearing, mobility, self-care and vision. They may be physical products such as wheelchairs, spectacles, hearing aids, prostheses, orthoses, walking aids or continence pads; or they may be digital and come in the form of software and apps that support communication, time management, monitoring, etc. They may also be adaptations to the physical environment, for example portable ramps or grab-rails.

Those who need assistive technology include, among others: people with disabilities; older people; people with communicable and noncommunicable diseases including neglected tropical diseases; people with mental health conditions; and people with gradual functional decline or loss of intrinsic capacity. The need for assistive technology also increases in most humanitarian crises.

Assistive technology is important across the lifespan. Access to assistive technology for children with disabilities is often the first step for childhood development, access to education, participation in sports and civic life, and getting ready for employment. Children with disabilities have additional challenges due to their growth, which require much more frequent adjustments or replacements of their assistive products. Along with existing functional difficulties, persons with disabilities will experience further challenges because of gradual functional decline in other functional domains as they get older.

Access to assistive technology is a human right, and a precondition for equal opportunities and participation. While the need for it is rising, the majority of people who would benefit from it do not have sufficient access. Yet everyone is likely to need assistive technology during their lifetime, especially as they age.

The positive impact of assistive products goes far beyond improving the health, well-being, participation and inclusion of individual users – families and societies also benefit. In addition to policy requirements, economic and social benefits make the case for health and welfare systems to invest in assistive products and related services.

Measuring access to assistive technology

To better understand the current global assistive technology access situation, data were collected from 35 countries with nearly 330 000 individuals. Based on representative self-reported population surveys in 29 countries, WHO/United Nations Children's Fund (UNICEF) estimate that there are more than 2.5 billion people who would benefit from one or more assistive products. With populations ageing and the prevalence of noncommunicable diseases rising across the world, this number is likely to rise above 3.5 billion by 2050.

The need for assistive products is influenced by many factors including a person's functional ability, level of awareness, socioeconomic situation, living context, and interaction with the environment. However, there is a considerable global inequity among countries in terms of access. Survey results show that estimated access (i.e. the proportion of people with their need met among those with a need) varied from 3% to 90%. Both need and access vary according to the Human Development Index, a composite measure of life expectancy, education, and per capita income indicators.

Seventy Member States completed a survey about their assistive technology systems. Almost all of them had at least one piece of legislation on access to assistive technology, and at least one ministry or other authority responsible for it. Most countries had a public budget allocated for assistive technology and financing mechanism(s) in place to cover users' costs for assistive technology either fully or partly. Several countries had assistive technology regulations, standards or guidelines in place. Large gaps in service provision and trained workforce for assistive technology were reported from many countries, especially in the domains of cognition, communication and self-care.

The population need for assistive technology was far from being fully met in most surveyed countries. Improvements are needed in affordability, availability and necessary support for people to obtain the assistive products they need.

Identifying barriers to assistive technology

There are many barriers to accessing assistive technology, including lack of awareness and affordability, lack of services, inadequate product quality, range and quantity, as well as procurement and supply chain challenges. There are also capacity gaps in the assistive technology workforce, and a low policy profile for the sector. In addition, people may also face barriers related to their age, gender, type and extent of functional difficulty, living environment and socioeconomic status. It is therefore important that strategies to improve access to safe, effective and affordable assistive technology employ a people-centred, rights-based approach, actively engaging users in all aspects of assistive technology.

Improving the assistive technology system

Improving the assistive technology system means developing and strengthening its four key components: products, provision, personnel and policies. Where possible, assistive technology should be integrated within health and social care systems.

Policy: Policy is an overarching component of the previous three components. It includes information systems, financing, leadership and governance. Political will, legislation and adequate funding, along with permanent implementation systems and structures, are required to ensure universal, rights-based assistive technology access for everyone, everywhere.

Products: The range, quality, affordability and supply of assistive products need to improve. When possible, repairing, refurbishing and reusing can be faster and more cost-effective than purchasing new assistive products. Strengthening and harmonizing assistive product standards can ensure safety, performance and durability, and simplify procurement processes. Addressing supply chain inefficiencies and resilience can reduce transaction costs and disruptions. Local and regional production plays a vital role in this regard.

Provision: Service delivery or provision of assistive products and related services should be as close as possible to people's own communities, including in rural areas. Services should be provided with consideration to individual needs, including the type and nature of their impairment and functional difficulty, and include early identification and intervention as appropriate. Services should be designed to minimize and prevent further injuries or disabilities, including among children and older persons. Information and

referral systems need to be simplified. Services need to be delivered across all geographic areas and populations. The range, quantity and quality of assistive products that are procured and provided needs to improve, as well as the efficiency of delivered services. Including assistive technology in universal health care and social care planning and services is an important part of this.

Personnel: The workforce required to ensure access to assistive technology needs to be mapped and addressed. Training and education for dedicated as well as allied assistive technology workforce and support networks are a prerequisite, including arrangements for effective task-shifting, task-sharing and training of community level workers. Adaptive staffing models and good retention strategies are vital.

Preparing for assistive technology in humanitarian crises

Every crisis, especially those related to war and conflicts, creates a greater demand for assistive technology, but its provision is still not a priority in emergency responses. Reducing barriers to assistive technology in humanitarian settings includes designing and producing assistive products that are appropriate for humanitarian settings, and including assistive products in catalogues of agencies responsible for medical or health product supplies during humanitarian crises. It also means ensuring that assistive technology is accessible to frontline staff when emergency medical or health care teams are triaging those in need. Stakeholders involved in all stages of a humanitarian response – from community to international level, and from managers to staff and volunteers – should be trained in inclusive policies and practices that incorporate use of assistive technology to address functional difficulties. Approaches in humanitarian settings should also ensure that emergency response policies and programmes protect the rights of users – both those with met and unmet needs.

Creating enabling environments

Enabling environments – whether age- or disabled-friendly, smart cities or villages, barrier-free or accessible, universally or inclusively designed – benefit everyone. The benefits of assistive technology are maximized when the environment in which it is used enables and improves functioning of the user and the assistive product. The environment includes: products and equipment; the built environment; the virtual environment; the natural environment and human-made changes to the environment, both temporary and permanent; services, systems and policies; support, relationships and attitudes. They constitute parts of public transport, health care, education, etc.

Enabling environments are created through supportive policies and accessible and inclusive designs. One of the key approaches to achieving this is applying the principles of universal design to increase the range of people who can access and make use of mainstream spaces, products and services without the need for adaptations or specialized designs.

Moving forward

This report presents ten recommendations intended to guide countries and the stakeholders in their work to progressively improve access to assistive technology and towards universal coverage.

Recommendation 1: Improve access to assistive technology within all key development sectors.
Assistive technology provision needs to be integrated in all key development sectors, especially within health, education, labour and social care. Every country needs an integrated or standalone assistive technology policy and plan of action with adequate budgetary support to improve access to assistive technology for everyone, everywhere without any financial hardship. Where needed, special focus should be given to children with disabilities, people with multiple or severe impairments, older people and other vulnerable populations.

Recommendation 2: Ensure that assistive products are safe, effective and affordable. Assistive products should be affordable, durable, safe and effective. This includes developing or strengthening necessary regulatory systems and standards; systematic feedback mechanisms built into the supply chain; provision of assistive products with the support of a competent workforce; and active engagement of users and their families in product selection as well as training on use and maintenance. UN agencies can use their procurement capacity and expertise to ease these barriers via international tendering accessible to governments and other relevant stakeholders, to ensure quality standards are upheld globally and drive best value for money.

Recommendation 3: Enlarge, diversify and improve workforce capacity. Knowledge, skills, motivation, attitudes and deployment of personnel working in assistive technology sector are keys to success. Adequate and trained human resources of different categories and skills mix for the provision and maintenance of assistive products need to be available at all levels of health and social services – from tertiary to community level. Investments in capacity building of dedicated and allied personnel are needed. The WHO Training on Assistive Products (TAP) and other similar materials can be used for training of the workforce.

Recommendation 4: Actively involve users of assistive technology and their families. Users and their families should be seen as partners in assistive technology provision, from service delivery design to monitoring and evaluation, rather than as passive service recipients. Assistive technology services need to be organized around the person and the environment they live in, not the disease, impairment or means of financing. Users and their family members or caregivers can be encouraged and trained to do simple repairs, maintenance and necessary adaptations. Peer-to-peer training and support should be encouraged.

Recommendation 5: Increase public awareness and combat stigma. Ensure all the key stakeholders – including policy-makers, duty bearers, especially health, education, social care service providers, media and public at large – are well aware of the need for and benefit of assistive technology, including its return on investment. The assistive technology sector can be de-stigmatized through better product design, preferably universal design, and larger acceptance. Political support is required to develop the assistive technology sector to achieve universal coverage through a rights-based approach.

Recommendation 6: Invest in data and evidence-based policy. Every country should have periodical population-based data on the need and demand for, and supply of assistive technology to understand the gaps and trends, in order to develop evidence-based strategies, policies and comprehensive programmes. The WHO rapid assistive technology assessment (rATA) tool can be used to collect population-based data. The assistive technology data collection process can be integrated within other national data collection activities or the health information system, where possible. Investing in good periodic data collection and generating evidence-based policy will support quality services and universal coverage. Establishing a mechanism for sharing experiences, information and evidence can support policy decision-making across sectors and countries.

Recommendation 7: Invest in research, innovation and an enabling ecosystem. The assistive technology sector is changing rapidly due to technological advances and evolving needs. Considering emerging needs, population ageing in particular, investment is urgently needed to ensure assistive products are appropriate, affordable, safe, effective, acceptable and accessible to those who need them most. Investments in research and innovation related to all four key components of assistive technology are needed to increase knowledge, to transform the existing product range and develop new products utilizing emerging technologies, and to develop innovative service delivery processes taking advantage of digital technology, universal design and mainstream consumer products. This can be done in partnership with academia, civil society organizations – in particular with persons with disabilities and older persons and their representative organizations – and the private sector, as appropriate. Such initiatives can be supported by investing in and enabling 'start-ups' to overcome challenges and quickly getting products into the market.

Recommendation 8: Develop and invest in enabling environments. Enabling environments are critical for users' independence, comfort, participation and inclusion, as they allow users to use their assistive products as intended with minimum effort by the user or caregiver. Enabling environments also benefit everyone. Investment in enabling environments is a key prerequisite to optimize the purpose of assistive technology provision: to enable people to live independently and safely with dignity, participating fully in all aspects of life.

Recommendation 9: Include assistive technology in humanitarian responses. Assistive technology provision during humanitarian responses increases benefits to potential users to restore productivity and dignity, and at the same time, enhances community ownership and inclusion. Efforts must be made to ensure that users in crisis settings are not further disadvantaged and that new potential users can access the assistive technology they need. Essential assistive products can be included within the essential health care supply and alongside trauma emergency surgical kits. Training materials focussing on task-shifting can be adapted and translated rapidly. Integrated and appropriate service provision can be set up to ensure that assistive products and related services are compatible with those to be used in the long term. Emergency response facilities should be barrier-free and inclusive.

Recommendation 10: Provide technical and economic assistance through international cooperation to support national efforts. As outlined in Article 32 of the UN *Convention on the Rights of Persons with Disabilities*, international cooperation to support national efforts is necessary to improve access to assistive technology across the world. Such cooperation can support efforts in areas of research, policies, regulations, fair pricing, market shaping, product development, technology transfer, manufacturing, procurement, supply, service provision and human resources. International cooperation is essential to reducing inequity and progressively achieving universal access to assistive technology – and leaving no one behind.

Introduction

Considering that the majority of the people who need assistive technology do not have access to it, and scarcity of data on need and access, on 26 May 2018 the World Health Organization (WHO) Member States adopted a resolution on *Improving access to assistive technology* (WHA71.8)*(1)*. The resolution urged Member States to take a series of affirmative actions and requested the WHO Director-General to prepare a global report on effective access to assistive technology in the context of an integrated approach, based on the best available scientific evidence and international experience, with the participation of all relevant units within the Secretariat and in collaboration with all relevant stakeholders. It also requested WHO to report every four years until 2030 on progress towards implementing the resolution.

This report outlines measures adopted worldwide to improve access to assistive technology, thereby enabling, empowering and promoting the inclusion, participation and engagement of persons with disabilities, ageing populations, and people living with chronic conditions or temporary impairments. Special attention is given to the needs of vulnerable populations, especially children with disabilities, people living with multiple or severe impairments, older people and people living in poverty.

The current report:

- presents a comprehensive dataset, description and analysis of current assistive technology access;
- draws the attention of governments, bilateral and multilateral organizations, private sectors and civil societies to the need for, and benefits of, assistive technology, including its related return on investment;
- makes recommendations for concrete actions that will improve access to assistive technology, especially in resource-limited settings, based on the best available scientific information and international experience; and
- supports implementation of the UN *Convention on the Rights of Persons with Disabilities (2)* and making universal health coverage (UHC) inclusive and achieving the Sustainable Development Goals (SDGs).

Who this report is for

This report is primarily directed at policy-makers, bilateral and multilateral organizations, donors and funding agencies, providers of assistive technology, as well as industry leaders. It is also aimed at: users and potential users of assistive technology and their families or caregivers; organizations representing people with disabilities, older people or people living with chronic conditions; health and social care professionals and their associations; designers and engineers; manufacturers; suppliers; academic institutions; communities; local authorities; public services; the private sector (including information and communication technology (ICT) companies); investors; media organizations; nongovernmental or faith-based organizations; and development organizations.

How this report was developed

The report was produced by WHO in partnership with United Nations Children's Fund (UNICEF), as previous experience shows the benefit of interagency collaboration for increasing awareness, commitment and action across diverse stakeholders and sectors. Report development was led by an Assistive Technology Expert Advisory Group (EAG), and an Editorial Committee. The EAG met for the first time in June 2019 and the Editorial

Committee had its first meeting in March 2020. Based on outlines prepared by the EAG and the executive editors, the Editorial Committee and contributors developed the report through a series of drafts and reviews that involved many stakeholders, including the EAG, other experts, user groups, and WHO and UNICEF colleagues. Draft report recommendations were discussed in one global and six regional consultations. In total, more than 500 people were involved in reviewing the drafts before the EAG consented to the final draft report in December 2021.

The contents of the report were informed by published literature and proceedings from the Global Report on Assistive Technology Consultation held in August 2019 *(3,4)*, complemented by 11 commissioned background papers published in the Special Issue: Companion Papers to the Global Report on Assistive Technology of the RESNA Journal on Assistive Technology *(5)*; nationally and sub-nationally representative population surveys from 29 countries and population-specific surveys on access to assistive technology from seven countries; as well as system-level data on access to assistive technology provided by 70 Member States. The collection of population survey data was guided and supported by global, regional and national teams. The recommendations were developed by the EAG, the Editorial Committee and participants in the regional and global consultations. Two technical editors edited the drafts of the report before final approval by WHO and UNICEF.


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What this report contains

Section 1 introduces the topic of assistive technology, explores who it is for, answers questions around assistive technology needs and benefits, and sets out the policies and implementation frameworks of which assistive technology is a part. Section 2 provides an overview of the global assistive technology landscape, with a focus on current coverage, needs and capacity to meet those needs. Section 3 identifies barriers to assistive technology access, while Section 4 outlines how the barriers can be addressed at national, regional and global levels. Section 5 describes challenges to access and use of assistive technology in humanitarian crises and ways to address these challenges. Section 6 recognizes the significance of enabling environments, accessibility in particular, and of measures to enable optimum use of assistive technology. Section 7 contains recommendations and outlines essential actions.

This report does not provide a complete overview of all available types of assistive products, nor does it provide recommendations related to any specific assistive product.

Note on terminology

In this report, **"functional difficulties"** is used as an overarching term for impairments, activity limitations and participation restrictions. The WHO *International Classification of Functioning, Disability and Health (ICF) (6)* defines "impairments" as problems in body function or structure such as a significant deviation or loss; "activity limitations" as difficulties an individual may have in executing a task or action; and "participation restrictions" as problems an individual may experience in involvement in life situations. The ICF uses "functioning" when referring to all body functions, activities and participation, and uses "disability" as an umbrella term for impairments, activity limitations and participation restrictions.

The UN *Convention on the Rights of Persons with Disabilities (2)* states that "persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others."

"Functional ability" is used in geriatrics and the ageing discourse. Optimizing functional ability is recognized as a key component to healthy ageing and the ultimate goal of the Decade of Healthy Ageing 2021–2030 *(7)*. Functional ability includes: 1) ability to meet one's basic needs; 2) ability to learn, grow and make decisions; 3) mobility; 4) ability to build and maintain relationships; and 5) ability to contribute. Functional ability combines the intrinsic capacity of the individual, the environment a person lives in and how people interact with their environment.

As the term **"disability"** has been used in different ways over the years, it may carry connotations that can prevent people from identifying themselves or being recognized as having a disability, for example, older adults and people living with chronic conditions. This can lead to a perception that assistive technology is not relevant to them. Therefore, this report uses "functional difficulties" or "functional ability" where possible and "disability" when disability is used in titles of publications or when it may otherwise be appropriate given the particular context.

In this report, **"user"** refers to people who use assistive products for their enhanced functioning, optimizing functional ability including activities and participation, being productive, safe and independent, and living with dignity. The term "potential user" is applied to those who might benefit from using an assistive product for the same purpose but do not yet have access.

My child's prosthetic legs give them independence, improved mental health and integration into society.

Mas'as Al Masri (33), Jordan

Section 1

Understanding assistive technology

Key messages

- Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being. Assistive technology is an umbrella term for assistive products and related systems and services.
- Access to assistive technology is a human right and a prerequisite for equal participation and opportunities. Member States and their institutions are responsible for ensuring that their citizens have access to safe, effective and affordable assistive technology.
- Being an integral part of universal health coverage and social welfare programmes, assistive technology should be easily accessible to everyone, everywhere without putting them in financial hardship.
- Assistive technology is relevant for everyone in the world who experiences functional difficulties, either for short or long periods of time or permanently, including children and adults with disabilities, older people, and people living with chronic conditions.
- The benefits of investing in assistive technology often outweigh the cost, both on an individual and a societal level.
- Access to assistive technology is a multi-step process that begins with a potential user being aware of possible assistive technology solutions and ends with the person realizing their rights and goals.

What is assistive technology?

A broad field

Assistive technology is an umbrella term for assistive products and their related systems and services. Assistive technology is of fundamental importance for persons with permanent or temporary functional difficulties as it improves their functional ability, and enables and enhances their participation and inclusion in all domains of life. Assistive products may be physical products such as wheelchairs, spectacles, hearing aids, prostheses, walking aids or continence pads; or they may be digital, occurring in the form of software and apps that support interpersonal communication, access to information, daily time management, rehabilitation, education and training etc. They may also be adaptations to the physical environment, for example portable ramps or grab-rails.

Definitions of assistive technology and assistive products differ depending on their purpose and scope. For example, some countries have developed their own definitions in order to specify legal measures, to classify products or to facilitate communication. Box 1.1 includes the WHO definitions of assistive technology and assistive products, and the definition of assistive products by the International Organization for Standardization (ISO) *(8)*. This report follows the WHO definitions of assistive technology and assistive products.

Box 1.1 Defining assistive technology and assistive product

WHO definitions

Assistive technology is the application of organized knowledge and skills related to assistive products, including systems and services. Assistive technology is a subset of health technology.

An *assistive product* is any external product (including devices, equipment, instruments or software), especially produced or generally available, the primary purpose of which is to maintain or improve an individual's functioning and independence, and thereby promote their well-being. Assistive products are also used to prevent impairments and secondary health conditions.

Source: Priority assistive products list. Geneva: World Health Organization; 2016 (https://www.who.int/publications/i/item/priority-assistive-products-list, accessed 20 April 2022).

ISO definition

An *assistive product* is any product (including devices, equipment, instruments and software), specially produced or generally available, used by or for persons with disability for participation; to protect, support, train, measure or substitute for body functions/structures and activities; or to prevent impairments, activity limitations or participation restrictions.

Source: Assistive products for persons with disability — Classification and terminology (ISO 9999). Geneva: International Organization for Standardization; 2016 (https://www.iso.org/standard/60547.html, accessed 20 April 2022).

Assistive technology is a key enabler for people of all ages and with all kinds of functional difficulties (e.g. cognition, communication, self-care, hearing, mobility or vision) in all areas of life. This makes it a varied field, covering many different products, related systems and services, as well as diverse users and settings. Demonstrating the breadth of this field, the ISO classification of assistive products covers about 650 types of assistive products *(8)*.

The benefits of an assistive product depend on the goals and needs of the person using it, on the environments and settings in which it is used, on the characteristics of the product, and whether it is appropriately provided. Additional factors – such as the level of training in using it, individual adaptation, available services for repair and maintenance, and support from family, friends and professionals – can have strong influence on the use and effectiveness of an assistive product. A good solution for one individual may not work for another, and what works in one setting may not work in another.

Various disciplines and sectors use their own terms to describe technology that overlaps with, or constitutes a subcategory of, assistive technology. Examples include "gerontechnology" *(9)*, which specifically supports older people; "rehabilitative technology" refers to aids that help people recover their functioning after injury or illness and are often used in a clinical setting *(10)*; technology for "ambient assisted living" or "ambient intelligent living" *(11)* to describe technology embedded in the living environment; "person-centred technology" *(12)* to indicate a personalized set of different mainstream and specially designed technologies and products useful for that specific individual; "accessible technology" *(13)*, which has built-in customizable features for individualized use, and "welfare technology" *(14)*, mainly used in Nordic countries.

A dynamic field

Assistive technology is a continuously changing and growing field especially in relation to advancement of digital technology and emerging needs; population ageing in particular. Although some assistive products are relatively unaffected by technological progress (e.g. walking sticks, hand-propelled wheelchairs and spectacles), others have benefitted from, adapted to, and sometimes driven technological innovation. For example, eye-gaze technology, brain–computer interaction, robotics, voice-input techniques, and text messaging have all been influenced by research involving persons with functional difficulties needing new solutions to overcome related barriers and exclusion. Increasingly, technologies that can solve accessibility and participation issues for many are embedded in mainstream products. Indeed, the distinction between assistive technology and mainstream technologies is becoming blurred, especially with the advancement of mobile phones and software. A World Intellectual Property Organization (WIPO) report on emerging technological trends relevant to assistive technology shows a large number of innovations that have a potential to lead to a new generation of assistive products and mainstream consumer products for assistive and interactive use *(15)*.

A human right

In terms of human rights, assistive technology is both a means and an end. An end, because access to assistive technology is a fundamental human right enshrined in the *Universal Declaration of Human Rights* (UDHR) *(16)*. Everyone is entitled to health care and social services that provide equality of opportunity for people to enjoy the highest attainable level of health *(17)*, and assistive technology is an integral part of such services *(1)*.

Assistive technology is also a means by which to exercise human rights. The *UN Convention on the Rights of Persons with Disabilities (2)* recognizes this. It requires states to provide necessary assistive technology to enable people with disabilities to exercise their rights to education, work, leisure, participation in the cultural life of the community etc., and freedoms of opinion and expression.

Accessibility, universal design and assistive technology

Many of the functional difficulties people experience in their lives are caused by physical, cognitive or social barriers in their environment that inhibit accessibility. This interaction between the individual and their environment is described in the *International Classification of Functioning, Disability and Health* (ICF) *(6)*, which shows how functional difficulties are understood as the negative aspects of the interaction between an individual and that individual's context, including environmental and personal factors.

Increasing accessibility by universal design or adaptation of products and environments, and fostering assistive product use when needed, can help to enhance functional ability and overcome exclusion. Investments in accessibility should be an integral part of products and infrastructure in general.

People who need assistive technology

Everyone is likely to need assistive technology during their lifetime, especially as they age. For some people there will be only short episodes of functional difficulties, for example after an accident or serious illness. People born with an impairment or functional difficulty may need longer periods using assistive technology, or even life-long use. Permanent or temporary health conditions can challenge everyday activities such as walking, seeing, hearing, understanding, communicating or controlling continence.

The largest groups of users are people with disabilities; older people who, because of decreasing functional ability, experience difficulties in everyday functioning; and people with chronic conditions such as diabetes, stroke, cancer, Parkinson's disease or dementia, who may need support with self-care, remembering daily routine tasks, mobility or independent living. In addition, people who do not consider themselves as having a functional difficulty may benefit from assistive products, for example spectacles, smart phones with accessibility features, and grab-rails.

There is evidence that the number of people needing assistive technology is growing worldwide. One estimate of the global need for rehabilitation shows that at least one in every three people in the world needs rehabilitation at some point in the course of illness or injury, with musculoskeletal disorders being the most prevalent condition *(18)*. This will lead to an increased need for interventions that support self-management, healthy lifestyles and rehabilitation, as well as assistive technology to cope with the functional difficulties resulting from these conditions.

It is important to note that circumstances change over time as technologies advance and needs, preferences and priorities evolve. Consequently, there is a continual need to update and replace assistive products and integrate new ones. This is particularly true for those with rapidly evolving pathologies and for children whose need is life-long and whose growth,

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Meet Sofia

Brazil

At the age of three, Sofia quickly learned how to use a motorized mobility device to move around independently inside and outside her home. She has cerebral palsy, with greater impairments on her right side. Muscle tightness caused by her condition makes all physical activities challenging – from eating to walking.

Designed for young children, Sofia's device includes features such as a midline joystick for ease of steering, an adjustable seat to allow for safe standing and sitting, and it has bright colours and a playful look. Sofia was immediately attracted to the appearance of the device and decorated it with stickers.

Since receiving the device, Sofia's mother noticed improvements in her coordination, how long she can sit, and her ability to stand. She also noticed Sofia being more engaged with her peers and that as she becomes more active in the world around her, family and friends are more willing to initiate interactions and become involved in her life. Sofia's mother expressed gratitude for how this device has enriched Sofia's life, "Dear Assistive Product, be very welcome in our home and in our lives! May you enhance Sofia's skills and minimize her hardships. You have arrived with beauty and charm, and I am grateful for that..."

development and maturation means regular review and provision of products that are size-, age- and developmentally appropriate.

Children

Assistive technology is vital for the development and participation of children with disabilities. By enabling communication *(19)*, mobility *(20)* and self-care, assistive products enable children to explore the worlds of family relationships, friendships, education *(21)*, play, and household tasks *(22)*. When used properly, these products greatly enhance children's quality of life *(23)* and that of their families (see Sofia's story) *(24)*. However, for many children with disabilities in all parts of the world, this potential remains unfulfilled *(25)*, as inadequate access to assistive technology, or no access at all, excludes them from education, health care and social services *(26)*. Such childhood conditions may have life-long consequences, reducing participation in civic life and employment. Among children, young girls face additional hardships to access assistive technology.

The general absence of assistive technology for children with disabilities results in lower rates of primary school completion *(27)*, higher rates of unemployment and poverty later in life *(28)*, and reduced household income due to care-taking requirements *(27)*. In fact, care-taking needs may result in lower earning potential for families of the child if one or more family members stay at home to take the role of primary caregiver. In addition, many children with functional difficulties live in countries where they have little or no access to assistive technology, leading to exclusion from academic, social and community participation *(28)*.

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People living with chronic conditions

People with communicable and noncommunicable diseases, including neglected tropical diseases, comprise an important group of users. For example, people with type I diabetes may not only need materials for injecting insulin, but may also – when experiencing complications such as amputations or vision problems – need mobility products such as diabetic footwear and products to compensate for vision loss, such as audible glucometers. Other examples are people with chronic obstructive pulmonary disease who need breathing support devices and mobility solutions; people with Parkinson's disease who need mobility solutions and tremor-suppression devices; and people with the long-term consequences of coronavirus disease (COVID-19), chronic heart failure or the effects of human immunodeficiency virus (HIV) infection, who may benefit from mobility solutions, cognitive support, physical training devices and monitoring apps. Most commonly-required assistive products for these populations include therapeutic footwear, wheelchairs, crutches, prosthetics, orthotics (splints), spectacles, white canes, and toilet and shower chairs *(29)*.

Older people

The world's population is ageing, with the global population aged 60 years or older more than doubling between 1980 and 2020 (from 382 million to 1.05 billion). The number of older persons is projected to reach nearly 2.1 billion by 2050 *(30)*. Significant declines in physical and mental capacities can limit older people's ability to care for themselves and to participate and contribute to society. Access to rehabilitation, assistive technology and enabling inclusive environments can improve and foster functional ability and thus well-being and participation *(31)*.

Access to affordable, safe and effective assistive products is fundamental for maintaining and improving older people's functional ability. Common needs are for self-care and personal hygiene, hearing and vision, memory, mental health, mobility, social connectivity (i.e. to avoid isolation and loneliness), safety, and daily activities and leisure *(32)*.

The high prevalence of falls among older people and the increasing global prevalence of dementia and frailty are associated with an increased need for assistive technology *(33–35)*. An important issue is that many older people are ambivalent about the use of assistive products: distrust, worries about privacy and safety, and social stigma are reported reasons for being reluctant to adopt such products *(36,37)*. Other barriers include lack of competence or negative


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attitudes among formal and informal caregivers, or a concern that the quality of care would be reduced if certain types of technology are used – all leading to a reluctance to let older people start using assistive products *(38)*.

Among older people, accessing assistive technology is more challenging for women and people with disabilities. The combination of gender inequality, age-based discrimination and ageist attitudes disadvantage women more than men to meet some basic needs *(31)* including accessing assistive products. As people with disabilities grow older, they may experience gradual functional decline in new domains or further functional decline in domains where they already have functional difficulties. For example, a wheelchair user with paraplegia who gets older may find it harder to push the wheelchair with reduced functional capacity of upper limbs, or putting on a pair of spectacles or hearing aids, which may lead to new adjustments and assistive technology needs.

People in humanitarian crises

People needing assistive technology in humanitarian settings include those who acquire an injury or impairment during the crisis – more so during conflicts and wars; those who may have lost, damaged or have become unable to use their assistive product during the crisis; and also those whose assistive technology needs have never been adequately addressed. Due to the need for emergency response, focus is more on life-saving or treating injuries (trauma care) than

meeting the need for assistive technology. Hence, the type, complexity, magnitude and duration of a humanitarian crisis impacts the need for and supply of assistive technology.

Benefits of assistive technology

As a life changer, assistive technology can support people in need in all aspects of life – for example, a child can go to school, make friends, and participate in sports and recreation like any other child in the school or community; adults can be independent and access higher education and jobs, carry out household activities, and participate in social life. When appropriate to users and their environment, assistive products enable them to move around independently, communicate more effectively, and reduce the consequences of cognitive, mobility, hearing and vision impairments *(39)*. Assistive products further increase individual user's well-being, self-esteem, self-image, and the motivation to pursue important life goals *(25,26)*.

Assistive products are generally considered a means to participate in important areas of life, to express full citizenship, and to participate in community life and in wider society on an equal footing with others. Without assistive products, people may suffer exclusion, be at risk of isolation and live in poverty, face hunger, and be forced to depend more on family, community and government support.

From the perspective of those responsible for public policy, assistive technology enables people to live healthy, productive, independent and dignified lives, and to learn, work and generally take part in society *(28)*. This can result in socioeconomic benefits such as reduced direct health and welfare costs (such as recurrent hospital admissions or state benefits), and a more productive labour force, indirectly stimulating economic growth. The benefits of providing assistive products are thus multiple, in different life areas, and at individual, community and society levels, with a clear potential impact on achievement of the Sustainable Development Goals (SDGs, Box 1.2) *(41,42)*. Investing in access to assistive technology is investing in people and society – helping societies to be inclusive, fostering economic growth and to leave no one behind.

Education

Assistive products support students of any age in enjoying their right to education and being successful and included at school, in vocational training and in higher education *(43)*. When assistive products are used in accessible school environments (e.g. settings with ramps to allow wheelchair access) and are welcomed and included by teachers and other students, students with disabilities are less likely to be marginalized, achieve better educational outcomes and have more opportunities for social interaction *(44,45)*. For instance, assistive products such as text-to-speech software, tablets with necessary software or magnifiers are an affordable way to improve education for students with reading or vision problems *(46)*. In a study in India, regular use of hearing aids was found to have a positive impact on students' performance *(47)*. Communication systems such as symbol charts or communication devices with synthetic speech are effective tools to improve the learning engagement and social participation of students with functional difficulties *(48)*. And when students are confined at home or in a hospital for a longer duration due to a health condition or because they live in rural or remote areas, accessible information and communication technologies (ICT) may allow them to participate remotely in education and stay in contact with their peers *(49)*.

Work

Assistive products open up opportunities for people with functional difficulties to participate in employment, raise their household income, and become entrepreneurs *(50–52)*. Computer equipment or smartphones with adapted software, for instance,

Box 1.2 Investing in assistive technology and achieving the SDGs

A recent study by the Lancet Global Health Commission on Global Eye Health explored the impact of better eye care services on the SDGs. The review showed that the provision of eye care services, including the provision of assistive technology, is associated with improvements in workplace productivity, household consumption, household income, employment prospects and economic productivity. Economic benefits, particularly in resource-limited communities, contribute to achieving SDGs such as no poverty (SDG1), zero hunger (SDG2), quality education (SDG4) and decent work and economic growth (SDG8).

Source: Burton, M.J. et al. The Lancet Global Health Commission on Global Eye Health: vision beyond 2020. 2021; 9(4):E489–E551.

have been successfully used to support employees with intellectual disabilities or autism spectrum disorders to effectively manage time, complete job-related tasks, and transition between activities and places *(53)*. With appropriate assistive technology, many people with functional difficulties can be as productive as others.

Health

Assistive products facilitate visits to health centres and accessing health care. For example, with an outdoor wheelchair or tricycle, a user can go to a nearby hospital or health centre. In countries where transport facilities are not accessible, wheelchairs or tricycles may be the only resource. Access to appropriate wheelchairs with a proper cushion enhances good health and well-being and reduces frequent hospitalization for taking care of pressure sores or urinary tract infections *(54)*. With early interventions and proper footwear and orthoses, many children born with congenital talipes equinovarus (clubfoot) can grow up like any other children, free from deformity or secondary impairments.

Mobile solutions such as adapted smartphones can provide an alternative means of patient contact and ensure access to health care for people with functional difficulties in situations where there is a lack of transport or health workers *(55,56)*. Assistive products are also a means for those with functional difficulties to prevent or reduce the effects of secondary health conditions such as weight gain and pressure ulcers, and to improve overall health. In Brazil, for instance, personalized assistive products resulted in a cost-effective strategy to improve independent oral care in people living with leprosy *(57)*. A survey conducted in Peru, Uganda and Viet Nam reported improved overall health among wheelchair users 12 months after provision *(58)*. Also, patients with amyotrophic lateral sclerosis (ALS) who used an eye-tracking device to communicate, showed increased self-reported quality of life and reduced symptoms of depression compared to non-user patients *(59)*.

Mental health

At every age, there is diversity in people's intrinsic capacity, including the mental capacities that a person can draw on. Cognitive difficulties vary across different mental health conditions (such as depression, anxiety, post-traumatic stress disorder or schizophrenia) and may include difficulties with attention, memory, executive function, extinction of fears, processing speed and social cognition *(60)*. The range of assistive products that are relevant to these functions among people with cognitive impairments or declining capacity can be useful for people with mental health conditions. Also, assistive products targeting emotions and behaviours, including mood-tracking apps, online support, computer-mediated therapy, and digitally-mediated support groups, can be helpful *(61–63)*. Digital mental health tools and apps were deployed for the management for mental health difficulties associated with COVID-19 *(64,65)* and they have been recognized as a preferred way of help-seeking by young people with mental health difficulties *(66)*. The potential benefits of assistive products related to mental health include person-centeredness, convenience, ease of accessibility and different modes of accessibility, increased coverage and availability of services, cost effectiveness and potentially the consistency of the service or support offered *(62,63)*.

Physical activities, recreation, leisure and sport

Participation in physical activities and sports is important for people of all ages with functional difficulties to improve or maintain functional ability, mental health, well-being and quality of life, as well as strengthening their social identity *(67)*. Specially designed assistive products such as arm-bicycles, prosthetic blades or ski-walkers enable people with functional difficulties to engage in physical activities as well as competitive sports, and allow them to participate independently and visit places for cultural performances or services, such as theatres, museums, cinemas, libraries, monuments and sites of cultural importance. Assistive products not specifically designed to support physical activity, such as products based on global positioning systems (GPS) have been used to support independent walks by older adults with dementia *(68)*. In addition, active video games with either off-the-shelf or adapted controllers can offer opportunities for youths with functional difficulties to engage in physical activities *(69)*.

My ankle-foot orthoses help me live life to the fullest as a vital component of my mobility.

Maximilian (23), Australia


© Abd Almawla Ebrahim

Everyday activities

Assistive products support people with functional difficulties in everyday activities to increase their well-being, independence and safety. For example, a wide range of assistive products is used for a better quality of life for older people with incontinence problems *(70)*. Memory supports such as electronic pillboxes help those with cognitive difficulties to take their medicine on time and may reduce the risk of adverse effects *(71)*. Self-care products, such as those enabling transfer to toilet, bath and shower seats, improve independence for those living with functional difficulties *(72)*.

Assistive products such as personal emergency alarm systems and grab-rails may help older adults live longer in their own homes by increasing their safety and independence, especially for those at increased risk of institutionalization. For instance, a range of assistive products used in a multidimensional intervention targeting low-income older adults resulted in a 30% reduction in disability after five months in participants' homes *(73)*. More advanced technologies such as health monitoring technologies and robotics are also considered promising to increase the safety and independence of older persons *(74)*.

Social relationships

Establishing and maintaining stable social relationships is associated with better psychological development, physical and mental health, cognitive functioning, a longer life span, and better quality of life and well-being compared to people who experience loneliness *(75,76)*. Assistive products can reduce the risk of social exclusion by facilitating social connectedness, help develop and maintain meaningful relationships and interactions, and enable participation in social contexts. For instance, use of mobility devices is associated with improvements in children's participation in social relationships and play opportunities *(77)*. In addition, adaptive seating devices can create opportunities for social interaction and play in young children with severe physical difficulties *(78)*. More advanced assistive products such as social robots have also shown promising results in fostering social interaction and communication in children with neurodevelopmental disorders *(79)*. In adults, hearing aids can increase social participation, more interaction among family members and reduce the risk of social isolation and emotional loneliness *(80)*.

Socioeconomic benefits

The positive impacts of assistive products goes far beyond improving the health, well-being and participation opportunities of individual users. There are known or potential socioeconomic benefits that make the case for health and welfare systems – as well as governments – to invest in assistive technology and include it within universal health coverage.

When implemented effectively in work environments, especially under reasonable accommodation, assistive products can help increase employee productivity, with positive consequences not only for those with functional difficulties, but also for employers who can retain qualified employees and eliminate the costs of training new ones *(81)*. In this respect, assistive products may be considered an important contributing factor to reduce the risk of poverty often experienced by people with functional difficulties as well as the consequent welfare responsibility of governments *(82)*. A study in Guatemala showed that, after receiving hearing aids, people with moderate–profound hearing loss spent more time on paid work or self-employment and experienced improvements in household income *(83)*. In addition, contrary to widespread misconceptions, the benefits for businesses of implementing assistive products in workplaces may outweigh their costs. A survey conducted in the United States of America revealed that companies that hire people with disabilities and promote inclusive cultures report revenues 28% higher than companies that do not *(84)*.

Assistive technology can have a significant effect on lifetime earning potential. One study found that in low- and middle-income countries sustained provision of hearing aids, prostheses, spectacles and wheelchairs can yield about US$ 100 000 in average increased income over the life of a child who receives assistive technology *(85)*.

The same study estimated the costs and economic benefits of assistive technology[a] and found that investing US$ 1 in assistive technology in low- and middle- income countries could return US$9 to users, families and the national economy over the next 55-years.[b] This 9:1 return on investment ratio excludes benefits in terms of improved health and wellbeing and social inclusion and as such the overall return on investment could be significantly higher.

There is a well-established link between caregiving for a person with functional difficulties and reduced health and functional ability of caregivers (e.g. psychological and physical stress), as well as direct and indirect costs such as health care, hospital and transport expenses, caregivers' loss of working days and earnings, and a general inability for caregivers to maintain stable employment (see Aine's story) *(86,87)*.

As assistive products increase functional ability, they help caregivers reduce the time, levels of assistance and energy needed for caregiving *(88)*. They also reduce anxiety and fear, task difficulty and safety risks (particularly for activities requiring physical assistance, e.g. dressing, transferring, toileting and general mobility). Ideally, increased independence, reduced caregiver burden and lower (social) costs go hand in hand *(89)*. When used in school, assistive products can reduce the costs of educational services and individual support *(90)*. Assistive products such as special call alarms or alphabet boards can help users with communication difficulties or those who are intubated to communicate in a medical or hospital setting, thus helping reduce the length of hospital stays, increasing patient safety, and lowering health care costs *(91)*.


© WHO/David Constantine

Meet Aine

United Kingdom of Great Britain and Northern Ireland

Aine, aged 13 years, has physical and cognitive disabilities as well as seizures that can be life threatening. She is the middle of three children and enjoys engaging with her siblings and parents, who have worked tirelessly to find the best assistive products to help her live a full life and ensure her safety.

Aine uses spectacles and a range of mobility devices including a wheelchair, a standing and walking frame, and orthopaedic footwear. She uses environmental adaptations including ramps, a chair lift, and handrails. Her father Mark explains: "Aine would be in pain from contracted tendons and muscles without some of these products". These assistive products are also supporting her parents' physical and mental health. Before installing the chair lift, Mark would typically carry Aine around the home, including upstairs, and to and from the bathroom and her bed. As a result, he was experiencing joint pain from the frequent lifting.

In addition, the danger posed by seizures was an ongoing source of stress for Aine's parents. Another assistive product, seizure-detection monitors, have had a big impact. Mark described the relief of having this device: "The epilepsy monitors have improved our mental health significantly and we are able to sleep more easily knowing that an alarm will wake us in the event of an emergency."

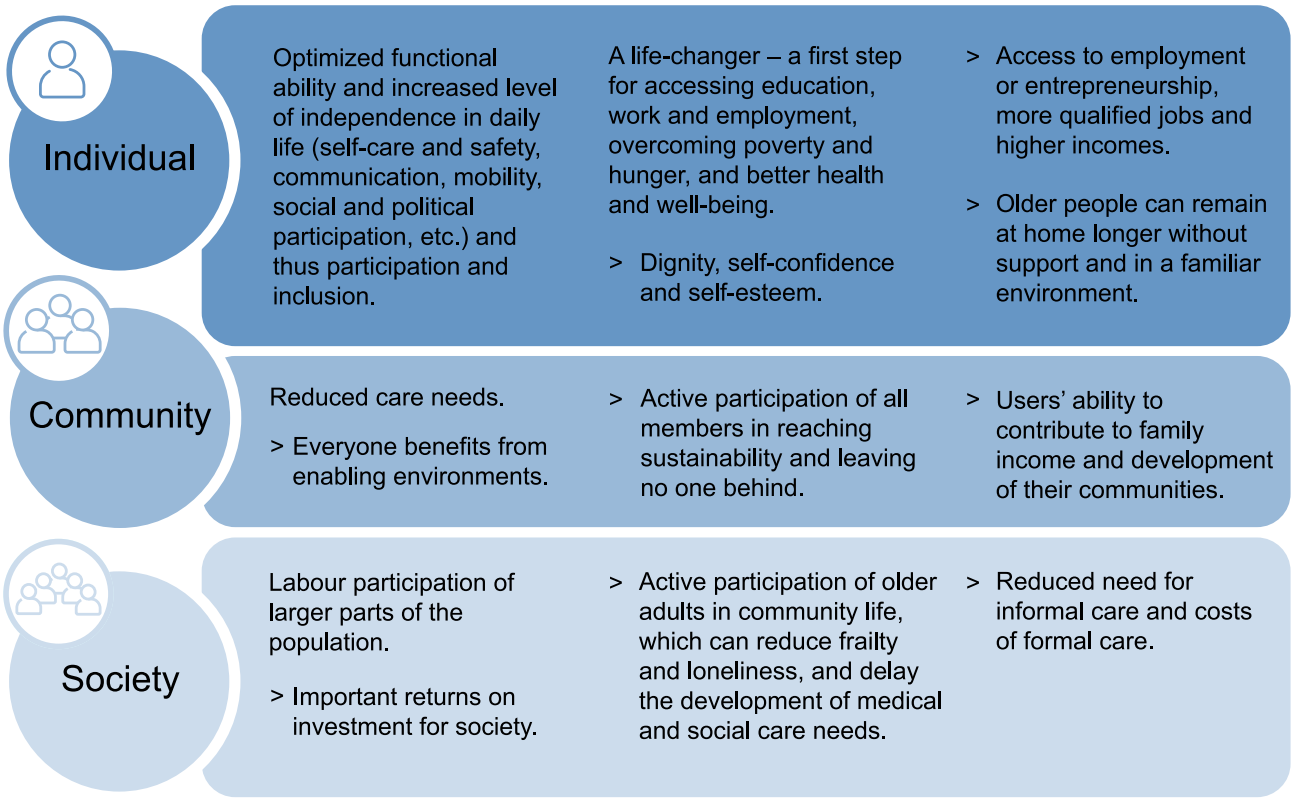
While Aine's parents are grateful for the assistive products, the design of products and delivery services provided have not been optimal, and the out-of-pocket costs are high. Delays in delivery have resulted in products no longer being the right size for Aine. They also have not yet accessed a wheelchair that reclines, which would help to keep Aine safe during a seizure.

a In this study, economic benefits included: (i) increased rates of employment and productivity (affecting adult users as well as children once they reach working age); ii) improved educational outcomes (affecting child users); and iii) unpaid family support providers taking up more paid work. Costs include initial investments critical to ensuring that systems are fully supportive and structured to effectively deliver appropriate assistive technology and the user-incurred costs of accessing and receiving assistance (for more details see reference *(85)*).

b Corresponds to assumed remaining lifetime of all individuals in need of the four priority products alive at the time of the study reference *(85)*.

Enabling older persons to remain in their local community and maintain their social networks for as long as possible may bring significant financial advantages in terms of health care and welfare expenditure *(92)*. Compelling evidence suggests that investment in deploying assistive products in older adults' homes is likely to be recouped through subsequently lower health care costs *(93)*. A report focusing on older Australians estimated that, when appropriately funded and delivered, assistive products may generate government savings of over AUS$ 12 for every AUS$ 1 spent over five years *(94)*. Similarly, a study of the economic benefits of providing assistive technology to students with cognitive impairments in Sweden also found evidence of cost-benefit (see Box 1.3). Figure 1.1 summarizes the core benefits of assistive technology at the individual, community and societal level. It is an area that attracts increasing attention (see Box 1.4 for an example).

Figure 1.1. Benefits of assistive technology for individuals, community and society



Box 1.3 Economic benefits of assistive technology for students with cognitive impairments (Sweden)

A project carried out by the Assistive Technology Institute in Sweden provided assistive products to 380 students with cognitive difficulties (many with a diagnosis such as dyslexia, Asperger's syndrome, autism, anxiety, depression, mild intellectual impairment) in three municipalities, to improve their results and support their transition from school to working life. At follow up, 72% of the students reported improved study results, 78% had improved the way they handled difficult situations in the school, and 96.5% said they would continue using their assistive products. The costs for providing the assistive technology ranged from around US$ 1500 to US$ 2500 per student – a cost that would be recouped by society if the student transitioned to employment at least one month earlier than if they had not used the assistive products.

Source: Nilsson Lundmark E, Nilsson I, Wadeskog A. Technology support in the school. A socioeconomic analysis of young, school failure and the labour market (in Swedish). Personal communication; 2013 (http://www.socioekonomi.se/Texter/Diverse_15/Teknikstod.pdf, accessed 20 April 2022).

Box 1.4 Global priorities for assistive technology outcomes and impacts

Measuring outcomes and impact is necessary to understand the benefits of assistive technology and create evidence-based policies and systems to ensure universal access to it. Using a collaborative, consensus-based discussion and prioritization process with regional and global consultations involving over 400 stakeholders, the Global Alliance of Assistive Technology Organizations (GAATO) has identified a set of challenges that define the need to measure outcomes and impact. They include: measurement of assistive technology outcomes and impact at the individual, community, local, national and global levels; tools for data collection, data storage and use; outcomes related to systems and their implementation; and evaluation of good practices and policies.

Source: Unpublished communication: Global Alliance of Assistive Technology Organizations (GAATO) (www.gaato.org)

Box 1.5 The GLIC Association, (Italy)

The GLIC Association unites more than 20 independent assistive technology centres across Italy. Membership criteria include a non-for-profit ethos and no commercial interests, a multidisciplinary approach, the provision of information, training and assessment services, as well as follow-up support. The centres have developed a common methodology and approach focussed on supporting not only service users but also their care teams, professionals in health, social care and education, researchers and policy-makers.

Source: www.centriausili.it

Paths to accessing assistive technology

Access to assistive technology includes assistive products and the range of supporting services needed to ensure that products match users' needs and the environment to enable users to realize their goals and do what they wish to do. In addition, the route to obtaining assistive products – for users, their caregivers and family members – must be feasible and not drain users' time, finances and motivation, which can result in lack of access or settling for a substandard option.

Assistive technology solutions must also be lasting and sustainable. For individuals with long-term or permanent functional difficulties, their assistive technology needs and related goals will likely change throughout their life, especially when the need for assistive technology begins during childhood as well as in old age due to gradual decline of functional ability.

Across diverse global settings, there is no single, universal system or process to access assistive technology. Current approaches range from comprehensive and free publicly run services for all, to an absence of services altogether. In countries with extensive universal public health and wider welfare programmes, governments provide full or partial funding for assistive technology not only through the health sector, but also under social care and support, education and employment schemes. Many also provide public services that assess people's needs and help them choose from a range of refundable or non-refundable assistive products considering individual preferences. In a health setting this will often lead to a prescription, while in a social or educational setting budgets will be available and expenditure will be authorized. It is not uncommon for the provision of assistive products to be in the hands of private companies, who are reimbursed *(95)*. To get the right product, some countries have independent assistive technology centres where assessments, personalization, training and other support can be found (see Box 1.5 for an example).

People also develop assistive products themselves. There are examples of smart self-made products and adaptations (e.g. motorcycles, cars), many of which are publicly shared on a growing number of online platforms *(96)*. The advantage is that these solutions can be highly personalized and made at relatively low cost with local materials. The disadvantage is that products do not necessarily meet safety or performance criteria. Others access assistive technology through a nongovernmental organization (NGO), who may be running camps or delivering local services.

In many countries assistive products are provided through a combination of government and nongovernment services, the private sector and the informal sector (see Boxes 1.6 and 1.7) *(25,97)*.

Box 1.6 ATscale, the Global Partnership for Assistive Technology

ATscale addresses prioritization, coordination and investment in assistive technology, as well as market challenges in key product areas at global and country level. ATscale has conducted a return on investment modelling for assistive technology to underpin the economic case for investing in assistive technology.

ATscale's vision is to enable a lifetime of potential, where every person can access and afford the assistive technology they need. As a cross-sector partnership, of which WHO and UNICEF are two of the founding partners, ATscale's mission is to catalyse change, amplify existing work, and coordinate and mobilise stakeholders with unified strategies to strengthen enabling ecosystems and increase the availability of and access to affordable and appropriate assistive technology. The goal is to ensure that 500 million more people globally are reached with life-changing assistive technology by 2030.

Source: www.atscalepartnership.org

Box 1.7 AT2030 programme

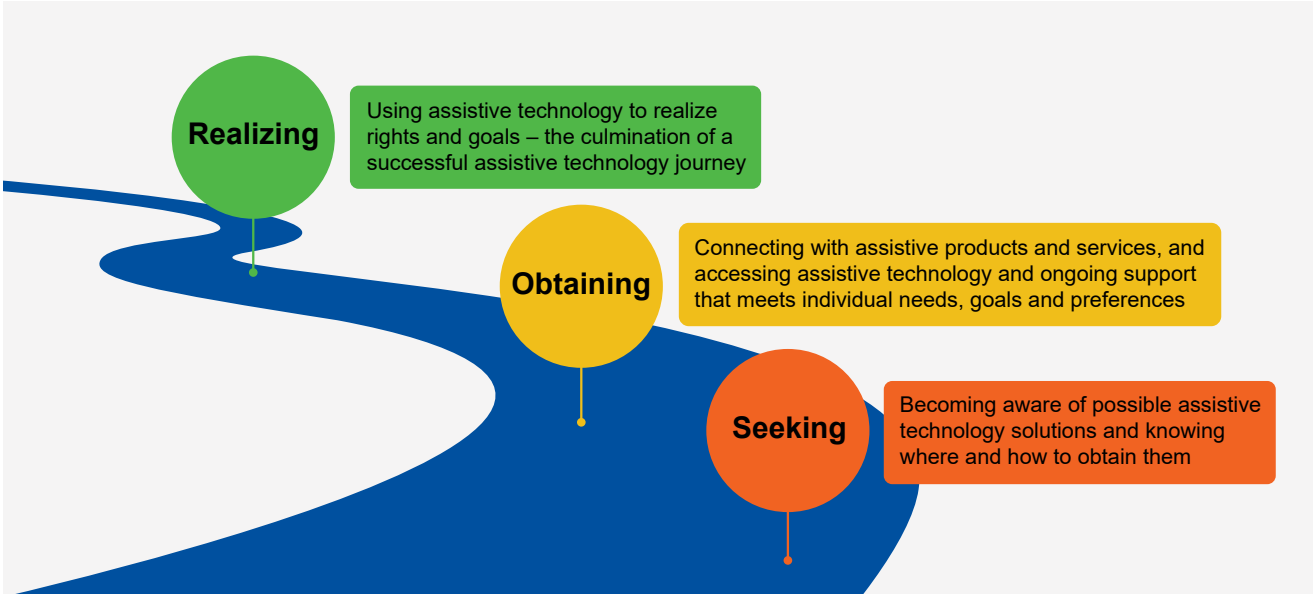
AT2030 is a UK Aid-funded programme designed to test innovative approaches to 'what works' to transform access to life-changing assistive technology. Led by the Global Disability Innovation (GDI) Hub based at University College London (UCL), AT2030 has worked with more than 70 partners in over 35 countries as of 2022.

GDI Hub hosts the WHO's Collaborating Center on Assistive Technology at UCL and was a founding partner of ATscale, and continues to work closely to share what works in order that it can be scaled. The collective mission is to transform assistive technology access for the billions of people in need.

Source: www.at2030.org

Whatever the situation, the person in need, a family member, health care worker, school teacher, etc., must first understand that assistive technology can improve the person's functional ability and participation, or that they can be further enhanced with new or additional assistive products. This requires that people become aware of the possibilities of assistive technology and have access to information, which is the first step on the assistive technology access pathway (Fig. 1.2). A successful person-centred assistive technology access journey is likely to encourage the user to embark on the access pathway again, as needs and goals evolve.

Figure 1.2. The assistive technology access pathway



Many people search for information about assistive products themselves and directly purchase equipment from companies. Existing databases, such as those aggregated by EASTIN *(99)* (see Box 1.8) and an assistive technology user platform in Shanghai, China *(100)*, can help provide information. This route can be rapid, especially when companies have online catalogues. However, this places the financial burden on the user or family, and without appropriate advice from professionals or other experts there is a risk of spending money on unsuitable solutions.

Box 1.8 Global Assistive Technology Information Network

The Global Assistive Technology Information Network (EASTIN) is an international consortium of organizations who together maintain a website that provides data from several national databases about daily living equipment and assistive products. It enables users to find information in an appropriate language and to analyse, compare and choose a solution.

Source: www.eastin.eu

Assistive technology systems and coverage

The people-centred assistive technology model

Standalone or integrated assistive technology systems include interrelated parts and dynamic processes. The WHO '5P' people-centred assistive technology model provides a simplified bird's-eye view of the assistive technology system (Fig. 1.3). In this model, people's experience along the assistive technology access pathway are determined by the four interrelated components of the assistive technology system: policy, products, provision and personnel *(101)*. Understanding each component of the system and the relationships between components helps inform holistic solutions.

The characteristics of the **products** available (range, quantity, quality, cost); the design and implementation of **provision** (procurement, delivery, services); and the capacity of the **personnel** (workforce); are shaped by **policy** (legislation, policy structures, information system, financing). Together these four areas determine the types and severity of barriers that **people** encounter along the assistive technology access pathway.

Figure 1.3. The 5P people-centred assistive technology model

Source: Policy brief: Access to assistive technology. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/978-92-4-000504-4, accessed 20 April 2022) *(101)*.

Figure 1.3 also illustrates how people in need of assistive technology are at the centre of the assistive technology system. Even though every assistive product has to be person-centered, the whole system should be 'people-centred'.

This means that strategies implemented to increase access to safe, effective, and affordable assistive technology should be informed by users' perceptions, experiences and aspirations. People-centred systems also reflect the importance of user engagement and choice, rather than people being regarded as passive recipients of assistive technology *(102)*. Active engagement in each step along the assistive technology access pathway – and in strengthening the broader assistive technology system – is critical to an individual realizing their rights and goals, and to the progressive realization of assistive technology access.

Examples of the active engagement of users and potential users across the components of the assistive technology system include:

- **Policy** – users are the key stakeholders in policy-making, raising demand and supply, implementation, monitoring and in providing feedback.
- **Products** – users participate in the design and testing of products and services, and have a choice in assistive technology options that can meet their functional needs, environment and goals.

- **Provision** – as part of quality assurance, users collaborate with service providers to select the devices that best meet their needs, and are involved in rating the quality, accessibility, timeliness etc. of assistive technology services provided.
- **Personnel** – direct service personnel receive training in how to be responsive to user preferences when conducting assessments and selecting products.

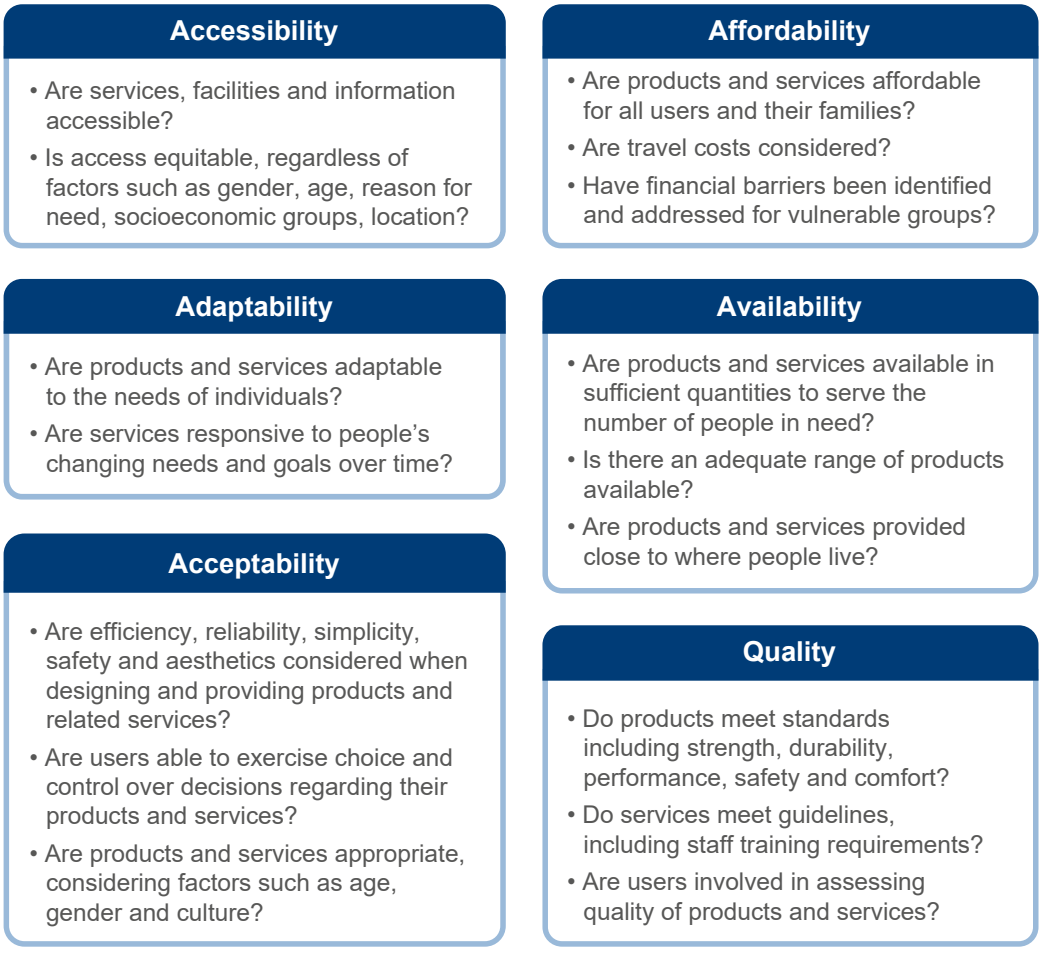
Principles of assistive technology access

Exploring the principles of assistive technology access described in Figure 1.4 can help identify strengths and weaknesses in current assistive technology systems, and inform strategic priorities to reduce access barriers. These principles are integral to all assistive technology systems. For example, in examining the 'personnel' component and considering the 'acceptability' principle, personnel training standards may include sensitivity training to promote inclusive interactions with diverse populations (e.g. in relation to impairment, culture, ethnicity, gender etc.). If 'affordability' for the user (i.e. the 'people' component) is reported as the top barrier to obtaining assistive technology, strategies to increase access may prioritize reducing out-of-pocket costs.

Universal assistive technology coverage

System-level strategies to reduce barriers and achieve universal access to assistive technology (where everyone, everywhere receives the assistive technology they need without delay, and financial or other hardships) must be rooted in users' experiences *(103)*. If assistive technology provision is not based on user involvement and adequate procedures, the risk of abandonment increases, bringing with it the potential waste of public resources and also needs not being optimally met.

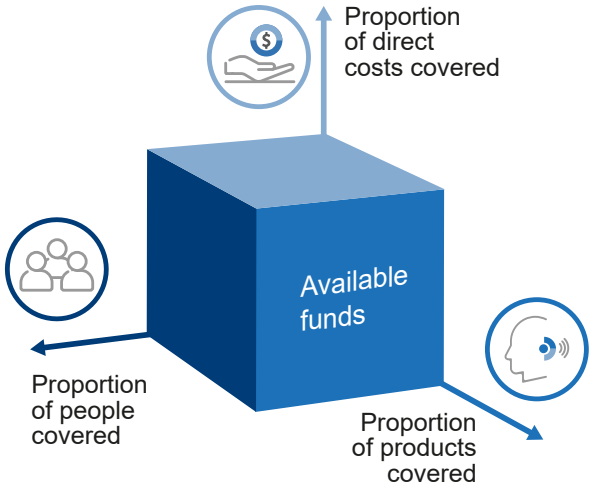
Figure 1.4. Principles of assistive technology access



Source: Joint position paper on the provision of mobility devices in less-resourced settings: a step towards implementation of the Convention on the Rights of Persons with Disabilities related to personal mobility. Geneva: World Health Organization; 2011 (https://apps.who.int/iris/handle/10665/44780, accessed 20 April 2022) *(2)*.

How universal access to assistive technology can be achieved is visualized in Figure 1.5. Available funds limit what can be covered in terms of people, products and costs, but where they are made available, funds can be used to include more users or potential users; more types or a broader range of products; or to cut users' assistive technology costs.

Figure 1.5. Dimensions of universal access to assistive technology



Source: Adapted from the World Health Report 2010: Health system financing: the path to universal coverage. Geneva, World Health Organization, 2010 (https://apps.who.int/iris/handle/10665/44371, accessed 20 April 2022).

Similarly, strengthening the provision and personnel components of the assistive technology system helps meet the needs of a wider diversity of users and provides a broader range of products that match their needs regardless of sex, age, size, diagnosis and severity of impairment.

Designing an integrated assistive technology system that addresses the needs of all users and potential users requires coordination among multiple government ministries and departments (e.g. health, education, social welfare); sectors (e.g. public, private, non-profit); and meaningful engagement of users. Frameworks, guidelines and technical implementation tools can guide countries towards progressively achieving universal access to assistive technology.

International policy frameworks

United Nations Standard Rules

The World Programme of Action Concerning Disabled Persons, adopted in 1982, was the first UN document defining disability as a consequence of the relationship between people with disabilities and their environment *(104)*. This programme paved the way for the *Standard rules on the equalization of opportunities for persons with disabilities* adopted by the UN in 1993 *(105)*. The areas of accessibility to the physical environment, information and communication, education, employment, income maintenance and social security, family life and personal integrity, culture, recreation and sports, and religion were defined as target areas for equal participation. The development and supply of assistive products were included among the preconditions for equal participation and opportunities. States were urged to ensure the provision of assistive products according to needs; to support the development, production, distribution and servicing of those products; to ensure access to assistive products including affordability; and also to require adequate training of personnel at all levels in the disability field. The training should be extended to parents, families and members of the community of people with disabilities, and to developing appropriate values and skills – including in relation to assistive technology. In all actions, people with disabilities should be actively involved.

United Nations Convention on the Rights of Persons with Disabilities

In 2006, the UN *Convention on the Rights of Persons with Disabilities* was adopted *(2)*. As of June 2020, 181 of the world's 197 independent states had ratified the Convention, binding them to the obligations of promoting, protecting and ensuring the rights of people with disabilities.

Assistive technology is mentioned as a human rights enabler in various articles of the Convention (e.g. articles 20, 26, 29). Article 4 (g) commits signatories: "To undertake or promote research and development of, and to promote the availability and use of new technologies, including information and communications technologies, mobility aids, devices and assistive technologies, suitable for persons with disabilities, giving priority to technologies at an affordable cost;" and (h) "To provide accessible information to persons with disabilities about mobility aids, devices and assistive technologies, including new technologies, as well as other forms of assistance, support services and facilities" *(2)*.

Article 32 calls for international collaboration between state and non-state actors in: "providing, as appropriate, technical and economic assistance, including by facilitating access to and sharing of accessible and assistive technologies, and through the transfer of technologies". Article 33 explains that states must set up national focal points within government to monitor implementation of the Convention. Signatories

to the Convention are at different stages in its implementation, with many still working on transposing it into national legislation and policy.

The United Nations Convention on the Rights of the Child

The UN *Convention on the Rights of the Child (CRC)* – adopted in 1989 – spells out the rights that all children possess, including children living with disabilities *(106)*. Some of these rights are particularly relevant to assistive technology. The CRC includes rights: to the protection and care necessary for well-being; to survival and the highest attainable standard of health; to facilities for the rehabilitation of health; to develop to the fullest; to education; to freedom of expression; to access information and material from a diversity of sources; and to participate fully in family, cultural and social life. In Article 23, the CRC specifically recognizes the right of children with disabilities to special care and assistance, which should be provided free of charge whenever possible.

2030 Agenda for Sustainable Development

The 2030 Agenda for Sustainable Development *(107)* (adopted by all United Nations Member States in 2015) and its 17 Sustainable Development Goals (SDGs) (Fig. 1.6) pledge to "leave no one behind", in particular people with functional difficulties who need access to assistive technology to be able to equally contribute to reaching the goals in an equitable manner *(41)*. However, the UN Flagship Report on Disability and Development, *Realization of the Sustainable Development Goals by, for and with persons with disabilities*, reports that the status of people with disabilities lags behind in relation to most SDGs *(108)*. Discrimination and stigma, issues around accessibility to physical and digital environments and content, and lack of access to assistive technology and essential services are some of the identified barriers. Within this context, a global increase in awareness of the need for quality, affordable, and reliable assistive products is evident *(109,110)*.

Ensuring the concept of universal health coverage (UHC) (Box 1.9) includes access to assistive products and services – without financial hardship for people – is therefore an important strategy contributing to sustainable development that is inclusive, effective and cost-beneficial. It aligns well with SDG target 3.8: "Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all."

Box 1.9 Universal health coverage

Universal health coverage means that all individuals and communities receive the health services they need without suffering financial hardship. It includes the full spectrum of essential, quality health services, from health promotion to prevention, treatment, rehabilitation and palliative care across the life course.

Figure 1.6. United Nations Sustainable Development Goals

World Health Assembly Resolution 71.8, 2018

In 2018, the Seventy-first World Health Assembly Resolution 71.8 entitled *Improving access to assistive technology* (Box 1.10) urged Member States to develop, implement and strengthen policies and programmes to improve access to assistive technology, and the WHO secretariat to develop this Global report on effective access to assistive technology *(1)*. WHO supports Member States in implementing the resolution and in fulfilling their commitments to the UN *Convention on the Rights of Persons with Disabilities* and the SDGs.

Other WHO assistive technology initiatives

The role of assistive technology in improving functional ability was also recognized in the WHO *Global strategy and action plan on ageing and health 2016–2020 (111)*, as well as in the *Decade on Healthy Ageing 2020–2030: Plan of action (31)*.

The *Decade of healthy ageing baseline report (7)* states that: "Access to affordable, appropriate and quality assistive technology is fundamental for maintaining and improving older people's functional ability, including mobility." It further lists the provision of assistive technology to facilitate mobility as an important area of action.

The role of technology in long-term care is also acknowledged – including sensor technology – as is the need for common home modifications such as grab-rails, adapted bathrooms and smart-home technologies *(7)*.

Other WHO initiatives acknowledging the importance of assistive technology include the Rehab 2030 Programme *(112)*. One of its priority areas for action is: "Building comprehensive rehabilitation service delivery models to progressively achieve equitable access to quality services, including assistive products, for all the population, including those in rural and remote areas."

Box 1.10 Improving access to assistive technology

WHA Resolution 71.8 urges Member States to:

1. develop, implement and strengthen policies and programmes, as appropriate, to improve access to assistive technology within universal health and/or social services coverage;
2. ensure that adequate and trained human resources for the provision and maintenance of assistive products are available at all levels of health and social service delivery;
3. ensure that users and their carers have access to the most appropriate assistive products and use them safely and effectively;
4. where appropriate, based on national needs and context, develop a national list of priority assistive products that are affordable and cost-effective and meet minimum quality and safety standards, drawing on the WHO *Priority assistive products list;*
5. promote or invest in research, development, innovation and product design in order to make existing assistive products affordable; and to develop a new generation of products including high-end or advanced assistive technology, taking advantage of universal design and new evidence-based technologies, in partnership with academia, civil society organizations, in particular with persons with disabilities and older persons and their representative organizations, and the private sector, as appropriate;
6. encourage international and/or regional collaboration for the manufacturing, procurement and supply of priority assistive products, ensuring that these remain affordable and available across borders;
7. collect population-based data on health and long-term care needs, including those that may be met by assistive technology in order to develop evidence-based strategies, policies and comprehensive programmes;
8. invest in and promote inclusive barrier-free environments so that all people who need assistive technology can make optimum use of it, in order to live independently and safely and participate fully in all aspects of life;
9. promote the inclusion of priority assistive products and inclusive barrier-free environments within emergency preparedness and response programmes.

Section 2

Measuring access to assistive technology

Key messages

- One in three people or more than 2.5 billion globally need at least one assistive product. As the global population ages and the prevalence of noncommunicable diseases increases, this figure will rise to 3.5 billion in 2050.
- Representative self-reported population surveys in 29 countries found:
  - » 10% to 69% of people reported needing assistive products.
  - » Between 3% to 90% of people reported they had access to assistive products, with this range impacted by each country's socioeconomic development.
  - » People reported the most common barriers to accessing assistive products as being high costs, low availability and lack of support.
  - » The majority of people obtained their assistive products from the private sector, paid for either by themselves, or with financial support from family and friends.
- Data from governments in 70 countries revealed:
  - » In almost all countries, there is one ministry or other authority responsible for assistive technology, and at least one piece of relevant legislation.
  - » Evidence of public budget allocation for assistive technology and financing mechanism(s) to cover fully or partly users' cost for assistive products and related services.
  - » Assistive technology related regulations, standards or guidelines are in place in some countries.
  - » Many countries have large gaps in their assistive technology service provision and trained workforce, especially in the cognition, communication and self-care domains.
- Despite the existence of legislation, policies and public budgets, the population need for assistive products was far from being fully met in most countries.

Understanding of latest available data is essential to formulating and implementing evidence-based policies and programmes. In relation to assistive technology, data on population needs and access, barriers to access and system preparedness for provision are required for stakeholders to design effective interventions, prioritize resources and raise awareness among the general public. Such data are also key for monitoring outcomes of the interventions and making informed decisions for improvement.

This section presents key findings from a global initiative to compile such assistive technology data, undertaken between April 2019 and December 2021. Subsections cover population access to assistive technology using findings from representative population surveys, and system preparedness for assistive technology provision using findings from a government survey.[c]

c Detailed data are published on WHO Global Health Observatory (https://www.who.int/data/gho/data/themes/assistivetech, accessed 16 May 2022).

Population access to assistive technology

Methodology for measuring population access to assistive technology

A person's needs for and access to assistive technology are influenced by many factors, including their functional ability, level of awareness, socioeconomic status, living context, and interaction with the environment. Fully understanding related needs in the population and identifying the key barriers to accessing assistive products are vital initial requirements for improving access.

In 2018, the WHO Assistive Technology Access team proposed the first draft of a rapid assistive technology assessment (rATA) questionnaire to collect self-reported data on access to assistive technology.[d] While it does have some limitations, self-reporting is a feasible and valid survey method, especially in resource-limited contexts. The rATA questionnaire covers six areas related to assistive products: use; source; funding; satisfaction; unmet need; and barriers to access. These areas also incorporate distance to source and suitability of assistive products for the environments in which they are used.

The key indicators of the rATA survey are:[e]

- Prevalence of need: the sum of the prevalence of met need and unmet need, where:
  - » Prevalence of met need: the proportion of a population using assistive products that do not need new or additional assistive products.
  - » Prevalence of unmet need: the proportion of a population that need new or additional assistive products regardless of whether they are already using assistive products.
- Access: the ratio of prevalence of met need to prevalence of need.

The prevalence of need for and access to different essential assistive products, which are including in the WHO *Priority assistive products list (113)*, can also be analysed using the rATA questionnaire.

By December 2021, data collection using the rATA questionnaire was completed in 35 countries, comprising nearly 330 000 individuals. National population surveys had been undertaken in Azerbaijan, Bhutan, Burkina Faso, Djibouti, Dominican Republic, Georgia, Indonesia, Iran (Islamic Republic of), Iraq, Italy, Jordan, Kenya, Liberia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Poland, Rwanda, Senegal, Sweden, Togo and Ukraine. Subnational population surveys were completed in one or more regions of China, Guatemala, India, Malawi and Tajikistan. Moreover, surveys were conducted in Bangladesh, Brazil, Costa Rica, Indonesia, Sierra Leone, the United Kingdom and the United Republic of Tanzania.[f]

All surveys were guided by the multi-country rATA survey methodology developed by WHO in collaboration with governments, NGOs and research institutes *(114)*.

Twenty-nine of the surveys were representative of the population in a country, or in one or more regions of a country, with a total of 323 647 participants. Among whom 51.2% were female, 32.6% were between 0 and 17 years, 54.2% were between 18 and 59 years, and 13.2% were 60 years and older. The distributions of their self-reported functional difficulties are provided in Table 2.1.

d Self-reporting recognizes the principle that choice and consumer participation are crucial in successful assistive technology implementation. It is necessary to take consumer choice and preference into account as users' understanding of their need for, uptake and use of, and benefit from assistive products are crucial for developing services for all in need.

e As the definitions of indicators may be different from that used by individual countries or institutes, the estimates presented in this report may not correspond exactly to a country's official estimates for a given indicator.

f These surveys were conducted within specific contexts. Findings from these surveys were based on the study report submitted by the survey teams and are non-representative of the general population.

Table 2.1. Functional difficulty among participants in 29 representative rATA surveys

Functional domain	Proportion of the participants reporting at least some difficulty (median and range)
Cognition	6.4% (1.4%–24.8%)
Communication	2.4% (0.7%–7.9%)
Hearing	4.8% (2.7%–11.5%)
Mobility	12.1% (5.9%–21.6%)
Seeing	20.9% (8.5%–64.3%)
Self-care	4.1% (1.1%–15.4%)

Note: The questions in the rATA questionnaire on functional difficulty are based on the Washington Group Short Set on Functioning (WG-SS) *(115)*. Some of them were slightly rephrased and exclude the use of assistive products, asking for levels of functional difficulty without the use of spectacles and hearing aids. Consequently, self-reported levels of functional difficulty using rATA are not comparable across all functional domains with surveys using WG-SS.

Commonly needed assistive products

In all surveyed countries,[g] the need for spectacles was highest among all types of assistive products. Hearing aids were among the most needed products along with a range of assistive products supporting mobility such as: walking sticks and crutches; chairs for shower, bath and toilet; and different types of wheelchairs, orthoses and prostheses. Table 2.2 presents prevalence of need for and access to a range of assistive products[h] in the surveyed countries.

The need for spectacles was so large that it affects the analysis of the entire survey data set. For this reason, selected data points are presented and interpreted in the current report both including and excluding spectacles.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g Data from national and subnational representative population surveys are included in the analyses presented hereafter. All data are weighted, except for Burkina Faso, China, Djibouti, Guatemala, Kenya, Malawi, Nepal and Tajikistan.

h The assistive products presented are from the WHO Priority Assistive Products List *(113)*.

Table 2.2. Prevalence of need for and access to different types of assistive products in surveyed countries

Assistive products	Prevalence of need (%)			Access (%)
	minimum	median	maximum	median
Spectacles	4.60	18.5	65.1	53.7
Walking sticks	0.92	2.36	7.33	47.2
Hearing aids	0.41	1.55	5.76	9.09
Crutches	0.10	0.97	3.24	44.9
Chairs for shower/bath/toilet	0.00	0.84	3.29	27.9
Manual wheelchairs - push type	0.08	0.42	1.52	34.7
Lower limb orthoses	0.00	0.41	2.14	25.2
Spinal orthoses	0.00	0.40	3.46	18.9
Manual wheelchairs - basic type	0.06	0.39	1.30	27.6
Therapeutic footwear	0.03	0.37	3.57	38.3
Optical magnifiers	0.01	0.32	2.84	24.2
Pill organizers	0.00	0.29	4.38	13.3
Walkers	0.08	0.29	2.07	35.9
Grab-bars/handrails	0.00	0.24	3.11	20.2
Electrical wheelchairs	0.00	0.23	2.45	8.42
Incontinence products	0.00	0.21	2.07	26.7
Wheelchairs with postural support	0.00	0.20	1.55	4.46
Pressure relief mattresses	0.02	0.20	1.11	16.4
Smart phones for communication	0.02	0.18	4.41	14.7
Upper limb orthoses	0.00	0.18	1.02	15.8
FM systems	0.00	0.16	1.12	7.01
Smart phones for cognition	0.00	0.15	2.10	8.33
Digital handheld magnifiers	0.00	0.14	1.72	15.3
Communication boards/books/cards	0.00	0.12	1.18	1.75
Pressure relief cushions	0.00	0.11	2.40	16.2
Simplified mobile phones	0.03	0.10	0.40	31.8
Lower limb prostheses	0.01	0.10	0.78	17.7
Rollators	0.00	0.10	1.62	12.3

Assistive products	Prevalence of need (%)			Access (%)
	minimum	median	maximum	median
White canes	0.00	0.09	1.38	16.7
Alarm signalers	0.00	0.08	1.76	0.61
Time management products	0.00	0.08	0.79	4.24
Club foot braces	0.00	0.08	1.63	24.3
Smart phones for vision	0.00	0.08	1.10	14.0
Communication software	0.00	0.07	1.99	0.00
Global positioning system locators	0.00	0.07	0.72	0.00
Adjustable standing frames	0.00	0.06	4.33	0.00
Personal emergency alarm systems	0.00	0.06	0.79	1.61
Tricycles	0.00	0.05	1.62	7.61
Portable travel aids	0.00	0.05	0.84	5.43
Smart phones for hearing	0.00	0.05	1.22	0.00
Upper limb prostheses	0.00	0.05	1.04	0.00
Recorders	0.00	0.05	1.19	0.00
Portable ramps	0.00	0.05	0.27	33.3
Deafblind communicators for hearing	0.00	0.04	0.59	3.40
Talking/touching watches	0.00	0.04	0.59	1.75
Deafblind communicators for vision	0.00	0.04	0.49	0.00
Fall detectors	0.00	0.04	0.60	0.00
Audio-players with DAISY capability	0.00	0.03	1.67	0.00
Video communication devices	0.00	0.02	0.48	0.00
Screen readers	0.00	0.02	1.20	25.0
Braille displays	0.00	0.01	0.76	0.00
Closed captioning displays	0.00	0.01	1.57	0.00
Keyboard and mouse emulation software	0.00	0.01	1.65	6.89
Braille writing equipment	0.00	0.01	0.52	9.65
Gesture to voice technology	0.00	0.01	0.44	0.00

Note: The rank orders are based on the median values of the prevalence of need in the surveyed countries.

Table 2.4. Prevalence of need for and access to assistive products in surveyed countries, by HDI classification

Classification (number of countries)	**Prevalence of need for assistive products including spectacles** (median and range)	**Access to assistive products including spectacles** (median and range)
Low (7)	14.4% (9.9%–27.2%)	10.7% (2.6%–17.1%)
Medium (9)	20.5% (13.4%–30.6%)	33.2% (15.7%–65.3%)
High (9)	26.1% (15.1%–40.3%)	64.6% (35.4%–80.2%)
Very high (4)	55.6% (34.6%–68.9%)	87.7% (54.7%–89.8%)
Classification (number of countries)	**Prevalence of need for assistive products excluding spectacles** (median and range)	**Access to assistive products excluding spectacles** (median and range)
Low (7)	8.2% (4.8%–19.6%)	7.6% (2.1%–13.8%)
Medium (9)	11.8% (4.6%–18.1%)	21.4% (9.1%–31.6%)
High (9)	8.7% (4.9%–12.1%)	52.4% (16.8%–60.9%)
Very high (4)	16.6% (8.4%–17.9%)	79.3% (40.2%–83.5%)

Notes: HDI classifications are based on HDI fixed cut-off points, which are derived from the quartiles of distributions of the component indicators. The cut off-points are HDI of less than 0.550 for low human development, 0.550–0.699 for medium human development, 0.700–0.799 for high human development and 0.800 or greater for very high human development (https://hdr.undp.org/en/content/human-development-report-2020-readers-guide, accessed 20 April 2022).

Assistive product need and access

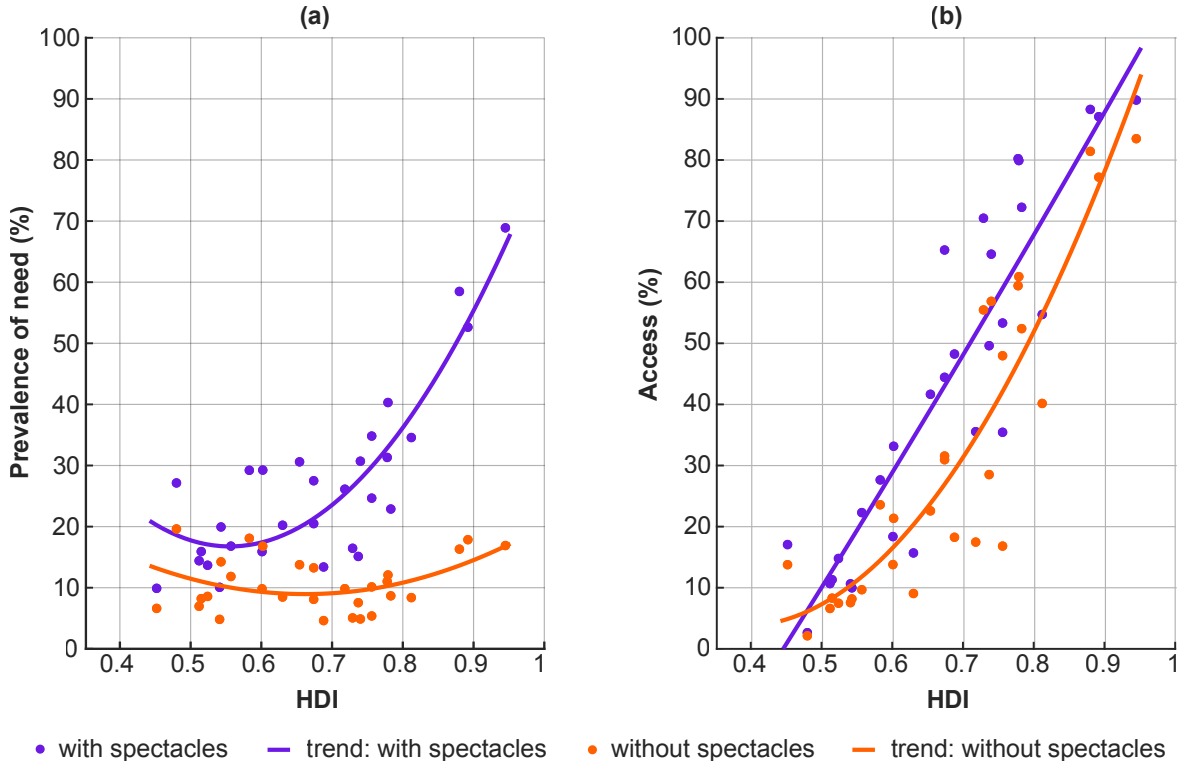
The overall prevalence of need for assistive products varied significantly between countries and when spectacles were included or excluded (Table 2.3). Need including spectacles ranged from 9.9% to 68.9% (median: 24.7%) and increased in countries with higher Human Development Index (HDI) scores,[i] whereas the need for assistive products excluding spectacles ranged from 4.6% to 19.6% (median: 9.8%) and did not vary with HDI (Fig. 2.1a). The greater need for assistive products in countries with higher HDI when spectacles were included in the analysis may indicate higher prevalence of vision conditions in high-HDI settings, more effective testing and diagnosis, or more general awareness about such problems and options for their correction.

While the proportions of the population using assistive products varied in the surveyed countries (from 2.9% to 68.0%, median: 14.7%, including spectacles, and from 1.3% to 16.3%, median: 3.6%, excluding spectacles), the need was not met for all. The reported access to needed assistive products ranged from 2.6% to 89.8% (median: 41.7%) including spectacles, and from 2.1% to 83.5% (median: 22.6%) excluding spectacles. In both cases, access increased with HDI. In all surveyed countries, access was lower when excluding spectacles (Fig. 2.1b).

The need for assistive products increased with age (Fig. 2.2a). The need including spectacles increased in countries with higher HDI in all age groups. The need excluding spectacles declined in countries with higher HDI in the 60 years and older group. Access in all age groups increased in countries with higher HDI (Fig. 2.2b).

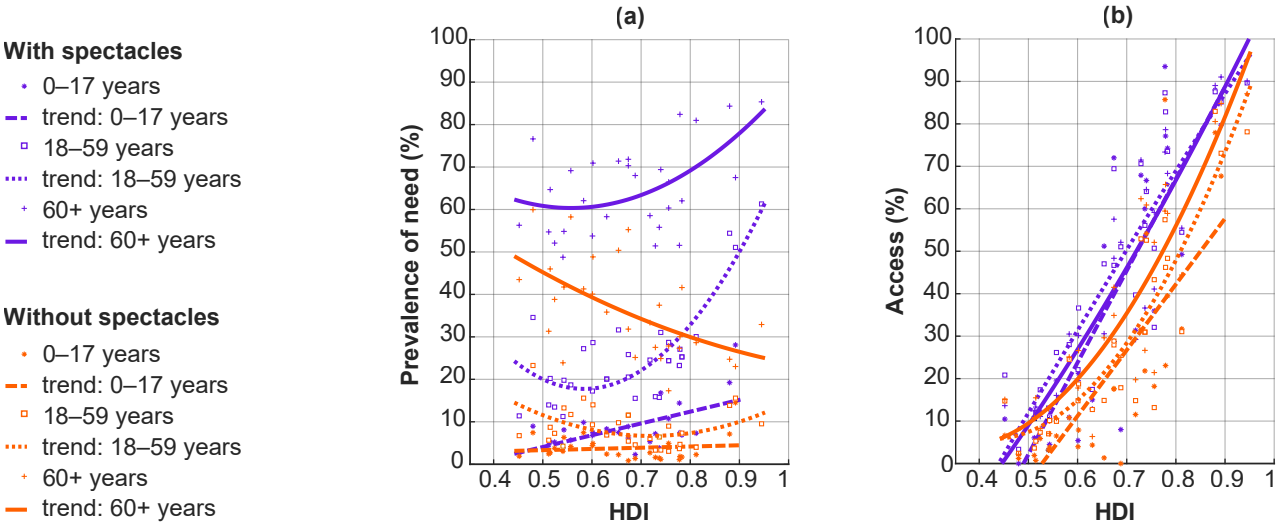
i The Human Development Index (HDI) is a statistical composite index of life expectancy, education (mean years of schooling completed and expected years of schooling upon entering the education system), and per capita income indicators. A higher HDI score indicates longer lifespan, higher level of education and higher gross national income.

Figure 2.1. Prevalence of need for (a) and access to (b) assistive products



Notes: Prevalence of need for assistive products and access, with or without spectacles, for each country are represented by individual markers. The trendlines are plotted as a 2nd order polynomial function of HDI.

Figure 2.2. Prevalence of need for (a) and access to (b) assistive products, by age groups

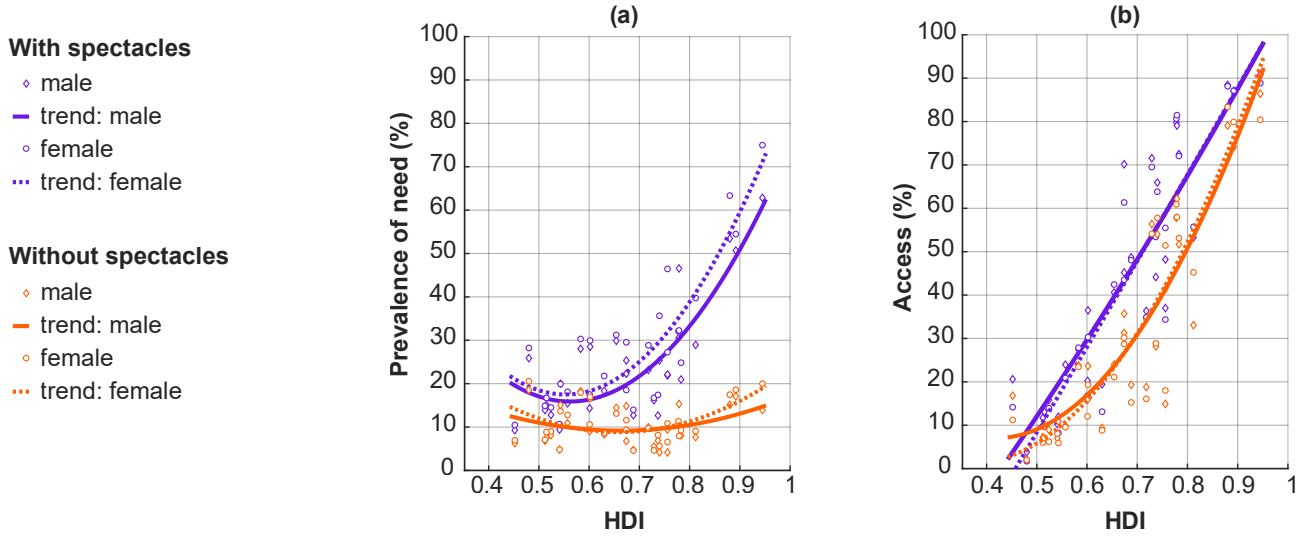


Notes: Prevalence of need and access, with or without spectacles, for each age group and in each country are represented by individual markers. The trendlines for group aged 0–17 years are plotted as a linear function of HDI. The trendlines for group aged 18–59 years and 60 years or older are plotted as a 2nd order polynomial function of HDI. Data from Dominican Republic and Sweden do not include those aged 0–17 years.

Females had a higher prevalence of need than males in most surveyed countries (Fig. 2.3a). With spectacles, the ratios between the needs of female to the needs of male varied between 0.69 and 2.10, and without spectacles, these ratios varied between 0.52 and 1.58. There was a tendency that males had higher access in most surveyed countries (Fig. 2.3b). This tendency increased in countries with lower HDI.[j] With spectacles, the ratios between the access of female to the access of male varied between 0.45 and 1.21, and without spectacles, these ratios varied between 0.54 and 1.37.

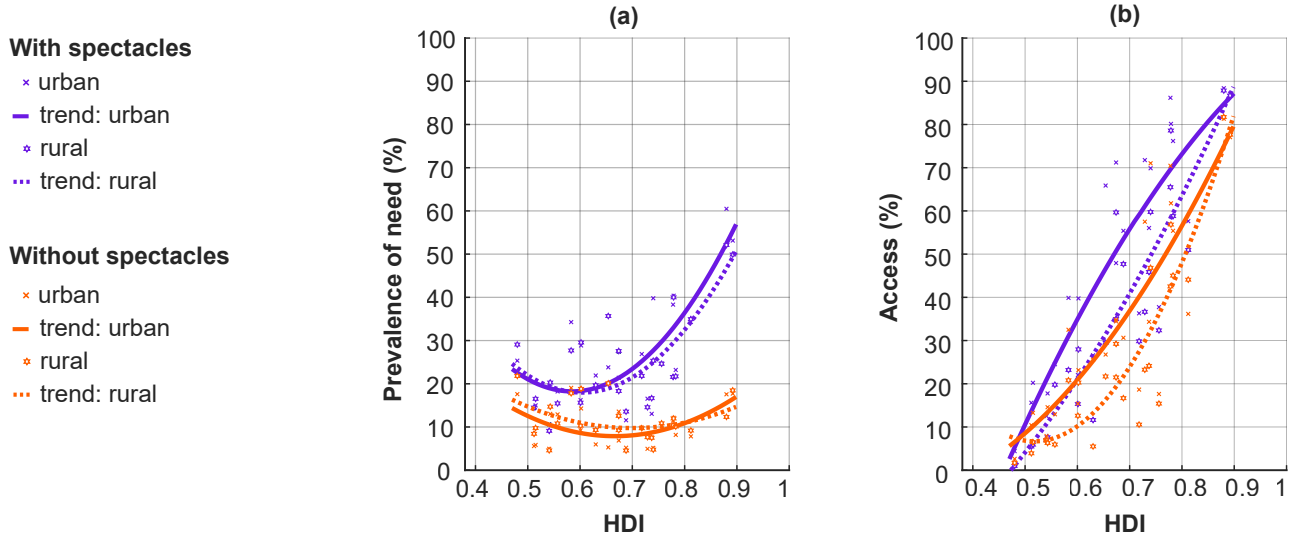
The data did not suggest a tendency of higher prevalence of need in the population living in one area than the other (Fig. 2.4a). With spectacles, the ratios between urban needs to rural needs varied between 0.67 and 1.78, and without spectacles, these ratios varied between 0.26 and 1.42. The access with and without spectacles was lower in rural areas in almost all surveyed countries (Fig. 2.4b). The magnitude of the difference tended to increase in countries with lower HDI.[k] With spectacles, the ratios between urban access to rural access varied between 1.01 and 4.44, and without spectacles, these ratios varied between 0.82 and 4.65.

Figure 2.3. Prevalence of need for (a) and access to (b) assistive products, by sex



Notes: Prevalence of need and access, with or without spectacles, among females and males and for each country are represented by individual markers. The trendlines are plotted as a 2nd order polynomial function of HDI.

Figure 2.4. Prevalence of need for (a) and access to (b) assistive products, in rural and urban areas



Notes: Prevalence of need and access, with or without spectacles, among populations in urban and rural areas and for each country are represented by individual markers. The trendlines are plotted as a 2nd order polynomial function of HDI. Data from Burkina Faso, Djibouti, Dominican Republic and Sweden did not include rural or urban location.

j Spearman rank correlation indicate that the magnitude of deficiency in access for females increased in countries with lower HDI (with spectacles: $\rho = 0.61$, $p = 0.0004$; without spectacles: $\rho = 0.59$, $p = 0.0007$).

k Spearman rank correlation indicate that the magnitude of deficiency in access for people in rural areas increased in countries with lower HDI (with spectacles: $\rho = 0.83$, $p < 0.0001$; without spectacles: $\rho = 0.53$, $p = 0.007$).

Figures 2.1 to 2.4 reveal that the need for assistive products varied with HDI. HDI measures a population's life expectancy, education and income, which influence the need for and the access to assistive technology. The trend of increased need in countries with higher HDI was more prominent including spectacles, whereas the need excluding spectacles varied less with HDI. The stronger association between the HDI and the need for assistive products including spectacles could be attributed to the higher prevalence of myopia in high-income countries and higher prevalence of near vision impairment in regions with longer life expectancies *(136)*. Lifestyle could also lead to need for assistive products. For example, countries where there is a higher proportion of population in office-based jobs, having more years in studies, etc, could see a higher prevalence of need for spectacles. The WHO *Decade of healthy ageing: baseline report* published in 2021 *(7)* found that older people with higher levels of education (post-secondary and secondary) are more able to meet some of their basic needs[l] compared to those with only primary or no formal education. The more years of education and higher healthy life expectancy (HALE) could be an explanation for the decreased need for assistive products excluding spectacles among people in the age group 60 years and older in surveyed countries with higher HDI *(116,117)*.

The trend of increasing access along with HDI suggests that socioeconomic development influences the provision of assistive products. However, HDI is not the only determinant responsible for improving access to assistive technology in a country. This is evidenced by the rATA surveys, where some countries in the low or medium group of HDI classification achieved comparable access as those countries in a higher classification group (see Table 2.3).

l According to the WHO Decade of health ageing: baseline report, functional ability (limited to meeting some basic needs) reflects a person's interaction with their environment. The three elements make up the score are: ability to get dressed, ability to take medication, and ability to manage money.

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Meet *Richard*

Australia

Richard, aged 93 years, lives with his wife Annette. Richard and Annette have been married for 60 years and have had a busy, eclectic and adventurous life together. They travelled the world before settling down and creating a home on 20 acres of land in rural Australia, where they grew grapes and reared alpaca and peafowl. Retired now, Richard and Annette live on an ecovillage and have three children, seven grandchildren, and two great grandchildren.

With Annette's support, Richard maintains his level of functioning by exercising on a treadmill daily and following a nightly routine that includes memory retention activities on his iPad. Richard uses hearing aids, spectacles, a walking stick, and incontinence products. Combined, they allow him to stay active, pursue his passions and maintain dignity. For instance, the walking stick helps with balance which allows him to safely walk around the ecovillage. Without his washable absorbent pants, he would be hesitant about going out of the house as he worries about having an embarrassing accident. Even though accidents are rare, these absorbent pants give him the confidence to continue enjoying his favourite activities such as going on a walk with Annette.

With the help of assistive products, Richard continues to have a meaningful and productive life. He is an active member of the large community at the ecovillage and is busy writing novels about his life. He has already published three books and two more will be released in 2022. In his recent books, he writes about his years spent raising his family in Papua New Guinea. He states, "I am very grateful to have the help of my assistive products. I would not have been able to write my last two books without them."

Global estimates of needs for assistive technology

Based on the self-reported survey data, the modelled estimate (see Annex) of the prevalence of need for assistive products including spectacles in the global population is 31.3% (uncertainty limits: 25.7% to 36.9%). Similarly, the estimated prevalence of need for assistive products excluding spectacles in the global population is 11.3% (8.8% to 13.9%). These estimates account for about 2.5 billion people globally who need at least one assistive product including spectacles and about 900 million who need assistive products other than spectacles. About two thirds of the global population aged 60 years and older need at least one assistive product, while the prevalence of need is lower in younger age groups (Table 2.4). The need for multiple assistive products is more likely among older people (see Richard's story).

By 2050, the need for assistive products in the global population is estimated to increase to 3.5 billion with spectacles, and 1.3 billion without spectacles.[m] This is partly explained by aging populations: by 2050 the global population of 60 years and older is expected to grow to 2.1 billion,[n] double the size today.

According to estimates in the WHO *World report on vision (118)* published in 2020, globally, at least 2.2 billion people have a vision impairment or blindness caused by eye conditions such as cataract, trachoma and refractive error.

Though not all eye conditions can be addressed by assistive technology, the high prevalence of vision impairment is reflected in the high prevalence of self-reported need for spectacles in the surveyed countries. An estimate based on the Global Burden of Disease study found that, globally, 401 million people with hearing impairment from moderate to severe categories are likely to benefit from using hearing aids *(119)*. In addition, the WHO *World report on hearing (120)* suggests that, globally, the prevalence of hearing loss (of moderate or higher grade severity) increases exponentially with age, rising from 15.4% among people aged 60–69 years, to 58.2% among those aged over 90 years.

Many factors influence an individual's need for and willingness to use assistive products; self-perceived functional abilities being one. It is therefore reasonable that self-reported needs for assistive products are lower than need estimates based on clinically assessed or self-perceived functional difficulty only. This is observed in the surveyed countries as not all people reporting functional difficulties expressed a need for assistive products.

Table 2.5. Modelled estimates of the prevalence of need for assistive products in the population

Age group	Prevalence of need for assistive products including spectacles (uncertainty limits)	Prevalence of need for assistive products excluding spectacles (uncertainty limits)
Below 18 years	9.7% (6.7%–12.6%)	4.3% (2.6%–6.1%)
Between 18 and 59 years	28.7% (23.8%–33.6%)	8.2% (5.3%–11.0%)
60 year and older	68.7% (63.2%–74.2%)	31.2% (25.8%–36.6%)

Box 2.1 Need for assistive products in informal settlements (Indonesia and Sierra Leone)

In September 2019, a rATA survey took place in two low-income communities in Banjarmasin (Kelayan Barat and Pelambuan), in Indonesia, involving a total of 2046 individuals. Another survey was undertaken at the same time in Thompson Bay and Dwozark, Sierra Leone, involving a total of 2076 individuals. In both surveys, assistive products to support self-caring (47% and 53%, respectively) or hearing (30% and 52%, respectively) were reported among the top needs. Other area of reported need were for vision (57%, Sierra Leone) and for speaking and communicating (42%, Indonesia).

m The projection was based on the proportion of the sum of the number of individuals needing assistive products in each age group to that in the total population in 2050, assuming the same prevalence of need for each age groups as of 2021. A factor of 1.13 (with spectacles) and 1.11 (without spectacles) was applied to correct the projected estimates based on observed uncertainty between estimated prevalence in each age group and that in the total population.

n Based on median variant fertility rate estimation United Nations' Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019 (https://population.un.org/wpp/Download/Standard/Population/, accessed February 2022).

The need for and access to assistive technology can also be influenced by specific contexts, and by either long-term or short-term circumstances (Boxes 2.1 and 2.2).

Provision of assistive products is one of the key interventions for rehabilitation. In 2019, an estimated 2.4 billion individuals globally had conditions that would benefit from rehabilitation services, with musculoskeletal conditions and sensory impairments being the two biggest contributors *(121)*. The need for assistive products other than spectacles can be much higher in a population undergoing rehabilitation than in the general population (Box 2.3).

Barriers to accessing assistive products

The most frequently reported barrier to assistive products access across surveyed countries was affordability (median with spectacles: 31.0%; without spectacles: 43.5%), followed by lack of support and lack of availability. A higher proportion of survey respondents report cost as a barrier to accessing assistive products other than spectacles (Fig. 2.5).

Learning from users' experiences of accessing and using their assistive products is essential to addressing barriers and improving access.

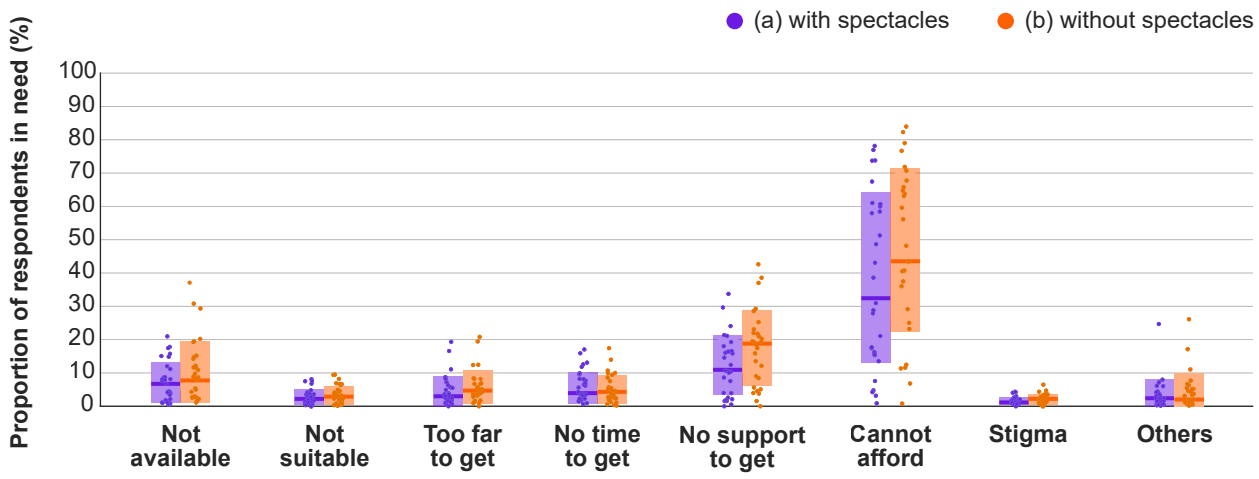
Box 2.2 Access to assistive products among refugees with disabilities (Bangladesh)

A rATA survey carried out in March 2021 included 401 households and 666 individuals with disabilities in refugee camps in Cox's Bazar District, Bangladesh. About half of the respondents in the survey, among both females (51%) and males (52%), reported unmet needs for assistive products. The reported unmet needs increased with age, which was 31% among young and teenage children aged between 2 to 17 years, 51% among people between 18 to 59 years older, and 85% among those aged 60 years and older.

Box 2.3 Needs for assistive products in rehabilitation services (Brazil and Costa Rica)

A rATA survey carried out with users of outpatient rehabilitation services provided by the public health care system in São Paulo, Brazil revealed that of the 929 surveyed participants: 50% of the survey respondents needed assistive products excluding spectacles, among which 22% reported a need for hearing aids. Another rATA survey was carried out in the outpatient rehabilitation service of the Caja Costarricense de Seguro Social in Costa Rica. Among the 619 participants, from all ages and geographical areas, 10% or more of the participants reported needs for assistive products supporting mobility, including: therapeutic footwear (16%), walking sticks (14%) and lower limb orthoses (10%).

Figure 2.5. Barriers to accessing assistive products, with (a) and without (b) spectacles



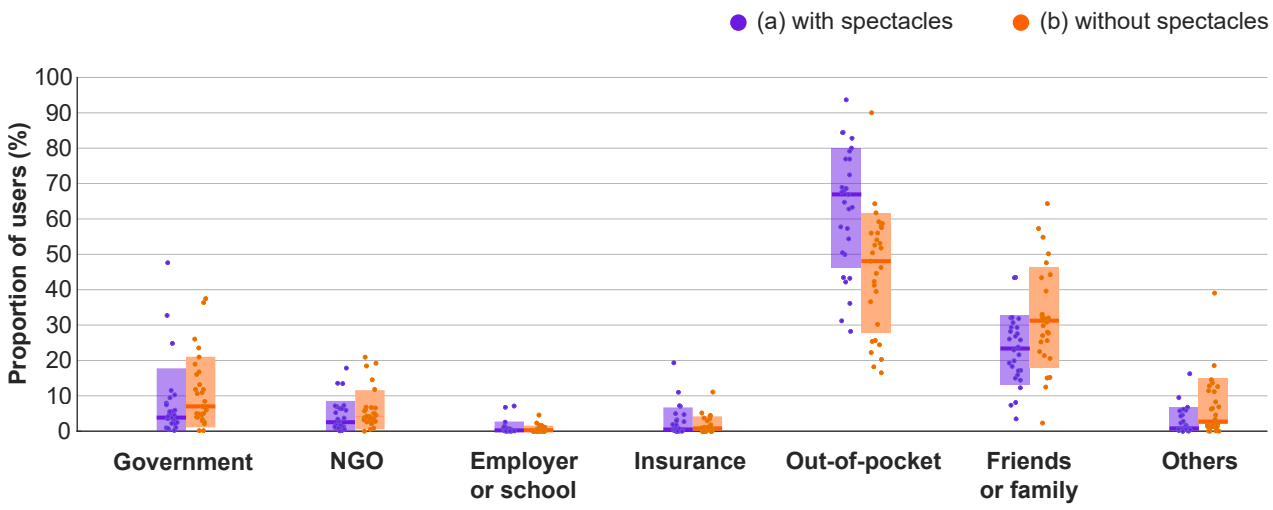
Notes: The proportions of responses in each surveyed country are represented by individual markers. The medians and the 25th and 75th percentiles of the proportions are represented by horizontal lines and vertical bars. Survey respondents can choose multiple answers. Data from Pakistan do not include the response options "No time" and "No support".

Funding for and sources of assistive products

Out-of-pocket payments for assistive products (when including spectacles) were reported by a large proportion of users in surveyed countries (median: 65.5%). When excluding spectacles, the proportion of users reporting out-of-pocket payments fell (median: 46.3%). Funding from family and friends was the second major funding source for assistive products in most surveyed countries, followed by funding from governments (Fig. 2.6).

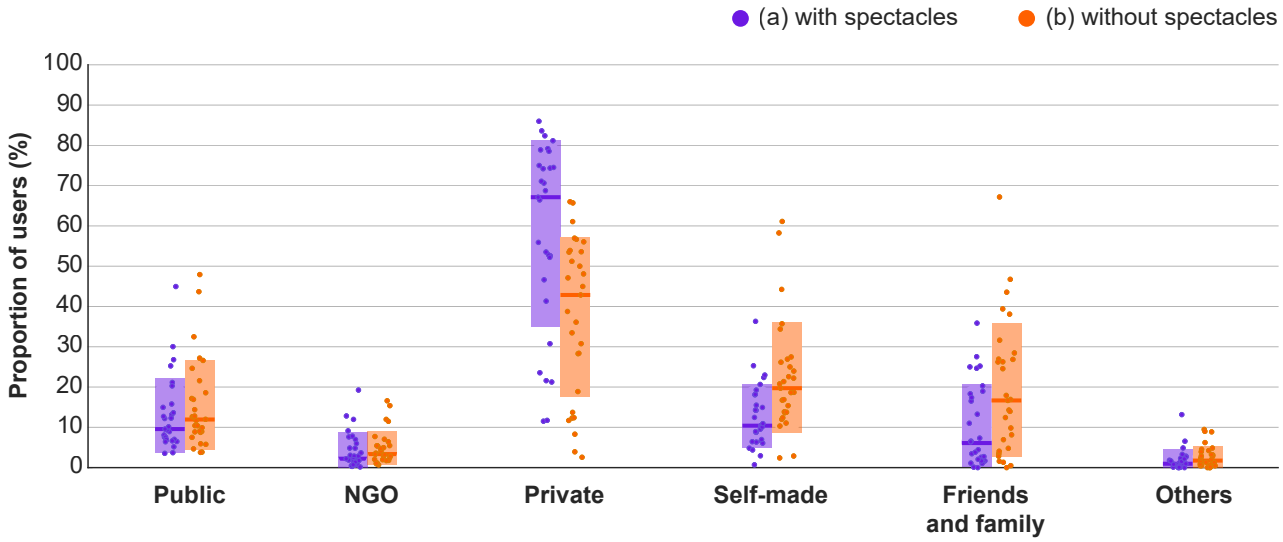
Private shops, clinics or pharmacies were sources to obtain assistive products, including spectacles, most reported by users in the surveyed countries (median: 67.1%). When excluding spectacles, the proportion of users reporting the private sector as the source decreased (median: 42.9%) and self-made products and products provided by friends and families[o] increased (Fig. 2.7).

Figure 2.6. Funding for assistive products, with (a) and without (b) spectacles



Notes: Respondents could choose multiple answers. Data from Pakistan did not include response options of "Friends or Family" and "Other".

Figure 2.7. Sources of assistive products, with (a) and without (b) spectacles



Notes: Respondents could choose multiple answers.

o For family or friends, the actual source of the assistive product is not specified. Hence, it may be one of the other options

To obtain their assistive products and access related services, most users reported travelling up to 25 km (median with spectacles: 68.2%; median without spectacles: 65.4%). However, in some countries, more than one in five users travelled more than 100 km (Fig. 2.8).

Users' experience of assistive products and related services

In most surveyed countries, more than 50% of users found their assistive products suitable for use at home and in public environments, and to help them participate fully in desired activities (Fig. 2.9).

Figure 2.8. Travel distance to obtain assistive products, with (a) and without (b) spectacles

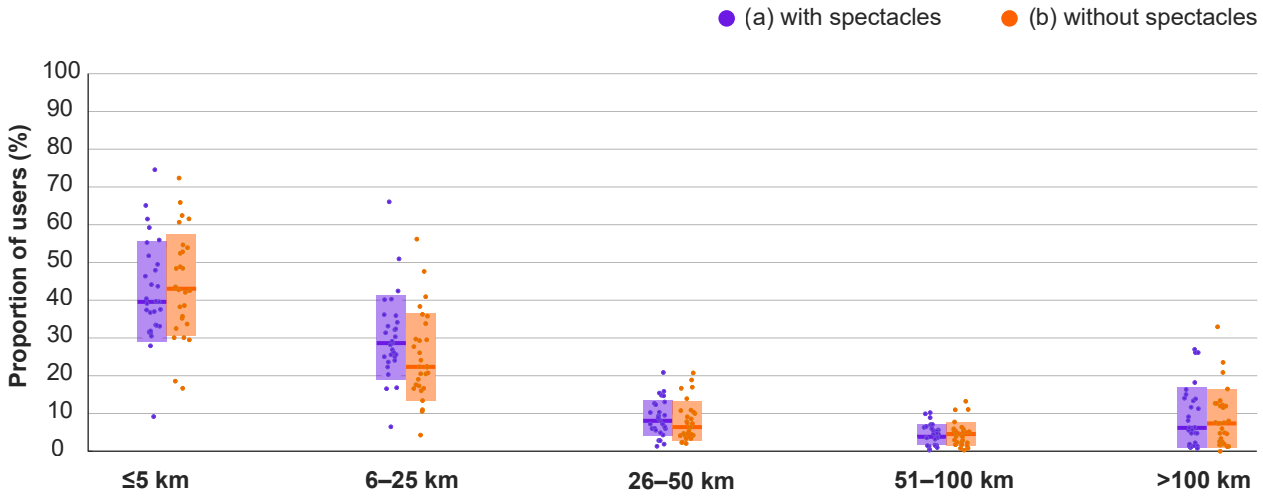
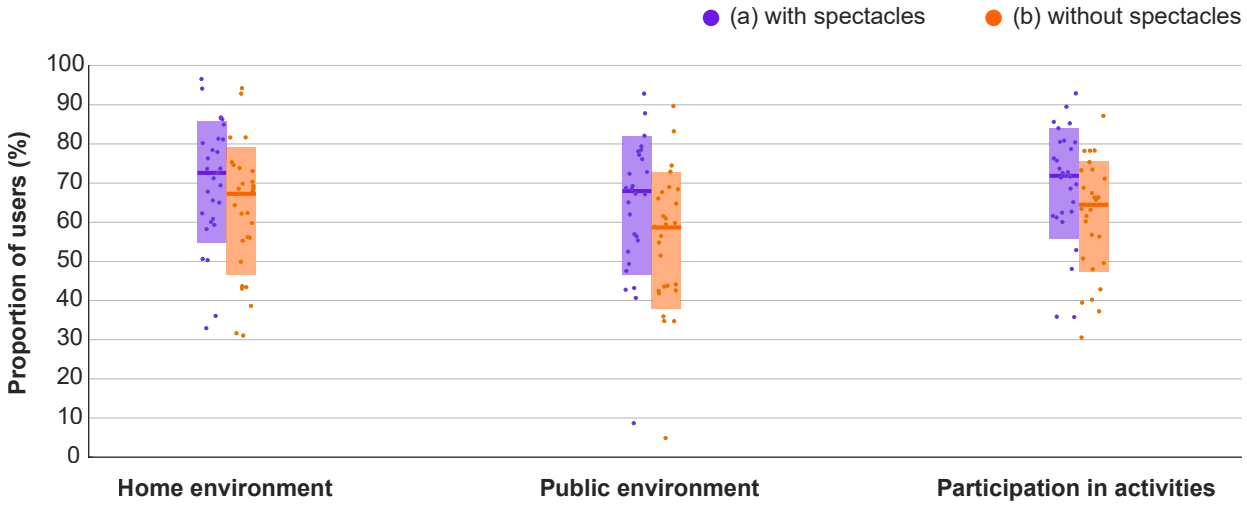


Figure 2.9. Satisfaction with assistive products for different environments and activities, with (a) and without (b) spectacles



Notes: Some users did not respond to one or more of the questions. Data from Pakistan do not include suitability for public environment.

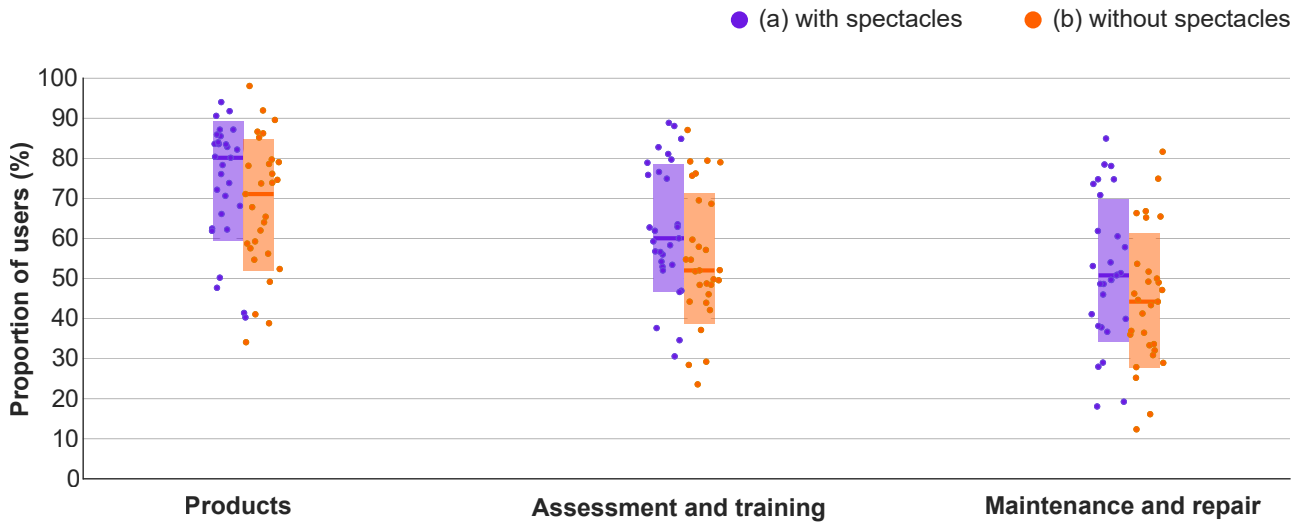
The majority of the users in surveyed countries were satisfied with their products (median with spectacles: 80.2%; without spectacles: 71.1%). Satisfaction was reported with the services related to assessment and training, and was lower with those related to maintenance or repair (Fig. 2.10).

Major sources of and funding for assistive products vary in different contexts (Box 2.4 and Box 2.5).

Users' experiences of satisfaction with their assistive products and related services provide valuable learning with which to address the issues in the current system and make effective improvements (see Box 2.6).

Population data on need, barriers to access and users' experience with assistive products and related services are instrumental to guiding the design of appropriate systems to meet reported needs.

Figure 2.10. Satisfaction with assistive products and related services, with (a) and without (b) spectacles



Box 2.4 Sources and funding for assistive products in rehabilitation services (Brazil and Costa Rica)

More than half of assistive products (62%) used by rehabilitation outpatients in the public health care system in São Paulo, Brazil were reported to come from private sources, while nearly one third (29%) came from public sources. Almost half of the assistive products were reported as being paid for out-of-pocket by users themselves (47%) and about one quarter (28%) were provided by government, with friends and family members financing just over a quarter (22%) of all products. Among outpatients of rehabilitation service of the Caja Costarricense de Seguro Social in Costa Rica, large proportions of assistive products reportedly came from the public sector (40%) and the private sector (47%). About 50% of the assistive products were reportedly paid for out-of-pocket and 22% were provided by government.

Box 2.5 Sources and funding for assistive products reported by refugees with disabilities in refugee camps (Cox's Bazar, Bangladesh)

Assistive products were reported as predominantly being sourced from NGOs (43%), with self-made products (26%) and products provided by friends or family (20%) also commonly reported sources. Private hospitals and shops also provide assistive products (11%). Charity was reported as the main payer (45%), followed by funding support from family and friends (30%) and out-of-pocket payments (26%). Public sector and government were reported as playing a small role in providing (2%) or paying (2%) for the assistive products. The main barriers for accessing assistive products were reportedly a lack of support (77% of those reporting barriers), product unavailability (44%) and being unable to afford products (31%). Additional information on where to access assistive products, and access to financial support were the ways in which most respondents suggested improving access to assistive products.

Box 2.6 Users' experience with assistive products and related services (United Republic of Tanzania)

Of the 2568 users interviewed in a rATA survey in Tanzania, more than half found their assistive products suitable for use in their home environments, as well as in public environments such as workplaces, schools or on public transport. About 58% of users reported that their assistive products helped them to do all they wanted to do. Most users (75%) were satisfied with their products. A majority were satisfied or very satisfied with the assessment and training services (80%) and maintenance and repair services (68%).

System preparedness for providing assistive technology

Methodology for measuring system preparedness for providing assistive technology

In response to the request in World Health Assembly Resolution WHA71.8, WHO developed a set of indicators[p] to measure Member States' progress in improving access to assistive technology up to 2030. The progress indicators measure system preparedness in terms of: governance; legislation; public budget; financing mechanisms; regulations and standards; collaborations and initiatives; service provision coverage; workforce availability; and training (Fig. 2.11).

In April 2021, WHO called for all Member States to provide data for these progress indicators through an online survey. By December 2021, 70 Member States[q] had completed the survey through the focal points in ministries of health or other relevant ministries and/or government agencies.

Governance

Of the 70 participating countries, 69 (99%) had at least one ministry or authority responsible for access to assistive technology, and in 65 countries (93%) this was the ministry of health (or an equivalent authority). Forty-four (63%) participating countries reported having three or more ministries responsible for assistive technology. Apart from health and social services, ministries of education, labour and defence were also reported as being involved in assistive technology policy and provision.

Legislation

Sixty-two countries (89%) had at least one piece of legislation on access to assistive technology. In most of these countries, assistive technology was covered in legislation on health (51 countries, 73%) or social services (49 countries, 70%). Twenty countries (29%) had separate legislation on assistive technology. Only two countries (3%) had no relevant legislation. In 47 countries (67%), legislation covered people with difficulties in all domains: cognition; communication; hearing; mobility; self-care; and vision. In 13 countries (19%) legislation covered people with difficulties in some, but not all, domains. People with hearing and mobility difficulties were most frequently covered: 59 countries (84%) and 58 countries (83%), respectively.

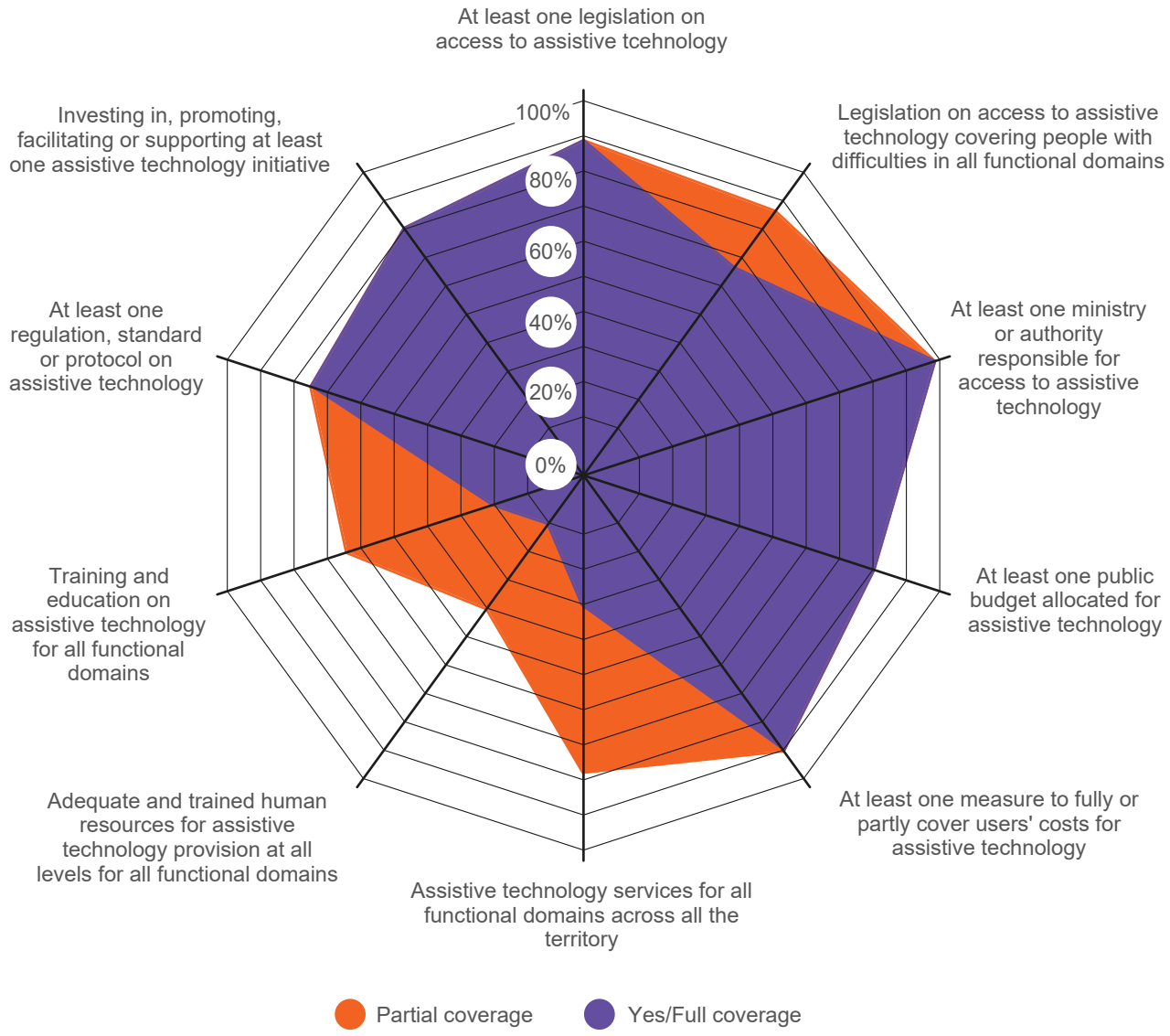
Public budget

At least one public budget was allocated for assistive technology in 56 countries (80%), while seven countries (10%) had no budget dedicated to assistive technology. In most countries the budget for assistive technology was within health (47 countries, 67%) or social services (38 countries, 54%) budgets. Nineteen countries (27%) had a separate budget for assistive technology and 34 countries (49%) reported that budgets for assistive technology were allocated across three or more ministries.

p For the set of indicators for data collection in 2021, see https://apps.who.int/iris/bitstream/handle/10665/354084/WHO-MHP-HPS-ATM-2022.01-eng.pdf, accessed 9 May 2022. The set of indicators will be updated for measuring progress in the implementation of resolution in Member States in 2026 and 2030.

q Afghanistan, Antigua and Barbuda, Australia, Azerbaijan, Bahrain, Belgium, Benin, Bhutan, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Canada, Chad, Chile, Costa Rica, Croatia, Czechia, Democratic Republic of Congo, Djibouti, Dominican Republic, Estonia, Eswatini, Gambia, Georgia, Guatemala, Iran (Islamic Republic of), Iraq, Italy, Jordan, Kenya, Malawi, Maldives, Mali, Mauritius, Myanmar, Namibia, Nepal, New Zealand, Nicaragua, Niger, Nigeria, North Macedonia, Pakistan, Paraguay, Peru, Poland, Portugal, Qatar, Republic of Korea, Republic of Moldova, Rwanda, Saint Vincent and the Grenadines, San Marino, Seychelles, Sierra Leone, Spain, Sri Lanka, Sudan, Sweden, Tajikistan, Thailand, Timor-Leste, Togo, Ukraine, United Arab Emirates, United States of America, Zambia, Zimbabwe.

Figure 2.10. Proportions of countries reporting established elements of assistive technology system preparedness, in 70 Member States



Notes: Full coverage: all six functional domains covered; Partial coverage: one to five functional domains covered. Outcome of service coverage refers to the combination of coverage of domains and coverage of geographical areas.

Financing mechanism

In 63 countries (90%), there was at least one measure in place to cover users' assistive technology costs either fully or partly. The two most common measures were a list of safe and effective assistive products that are subsidized or provided free to eligible people (44 countries, 63%) and public insurance schemes (39 countries, 56%). Twenty-seven countries (39%) had voluntary private insurance schemes and 14 countries (20%) had compulsory private insurance schemes in place. Nineteen countries (27%) reported having other measures to cover the cost of assistive technology. Forty-five countries (64%) had two or more measures to cover users' costs for assistive technology.

Regulations and standards

In 53 countries (76%), there was at least one regulation, standard or protocol in place on assistive technology or accessibility, while six countries (9%) reported having none.

Thirty-eight countries (54%) reported having regulations on barrier-free or accessible environments and 37 countries (53%) reported having regulations on procurement of assistive products. Moreover, 32 countries (46%) reported having regulations on safety of assistive products, 30 countries (43%) had regulations covering the qualifications of assistive products providers, and 29 countries (41%) had

regulations on the delivery of services. Regulations on inclusion of assistive products in emergency preparedness were reported by 14 countries (20%) and 16 countries (23%) had regulations on barrier-free or accessible environments in emergencies.

Collaborations and initiatives

A total of 56 countries (80%) reported investing in, promoting, facilitating or supporting initiatives related to assistive technology. This included initiatives covering: service delivery capacity (41 countries, 59%); product procurement (40 countries, 57%); information to users and families (38 countries, 54%); collection of data on population-based needs for products (36 countries, 51%); product affordability (36 countries, 51%); product development (31 countries, 44%); participation of users in planning and monitoring services (29 countries, 41%); and international collaboration on manufacturing, procurement or supply of products (22 countries, 31%).

Service provision coverage

Twenty-one countries (30%) reported having services in place for all functional domains across their entire territory. In 34 countries (49%) services were available only for some functional domains, or only in some geographical areas. Fourteen countries (20%) had insufficient information on availability of assistive technology services in their territories. Services for mobility (54 countries, 77%), vision (50 countries, 71%) and hearing (47 countries, 67%) were the most available services across participating countries.

Workforce availability and training

Seven countries (10%) reported adequate and trained human resources at all levels of service delivery, to provide, repair and maintain assistive products for all functional domains; 21 countries (30%) had human resources only for some functional domains; and 20 countries (29%) had no adequate and trained resources for any functional domains. Adequate and trained human resources were most frequently present for mobility (21 countries, 30%), vision (19 countries, 27%) and hearing (18 countries, 26%). In relation to training, 15 countries (21%) had training and education that covered service provision, repair and maintenance for all functional domains, while 30 countries (43%) had training and education opportunities only for some functional domains. Ten countries (14%) had no relevant training and education. Training and education opportunities were most frequent in relation to mobility (40 countries, 57%), vision (40 countries, 57%) and hearing (36 countries, 51%).

Previous efforts to measure access to assistive technology have provided useful examples for the global report development and confirmed the need for continuous efforts in data collection from both a population and system perspective (Box 2.7).

Box 2.7 Previous efforts in measuring access to assistive technology

A scoping review examining relevant literature and surveyed stakeholders in more than 50 countries in Europe and Central Asia to assess the need for, access to, and coverage of assistive technology revealed that data on this topic are limited and concentrated in a few countries *(122)*. The data that do exist show substantial variation in access within and between countries.

Several previous efforts had been made to identify needs and unmet needs for assistive technology in Africa *(123,124)* and Asia *(125,126)* through population surveys or other available datasets, which revealed large unmet needs, ranging from 25% to more than 90%. Specific research attention has also been given to commonly known assistive products such as spectacles, hearing aids, wheelchairs, limb prostheses and personal digital assistants, where high unmet needs were revealed *(127)*. High costs, limited availability, lack of awareness, lack of suitably trained personnel, lack of governance, and inadequate financing of assistive technology were reported as barriers to access in developing countries *(128)*. Similar efforts have also been made in North America, where unmet needs were mostly seen for hearing aids and bathroom aids *(129)*. Despite various efforts, research in different regions of the world, including at different socioeconomic levels, found that different national-level information about assistive product use, needs and met/unmet needs was not adequately captured by existing data collection tools *(130)*. Variations in methods for data collection *(127)* have likely led to the substantial variations in the data, also preventing comparison of findings across contexts.

Research efforts examining the assistive technology provision system in a few countries in Europe and Central Asia reported capacity to distribute a range of priority assistive products as long as people in need accessed the appropriate services *(131)*. However, lack of qualified assistive technology professionals, insufficient funding, suboptimal assistive technology distribution and services, lack of information among individuals using and in need of assistive technology, and low quality and durability of assistive products were identified as common gaps in the system *(132)*.

These previous studies provide examples of research and confirm the need for continuous efforts to collect both population- and system-level data to improve access to assistive technology.

System shortfalls to meet population need

The assessment of population access to assistive technology in this report reveals shortcomings in system preparedness, and that the need for assistive products is far from fully met in many surveyed countries. Having legislation and responsible government bodies for assistive technology does not guarantee that products or services are available for people in need. Likewise, available public budget and multiple financing mechanism options do not sufficiently cover the costs for people to obtain the needed products or services. And shortfalls in well-trained workforces and service provision are likely to exacerbate the lack of necessary support needed for people to access assistive products, especially for communication, cognition and self-care, and to use these products safely and effectively. Raising awareness among everyone – from the general public to professionals and policy-makers – of the broad range of assistive products and their benefits is still much needed.

Section 3

Identifying barriers to assistive technology

Key messages

There are many barriers to accessing assistive technology, including:

- **Lack of awareness** often drives low uptake, compounded by an absence of information on the types and availability of assistive products.
- **High costs** due to over-priced assistive products and associated service delivery cost.
- **Limited physical and geographical access** puts assistive technology out of reach for many potential users.
- **Inadequate product range, quantity, quality and suitability** can make assistive products unavailable, unsafe, ineffective and even abandoned.
- **Procurement and delivery challenges** delay and reduce access.
- **Capacity gaps exist in the assistive technology workforce** with shortage of workforce with adequate knowledge on assistive technology and lack of trained personnel.
- **Low policy profile and lack of legislation** lead to the low prioritization of assistive technology, and legislation that fails to cover people with all types of functional difficulty.
- **Lack of funding and investment** for the strengthening of national assistive technology systems exists in many countries, alongside disparities in funding levels by programmes.
- **Fragmentation of the assistive technology sector**, including between professions, user groups, funding and provision mechanisms.
- **Sociodemographic barriers** hinder equitable universal access to assistive technology.

Assistive technology should be – like all aspects of a health service – available and accessible equally to all, regardless of gender, socioeconomic status or geographic location. As shown in Section 2, however, the real access scenario is often far from this ideal.

Limited services

Lack of awareness and information

Poor understanding of assistive technology often drives low uptake, compounded by an absence of trusted information on the types and availability of assistive technology and possible solutions *(133)*. Beliefs, misconceptions and stigma can also discourage and prevent users and their families from finding out how to obtain needed assistive products *(134)*.

While there may be awareness of more commonly available assistive products such as wheelchairs, hearing aids and spectacles, potential users and providers may not be familiar with a wide range of assistive products for communication, cognition or self-care that could make significant improvements in the lives of people in need. Poor literacy, lack of internet access, inaccessible or untrusted information pose further barriers to becoming aware of the need for and benefits of using assistive technology *(28)*.

Information about product costs and how to gain access to assistive technology tends to be fragmented across several public institutions (e.g. health, social welfare and education), as well as private or NGO providers. Without a centralized and accessible assistive technology information source, the burden of finding basic information (e.g. how do I get a pair of affordable crutches that suit my size and living environment?) is placed on the user and their support networks.

Lack of services

Many assistive products require pre- and post-purchase services involving trained personnel – services that should be integrated into health, education or social services rather than being linked to the standalone purchase of a product from a local shop. To ensure that assistive products are fit for purpose, WHO recommends four types of provision services: assessment, fitting, user training and follow up *(135)*. Benefits and safety may be compromised by weakness in any of these steps. When product options and related services are inadequate or not available close enough to where the potential user lives, more time and financial resources are needed to reach assistive technology providers. Discrimination has been identified as a common experience for people with disabilities when accessing the health system. A negative experience with health care or other providers can discourage users from accessing assistive products and related support *(136)*.

Lack of early identification – such as universal hearing or eye screening – results in unmet assistive technology needs. For those able to access assistive technology, the quality of products and services available depend on the presence of trained personnel, service standards, delivery time, number of visits required and procurement of safe and effective products.

The amount and nature of services provided are determined by training and practice standards and resources available to ensure those standards can be met. For instance, personnel working within the public health system may be trained in all four services (i.e. assessment, fitting, user training and follow up) but follow-up services are not funded. Thus, even when users receive a product that meets their needs, inadequate follow-up services can reduce long-term usability and lead to abandonment. The lack of planning and funding for follow-up services such as maintenance, repairs and spare parts can be a barrier to sustained use of assistive products. Deficits in service provision were observed in the current systems, as described in Section 2. Even when safety and durability standards are in place to ensure product quality, some assistive products require ongoing maintenance, adaptations or repairs. The more customized and complex the product, the more likely it is that the user will need follow-up services to ensure optimal and sustained fit and function. Children and older people need more frequent follow-up services than others to match gradually changing body structures and functional abilities.

Limited physical and geographical access

Limited geographic and population coverage often puts assistive technology out of reach for potential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users (see Andriana's story).[r] For example, many assistive products and related services may only be available through selected tertiary hospitals in urban centres or the capital city, which can require extensive travel and overnight stays for users, their families and caregivers. Lack of accessible and inclusive transport, communication and physical environments create additional barriers. Even when provision covers broader geographical areas (including at community level), the range of assistive products can be limited.

Inaccessible facilities, equipment, information and negative attitudes of providers add to barriers to assistive technology.

Inadequate products

Low quality

National and international technical standards determine product quality in terms of strength, durability, performance, safety, reliability, comfort, etc. Poor quality assistive products exist due to inadequate standards, lack of regulatory enforcement and lack of knowledge about the need for safe and effective products. When users have no access to affordable, safe and effective assistive products, the only alternative may be a substandard device that does not meet needs or match local context *(137)*.

The enforcement of standards is a complex and costly task given the range of assistive product types and assistive technology suppliers and providers (e.g. pharmacies, NGOs, manufacturers and individual private brokers). Determining if assistive products adhere to safety and performance standards often requires trained experts in different specialties and enforcement by regulatory agencies. It is essential that assistive products comply with adequate standards to avoid further harm and lack of reliability and usability *(138)*.

Limited range, option and quantity

Many countries have inadequate ranges, options and quantities of assistive products, as evidenced by the survey outcomes presented in Section 2, where assistive products in use – as well as service provision – primarily included basic products to support vision, mobility and hearing. Assistive products, including spare parts, are frequently imported because local (national) manufacturing capacity is limited both in the scale of production and product range (i.e. types, sizes, price points) *(25)*.

r "Coverage" refers to currently met assistive technology needs, not legislative and policy level coverage that has yet to be implemented at the ground level.

Meet *Andriana*

Indonesia

Andriana lives with her mother and grandmother, some distance from the closest urban centre. She was born with an impairment that made walking difficult. When she walked, she dragged her feet, moved carefully and slowly, and often fell.

While Andriana was growing up, her mother and grandmother tried to get help from the local health clinic, but the medical staff were only able to treat common health conditions and did not refer them to another clinic that could address her disability-related needs. Thus, she did not know the cause of her impairments throughout her childhood.

The absence of needed services and inclusive attitudes during Andriana's youth contributed to some traumatic experiences. Andriana was persistently bullied in school, so her family decided to withdraw her from school and keep her at home to help with daily chores. When an earthquake hit her village, she was not able to quickly escape her house. Some of the walls collapsed and she had to wait to be rescued.

When Andriana was 22 years old, she and her family were introduced to a visiting physiotherapy team by a local organization. Andriana learned that she has cerebral palsy, and her needs were assessed. She was fitted with orthopaedic shoes and provided with physical therapy. After only three visits she learned how to walk safely with her new shoes. She also noticed that physical therapy helped to relieve the pain in her back. One of her family members expressed their gratitude for Andriana finally receiving this critical and long-awaited care, "On behalf of her family, I would like to say thank you very much… and we hope that the government could pay more attention to us."

Even in countries that have local capacity to design and test assistive products, manufacturing equipment may be imported.

Although importing assistive products is a feasible and cost-effective option, inadequate buying power (even in bulk quantity) can be the most significant barrier to increasing national supply. Other barriers include the lack of information to enable buyers to compare and purchase assistive products on the global market, and a limited range of assistive products that are suitable for a diversity of local contexts, particularly assistive products designed for and tested in low-resource settings *(139)*. Donations of new or second-hand assistive products, which meet standards and regulatory requirements, can be a major supply source in some countries. However, donations can have limited and inconsistent supply and may be of poor quality *(140)*.

Lack of repair, refurbishment and reuse of assistive products reduce how long they can be kept in circulation within a service delivery system to meet the needs of more than one user. The exclusion of spare parts at the time of or after purchasing assistive products can lead to abandoned products. Additionally, manufacturers may not design assistive products to ensure easy repairs, or may restrict supply of spares causing additional economic hardship on users and family members.

Assistive products need to match the needs of all age groups, functional requirements and environments. Sometimes designers and manufacturers tend to develop high-end and or high-margin products for a minority group rather than the majority. Also, an emphasis on producing urban-oriented assistive products rather than products suitable for use in rural or all-terrain environments can lead to lack of access to appropriate products or abandonment of provided products.

Lack of supply

Changing funding priorities and broader economic instability can cause an erratic supply of assistive products. Public ministries involved in assistive technology procurement may be subject to shifting leadership and budget priorities *(141)*.

At the macroeconomic level, fluctuating international exchange rates and financing system instability (e.g. banking, inflation) influence the buying of assistive products. During a crisis, assistive product sourcing and supply can be halted. For example, health product supply chains around the world were disrupted by the COVID-19 pandemic *(142)*. Given that some crises themselves result in injuries that require additional supply of assistive technology, designing resilient assistive technology supply chains and systems that function during crises is imperative *(143,144)*.

Poor suitability

When assistive products are mismatched for user needs, they can cause harm or be abandoned. For example, a video relay service may be the most effective solution for someone who has hearing difficulties, but lack of consistent internet access makes this option unsuitable. In addition, evidence shows that users' perceived usefulness of assistive products and user choice improves adoption and outcomes *(145)*. Aesthetic preferences are particularly important for prominent devices (e.g. spectacles) and specific populations (e.g. young adults) *(146)*. Despite the importance of design for the willingness to access and use assistive products, many are neither child- nor gender-friendly.

Procurement and delivery challenges

Procurement practices determine what is purchased (i.e. products, spare parts and accessories, and services), alongside factors such as price and contractual arrangements with buyers and suppliers. Poorly designed, funded and managed procurement and delivery processes delay and reduce access and can be overlooked when identifying bottlenecks in the assistive technology system.

Inefficient procurement

Procurement mechanisms can be fragmented across and within ministries and multiple sectors (e.g. NGOs, private providers), and can cause fluctuations in quantity and characteristics of assistive technology from year-to-year *(140)*. Procurement priorities are

The wheelchair is my leg, my chair and my everything.

Sammy (32), Kenya

rarely demand-driven because of lack of required data.

Gatekeepers that determine what assistive products are ultimately purchased (e.g. procurement officials, budget managers) may not always make the best buying decision or take user preferences into consideration. Even when adequately trained assistive technology professionals suggest a specific product, purchasing decisions by procurement officials can default to the lowest cost option due to budget limitations or inadequate training. Consulting users while doing large-scale procurement is exceptional.

Inefficient delivery

Inadequate delivery systems to get assistive technology or other health products to users present a bottleneck in assistive technology systems *(141)*. Lack of transparent information systems (e.g. for inventory, tracking), poor delivery infrastructure, inefficient distribution channels, mismanagement of supply warehouses etc. can all create a host of logistical challenges in getting purchased products to users (Box 3.1). In addition, product delivery delays or non-inclusive services can prevent someone from moving forward along the access pathway. Delays may also worsen users' health status or lead to poor usage *(147)*.

Workforce capacity gaps

Workforce shortfalls limit geographic and population coverage and compromise the quality of assistive technology services *(148,149)*. As indicated in Section 2, many countries have limited or no assistive technology dedicated professionals able to offer expertise in a broad range of assistive products. Given the broad scope of assistive technology and the multi-tasking skills required in many product categories, the breadth and depth of dedicated training of assistive technology professionals is not feasible in all contexts. Lack of data on the extent and nature of this workforce shortage hinders advocacy and policy-making efforts.

The degree of specialization, training requirements and practice standards vary across the diverse range of assistive technology disciplines and sectors (i.e. public, private and non-profit), creating a fragmented landscape for human resource planning.

Overall, there are too few well-trained assistive technology personnel, whether they are direct service providers, or part of the broader assistive technology workforce (which supports the functioning of the assistive technology system itself).

Lack of direct service providers

Academic and professional training programmes that prepare assistive technology professionals are few and far between and may in any case not adequately equip direct service providers with the knowledge and skills to meet the diverse needs of users. Assistive technology competence is not just knowledge of assistive products and how they might assist a person with a functional difficulty – it also involves understanding the implications of the health condition of the person and the future outlook, awareness of environmental barriers, context awareness, and supporting the user in realizing life goals using the assistive product. A lack of skilled professionals to support the choice and personalization of assistive products can lead to poor procurement choices (see Jack's story). Providing the incorrect assistive products can also result in abandonment, developing secondary conditions or even premature death *(150)*.

Limitations in broader assistive technology workforce

In addition to direct service providers, there is a lack of personnel that play important roles in the assistive technology system (e.g. biomedical and rehabilitation engineers involved in the design, development and production of assistive products). Trained staff are also needed in a variety of roles to effectively operationalize assistive technology policies and plans (e.g. procurement managers).

There is a need to attract many different types of well-qualified personnel into the assistive technology field, such as nurses, pharmacists and community

Box 3.1 Assistive technology procurement study: WHO Western Pacific region

A procurement study in the WHO Western Pacific region found that procurement for assistive technology is not well integrated into government annual budget and planning cycles, and thus receives minimal and inconsistent funding from year-to-year. The provision of assistive technology is limited for all categories, with the least availability for low-vision, communication, self-care and cognition products.

Source: Assistive technology procurement study: technical report. Manila: World Health Organization Regional Office for the Western Pacific; 2020 *(140)*.

© National Orthotics Prosthetics Service, PNG

Meet *Jack*

Papua New Guinea

Jack is 17 years old, and lives in the remote highlands of Papua New Guinea. As a young teenager, Jack sustained a spinal cord injury when a tree fell on him. He was cared for in the local hospital, where he was provided with a donated, second-hand wheelchair. This wheelchair was too large for him, had no cushion to protect him from pressure wounds, and he was unable to propel himself in it.

Recognizing Jack's need, a collaborative effort by his community, the local hospital, the government wheelchair provider based in Port Moresby, and support from donors and a non-government organization, enabled an outreach visit by the government wheelchair provider. Two staff made the journey, including a flight and five hours four-wheel driving.

For Jack, meeting the trained staff provided him with a chance to learn more about how to use his wheelchair including how he can propel himself. He was more comfortable in the new wheelchair, better protected from pressure wounds, and able to access and move about his school.

Since the initial visit, the outreach programme has continued, further supporting Jack and others in his community.

health workers. Unlike the medicines sector, assistive technology may not be treated as a holistic sector in professional training programme or in the labour market, where industry-specific positions (e.g. assistive products supply chain management) are commonly available.

Market failures

The current and growing demand for assistive products globally has yet to translate into actions addressing various forms of market shortcomings *(139)*.

Market fragmentation

The potential market size of the current and future assistive technology sector is not known, partly because assistive technology is not treated yet as a distinct sector. The fragmentation of provision and funding, along with the broad range of assistive products and related services, means that assistive technology is viewed in categories, subgroups of users or disciplines, and not as the collective and vast global market it represents.

Inadequate demand information

On the supply side, manufacturers and suppliers lack information to estimate demand *(151)*. On the demand side, buyers from all sectors (i.e. public, private, non-profits) and users are not equipped with necessary information that allows them to compare product features and purchase products.

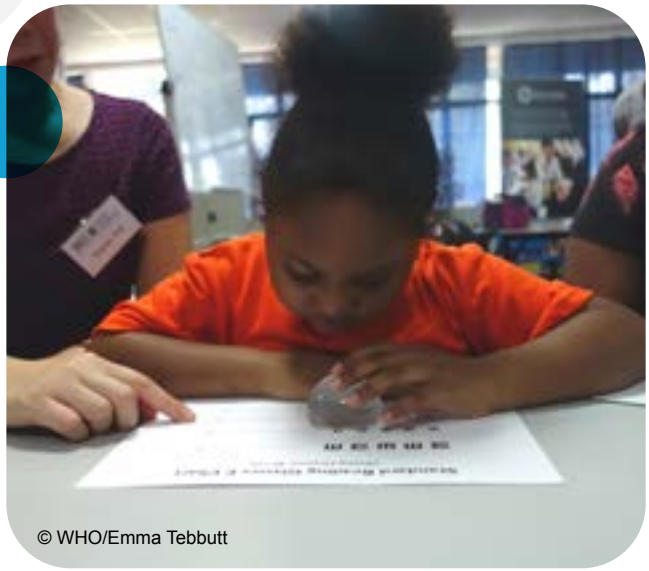
Barriers to market entry

For manufacturers or suppliers, getting new assistive products certified – especially when they are recognized as medical products, and covered by financing schemes – can be a time- and resource-intensive process. Likewise, getting registered as a new assistive technology company (i.e. start-ups, manufacturers, suppliers, or support services) can be a lengthy process. Inconsistent product specifications and standards can also pose a disincentive to market entry.

Governance and funding issues

Low policy profile

Lack of awareness about the scope and scale of assistive technology needs and the potential benefits of assistive technology access to individuals, communities and broader society lead to the low



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prioritization of assistive technology, and legislation that does not always cover people with all types of functional difficulty (as the progress indicators on system preparedness presented in Section 2 reveals). Coverage is inadequate and inconsistent in terms of who is eligible to receive assistive technology, and what types of products and services are covered. Access to assistive technology has been shown to increase participation in socioeconomic activities, and reduce poverty and hunger for users and their households, yet there is a lack of disaggregated data on the return on investment for different types of assistive products to motivate public or private sector funding *(152)*.

Lack of funding and investment

As demonstrated in Section 2, there is inadequate funding for products and services, and lack of investment in strengthening national assistive technology programmes and systems. Funding mechanisms for assistive technology can reside with ministries (e.g. health, education, labour and social welfare), or be privatized like private health or social welfare insurances and schemes, or follow a hybrid model of public–private partnership. There can also be disparities in funding levels by geographical area within a country. Where provision of assistive technology has been part of welfare or charity-based services it may not have been fully integrated into public funding streams and services *(153)*.

During budget decision-making at national or district levels, assistive technology may not be a discrete category but is instead covered under a general line (e.g. consumables, or products for older people or people with disabilities). Without a dedicated budget for assistive technology (and for specific types), it is hard to advocate for an increased budget or track assistive technology expenditure.

Fragmentation of the assistive technology sector

Fragmentation of assistive technology provision among sectors, departments and ministries increases the complexity of information users need about how to gain access to assistive technology. A pathway to access assistive technology often varies based on a user's profile, assistive technology needed and context. Fragmentation is due to the wide range of assistive products and the way the sector has been developed or professionals have been trained thus far. Professional silos, fragmented funding and provision mechanisms, and multiple access pathways characterize the sector *(153)*. While some countries have designed and implemented an integrated assistive technology system that covers the full range of assistive products, others have a piecemeal approach with little coordination among the stakeholders.

Sociodemographic barriers

Access barriers can be unique to different users and overcoming them is essential to achieving equitable access to assistive technology. Sociodemographic factors such as age, gender, type of functional difficulty and socioeconomic status have been reported to influence access *(154)*.

Age

Stigma among peers or non-inclusive school settings can prevent children from accessing or using assistive technology *(25)*. Families' beliefs about children's capabilities and the benefits of assistive technology play a major role in accessing it (see Lupita's story) *(155)*. Lack of time and necessary support can be a hindering factor for people at working age to access assistive products, as they cannot afford loss of income due to time off work. As people age, the need for assistive products increases, and older people likely need multiple assistive products as discussed in Section 2 *(156)*. However, inaccessible physical environments or information sources can create extra barriers for older people to access assistive products and services without support from their family. Low availability of assistive products that meet the needs of older people can also be a barrier *(157,158)*.

Gender

The outcomes of the population surveys reported in Section 2 indicate that women tend to access assistive products to a lesser extent than men, although there are variations between countries. In

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Meet Lupita

Nicaragua

Martha, or 'Lupita' as her family and friends call her, is a lively and cheerful young girl. She lives with her mother and extended family on the outskirts of the city of Leon, Nicaragua. When Lupita was six months old, the family noticed that she had problems following sounds produced by toys and 'chichiles', a Nicaraguan handmade rattle.

Lupita was diagnosed with a hearing impairment, a condition that has had a big impact on her relationship with other children in her neighbourhood. They refer to Lupita as a 'rare animal', as she can neither hear nor talk and communicates only via signs. In addition to a hearing impairment, Lupita has stiffness in her legs, which meant it took her longer to walk and affected her moving around.

Lupita and her family have been supported since her diagnosis by a local organization with language stimulation therapy and introduction of sign language. The family were also very keen for Lupita to have hearing aids as soon as possible. They felt that this would assist her development and help her to better integrate with her community. Since receiving her hearing aids, as she adjusts to them, Lupita continues to participate in language therapies and uses sign language to keep developing her overall use of language. Most importantly she has now joined her peers at school and is rapidly gaining confidence.

some countries, men were twice as likely than women to access assistive products. Assistive products, professionals and service delivery systems are not always gender-friendly. Even privacy is compromised while providing assistive products especially during mass distribution. Previous studies have found that women are less likely to access assistive technology because of financial and cultural factors *(39)*.This is in line with evidence showing difficulties for women with disabilities to access health care in general due to sociocultural, financial and structural barriers in some countries *(159)*.

Type of functional difficulty

Low awareness of the variety of assistive products is a barrier to access, especially for people with certain functional difficulties. This was reflected by the low prevalence of use of assistive products in communication, cognition or self-care. The barrier may have been worsened by low service coverage in certain functional domains, as revealed in Section 2. People with multiple or severe functional difficulties face additional hardships to access all the assistive products they need.

Living environment

The population surveys presented in Section 2 found that access to assistive products was lower for people living in rural areas compared to urban areas. Limitations in the range of assistive products, low coverage of assistive technology providers and poor infrastructure in rural or remote living areas can impose additional barriers for people to access and use their assistive products (Box 3.2) *(160)*.

Socioeconomic status

The outcome of the population surveys in Section 2 suggested a strong association between access to assistive products and the socioeconomic status across the surveyed countries. High out-of-pocket expenditure for the products is the most frequently reported barrier by participants in almost all surveyed countries.

Box 3.2 Accessing assistive technology in remote settings (Canada)

In northern Canada, a combination of factors such as harsh cold weather and infrastructure issues contribute to reduced access to assistive technology. Travel by boats, snowmobile and sleds can be particularly challenging for those with locomotor disabilities, while assistive technology that depends on electricity can be compromised by power interruptions. Governments can fulfil their responsibility under the UN *Convention on the Rights of Persons with Disabilities* by designing assistive technology systems that are context-sensitive.

Source: Altin N, MacLachlan J, Phenix A, Nixon S. Colonization, climate, and critical analysis: Examining access to assistive technology in Northern Canada using the World Health Organization's Global Cooperation on Assistive Technology initiative. In N. Layton, J. Borg (Eds), Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019, World Health Organization, Geneva, Switzerland, 22–23 August 2019. Volume A *(160)*.


luna

Section 4

Improving the assistive technology system

Key messages

Improving the assistive technology system means developing and strengthening the following four components.

Policy: Policies, financing and programmes for realizing universal access to assistive technology vary across countries, and leadership and governance are key. Assistive technology can be integrated within national systems or directories for health information or social welfare. Adequate and consistent financing can protect users from financial hardship and make access equitable, with common financing mechanisms being ministries and public or private health and social insurance schemes. National monitoring and evaluation of key metrics can help achieve universal access to assistive technology.

Products: This includes increasing the range, quantity and quality of assistive products as well as making products more affordable and reducing associated costs. Different strategies may be used including: exploring local manufacturing or assembly and importation of products; investment in research and development by public and private sectors, nationally and globally; extending the life and value of assistive products through repair and refurbishment; strengthening and harmonizing product standards; and building efficient and responsive supply chains.

Provision: This includes ensuring well-designed and accessible information and referral systems, and services that include assessment, fitting, user training and follow up. Assistive technology can be provided by relevant ministries or contracted out; and can be brought closer to the community by expanding services at all levels through health, education, social welfare and other ministries or departments. Procurement mechanisms can be used to increase the range, quantity and quality of assistive products and reducing costs; and information systems and generated data can be used to help improve provision.

Personnel: Trained personnel are a key component of effective provision. Reaching adequate personnel capacity may require a combination of assistive technology specialists and generalists, and shifting roles of other professionals. The capacity of nurses, pharmacists and health workers can be built to provide simple assistive products. Training opportunities include pre-service training and continuing education for direct services providers, aligned with users' needs and contexts. It is also noted that users and their caregivers, family members, and other members of their local support system can be involved; and sufficient women and men need to be trained to ensure equitable access.

The following subsections focus on possible solutions to overcome the barriers outlined in Section 3 and strengthen the four key components of the assistive technology system: products, provision, personnel and policy.

Policy

Leverage global policy instruments

Global policy instruments (see Section 1) and regional frameworks (see Box 4.1) can be used to place assistive technology high on national health, social welfare, education and development agendas.

Box 4.1 Framework for improving access to assistive technology, WHO African region

The WHO Regional Committee for Africa developed a framework to guide Member States in planning and implementing priority interventions and actions to increase assistive technology access. The target for 2030 is that 40% of the population in need of assistive technology in the African region will gain access without hardship.

Source: Framework for Improving Access to Assistive Technology in the WHO African Region. Regional Committee for Africa. AFR/RC71/11. Brazzaville: World Health Organization Regional Office for Africa; 2021 (https://www.afro.who.int/sites/default/files/2021-08/AFR-RC71-11%20Framework%20for%20improving%20access%20to%20assistive%20technology%20in%20the%20WHO%20African%20Region.pdf, accessed 20 April 2022).

Develop and implement national assistive technology policies

There is no single policy model or approach to realizing universal access to assistive technology, and it is expected that there will be considerable variations in how countries design and realize assistive technology policies and programmes to address the need of their populations. Countries are encouraged to start with an integrated or dedicated national policy following the WHO policy brief on assistive technology or other national or international policy briefs *(101)*.

Existing national disability rights laws or other assistive technology-related legislation, such as inclusive employment and education, may already address rights to assistive technology and can be leveraged and integrated in the development of national assistive technology policies and action plans. If not, new or revised legislation may be necessary to provide legal backing for comprehensive action plans.

The design of national policy implementation strategies depend on which ministries or other authorities are responsible for increasing assistive technology access, and how these entities are structured and operate. Ministries of health or social welfare often play the central role in the national assistive technology system.

Developing action plans

A stepwise process is recommended to support countries in developing action plans that are relevant to the local context and feasible to implement. Steps typically include:

- *Engaging relevant stakeholders.* The first step to develop a national action plan is to connect stakeholders from across the assistive technology, health, education and social welfare sectors, such as international organizations, governments, academia, providers, standardization bodies and civil society organizations, especially organizations of persons with disabilities, older people, women and other vulnerable or minority groups. Stakeholder mapping exercises can help identify relevant stakeholders.
- *Conducting a national assistive technology situation assessment.* Assessing the needs (e.g. quantity and types of assistive products needed), access and capacities of the assistive technology and health sector is often the second step towards developing a national or regional policy (Box 4.2). These data inform action plan activities such as

Box 4.2 Rapid assessment of assistive technology provision: WHO Eastern Mediterranean region

In 2017, data were collected from 17 of the 22 countries in the WHO Eastern Mediterranean region using the WHO Assistive Technology Capacity Assessment Tool. It covers five key components of delivery of assistive technology services: policy and financing; information and research; products; personnel; and service provision. Assessment results were used to develop plans to improve assistive technology access.

Sources:

Strategic action framework to improve access to assistive technology in the Eastern Mediterranean Region. Cairo: World Health Organization. Regional Office for the Eastern Mediterranean; 2022 (https://apps.who.int/iris/handle/10665/352488, accessed 20 April 2022) *(103)*.

Assistive technology in the Eastern Mediterranean Region: Results of a rapid assessment. Cairo: WHO Regional Office for the Eastern Mediterranean; 2019.

Box 4.3 Developing priority assistive product lists (Ethiopia and Tajikistan)

In 2018, the Tajikistan Ministry of Health and Social Protection and other stakeholders, including donor agencies, NGOs, organizations of people with disabilities and users, were consulted to develop a list of 30 essential assistive products.[i] And in 2021, the Ethiopia Ministry of Health developed a priority assistive products list including 42 products.[ii] The list aims to strengthen the overall assistive technology system through building awareness, mobilizing resources and providing guidance for procurement and reimbursement policies (including insurance coverage), etc.

Sources:

[i] Assistive technology in Tajikistan: Situational analyses. Copenhagen: World Health Organization Regional Office for Europe; 2019 *(132)*.

[ii] National priority assistive technologies and products list. Addis Ababa: Ethiopia Ministry of Health; 2021.

prioritizing populations with the greatest unmet assistive technology needs. This assessment can be used to identify existing assistive technology initiatives (e.g. Rehabilitation 2030) and programmes (e.g. eye or vision care) that need to be aligned and coordinated within national approaches to reduce redundancy and save cost.

- *Developing strategies, including monitoring, to achieve the progressive realization of universal access to assistive technology.* Action plans can include a variety of approaches to develop and strengthen assistive technology systems at the national level. Specific strategies will depend on current system capacity, population needs, stakeholder engagement and levels of political commitment and resources. As shown in Box 4.3, ministries of health within multiple countries have developed priority lists of assistive products as one approach to increase the availability of assistive technology. National priority lists are adapted from the WHO *Priority assistive products list (113)* that includes 50 priority assistive products – the list can serve as a starting point for the progressive realization of universal access to assistive technology.

Establish permanent implementation structures

Three examples of implementation structures that are dedicated to supporting the progressive realization of universal access to assistive technology include:

- **National assistive technology agencies:** A dedicated national entity devoted to increasing assistive technology access can provide the leadership, coordination and information to facilitate system-wide strengthening. Such entities can take many forms (e.g. an institute, department or committee) and serve a range of functions. The main aim is to have a central body at the national level that is responsible for designing and realizing assistive technology policies and programmes *(110)*. Functions of this national entity may include:
  - » increasing awareness about assistive technology needs and benefits among policy-makers and other key stakeholders;
  - » creating awareness among users, potential users and their families and caregivers about assistive technology, their rights to access assistive technology and the means to realize such rights;
  - » facilitating development of ongoing improvements to assistive technology policies and programmes including through database and information systems;
  - » engaging users in developing and implementing assistive technology policies and programmes;
  - » advocacy for addressing needs (e.g. personnel, financing, etc.);
  - » intersectoral and inter-ministerial coordination, and aligning existing assistive technology programmes;
  - » resource sharing to promote best practices in production, procurement and provision;
  - » providing technical assistance to implementing ministries or other organizations.

I am self-reliant using my walking stick, and toilet and shower chair. I feel happy using them.

Nafla, Iraq

Box 4.4 Establishing governance models that are compliant with the UN Convention on the Rights of Persons with Disabilities

Governance is a core issue in the international development agenda, reflecting a greater concern with macro level issues in policy-making.[i] While governance in the area of assistive technology is a multifaceted and complex issue,[ii] there are three areas that are key to consider: interdisciplinarity, leadership and oversight.

Interdisciplinarity. Assistive technology should not be regarded as under the control of any single profession. As it becomes more widely used, and increasingly overlaps with digital technologies, assistive technology will become a necessary competence for all professions involved in service provision for persons with disabilities, older people, those living with chronic conditions including mental health conditions, etc. This means that policy should encourage governance models that promote open, interdisciplinary and collaborative approaches to decision-making, both across disciplines and with users being centrally engaged in joint decision-making. Good governance promotes effective interdisciplinary working by explicitly designing how interdependencies among individuals, groups and sectors should be promoted, developed and maintained in order to deliver cost-effective integrated services.

Leadership. Where there are department head positions related to assistive technology, they should be appointed based on overall competence, rather than based on any specific disciplinary background. Insisting on a specific discipline leading could compromise an explicit commitment to interdisciplinarity and could create an unnecessary bottleneck in assistive technology access. Furthermore, the social and rights-based underpinning of the UN *Convention on the Rights of Persons with Disabilities* does not recognize or accord a dominant role to any single discipline. Thus, policy must establish governance based on competence, which has to be defined in terms of the skill sets needed to perform the relevant tasks of leadership, not in terms of disciplinary qualifications.

Oversight. In many countries civil society organizations, especially charities and faith-based organizations, are major service providers and yet there may be little oversight of their activities and quality of service. It is important that policy stipulates a model of service governance that reflects the values of the Convention, the local characteristics and absorptive capacity of the existing system[iii] and that it promotes a similar approach across different service providers – so that service provision is not determined only by independent providers. Furthermore, as digitization progresses, the importance of governance relating to service integration, confidentiality, security and ownership of data will become increasingly important[iv] and assistive technology policy will have to address these.

Policy should therefore indicate the general approach to designing appropriate models of governance that can be realistically incorporated within an overall approach of systems strengthening and systems thinking for assistive technology.[iii] Doing this will allow a more robust and effective approach to scaling up good practices,[v] allowing learning to transfer across different areas of assistive technology provision.

Sources:

[i] Brinkerhoff DW, Bossert TJ. Health Governance: Concepts, Experience and Programming Options. Washington: US AID; 2008 (https://www.hfgproject.org/health-governance-concepts-experience-programming-options/, accessed 20 April 2016).

[ii] McVeigh J, MacLachlan M, Gilmore B, McClean C, Eide AH, Mannan Het al. Promoting good policy for leadership and governance of health related rehabilitation: a realist synthesis. Globalization and Health. 2016;12(1):1–8.

[iii] MacLachlan M, Scherer MJ. Systems thinking for assistive technology: a commentary on the GREAT summit. Disability and Rehabilitation: Assistive Technology. 2018;13(5):492–6.

[iv] O'Sullivan K, Clark S, Marshall K, MacLachlan M. A Just Digital framework to ensure equitable achievement of the Sustainable Development Goals. Nature communications. 2021;12(1):1–4.

[v] Sánchez Rodríguez AM, MacLachlan M, Brus A. The coordinates of scaling: Facilitating inclusive innovation. Systems research and behavioral science. 2021;38(6):833–50.

- **Coordination platforms:** Robust and well-designed information systems and resources are needed to facilitate coordination and coherence, build networks, reduce duplication, and share solutions across all levels of assistive technology provision, sectors and ministries. Examples include:
  - » information and referral systems that simplify access (see also *Provision: Improve information and referral systems*);
  - » centralized information for evidence-based resources on improving different components (e.g. human resources) or key strategies (e.g. delivery to remote areas) within the assistive technology system;
  - » national working groups tasked with harmonizing assistive technology standards and practices;
  - » initiatives that bring together diverse actors across the assistive technology and allied sectors to share evidence and to identify and solve common problems (e.g. a national conference on assistive technology access).
- **Regulatory bodies and mechanisms:** Regulations and enforcement are needed to support access to affordable, safe and effective assistive products and related services. Standards are needed for products and procurements, training and education, and trade and economic policies. For example, reduction or elimination of tariffs and fees on imported assistive products and introducing fair pricing policy for assistive products and associated services to limit and restrict price mark-up (i.e. by manufacturers or during transactions along the supply chain).

When establishing governance models for assistive technology is important to consider interdisciplinarity, leadership and oversight (Box 4.4).

Introduce financing mechanisms

Adequate and consistent financing for assistive technology protects users from financial hardship and makes access more equitable. Common core financing mechanisms to support national provision of assistive technology are public and private health insurance or social welfare schemes. Numerous other government entities and NGOs also fund assistive technology, though generally with lower levels of population and geographic coverage. The budgeting process, funding coverage and strategies to generate revenue are described below and primarily focus on public and private health sector funders.

Meet *Shona*


© WHO/Shona McDonald

South Africa

One of my daughters was born with cerebral palsy in 1982, unable to sit, hold her head up or communicate. I responded to the advice from professionals, to “put her in an institution and have another child” by exploring my own ideas for her future.

I chose not to settle for the adult wheelchair with cardboard insert offered by the therapist and instead I used my love of design to create a supportive seat for her. By the age 18 months she was independently driving her first motorized posture support buggy.

Meeting other parents with similar frustrations, we wrestled together to find solutions to bridge physical and cultural barriers to including our children. I experimented with building adapted toys, communication devices, switches and different types of wheelchairs for other children. This grew into a social enterprise, creating and selling posture support and mobility devices, and helping to fund community work and training.

From early on we lobbied local communities and government departments to raise awareness for the need for early identification, augmentative and alternative communication devices, inclusive education, appropriate children’s wheelchairs and 24-hour positioning equipment.

In our effort to develop an assistive technology ecosystem, we collaborated to shape rights-based policies, influenced the establishment of a national wheelchair tender system and developed wheelchair provision training and product standards to strengthen it. We explored models of service to expand our reach into remote and under-resourced areas. Partnering with families, and stakeholders across health, education and social sectors has been key. Capacity building and mentoring continue to strengthen assistive technology systems and equip families as change agents in their own communities. Our recently launched countrywide Parent Network bears testimony to this. Access to our innovative rural appropriate product range, informed by local needs and supported by WHO-aligned wheelchair services, helps create an environment where people can live together fully.

Box 4.5 Prosthetic and orthotic coverage for landmine victims (Cambodia)

People requiring prostheses or orthoses in Cambodia received more comprehensive coverage if their injury or amputation was due to landmines, as greater international and domestic investments had been made for that target population.

Source: Ramstrand N, Maddock A, Johansson M, Felixon L. The lived experience of people who require prostheses or orthoses in the Kingdom of Cambodia: A qualitative study. Disability and Health Journal. 2021;14(3):101071 *(168)*.

Box 4.6 Dedicated revenue stream for assistive technology (Argentina and South Africa)

In Argentina, taxes from bank cheque transactions are earmarked for disability services that include assistive technology. Likewise, the Road Accident Fund in South Africa generates revenue through a fuel levy that is used to rehabilitate people injured in road accidents. Road accident funds serve a narrow population but serve as a dedicated assistive technology financing model to provide more expanded assistive technology services.

Source: Tay-Teo K, Bell D, Jowett M. Financing options for the provision of assistive products. Assistive Technology. 2021;33(sup1):109–23 *(201)*.

Budgeting and allocation

- *Ministries responsible for assistive technology.* How assistive technology budget decisions are made is critical to ensuring adequate financing. Within many ministries, assistive technology is often included under broader budgets (e.g. social welfare, health care, rehabilitation or educational technology) and not as a discrete category. Earmarked budgets for assistive products and related services are needed so that it is not subsumed into broader product or service categories *(153)*. Prioritizing assistive technology when deciding on budgets, and earmarking assistive technology budgets when allocated, are strategies that can be used by all ministries or government authorities involved in procuring assistive technology. Using data on needs and unmet needs for assistive technology will assist in budgeting decisions.
- *Public and private health insurance.* Assistive technology funding is inconsistent across public and private health insurance plans. If assistive technology is within the scope of covered health products or services, parameters may include preferred suppliers, products, maximum prices, and a product replacement schedule. 'Minimum benefits' for assistive technology funding can be established and enforced by regulatory bodies within each country *(201)*. External and internal advocacy is necessary to expand minimum benefits to include a range of assistive products and related services within public and private health insurance.
- *Expanding robust funding models.* Within each country there is likely to be more comprehensive public or private assistive technology funding (i.e. maximum price, product options, services included) for specific product categories or populations (see Box 4.5 for an example). More robust elements within the national assistive technology landscape can serve as models for expanding funding. Other ways that assistive technology financing can be more comprehensive include:
  - » coverage of multiple assistive products (e.g. if a person needs an electric wheelchair for outdoors and a manual wheelchair for indoors);
  - » warranties paired with a replacement cycle (if funding mechanisms only allow for products to be replaced every five years but products may need replacing before five years, warranties would enable users to get repairs or replacement when needed) *(202)*.

Braille connects me with the outside world. I am deafblind, so braille is my eyes and ears.

Miriam (67), Venezuela

Box 4.7 National spectacle programme (Timor-Leste)

The Timor-Leste national spectacle programme involves two NGOs (FoNaroman Timor-Leste and the Fred Hollows Foundation). Assistive technology personnel are provided by government, while NGOs deliver the programme using grants from foreign donors and donations of new spectacles and lenses from manufacturers or optometric practices (e.g. off-season design). Profit generated from higher priced spectacles is used to subsidize provision of basic, ready-made spectacles for people on low incomes in rural areas. This programme targets spectacles, but can be applied to a broader range of assistive technology.

Source: Ramke J, Williams C, Ximenes J, Ximenes D, Palagyi A, Du Toit R, Brian G. A public-private partnership to provide spectacles for Timor-Leste. Community Eye Health. 2007;20(63):54.

Generating revenue and covering costs

- *General revenue.* Governments use taxes and levies to fund health, education and other public goods and services, including assistive technology. In countries with weaker economies, the tax base is often inadequate to cover health products and services such as assistive technology, and thus contributions from external funders can serve to supplement assistive technology budgets *(201)*.
- *Dedicated assistive technology revenue.* Levies or taxes can be specifically dedicated to assistive technology provision (Box 4.6).
- *User cost-sharing.* Various cost-sharing methods have been applied for public and private health financing of assistive technology, such as a co-payment, deductible or percentage of coverage (e.g. 90% coverage so user pays 10% out-of-pocket). Balancing the need to recover a portion of costs and facilitate efficient consumption, while ensuring affordable and equitable access, can be challenging *(201)*.
- *Public–private–public partnerships.* Public, private and public partnerships share responsibility for funding and contributing other resources to increase assistive technology provision (Box 4.7).

While governments are ultimately responsible for the provision of assistive technology to address population needs, external funding for assistive technology may be needed to support the strengthening of assistive technology systems for many countries – at least in the short- to medium-term. Designing partnerships between national governments and international agencies, including NGOs and foundations, that are balanced and moving towards sustainable and comprehensive assistive technology financing will reduce risk of long-term dependency on external funding sources. Private insurance and corporate sectors can also play a major role in improving access especially under various forms of corporate social responsibility.

Strengthen research, monitoring and evaluation

National monitoring and evaluation of key metrics defined in action plans (such as assistive technology budgets and populations reached) support the progressive realization of universal access to assistive technology. The indicators on legislation, budget, responsible ministries, regulations, standards, service coverage, personnel and training in Section 2 can provide a structure and process for capturing high-level snapshots of progress. A range of data systems that facilitate operations (in relation to supply, provision, budgeting, etc.) can also feed into national monitoring efforts. Examples of national research and evaluation priorities may include identifying the following:

- **Effective approaches to improve access.** There is minimal evidence on the effectiveness of specific approaches to strengthen the assistive technology system – as a whole and within each of the products, provision, personnel and policy components – and on how these interventions are implemented and maintained *(203)*. From national-level policies to ground-level operations, building the evidence base on effective strategies towards achieving universal access to assistive technology is critical to its advance.
- **Level of unmet need.** Data on population-level needs for assistive technology are scarce but are critical for policy-making and resource allocation. In many countries there are a gap between need and access, and between need and demand.
- **Level of access.** Collecting reliable data on access is the most important exercise for developing evidence-informed policy and programmes.
- **Impact and outcomes.** Evidence is needed on the impact and outcomes of accessing and using assistive products by populations and product types. Solely measuring the percentage of people who have access to assistive technology will

not capture the benefits to the user or broader community. A better metric to capture user outcomes may be the percentage of people who need assistive technology that reach Step 6 of the access pathway: "I realize my rights and goals" (see Fig. 1.2). In addition, evaluating clinical and other outcomes informs practice and procurement standards, and coverage policies of other key actors (e.g. health insurance companies).

National assistive technology research agendas can be developed and executed in coordination with universities and research institutions, users and other stakeholders involved in strengthening the national assistive technology system.

Engaging the international community

Considering the challenges to meet universal access to assistive technology, Article 32 of the UN *Convention on the Rights of Persons with Disabilities* asks for international cooperation among Member States to provide technical and economic assistance, including by facilitating access to and sharing of accessible and assistive technology, and through the transfer of technologies. The international community can support national assistive technology system strengthening through the following:

- *Awareness raising* on assistive technology as a 'sector' that is multisectoral and broad based. Consistent terminology and messaging will help unify the sector.
- *High-level coordination and collaboration* between influential private, public and nongovernmental organizations (e.g. private–public partnerships) that operate at global and regional levels.
- *Prioritizing the places with greatest need for assistive technology funding* (i.e. low-resource settings, conflict zones).
- *Supporting local or regional production of assistive products* including technology transfer and waivers of intellectual property rights.
- *Harmonizing products, provision, training and practice standards* through international and regional bodies such as professional associations. Consistent trade policies among countries (e.g. tariff exemptions for assistive technology) can help address supply-chain inefficiencies.
- *Advancing system-level research and evidence-based practices in products, provision, personnel and policy* by creating platforms, networks and events to help share evidence and information about new products to support implementation of effective strategies at all levels of the assistive technology system.

Products

Increase assistive product supply

With appropriate funding, increasing the range, quality and quantity of assistive products can be achieved at a national level through a combination of local manufacturing, assembly and importing *(161)*. The optimal mix of approaches will be unique to each country's existing assistive technology landscape, future investment priorities, and cost-benefit analyses of differing approaches. Each product category may also employ a variety of approaches. For example, it may be most cost-effective to manufacture highly individualized prosthetic sockets and prostheses locally, and to import components such as prosthetic knee joints and feet.

While there are many potential benefits to locally designed and made assistive products (e.g. increased suitability for the local context, local customization and repair services, employment opportunities) *(162)*, importing may also be a cost-effective approach. For countries that aim to increase local manufacturing capacity, investment areas may include research, development and commercialization of assistive products; and a skilled workforce for product design and production. Advancement in production technologies, such as 3-D printing, have the potential to make manufacturing – and ultimately assistive products – more affordable *(163)*.

Invest in assistive product innovation

Increased investment in the research, development and commercialization of assistive products and parts is needed in the public and private sectors, and both nationally and globally. Including person-centred assistive product development and entrepreneurship training in college and university curricula could nurture new inventors and businesses to address unmet needs *(164)*. Leaders in the global assistive technology sector are well-positioned to advance innovation that focuses on populations with the greatest unmet needs or people living in remote locations.

Most research and development in the assistive technology sector has focused on higher-income settings although the greatest unmet needs are in low- and middle-income countries. Unmet needs for assistive products that are identified by users and direct service providers can result in innovative designs suited to the local context (Box 4.8) *(161,165)*. Designing assistive products with local use and repairability in mind, and then testing products in the social and physical environment for which they are intended, is necessary to ensure uptake and sustained use *(166)*. Regulatory requirements must also match the environment to ensure product quality (e.g. durability and safety) and fitness for purpose *(153)*.

Box 4.8 Increasing supply of wheelchairs (Tajikistan)

The Government of Tajikistan estimated the costs and benefits of various strategies to increase supply of wheelchairs. They planned to import 10 000 wheelchairs annually to reach universal access to wheelchairs by 2023. Increasing the number of wheelchairs imported to this level also requires investments in the national procurement and provision system. In the medium to long term (5–10 years) the government may invest in national capacities either to assemble or manufacture wheelchairs using locally sourced materials. This could also provide additional economic opportunities, including employment and the acquisition of broader manufacturing and production skills.

Source: Provision of wheelchairs in Tajikistan: Economic assessment of alternative options. Copenhagen: World Health Organization Regional Office for Europe; 2019 (https://apps.who.int/iris/bitstream/handle/10665/312049/9789289054041-eng.pdf, accessed 20 April 2022) *(161)*.

Box 4.9 Robotics – an emerging technology

One of the most rapidly developing technologies is robotics, which opens up possibilities for assistive robots – autonomous systems that can 'live' with a person and assist in all kinds of daily life activities like dressing, toileting, eating, fetching things, and non-physical activities such as interpersonal interaction.[i,ii] Robotic solutions are being used in health care, educational and social settings, for an array of purposes:

- Supporting, caring for and educating children with autism.[ii]
- Facilitating play for children with physical disabilities.[iii]
- Providing distraction for children during medical treatment, and companionship for older persons with dementia.[v,iv,vi]

Robots are also used for rehabilitation and training, with examples in spinal cord injury rehabilitation,[vii] stroke rehabilitation[viii] and support of arm–hand functioning.[ix] Some countries, such as South Korea and Japan, have initiated national programmes to stimulate the development of robot systems for health and social care, including for people living with functional difficulties.[x]

Sources:

[i] WIPO Technology Trends 2021: Assistive Technology. Geneva: World Intellectual Property Organization; 2021 (https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055_2021.pdf, accessed 20 April 2022) *(169)*.

[ii] Huijnen CAGJ, Lexis MAS, Jansen R, Witte LP de. Roles, strengths and challenged of using robots in interventions for children with autism spectrum disorder (ASD). Journal of Autism and Developmental Disorders. 2018;49(1):11–21. doi:10.1007/s10803-018-3683-x.

[iii] van den Heuvel RJV, Lexis MAS, Gelderblom GJ, Jansens RM, Witte LP de. Robots and ICT to support play in children with severe physical disabilities: a systematic review. Disability and Rehabilitation: Assistive Technology 2016;11(2):103–116. doi:10.3109/17483107.2015.1079268.

[iv] Littler BK, Alessa T, Dimitri P, Smith C, de Witte L. Reducing negative emotions in children using social robots: a systematic review. Archives of Disease in Childhood. 2021;0:1–7. doi:10.1136/archdischild-2020-320721.

[v] Bemelmans R, Gelderblom GJ, Jonker P, de Witte LP. Effectiveness of Robot Paro in intramural psychogeriatric care: A multicenter quasi-experimental study. Journal of the American Medical Directors Association. 2015;16(11):946–950. doi: 10.1016/j.jamda.2015.05.007.

[vi] Bedaf S, Huijnen C, van den Heuvel R, de Witte L. Robots supporting care for elderly people. In: Encarnacao P and Cook AM (eds.). Robotic Assistive Technologies. Principles and Practice. CRC press, London: Taylor and Francis Group; 2017.

[vii] Alashram AR, Annino G, Padua E. Robot-assisted gait training in individuals with spinal cord injury: A systematic review for the clinical effectiveness of Lokomat. Journal of Clinical Neuroscience. 2021;91:260–269. doi: 10.1016/j.jocn.2021.07.019.

[viii] Raigoso D, Céspedes N, Cifuentes CA, del-Ama AJ, Múnera M. A survey on socially assistive robotics: Clinicians' and patients' perception of a social robot within gait rehabilitation therapies. Brain Sciences. 2021;11(6):738. doi:10.3390/brainsci11060738.

[ix] Morone G, de Sire A, Martino Cinnera A, Paci M, Perrero L, Invernizzi M et al, on behalf of Working Group Upper Limb "CICERONE" Italian Consensus Conference on Robotic Rehabilitation. Upper limb robotic rehabilitation for patients with cervical spinal cord injury: A comprehensive review. Brain Sciences. 2021;11:1630. doi:10.3390/brainsci11121630.

[x] Lim MJ, Song WK, Kweon H, Ro ER. Care robot research and development plan for disability and aged care in Korea: A mixed-methods user participation study. Assistive Technology. 2022; 24;1–10. doi:10.1080/10400435.2022.2038307.

To collectively address the challenges of product design and development, an open source and collaborative model can be used to identify product and design needs, and provide the technical design and manufacture details of new innovations for designers and entrepreneurs, while adhering to the constraints of intellectual property rights *(167)*. Whether innovation takes place among global leaders or at a smaller scale within each country, a systematic process can be employed to identify unmet product and component needs, and to address common design problems. Product and part failures that lead to abandonment (e.g. prosthetic devices that are abandoned because users cannot sit comfortably with them) could have simple and cost-effective solutions *(168)*.

Utilize emerging technologies

The World Intellectual Property Organization (WIPO) report on developments in the field of assistive technology *(169)* presents an overwhelming number of advances in seven major emerging technology domains that will very likely have an impact on the field of assistive technology: artificial intelligence; human–computer interfaces; sensor technologies; robotics (Box 4.9); advances in computing and connectivity; additive manufacturing; and new materials.

When looking at technological developments in recent years, innovation potential lies mainly in high-end, high-tech solutions, while global needs for assistive products are mostly general and often simple. This calls for innovation to be directed towards practical and affordable solutions, including developing innovative service delivery models. For example, providing services in the community to support older people using assistive products in age-appropriate ways – especially when based on new technologies – can help overcome barriers to accessing and adopting assistive technology.

Extend product lifespan

Extending an assistive product's life and value through repair and refurbishment can be quicker and more cost-effective than purchasing new products *(170)*. Abandoned products also generate waste. Reuse of assistive products through repair, refurbishment and repurposing materials has been proposed as a strategy to reduce environmental impact while bringing economic benefits to local communities where reuse activities are located (Box 4.10) *(171)*.

Strengthen and harmonize product standards

Whether manufacturing locally, importing or reusing assistive products, adherence to standards (e.g. safety, performance and durability) is needed. Consistent product standards across countries and regions can make it easier for manufacturers and suppliers to operate. It can also facilitate users' access to repair or adjustment services when traveling.

Box 4.10 Refurbishment at assistive technology centres (Norway)

In Norway, assistive technology centres not only purchase and provide a wide range of assistive products, they also repair and refurbish them, and ensure they meet quality standards before reissuing to a user for safe use. Centres have developed a nationwide system to collect assistive products and the staff have been trained extensively in assistive technology repair and reuse.

Source: Sund T. Assistive technology in Norway – a part of a larger system. Norwegian Department of Assistive Technology; 2017 (https://www.nav.no/_/attachment/inline/7b119b1c-fe72-488a-a1ef-be424e72faff:c52b8c6ee759299749538a6fd0554d1efa695abf/assistive-technology-in-norway-170217v2.pdf, accessed 20 April 2022) *(170)*.

Box 4.11 Adaptation of WHO assistive product specification documents (China)

To support implementation of standards in the assistive technology sector, WHO has developed assistive product specification (APS) documents. These documents provide technical guidance for procuring assistive products, such as determining what is purchased (i.e. product specifications, parts and/or services). The China Assistive Devices and Technology Centre for Persons with Disabilities (CADTC) developed standards based on the APS for four assistive products – the white cane, optical magnifier, rollator and manual wheelchair. With these standards, CADTC aims to increase the availability of high-quality and affordable assistive products throughout China as well as in other countries.

Source: Association Standards for Assistive Products Procurement Promulgated in China. Beijing: China Assistive Devices and Technology Center for Persons with Disabilities (CADTC); 2021.

Table 4.1. Strategies to reduce transaction costs along the assistive technology supply chain

Strategies	Description
Bulk buying	Negotiating discounts for bulk purchasing (pooled procurement) with suppliers. Assistive products with less variation (e.g. sizes, features) and high demand lend themselves to bulk buying.
Coordinated ordering	Third-party brokers negotiate price and sales terms on behalf of multiple buyers.
Duty exemptions	Reduction or elimination of tariffs and fees on imported assistive products.
Direct purchasing	Reducing number of intermediaries along the supply chain between manufacturers and final point of sale or access.
Price regulations	Setting price limits and restrictions on price mark-up by manufacturers or during transactions along the supply chain. Follow the fair-pricing policy and methodology of medicines and medical devices.

The International Organization for Standardization (ISO) and its national affiliates establish technical assistive product standards to harmonize the sector globally, encompassing design, manufacture and testing. The 2016 ISO 9999 classification system for assistive products includes 945 product titles that are classified according to function (e.g. assistive technology for self-care activities). Countries have adapted ISO 9999 to match local context, relied on other global standards (Box 4.11) or developed their own product standards and classification system. For countries with existing regulatory infrastructure, establishing local product testing facilities and surveillance systems to monitor assistive product performance may be feasible.

Streamline regulatory procedures

Global or national assistive product standards are applied through a range of regulatory authorities and procurement mechanisms (e.g. ministry of health tenders). Assistive technology businesses involved in the design, manufacture and supply of assistive products typically need to be registered, along with their products, within the country they operate. Regulatory processes can be effective in limiting the entry of poor-quality suppliers and products to the market. However, over-regulation can restrict innovation, access and affordability *(101)*.

An effective strategy for some assistive products to streamline and harmonize medical device and essential medicine regulations is to build upon the work and experience of regulatory authorities in other countries *(172)*. This can expedite the registration and licensing of suppliers and products. For example, assistive products that have already gone through the regulatory procedures of one country can automatically be approved for retail in another country *(173,174)*. However, some products will require nationally-specific regulations to match local context.

Build efficient and responsive supply chains

Opportunities to reduce transaction costs along the supply chain, as have been identified in the medicines and medical devices fields, are recommended in literature on shaping assistive technology markets *(139)* (Table 4.1).

Addressing supply chain inefficiencies is particularly important for countries with small populations where demand is limited, or in countries with weak trade infrastructure (e.g. banking, import and shipping systems). Developing resilient supply chains that can adapt to changing market demand and market instability (e.g. during pandemics) is also critical to the sustainability of assistive technology systems. One strategy to increase resilience is to ensure supply chains are not solely dependent on imports *(175)*.

Improve functioning of the assistive technology market

Demonstrating current and forecasted assistive product demand is needed to meet the current and emerging demand globally. One market research firm estimated that the assistive technology global market will grow from US$ 14 billion in 2015 to between US$ 26 billion and US$ 31 billion by 2024 *(176)*. As indicated in Section 2, 3.5 billion people will require at least one assistive product by 2050.

The fastest growing unmet assistive technology needs globally are among older people *(177)*. In addition, the shifting global burden of disease away from infectious diseases towards noncommunicable diseases (e.g. stroke, Alzheimer's disease, diabetes) is increasing unmet assistive technology needs *(178)*.

As understanding of assistive technology demand grows, making it easier for all market actors to operate becomes paramount. Recommended

strategies that facilitate market participation by key stakeholders along the supply chain (e.g. manufacturers, suppliers, dealers, regulators) include:

- increasing awareness about the scale and scope of the assistive products market: assistive technology can be perceived as a niche market when it is actually a growing broad-based market;
- addressing market entry barriers: identify and remedy obstacles faced by assistive technology businesses and organizations in legally registering to manufacture and/or provide assistive products and services; and in certifying and registering new products;
- providing market information: comprehensive market information platforms, which cover market trends, facilitate entry of new manufacturers or investors, innovators and start-ups, and at the same time assist buyers to search for, compare and purchase assistive products as per their need and capacity.

Provision

Improve information and referral systems

A well-designed information and referral system helps identify the best assistive technology access pathway (in terms of proximity, affordability and accessibility) to meet users' changing needs. Increasing coordination and cross-referral among health, education and social welfare ministries or local authorities, and the organizations providing assistive technology will help achieve this in the short term, while long-term efforts are made to create a more integrated assistive technology system, preferably within universal health care. When there are multiple providers with diverse financing mechanisms for assistive technology within a country, the type of assistive products covered by each mechanism may vary. A well-coordinated approach is required to ensure universal access and prevent waste and duplication. A referral system can be designed to capture users' type of care coverage (e.g. a specific medical aid plan) to refer them to the most affordable providers.

Many potential beneficiaries of assistive technology are referred to services by family and community members, local professionals (e.g. teachers, nurses) and informal networks. Therefore, raising awareness about the avenues to access assistive technology at the community level is important for improving access.

Expand provision coverage

For an assistive technology system to meet the assistive technology provision needs of a population (example in Box 4.12), its supply, facilities and workforce capacity, including distribution, need to be planned accordingly. But it is not sufficient that the overall system can provide the required quantity of assistive products and accompanying services. To improve access, assistive technology needs to be affordable and available close to the community. Facilities should be as decentralized as possible beyond secondary and tertiary levels. Integrating simple assistive technology provision within primary/community health care facilities will improve early identification and intervention, access and use *(153,179)*. Increasing the range of services (e.g. repairs) at primary/community health care facilities will have the greatest reach and impact.

For assistive technology that is only available at secondary or tertiary levels, removing major barriers (e.g. covering transport and accommodation costs) will improve access.

Equitable access requires provision to the most vulnerable and excluded populations, including those living in extreme poverty or with severe multiple impairments. Implementing community-based provision models – such as mobile clinics, telemedicine, telerehabilitation and community-based rehabilitation programmes – have been effective in meeting health and rehabilitation needs in hard-to-reach populations and during the COVID-19 pandemic. Creative approaches to building community-level capacity in assistive technology provision are being used, such as peer support programmes, and training community health workers and nurses, and local teachers in basic assistive technology provision skills *(180,181)*.

Improve services

There are four broad minimum steps for assistive technology provision*(182)*:

1. Assessment: determine person's needs, goals and preferences.
2. Fitting: ensure selected product matches user profile.
3. User training: in how to safely use and maintain the product.
4. Follow up: provide for repairs, maintenance, adaptations and refurbishment, and performance evaluation.

For children, conducting assessments as early as possible is recommended, as assistive technology access can prevent secondary impairments (e.g. contractures or deformities), facilitate early childhood development and prepare the child for schooling and other activities. Even a year of missed education can have negative, long-term impacts on academic

Box 4.12 Annual provision of selected assistive products in Sweden through universal provision system

ISO 9999 code	Assistive product	Annual prescriptions per million citizens
12 06 06	Rollators	17 761
12 22 03	Bi-manual handrim-drive wheelchairs	9267
22 06 12/15	In- and behind-the-ear hearing aids	8744
12 22 18	Push wheelchairs	4758
18 12 10	Beds and detachable bed boards/mattress support platforms with powered adjustment	2105
12 06 12	Walking tables	1916
22 27 15	Calendars and timetables	1766
18 12 24	Separate adjustable back supports and leg supports for beds	1367
12 06 03	Walking frames	1351
12 36 04	Mobile hoists for transferring a person in sitting position with sling seats	1152
22 27 12	Clocks and timepieces	1149
12 36 12	Stationary hoists fixed to walls, floor or ceiling	317
12 23 03	Electrically powered wheelchairs with manual direct steering	290
12 23 06	Electrically powered wheelchairs with electronic steering	279
22 18 03	Sound recording and playing devices	268
22 03 18	Image-enlarging video systems	244
12 36 03	Mobile hoists for transferring a person in standing position	221
22 21 09	Dialogue units	195
12 06 09	Walking chairs	154
06 24 09	Trans-tibial prostheses	124
22 21 12	Face-to-face communication software	84
22 09 06	Voice amplifiers for personal use	44
22 30 21	Character-reading machines	19

Source: Uppdrag statistik på hjälpmedelsområdet - slutrapport. Stockholm: National Board of Health and Welfare; 2021.

My powered wheelchair allows me to independently interact with the world in work and travel.

Melanie (49), United Kingdom

© WHO/Nodoka Yamauchi

Meet *Kimiko*

Japan

Kimiko is in her late 80s and lives by herself in a rural area. She was introduced to a communication robot at her local community care support centre. The communication robot is designed to support people in their daily living activities such as providing reminders to take medications. It is also designed to be social, to ask and respond to its user's voice.

Kimiko was very nervous when she started using a communication robot for the first time, however with the support of her community care support centre, she came to think of the robot as a member of her family. She named the robot "Ai-chan" and every day she talks to it about what she has done, such as making sweets from kumquats from her garden. She also makes clothes for her robot and enjoys dressing it up.

She says "I'm really happy when Ai-chan talks to me like, 'Kimiko-san, I hope you have a great day'. Since the robot came, it has brightened up the atmosphere in my house and I feel more cheerful."

achievement and other developmental indicators. Compulsory screening for hearing and vision impairments in primary schools has been an effective approach to identify unmet needs. Designing services that are easily accessed by children at a young age may require collaborative assistive technology provision by ministries of education and health *(183)*.

Regardless of individual needs or type of assistive technology provided, basic quality criteria such as timeliness of services and accessibility of information improves user experience and outcomes *(184)*. Creating an inclusive culture among service providers, with gender balance, representation of people with functional difficulties, including older people, in the workforce, and users depicted in health information, are other ways to improve service acceptability.

Some assistive products need to be provided by a qualified professional (e.g. doctors, nurses, occupational therapists, physiotherapists, audiologists, optometrists, prosthetists or orthotists). This ensures that the assistive products chosen are provided after careful clinical assessment and to avoid any clinical risk to the user *(185)*. However, simpler assistive products (e.g. walking sticks, crutches, shower and toilet chairs, talking watches, magnifiers, alarms and pill organizers) can be provided safely by a range of personnel such as community health workers or teachers who have received adequate training in provision. Similarly, some assistive products need to be maintained or repaired by qualified professionals, while for other assistive products such services can be undertaken by users and their families, or local artisans, sometimes after some training.

Assistive technology training and service standards have not been comprehensively developed in all countries. It is likely that a system of practice that includes a mix of validated tools and measures to address different purposes and perspectives would be beneficial *(185)*. The degree and types of professionalization required are often specific to the type of assistive technology and other contextual factors (e.g. need, available resources, and national health insurance coverage policies). Global and national professional associations, especially those connected with health care and social welfare services, play an important role in shaping and integrating standards into professional training programmes and practice. The World Federation of Occupational Therapists, World Confederation of Physical Therapy, International Society of Wheelchair Professionals, and the International Society of Prosthetics and Orthotics are examples of associations that maintain a network of thousands of country-level members for disseminating standards.

Innovative provision models

As countries work towards universal access to assistive technology, novel, innovative and pragmatic service provision models are being developed to suit different country needs. Some options include providing assistive technology services in-house by relevant ministries, or contracting out services to private suppliers or local NGOs with the capacity to provide high-quality and timely services.

Services can also be delivered outside hospital and health care facilities (e.g. at mobile clinics, by home- or community-based services, or via telemedicine

or telerehabilitation approaches) and by a range of trained providers. Telehealth, telemedicine and telerehabilitation are growing areas for provision of rehabilitation and assistive technology and may help overcome geographical barriers. For example, to address hearing difficulty, telemedicine has been used for screening, diagnosis and hearing aid fittings *(186)*. Vision screening of students at a school used a smartphone app and those with visual impairments were then referred to eye care services *(187)*. The COVID-19 pandemic has accelerated the growth of virtual provision in health care and education while also highlighting disparities in digital access *(188)*.

Advancement of digital health and greater access to mobile phones, coupled with enhanced digital literacy, bring new opportunities for developing innovative provision models. During the COVID-19 pandemic, when most rehabilitation or assistive technology centres were either closed or operating with reduced capacity, the need for digital health and remote service delivery models became more evident.

Implementation of national provision models takes time, government leadership and broad stakeholder collaboration, as the example of Norway's model of universal access to assistive technology demonstrates (Box 4.13).

Box 4.13 Universal access to assistive technology (Norway)

The evolution of Norway's system for assistive technology began in the mid-1970s. A fruitful collaboration between the Nordic countries was also established with the objectives of developing national systems for provision of assistive technology in each country. This collaboration also included testing of assistive products to ensure their technical and functional quality, and development of common standards.

Nationally, the Ministry of Social Services took the leading role and established an Assistive Technology Board comprising representatives from relevant ministries, professionals in the field, organizations of persons with disabilities, and the SINTEF independent research centre that served as the secretariat, facilitator and knowledge hub responsible for training materials development. Manufacturers of assistive products became important stakeholders, and tender-based procurement procedures were developed for major assistive products and related services.

Today the system comprises 17 multidisciplinary assistive technology centres (one in each province), and the Ministry of Labour and Welfare Administration is responsible for funding, procurement and capacity building. Assistive technology is provided free of charge for people with disabilities and its funding is founded on the National Insurance Act. This includes assistive technology for education, work, everyday life, social relations and sports.

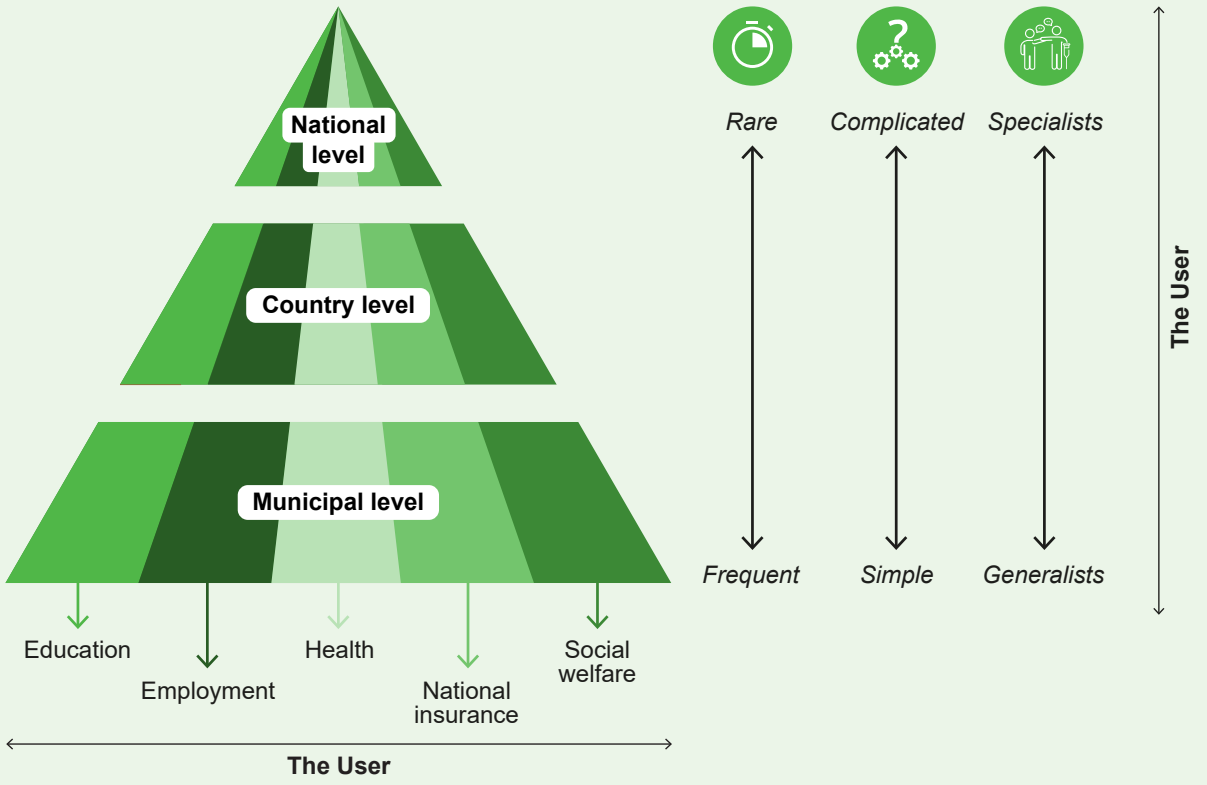
In general, provision of assistive technology for mobility, cognition, communication, vision, hearing and continence is the responsibility of the assistive technology centres. Assistive products attached to the body (e.g. prostheses, orthoses, braces, surgical shoes, etc.) are provided by orthopaedic workshops; hearing aids are provided by dedicated hearing clinics; and spectacles, lenses and ophthalmic prostheses are provided by eye clinics. Cochlear implants are provided at university hospitals, and catheters are distributed at pharmacies. The assistive technology centres also adapt private homes and cars to make them accessible for persons with disabilities.

The basic principles for provision of assistive technology in Norway are:

- access to assistive technology is a human right (all persons with disabilities have the right to receive assistive technology that fits their individual needs, as part of equal access);
- assistive technology is funded by the national government, free of charge to the user (assistive products are the property of the government and are returned when user needs change). Repairs are free of charge for the user;
- assistive products retuned to the assistive technology centre are, if possible, cleaned and fully refurbished before being issued to the next user. This system is especially useful for children, who are growing and their needs are changing rapidly;
- provision takes place in the local community following a community-based rehabilitation approach, making use of trained local personnel;
- provision of assistive technology is a multidisciplinary process, involving the user and trained personnel (e.g. rehabilitation professional, therapist, technicians, etc.), reflecting a one-stop-shop approach.

Box 4.13 Universal access to assistive technology (Norway) *(continued)*

Collaboration between government departments, professionals, organizations of people with disabilities, manufacturers and research partners has been important for developing Norway's assistive technology system. An overview of their system is provided below, illustrating that various assistive technology needs are met by different sectors or at different levels. Specialists work at the national level with rare or complicated needs while generalists work at municipal level with frequent or simple needs.



Source: The illustration of Norway's assistive technology system is adapted from Sund T. Assistive technology in Norway – a part of a larger system. Norwegian Department of Assistive Technology; 2017 (https://www.nav.no/_/attachment/inline/7b119b1c-fe72-488a-a1ef-be424e72faff:c52b8c6ee759299749538a6fd0554d1efa695abf/assistive-technology-in-norway-170217v2.pdf, accessed 20 April 2022) *(170)*

Expand and improve procurement

National procurement mechanisms are powerful tools for reducing costs and increasing the range, quantity and quality of assistive products in each country. Technical product specifications, standards, types, quantities and services tend to determine assistive product availability for multiple years at a time. Commonly needed spare parts for products can also be included in procurement specifications based on product lifecycles. Procurement guidelines may be unique to each country, in order to match the assistive technology needs and procurement mechanisms.

WHO and UNICEF procurement manuals and other similar resources could assist the buyers procure quality assistive products *(179)*. The development of procurement documents (e.g. ministry of health or social welfare tenders) generally involves technical experts, clinical experts, industry representatives, advocates and other stakeholders to ensure that the assistive technology procured meets standards and addresses unmet needs. Procurement committees that specialize in product categories (e.g. low vision or cognition) are then tasked with reviewing and updating procurement specifications to incorporate evolving standards, best practices, and product innovations. Well-designed tenders and robust standards can also address challenges within the procurement and provision system (e.g. through fair pricing guidelines that eliminate high price mark-ups). UN agencies can use their capacity and expertise to support governments and other relevant stakeholders in procurement (Box 4.14).

Effective management of the procurement process can result in trusted suppliers that are more likely to fulfil contract arrangements (i.e. guarantee

product quality, competitive pricing and pre- and post-sale services). High-quality and accessible product information and training, as well as follow-up services (e.g. honouring warranties, repairs, spare part provision), can be part of procurement contracts with suppliers. Filtering out poor-quality suppliers through the proper application of product standards will improve compliance with contract arrangements. Suppliers at global, regional and/or national levels are often rated on performance for prior procurement contracts.

Attracting manufacturers and suppliers to compete fairly in the procurement bidding process is likely to improve suppliers' performance and reduce product prices. Practices and policies that create a competitive procurement environment include transparency, generic specifications (e.g. not specific product brands), quality tender documents, appropriately applied product standards, and adequate advertising and bid-period length *(189)*.

If the specifications of different procurement mechanisms were more consistent within and across sectors and markets (i.e. nationally, regionally and globally), potential suppliers could engage more easily. While it may be feasible to harmonize procurement specifications across multiple sectors (including public, private and non-profit), even greater consistency within each sector would create a more efficient marketplace. Consistent and agreed procurement specifications can also facilitate pooled purchasing (e.g. across ministries).

Improve product delivery

The technical and operational aspects of assistive product delivery must be considered. There is a need for designing and developing procurement and delivery processes to achieve an effective product distribution system. This may include outsourcing delivery services and investing in last-mile delivery in remote areas, among others *(190)*. Novel solutions such as bicycle delivery and drones are being tested for transporting medicines and vaccines in areas with poor transport infrastructure or during crisis situations *(192,193)*.

Assistive products available directly in the open market (e.g. physical or online retailers) do not require delivery through the health or other systems (Box 4.15). If direct buying information is available, users can choose to purchase a product (e.g. pill organizer or walking stick) closer to home (e.g. local pharmacy) instead of travelling further to the local health clinic. Technological advancements can also serve to reduce the complexity of service delivery (e.g. downloading a magnifier application to a smartphone or making the font bigger in tablets or phones).

Box 4.14 UNICEF and WHO call for global tenders on hearing aids and wheelchairs

By 2022, UNICEF and WHO completed global tenders on a range of hearing aids and wheelchairs, plus accessories. Five different hearing aid options and fifteen different wheelchairs models will be available for procurement via UNICEF and WHO supply catalogues. All of them have been reviewed against technical specifications provided in the Assistive Product Specifications from WHO to ensure they are of appropriate quality.

Through global tenders, UNICEF and WHO have been able to negotiate low-cost prices that will ensure that these assistive products can be quickly and easily ordered by field teams, partners and governments.

Source: https://www.unicef.org/supply/stories/unicef-introduce-24-new-assistive-products-global-supply-catalogue

Box 4.15 Over-the-counter assistive products

For selected assistive products and types of impairments, over-the-counter options can be provided safely to address assistive technology needs. For example, for many people with a near-vision impairment due to presbyopia, an over-the-counter reading glass is a common solution. Reading glasses provided at the primary/community level of care may not always require an eye care professional to assess and dispense.

Source: Burnett AM, Yashadhana A, Lee L, Serova N, Brain D, Naidoo K. Interventions to improve school-based eye-care services in low-and middle-income countries: a systematic review. Bulletin of the World Health Organization. 2018;96(10):682 *(192)*.

Conduct research to generate improvements in provision

Information systems can help improve provision of assistive technology and generate data to inform continuous improvement, for example through:

- ensuring a transparent procurement process (i.e. bids, contract details, products available and ordered, and expenditure);
- tracking product inventory and delivery;
- facilitating client management, such as capturing assessment results, services provided, and scheduling follow-up appointments.

Alternative provision models are not widespread or well documented, highlighting a research gap. Research to understand how these models are successfully implemented and maintained in different contexts is needed to promote replication.

Operational and implementation research into the causes of provision problems is needed to develop effective remedies. For example, the day-to-day process of how procurement decisions get made may not align with procurement policies due to inadequate staff training. Research that identifies chronic bottlenecks in provision will also inform funding needs and innovation opportunities *(193)*.

Personnel

Direct service personnel can be grouped by those whose roles relate to health, social welfare, education and specific workplaces/occupations (see Figure 4.1 for a non-exhaustive list of roles that aims to convey the diversity of disciplines and professionals involved in direct provision).

Identifying and closing personnel gaps

A systematic process is recommended for identifying gaps in direct service personnel and defining feasible staffing models:

1. Take stock of assistive technology staffing across all levels of the assistive technology provision system and validate that against the need. The WHO rapid Assistive Technology Assessment and Capacity Assessment Tool can be used for this *(194)*.
2. Identify the ideal personnel composition, quantity and distribution required to move towards universal access to assistive technology.
3. Identify, implement and evaluate strategies to address short-term and long-term personnel gaps.
4. Use task-shifting and -sharing methods to engage other health care professionals in universal access to assistive technology (e.g. nurses, pharmacists and community health workers).

Figure 4.1. Assistive technology direct service personnel

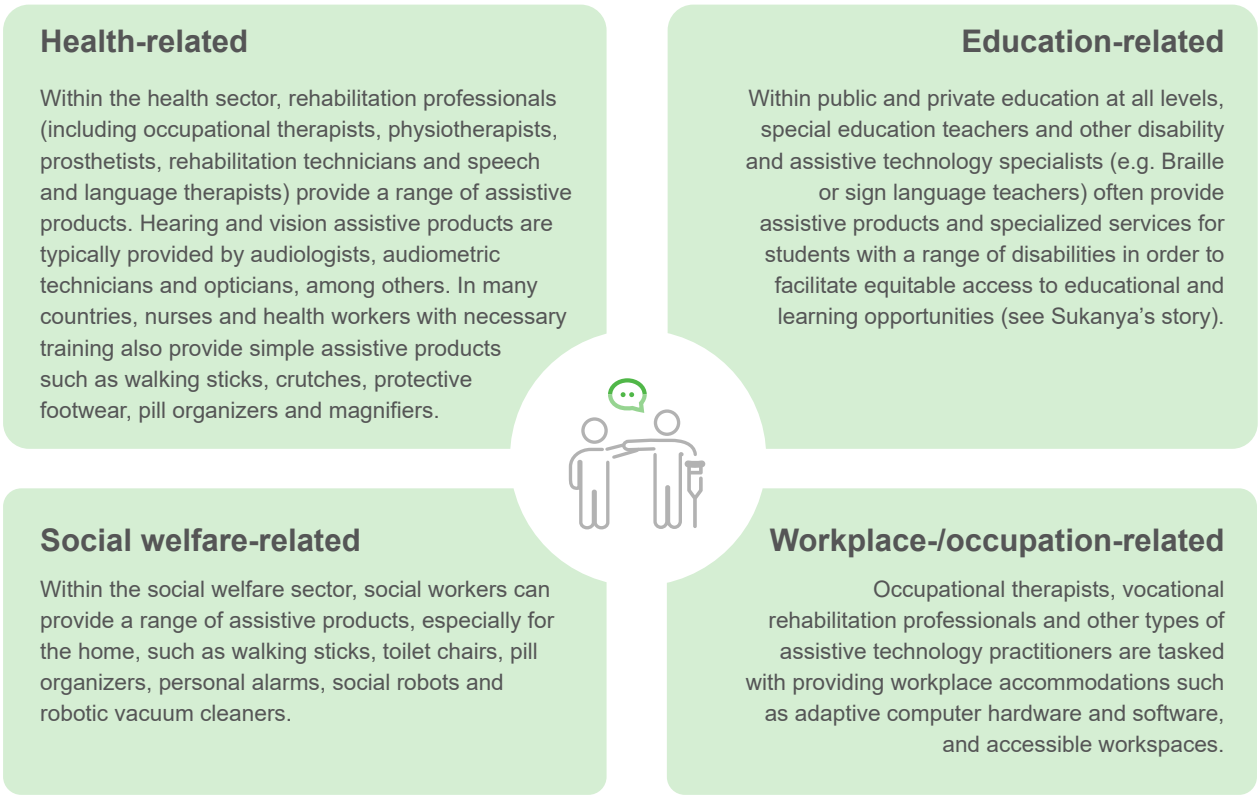
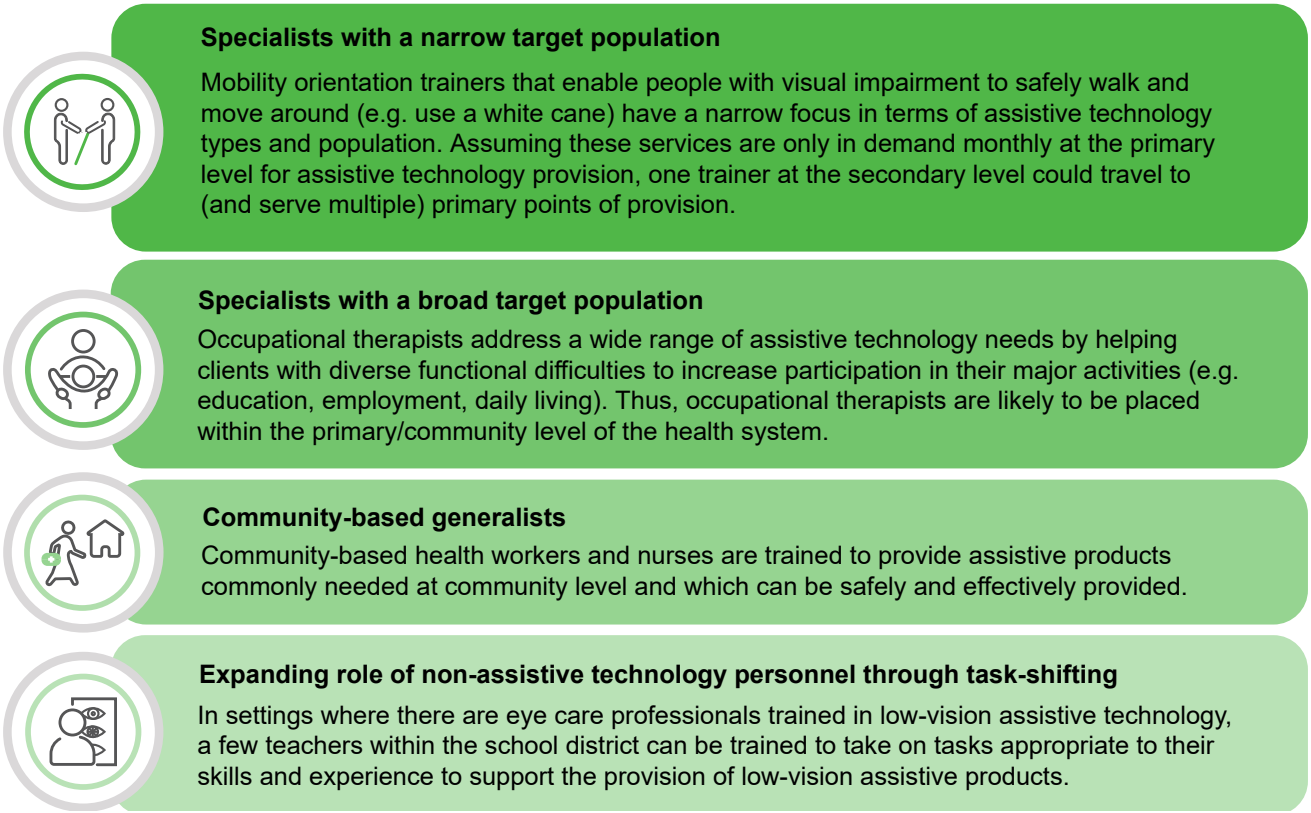


Figure 4.2. Examples of ways to address personnel gaps



Source: Gray Z, Keeffe J, Minto H, Ho M, Yasmin S, Jackson J, Gray Z. Closing the gap on access to vision-related assistive technology. In N. Layton, J. Borg (Eds), Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019, World Health Organization, Geneva, Switzerland, 22–23 August 2019. Volume A.

Reaching adequate personnel capacity at all levels (i.e. community/primary, secondary and tertiary) can demand a combination of assistive technology specialists and generalists, as well as shifting roles of other professionals. Coordination across levels of the provision system reduces duplication and fragmentation in provision *(195)*.

Assistive technology generalists have the basic skills to provide some assistive technology safely and effectively. Generalists have fewer training requirements than specialists and tend to serve closer to communities. Community-level assistive technology generalists such as community ophthalmic technicians or rehabilitation technicians can help address workforce shortages, but they may be in short supply *(196,197)*. It is recommended that this cadre of assistive technology generalists be prioritized to increase the number of personnel and improve access *(195)*.

Figure 4.2. provides sample scenarios of how different types of assistive technology specialists and generalists can be arranged within the assistive technology provision system.

Recruiting and retaining workforce

Countries that have assistive technology training and education programmes to increase the number of assistive technology professionals may not be able to retain them if there are better employment opportunities abroad. A variety of recruitment and retention strategies may be needed to attract and maintain a well-qualified workforce, especially in low-resource and remote settings. Financing incentives (e.g. salary, benefits, loan forgiveness) are effective, along with professional growth opportunities, professional networks, and supportive management and leadership. Personnel who have prior understanding or experience in rural areas are more likely to be successfully recruited and retained in positions within those settings *(198)*.

Training the workforce

The pre-service training and continuing education requirements for direct services providers should align with users' assistive technology needs and contexts. Several globally recognized assistive technology training programmes that have been developed by professional associations can be applied and adapted

to do this. Examples include the Rehabilitation Engineering and Assistive Technology Society of North America – Assistive Technology Professional certification[199] and the International Society for Prosthetics and Orthotics accreditation *(200)*.

Ensuring training is relevant for staff serving rural and/or hard-to-reach areas, or areas with diverse cultures and languages, requires ongoing evaluation to inform curriculum changes. For example, in settings where access to assistive technology is influenced by the gender of the staff, sufficient numbers of staff of each gender need be trained and employed to ensure equitable access. Training users and people from the community they serve can increase relevance (Box 4.16).

Improving and increasing training and education to address gaps in knowledge and skills can also include the following:

- **System-wide awareness-raising:** Basic assistive technology awareness-raising is needed across the broader assistive technology and general health care workforce (in terms of the range of products, potential users and benefits). Anyone in a position likely to refer a user to an assistive technology access pathway can be informed about how to use a referral system. Personnel who make decisions in the procurement process must understand product standards and the scope of assistive technology.
- **Competency-based approaches:** Identifying the knowledge, skills, attitudes and other professional competencies required for assistive technology roles within different levels of service can be used to shape job descriptions, and recruitment and retention strategies for generalist and specialist positions. These competencies can be used in planning and certifying training and education standards as well as programmes (Box 4.17) *(195)*.
- **Identifying and applying best practices:** Research and data systems that monitor user outcomes are useful in identifying best practices and staffing models. Sharing platforms and learning from communities of practice can facilitate the widespread application of well-documented best practices, such as:

Box 4.16 Training in priority assistive products package

The WHO online Training in priority assistive products (TAP) is designed to prepare primary health and other personnel to fulfil an assistive technology role. This may include identifying people who may benefit from assistive technology; providing simple assistive products such as magnifiers and transfer boards; and referral for services for more complex products and other services. The training blends online learning with practice supported by local mentors. Provision of simple assistive products is taught following a four-step process: select, fit, use and follow up.

TAP is a flexible, modular training resource that can be tailored to support local health systems and training for assistive technology provision. For example, in Papua New Guinea, nurses and nurse assistants in primary health facilities were trained using TAP to screen their patients for vision, mobility and self-care needs, and on how to provide related simple assistive products. With the support of national tertiary level vision and mobility device services, these primary health care personnel are now equipped to provide reading glasses, walking aids, and toilet and shower chairs. They also have a better understanding of referral pathways and can refer on people who would benefit from tertiary level rehabilitation or assistive technology services.

Source: Personnel training in priority assistive products [website]. Geneva: World Health Organization; 2018 (https://www.who.int/teams/health-product-policy-and-standards/assistive-and-medical-technology/assistive-technology/training-in-products, accessed 20 April 2022) *(135)*.

Box 4.17 Core competencies for the eye health workforce in the WHO African region

This framework comprises clinical and non-clinical competencies to improve the quality and relevance of eye-health personnel (e.g. ophthalmologists, optometrists and allied ophthalmic personnel). Each competence describes relevant knowledge, skills, attitudes and behaviours.

Source: Core competencies for the eye health workforce in the WHO African Region. Brazzaville: World Health Organization Regional Office for Africa; 2019 (https://www.iapb.org/learn/resources/core-competencies-for-the-eye-health-workforce-in-the-who-african-region/, accessed 20 April 2022).

- » multidisciplinary provision of assistive technology (team approach to assessing needs for complex assistive products and services, and developing the most suitable solutions for the user);
- » equity and inclusion practices (a representative workforce, anti-discrimination training, accessible communication);
- » user involvement in the provision process.

Centralized resource centres can help produce and disseminate assistive technology evidence, training resources and information to a broad range of assistive technology professionals (Box 4.18). Information needs of both assistive technology specialists and generalists may include:

- up-to-date knowledge about the range and features of products available, including new innovations on the market;
- evidence on product quality or effectiveness;
- how to operate products; and
- up-to-date knowledge of the assistive technology procurement process.

Replicate training models

Effective curriculum and training programmes in different assistive technology disciplines or categories have been developed at national and international levels (see Box 4.19 for examples).

Evaluating and documenting the implementation process of these models can support replication in other countries.

International or global umbrella organizations – for example the Global Alliance of Assistive Technology Organizations (GAATO) and its national affiliates (national professional organizations) – play a role in sharing effective training models and resources. Annual conferences for assistive technology professionals and national accreditation programmes can also be a starting point for training and education

Box 4.18 The Rehabilitation Reference Centre (Brazil)

The Rehabilitation Reference Centre in Brazil is designed as an evidence-based, point-of-care information resource for physical therapists, occupational therapists, speech therapists and sports medicine professionals. Rehabilitation professionals can access patient education printouts and customize these evidence-based resources for their facility. The centre also links professionals to the latest research through rehabilitation and health journals, and other online information sources.

Source: Toro-Hernández ML, Kankipati P, Goldberg M, Contepomi S, Tsukimoto DR, Bray N. Appropriate assistive technology for developing countries. Physical Medicine and Rehabilitation Clinics. 2019;30(4):847–65.

Box 4.19 Replicating training models nationally and internationally

The Cambodian School of Prosthetics and Orthotics (CSPO) replicated their model (including the curriculum, management processes, teaching methods and teaching manuals) in four other countries (Indonesia, Myanmar, Philippines and Sri Lanka) between 2004 and 2014. The regional approach to strengthening prosthetics and orthotics services was supported by philanthropic funding, with the plan to sustain schools by relevant government ministries. In Indonesia and Sri Lanka, following 10 years of outside investment, training of trainers and institutional development, the prosthetics and orthotics schools were fully managed and financially sustained by the respective ministries of health.

The International Agency for the Prevention of Blindness' low-vision work group has produced guidance on low-vision curricula to inform both pre-service training and continuing education for five different cadres of providers (ophthalmology, optometry, teachers, community-based rehabilitation workers, refractionists).

Sources:

Pryor W, Harte C, Ishii Y, Kohler F, Smith F, Pryor W. Integrating a new prosthetics and orthotics workforce: Lessons from an evaluation of the Nippon Foundation's investments in South East Asia. In N. Layton, J. Borg (Eds), Global perspectives on assistive technology: proceedings of the GReAT Consultation 2019, World Health Organization, Geneva, Switzerland, 22–23 August 2019. Volume A.

Low vision curriculum. London: International Agency for the Prevention of Blindness (IAPB); 2017 (https://www.iapb.org/news/low-vision-curriculum/, accessed 20 April 2022).

in other countries. National professional associations are often affiliated with international bodies tasked with harmonizing training and practice standards, among other roles.

Build capacity of users and their support networks

In meeting the needs of assistive technology users, one of the most underutilized human resources are the users themselves, their caregivers, family members, friends and other members of their local support system (e.g. teachers and community health workers) (see Shona's story). Potential areas of contribution include:

- **Awareness and referral:** Increasingly, people are developing awareness about assistive technology, but this needs to be accelerated. Potential users and their support networks need to know what types of assistive products will assist them most, and how and from where they can access them. Necessary information in local languages and accessible formats needs to be available in the local community or health centres can direct them to the best assistive technology access pathways, from local to referral systems.
- **Provision:** For many product types, adequate training, tools and support enables users to identify needs and adjust, maintain and repair assistive products. Out of necessity, users are continually creating solutions to daily living challenges. Capturing and sharing assistive products developed by users is another avenue to increase provision, particularly in areas where formal assistive technology provision is absent.
- **Advocacy:** Users and potential users are the best advocates to improve access to assistive technology. Understanding the broader assistive technology system, legal rights to assistive technology, and avenues to advocate for increased and improved access are important parts of user engagement. Advocacy organizations and networks worldwide have and will continue to play a major role in advancing the rights of persons with disabilities and older people, including the right

Meet *Sukanya*

India

Sukanya, who was born with a vision impairment, lives in Andhra Pradesh, India, with her mother and two elder sisters. Sukanya began her education at a local school. However, the school could not meet her needs, and she joined a school with specialist teachers where she was introduced to a range of vision assistive products. After graduating primary school, Sukanya began studying at a regular high school, relying on assistive products for her studies. She uses braille, a Taylor frame and an abacus for mathematics, a laptop, smartphone and audio player.

Sukanya moves about her school and home with the assistance of a white cane. Before learning how to use her cane, she was dependent on others for mobility. Nowadays, thanks to her white cane and mobility skills training, she has become more independent and is even able to help her mother in household activities. She likes to play skipping games, group games.

The COVID-19 pandemic caused Sukanya to experience disrupted access to school and many of the assistive products she uses while there. Isolated at home she felt that she forgot much of what she had learned, and greatly missed the social connection with her fellow students. She looked forward to the pandemic passing, and dreams of a future as a special needs teacher.

I use my magnifier to complete my work with accuracy and quality without taking additional time.

James (24), USA

to accessing assistive technology. Community-based rehabilitation and civil society organizations including organizations of persons with disabilities and older people can be the main provider of information, services and support.

- **Assistive technology careers:** Many users are making significant contributions to advance assistive technology – for example as policy-makers, designers, providers, educators, etc. Professional or community training programmes can develop outreach and recruitment strategies that target users who are interested in pursuing a professional career in the sector. Engaging the skills, experience and aspirations of users will likely yield effective and relevant solutions.

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Section 5

Preparing for assistive technology in humanitarian crises

Key messages

In most humanitarian crises the need for assistive technology grows, as do the barriers to its access. People with pre-existing functional difficulties may not have or be able to use their assistive product during a crisis, and when humanitarian facilities, services and programmes are inaccessible and not inclusive, the most vulnerable groups can get left behind.

In response to this, approaches to reducing barriers to assistive technology in humanitarian settings include:

- **Policy:** Inclusive emergency response policies and programmes must ensure rights to access assistive technology are protected.
- **Products:** Designing and producing assistive products to better respond to humanitarian settings, for example through sustainable design and production; accessible humanitarian products and infrastructure; assistive technology catalogues and lists for humanitarian settings.
- **Provision:** Ensuring that assistive technology is accessible to frontline staff when emergency medical teams are triaging those in need.
- **Personnel:** Training all stakeholders involved in all stages of a humanitarian response – from community to international level, and from managers to staff and volunteers – in inclusive policies and practices that incorporate basic awareness of assistive technology to address functional difficulties.

Identifying effective information systems to help coordination among humanitarian actors and encourage collaboration between those actors in the interests of protecting the rights of people with disabilities is essential.

Humanitarian crises, temporary or protracted, sudden or slow-onset, include: natural disasters; public health emergencies such as epidemics; human-made and technological disasters; armed conflicts and wars.

The need for assistive technology grows in most humanitarian crises, as do the barriers to accessing it. A rapid and flexible response is therefore required to ensure assistive technology is available and accessible, which is why World Health Assembly Resolution WHA71.8 calls on Member States to ensure access to assistive technology and inclusive barrier-free environments within emergency preparedness and response programmes. Similarly, the UN *Convention on the Rights of Persons with Disabilities* calls upon States Parties to take "all necessary measures to ensure the protection and safety of persons with disabilities in situations of risk, including situations of armed conflict, humanitarian emergencies and the occurrence of natural disasters" *(2)*.

Technical know-how to practically deploy assistive technology during humanitarian crises has been identified as a gap, alongside the lack of coordination among the agencies and organizations for developing and deploying inclusive strategies to meet the assistive product needs of people with disabilities, older adults and other groups *(204)*.

Assistive products that are likely to be needed as a priority during a crisis include products for mobility, continence and communication (see Box 5.1).

Challenges for users

When humanitarian facilities, services and programmes are inaccessible and not inclusive, the most vulnerable groups can get deprioritized or left behind *(205)*. Those most at risk and disproportionately affected by crises include people with disabilities, especially children and older persons with disabilities, and chronic conditions, women, migrants and older persons *(205,206)*. Many of these subpopulations are also more likely to require assistive technology. In the Japan tsunami and earthquake of 2011, the mortality rate of people with disabilities was double that of the general population *(207)*.

And in relation to COVID-19, people with disabilities have been shown to be at higher risk of contracting the virus than those without disabilities and have less access to COVID-19 information and health care *(207)*. For populations experiencing another humanitarian crisis alongside COVID-19 the risks are magnified. For instance, the *Global Humanitarian Overview 2021* reported particular problems with accessing assistive products as an additional negative impact on refugee populations in the occupied Palestinian Territories during the COVID-19 pandemic *(208)*.

The COVID-19 pandemic has particularly exacerbated access barriers to assistive products and services worldwide due to disruption of supply chains, requirements for social distancing, and strains placed on health care, education and other economic and social systems. COVID-19 has also reduced access to assistive technology services including training and repair, which are often provided through one-to-one, in-person support *(143,144,188)*.

Persons who have pre-existing functional difficulties may not have (or be able to use) their assistive products during a crisis. For example, people may lose or break their assistive products, or assistive products that depend on electricity or the Internet may be compromised by damage to infrastructure. In trying to access assistive technology, transport to reach products and services may be compromised, personnel capacity may be reduced, and procurement and provision systems may not be operational during a crisis. Movement between areas may be restricted due to security concerns, blocking access to available services for affected populations.

Box 5.1 Priority assistive products during humanitarian crisis in Ukraine

Responding to a rapid increase in need for assistive technology as a result of the humanitarian crisis in Ukraine in 2022, WHO has developed two priority product lists. They are based on results from a stakeholder survey on priority assistive products for humanitarian crises carried out in 2020 and information from Ukraine health personnel and assistive technology users. In addition, UNICEF has developed a list of assistive products for children and people with disabilities in emergencies.

The first WHO list of six products (AT6) includes wheelchairs and cushions, elbow and axilla crutches, walking frames and mobile toilet and shower chairs. They were included in deliveries of WHO Trauma Emergency Surgical Kits to health facilities in Ukraine. The second list of ten products (AT10) includes two types of wheelchairs and cushions, elbow and axilla crutches, walking frames, static toilet and shower chairs, absorbent products and three different types of catheter kits, targeting internally displaced people and refugees. Complementing AT6 and AT10, a communication board using pictures, symbols and letters was translated and printed locally.

Procurement and provision of both the AT6 and AT10 products was coordinated in collaboration with UNICEF, other UN Agencies, the Ministry of Health, government and nongovernmental service providers. Printed guidance in Ukrainian for service providers and those receiving the products was prepared; as well as online short training videos and information on product selection, fitting, use and follow up. Onward referral options for people with for more complex needs were mapped and clearly signposted in medical facilities and locations supporting displaced people and refugees.

Source: Product List: Assistive Technology and other relevant products for children and people with disabilities in emergencies. Copenhagen: UNICEF Supply Division; 2021 (https://www.unicef.org/innovation/sites/unicef.org.innovation/files/2022-03/Assistive-products-for-emergencies_0.pdf, accessed 20 April 2022).

Barriers familiar from non-crisis contexts – such as lack of perceived need, lack of awareness about products and services available, inadequate availability, financial barriers, limited or inaccessible transportation, and stigma and discrimination – have also been reported during crises *(209)*. Low levels of awareness of functional difficulty, rehabilitation and assistive technology, and a lack of appropriate skills and programming in relation to assistive technology on the part of emergency medical teams and other humanitarian actors, have also been identified as barriers *(204)*. While substantial efforts have been made to improve inclusive practices for people with functional difficulties among humanitarian organizations, policies and guidelines do not always translate into on-the-ground practice.

In a life-threatening crisis, saving lives is the highest priority of frontline emergency responders, along with reducing morbidity and other losses. Medical attention can include the provision of assistive technology for stabilizing and triaging those injured in order to get them to the most appropriate point of care. However, these products, services and personnel (e.g. rehabilitation professionals) may not be part of the frontline humanitarian response (see Box 5.2, for example).

Published evidence on assistive technology needs and provision during humanitarian crises is limited, with comparatively more studies on the acute stage of a crisis rather than on preparedness planning or recovery efforts after a crisis. The evidence base is insufficient across all types of assistive products to determine the extent of use and met needs, with more attention to mobility and vision assistive products. Studies of humanitarian programmes have shown that refugees who are older, who have disabilities or newly acquired injury are often neglected in the assessment, data collection, design and delivery of responses *(210)*.

Access to assistive technology does not necessarily mean satisfaction with products and services, or that a functional difficulty has been fully or even partially addressed. Users in humanitarian settings report high rates of continued functional challenges, such as still experiencing difficulties in seeing among those who wear spectacles *(211)*.

Few studies have examined the effectiveness of assistive technology provision during a crisis, but one systematic review of physical rehabilitation interventions during emergencies (primarily focused on earthquakes) found that in these settings, prostheses were the most provided type of assistive product, generally by international humanitarian organizations. Provision challenges were also identified, such as 'product dumping' in Haiti *(212)*.

Box 5.2 Assistive technology challenges during the humanitarian crisis in Syria

After nearly eight years of conflict in Syria, more than a quarter (27%) of the population aged 12 or above had a disability, and more than half of those aged 40 and above, (56%) had a disability.[i] In addition, over a third (36%) of those displaced inside Syria (12 years and older) have a disability. This can be compared with the estimated global disability prevalence of 15%.[ii] The need for assistive technology (e.g. prosthetic/orthotic services) has been identified as a priority, yet the lack of specialized care for people with disabilities and financial constraints pose major barriers.

Older people and those with disabilities are at increased risk of separation from their families and care providers and are dependent on assistive products for their independence. For Syrian refugees living in Jordan and Lebanon, persons with disabilities also experience accessibility challenges. One study of 1600 households in refugee camps[iii] with at least one member with a disability revealed that half face challenges with moving around the home (47.5% in Lebanon and 64% in Jordan). Lack of accessible latrines and access to safe water were also reported as challenges.[iv]

Sources:

[i] Disability: Prevalence and Impact. A nationwide household survey using Washington Group methodology. Syrian Arab Republic: Humanitarian Needs Assessment Programme (HNAP), United Nations–Syria; 2019 (https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/assessments/disability_prevalence_and_impact_2019.pdf, accessed 20 April 2022).

[ii] Syrian Arab Republic: Disability Prevalence and Impact. IDP Report Series (Fall 2020). Geneva: UN High Commissioner for Refugees; 2021 (https://reliefweb.int/report/syrian-arab-republic/syrian-arab-republic-disability-prevalence-and-impact-idp-report-series, accessed 20 April 2022).

[iii] World report on disability. Geneva: World Health Organization; 2011 (https://www.who.int/teams/noncommunicable-diseases/sensory-functions-disability-and-rehabilitation/world-report-on-disability, accessed 20 April 2022) *(28)*.

[iv] Hidden victims of the Syrian crisis: disabled, injured and older refugees [website]. London: Handicap International and HelpAge International; 2014 (https://reliefweb.int/report/syrian-arab-republic/hidden-victims-syrian-crisis-disabled-injured-and-older-refugees, accessed 20 April 2022) *(210)*.

Reducing barriers

The global impacts of COVID-19 have heightened awareness of health disparities (e.g. access to health care and information). Addressing COVID-19 has also revealed the potential to accelerate transformative changes across global health fields to address structural inequities and barriers to access, including access to assistive technology. Empowering at-risk groups and community-level actors to identify and address needs, and to be active participants (not passive recipients) in developing humanitarian plans and responses, is at the heart of many recommendations (see Mahpekay's story) *(144)*.

Preparedness planning and practice for a crisis can occur at all levels – from individuals to national governments. Addressing the needs of users can be integrated into plans, programming and disaster drills for all humanitarian actors – from international humanitarian organizations to national and local government agencies and civil society organizations (see Box 5.3, for example). Individual users and their support networks can also create emergency preparedness plans that increase their capacity to cope with a crisis.

Preparedness guidelines and resources have been developed by humanitarian and other organizations for specific types of crises, regions and populations. Most resources provide guidelines on how to design and implement inclusive programming, train personnel, and meaningfully engage at-risk groups.

Specific solutions to overcome identified barriers to assistive technology during a humanitarian crisis according to the four components of the assistive technology system include the following examples.

Policy

Inclusive emergency response policies and programming must aim to ensure the rights of people with functional difficulties are protected, including the right to access assistive technology *(222)*.

Mandates such as UN *Convention on the Rights of Persons with Disabilities* (Article 11) enshrine the rights of vulnerable groups in humanitarian crises, and many include the provision of assistive technology (2,223). Funding the implementation of policies and best practices to provide assistive technology during and after a crisis generally demands national and international financing, specifically:

- funding assistive technology through national and international emergency response plans;


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Meet *Mahpekay*

Afghanistan

Mahpekay lives with her mother, six sisters and two brothers in Kabul, Afghanistan. Originally from rural Afghanistan, Mahpekay was six years old when she and her family fled to Kabul due to the growing conflict and lack of security in her country. Shortly after their arrival Mahpekay was injured in an explosion and both of her legs were amputated.

Growing up as a double amputee, Mahpekay often felt excluded because she was not able to walk like the other children, and she felt depressed. Even with mobility devices, she had difficulty going to school as it was not accessible: “At that time, my life didn’t feel like it had any meaning.”

Today, Mahpekay is a qualified orthotist/prosthetist, and deputy director of the Kabul Orthopedic Organization. She has provided many children and adults with prosthetics like those that she wears herself. She says, “there are thousands of people like me, including many children who lost their limbs from the use of these explosive weapons.”

Achieving her qualifications and being able to work and support her family relies on her continued access to prosthetics, a wheelchair and other assistive products. “I enjoy it the most when I provide quality services for people with disability, because I have disability and I know the difficulties the people with disabilities face. When I solve their problem, I give them new hope for life.”

“Assistive technology enabled my access to education, and the knowledge I have gained has changed my life and my family’s life as well. I financially support my family and I am the only one that has a job, my sisters are students at school and my brother is a student in university”.

Box 5.3 Humanity and Inclusion's approach to disaster risk reduction

Humanity and Inclusion (formerly Handicap International) employs a twin-track approach to disaster risk reduction (DRR):

3. **An inclusive DRR system and stakeholders** that support and strengthen the capacity of local, national, regional and international DRR stakeholders (i.e. service providers and service delivery) to include the most-at-risk groups, in particular people with disabilities.
4. **Empowerment of at-risk groups** that includes identifying and supporting at-risk groups, in particular people with disabilities and their families and representatives, to increase their resilience to disaster risks and facilitate their participation in mainstream DRR.

Source: Inclusive Disaster Risk Reduction (Policy Brief no 13). London: Handicap International; 2017 (https://d3n8a8pro7vhmx.cloudfront.net/handicapinternational/pages/1500/attachments/original/1499955359/Inclusive_DRR_2017.pdf, accessed 20 April 2022).

Box 5.4 First physical rehabilitation centre in Maidugur (Nigeria)

The International Committee of the Red Cross (ICRC) has built a physical rehabilitation centre to provide assistive technology and rehabilitation services in a conflict prone area of northern Nigeria. Government and academic partners collaborated with ICRC in establishing the centre, which is funded through an innovative private–public investment mechanism called the 'Humanitarian Impact Bond'. ICRC provides physical rehabilitation services in countries experiencing armed conflict and violence.

Sources:

Nigeria: First physical rehabilitation centre opens in Maiduguri [news release] – 19 Nov 2020. Geneva: International Committee of the Red Cross; 2020 (https://www.icrc.org/en/document/nigeria-first-physical-rehabilitation-centre-opens-maiduguri, accessed 20 April 2022).

International Committee of the Red Cross [website]. Geneva: International Committee of the Red Cross (https://www.icrc.org/en, accessed 20 April 2022).

- developing funding mechanisms that enable humanitarian agencies and other donors to quickly fund response priorities, including the rapid provision of assistive technology *(224)*;
- applying creative funding models to support long-term rehabilitation and assistive technology provision, particularly in fragile and conflict areas (Box 5.4).

Additional approaches to strengthen the humanitarian policy environment include *(204,207,225)*:

- clarifying which bodies (international and national) are responsible for addressing assistive technology needs during a crisis;
- identifying effective information systems to help coordination among humanitarian actors, and rapid procurement and deployment of essential products and services;
- establishing a multi-stakeholder taskforce that meaningfully engages users to develop plans and strategies for responding to humanitarian crises and monitoring progress;
- collaboration among leading global organizations working to ensure that the rights of people with functional difficulties are realized within complex humanitarian settings, and to produce practice and training resources that are tested for effectiveness, evaluated and continually updated as new evidence becomes available.

Products

Assistive products can be designed and produced to better respond to humanitarian settings, for example through:

- *Sustainable design and production:* Repair, reuse and materials recovery at the local level have been proposed as alternatives to relying on global supply chains that may be disrupted during a crisis *(171)*.
- *Accessible humanitarian products and infrastructure:* Assistive products and accessibility measures that can be quickly deployed during a humanitarian crisis are becoming more common (e.g. accessible showers, toilets, pathways, ramps, etc.). Procuring such humanitarian products is recommended as best practice by leading humanitarian organizations, which are also investing in designing new technologies specifically adapted to these contexts.

- *Assistive technology catalogues and lists for humanitarian settings:* These can expand and segment assistive products suitable for different humanitarian settings in supply catalogues and lists to facilitate procurement by humanitarian actors *(204)*. For example, a list of priority products was developed by WHO and UNICEF to ensure that people with disabilities were not excluded from COVID-19 response efforts. The list includes COVID-19-specific products (e.g. face masks) and a range of assistive products *(213)*.

During crisis situations, supply chains for health and other essential products may be disrupted. Mitigating these disruptions includes carrying stock of inventory locally, having back-up suppliers for situations where primary suppliers cannot fulfil orders, and building the capacity of assistive technology resources at the community level *(204)*.

Provision

Assistive technology may be needed on the frontline when emergency medical teams are triaging those most in need. Lists of essential assistive products and equipment for trauma care already exist, alongside best practices to address common types of injuries *(214)*.

Many common types of traumatic injuries require assistive technology. People who experience fractures, amputations, spinal cord injuries and brain injuries are likely to have short- or long-term needs for assistive technology. In conflict zones, injury patterns correspond to types of weapons used – which makes it possible for emergency responders and other humanitarian actors to plan for specific types of assistive products and services needed *(215)*. In all humanitarian settings, quickly identifying those who use, or may need, assistive products is recommended *(143,204,216)*.

Other inclusive practices include providing:

- information in accessible formats, including addressing the information needs of people with intellectual or developmental disabilities;
- accessible and equitable humanitarian assistance such as specialized services for users (e.g. home-based services, nearby service points);
- remote training and service delivery for some types of assistive technology provision (e.g. telemedicine); and
- efficient systems to procure and supply assistive technology that are most essential in a crisis setting.

As humanitarian responses shift to the recovery phase and longer-term solutions, national assistive technology system actors and humanitarian relief organizations may share responsibility for ongoing provision. Partnerships between national or local governments, private sector and international humanitarian organizations all play a role in long-term assistive technology provision, and international resources (i.e. funding, expertise, technology and equipment) can be leveraged to strengthen this response to meet local needs *(217)*. In protracted humanitarian situations, long-standing refugee camps may have to provide ongoing housing and a range of services. Accessible infrastructure can be used in these settings, such as accessible latrines. For example, UNICEF has worked with private sector partners to design, test and produce multiple products to create accessible latrines that are easy to transport and assemble, and which can be deployed in emergency settings. CBM International describes 16 minimum requirements for building accessible shelters that are practical and cost-effective. These requirements apply universal design principles and aim to create a barrier-free environment for people with a range of disability types (e.g. mobility, sensory) *(218)*.

Raising awareness about assistive technology and inclusive attitudes and practices is also recommended for the broader refugee community and humanitarian staff *(219)*. Recovery in this context aims to increase refugees' self-reliance through self-help groups and peer support. Rehabilitation and reintegration of those who have experienced physical or psychological trauma is also often part of recovery efforts.

My hearing aid allows me to hear a baby crying, the sound of trains and sirens.

Mar'yana (36), Ukraine

Personnel

Stakeholders involved in all stages of a humanitarian response – from community to international level, and from managers to staff, family members and volunteers – can be trained in inclusive policies and practices that incorporate basic awareness and provision of assistive products to address functional difficulties. Examples of resources on inclusive practices in humanitarian settings that incorporate assistive technology include the following guidelines and standards:

- Age and Disability Capacity Programme (ADCAP), which is designed to ensure older people and people with disabilities are included during emergency responses *(220)*.
- *Guideline on the inclusion of persons with disabilities in humanitarian action*, which sets out "essential actions that humanitarian actors must take in order to effectively identify and respond to the needs and rights of persons with disabilities who are most at risk of being left behind in humanitarian settings" *(221)*.
- *WHO Emergency medical teams minimum technical standards and recommendations for rehabilitation*, which aims to strengthen the capacity of emergency medical teams to better prevent patient complications and ensuing impairments *(214)*.

Personnel likely to provide assistive technology during a crisis, such as frontline rehabilitation or health care personnel, require clinical and technical training specific to the assistive products most needed and feasible to deploy in a crisis setting. Training frontline workers in the rights of people with functional difficulties (including users) is recommended.

Coordination and management personnel are central to a humanitarian response – both to address acute needs and provide ongoing humanitarian assistance. Developing systems and training that support these personnel in quickly mobilizing assistive technology resources is essential (e.g. training service providers in using virtual provision platforms) *(188)*. Addressing the shortage of assistive technology personnel during a crisis can be achieved through strategies such as task-shifting (see *Personnel – Identifying and closing gaps* in section 4).

Section 6

Creating enabling environments

Key messages

- Accessible, inclusive, barrier-free or age-friendly environments can enable the use of assistive products and make life easier for everyone, including users and their caregivers.
- Enabling environments are essential for users to access buildings, transport systems, digital spaces, etc.
- Services including access to health, education and livelihoods are only possible for users when they are accessible and located within inclusive enabling environments.
- Three types of barriers exist to enabling environments: infrastructural, informational and attitudinal.
- Universal design helps increase the range of people who can access and make use of mainstream products, spaces and services.
- Cross-department approaches and coordination are essential when planning and delivering services that are inclusively designed and usable by people with functional difficulties.

The environment is made up of: products and equipment; built and digital environments; the natural environment; services, systems and policies; and support, relationships and attitudes*(6)*. It comprises spaces, places, services and interactions that are important for living. When the environment is accessible, inclusive, barrier-free and age-friendly, then all people benefit – irrespective of functional abilities – and users have an experience that is equal to that of people without functional difficulties. But when barriers exist, having assistive products is of limited use. Access to assistive technology and accessible environments is complementary – without one, the other is of little use. A user of a manual wheelchair cannot wheel up steps; and a screen reader user cannot hear a website that has not been made accessible. Similarly, accessible environments without access to assistive products can defeat the purpose. Assistive technology needs increase when people with functional difficulties cannot use mainstream products, buildings and services. Creating an enabling environment means ensuring that it has a positive impact on the functioning of users and their caregivers.

The right to equitable access to the environment is a fundamental aspect of the UN *Convention on the Rights of Persons with Disabilities*. Achieving universal accessibility requires a cohesive approach to access and inclusion. For a service to be *accessible*, the buildings or online platforms that house the service must be accessible, services must be designed inclusively, and staff need to have adequate disability equality and awareness training. If any one aspect of a user journey is inaccessible, then the whole service is considered inaccessible. And for a service to be truly *inclusive*, everyone – irrespective of differences or diversity – should be able to experience that service in an equal way without the need for overlay or 'special' treatment or provision. An example of this would be a government building with level access and automatic, sliding double entrance doors. There is no need to add a ramp or an 'accessible' entrance as the building has been designed inclusively.

Box 6.1 Enabling transport systems

Transportation includes services, systems and policies that enable goods or people to get from one location to another. Without transportation, people do not have access to employment, education, health care, and everyday activities such as shopping, banking, social and recreational activities *(28)*. Article 9 of the UN *Convention on the Rights of Persons with Disabilities* states that to create an environment where all can participate in all aspects of life, transportation needs to be accessible *(2)*.

Country-specific regulations such as Canada's *Accessible Transportation for Persons with Disabilities Regulations* describe the legal mandates that are required to make all federally-regulated transportation such as air, and interprovincial and international passenger rail, bus and ferry, security and border crossing accessible *(226)*. Despite international, national and local policies to make transportation accessible to all, barriers remain. For example, in a study of a bus terminal in Kenya, a disconnect between policies and their implementation resulted in lack of accessible signage and physical barriers resulting from wear and tear in the terminal *(227)*. Many steps need to be taken to successfully complete the travel process, including accessing travel schedules if relevant, getting to and into the transportation option, navigating to and arriving at the destination. If any link along the way is not accessible the chain is broken.

Many examples of how to design enabling transportation environments are available. Travel schedules can be made accessible by using large print or audio output, or ensuring that websites follow accessibility guidelines *(228)*. Some suggestions for incorporating universal design principles into large transportation terminals include decreasing the number of decisions points for getting to a final departure location/gate, breaking up large terminals into smaller sections, ensuring that seating is available for those who need it, and making sure that signage is visible, uses accessible fonts and internationally recognized symbols *(229)*. Recommendations for accessible buses include having lowering floor or lift access with wide doors for those who use wheelchairs, have baby carriages or heavy luggage when boarding. Seating for people with strength or endurance difficulties should be available and signage should be visible and use colour-coding, which has been shown to help all people with direction finding *(230)*. The WHO *Age-friendly cities framework* identifies access to transportation as one of the eight domains that are critical for ensuring that elders remain active and connected. To decrease financial barriers to transportation, numerous countries have provided free access to public transportation or taxis for elders in the community *(231)*. Other recommendations include ensuring a safe driving experience for all by having adequate signage, roads with adequate lighting and in good repair. Safe parking that is located close to a destination is also recommended *(232)*. Finally staff training regarding how to welcome all people to the transportation they choose is recommended to decrease stigma and bias *(233)*. Attitudinal barriers can include discriminatory practices or processes from both service staff and other service users. Informational barriers include not providing information in accessible and/or alternative means, including vital information relating to routes, timetables and service accessibility.

Physical barriers include the accessibility of transport infrastructure and the vehicles themselves such as trains, buses, train stations and bus stops; for example, ensuring there are no hazards such as wide gaps between a train and platform *(234)*.

A goal of universal or inclusive design is settings with no need for any additional modifications or accommodations. Inaccessibility of infrastructure and services create not just physical barriers for people with disabilities, but limit access to transportation, health care, education, employment, etc. Barriers also often relate to attitudes, behaviours, information or infrastructure.

To participate fully and experience the world around them in a fair and equal way, people need access to a range of infrastructure and services that must be accessible and inclusive. A cohesive approach across domains and sectors, complemented by compliance with legislation and standards and universal or inclusive design approaches, supports this, as demonstrated in the transportation (see Box 6.1), health (see Box 6.4), education (see Box 6.9) and humanitarian (see Box 6.10) sectors.

Universal design for enabling environments

One of the key approaches to achieving enabling environments is to apply the principles of universal design. Text-to-speech functions built into cell phones or motion-controlled doors are examples of universally designed products. Other examples include digital assistants that enable people to control a variety of communication and home-based functions with their voice.

Universal design involves designing products, buildings and services so that they can be used by all people, to the greatest extent possible, without the need for adaptation or specialized designs *(2).*

Universal design aims to ensure that people with functional difficulties "have access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas *(2)*." It also involves promotion of research and development leading to universally designed goods, services, equipment and facilities. To promote their availability and use, they should require the minimum possible adaptation and the least cost to meet the specific needs of people with functional difficulties (see Constance's story). Universal design should also be included in the development of standards and guidelines.

The seven principles of universal design *(235)*

1. *Equitable use:* The design is useful and marketable to people with diverse abilities.
2. *Flexibility in use:* The design accommodates a wide range of individual preferences and abilities.
3. *Simple and intuitive use:* Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level.
4. *Perceptible information:* The design communicates necessary information effectively to users, regardless of ambient conditions or the users' sensory abilities.
5. *Tolerance for error:* The design minimizes hazards and the adverse consequences of accidental or unintended action.
6. *Low physical effort:* The design can be used efficiently and comfortably and with a minimum of fatigue.
7. *Size and space for approach and use:* Appropriate size and space is provided for approach, reach, manipulation and use, regardless of user's body size, posture or mobility.

Universal design was originally intended to go beyond minimum accessibility requirements mandated by law in many countries and push designers, architects and others involved in constructing built and virtual environments to incorporate its principles from the beginning of the design process, and to avoid creating barriers that later need to be mitigated by the use of assistive technology. Despite the cost-benefits and increased inclusivity that result from implementing universal design *(236,237)*, barriers to its implementation remain, including lack of awareness, lack of education regarding the concepts of universal design, mistaken notions that universal design is only for people with disabilities and is a regulatory and cost concern.

My prosthetic leg has been my one-way ticket to freedom and independence. I am so thankful for it.

Jacqueline (28), Zambia

© EYEscape/Mariki Uitenweerde

Meet *Constance*

South Africa

Constance is an office assistant and advocate for people with disabilities at a prominent university. When not at work, she enjoys being the mother of two young daughters.

When she was a young girl, Constance mysteriously lost her voice. Her family sought medical help, but Constance was not able to regain her ability to speak. This marked the beginning of a difficult time in her life. She was taken out of school because she was being made fun of by other students and the staff felt they could not protect her from discrimination.

Constance eventually enrolled in a school that offered disability-related support, where she received speech therapy services and a customized communication board. With this help she finally felt understood. Constance was then invited to participate in a youth empowerment programme for people who require augmentative and alternative communication (AAC) devices. The programme included a full week of training where Constance learned how to use different AAC devices, improve her communication skills, and realize her potential. She said, “I was introduced to a whole new world of AAC and it changed my life. I started to have dreams and goals for my life again,”

Constance received her first digital AAC device at the age of 23 years. Today, she uses a speech assistant app on her smartphone every day to communicate. This app converts text to speech and is available in different languages.

Access to AAC has helped Constance gain confidence and create a full life. She hopes better performing digital communication technologies such as higher quality sound and Bluetooth speakers will become more affordable in the future.

Physical and digital environments

Products and equipment

For products and equipment to be useable by all, their physical, sensory and cognitive features, as well as their psychosocial and emotional characteristics, must be considered. However, some may resist these changes because they do not see the immediate value in new design options, or they may think it is too frustrating to make this kind of a change when they have been doing things a certain way for a long time. These psychosocial and emotional attributes must be considered in product (and service) design because they are equally important as the physical or sensory features in people’s decision to use them *(238,239)*. Moreover, instructions and manuals, regulatory legislation and standards, cultural context, and aesthetics must also be considered.

Solutions

Numerous studies have shown that including users in the design of products and equipment that they will be using increases the likelihood that the products will not be abandoned *(240–242)*. For example, older adults are more likely to adopt equipment for aging if they have been involved in developing them *(243)*.

Product designers in a variety of areas are using principles of universal design to ensure their designs meet the needs of an inclusive society. Everyday tools can cause wrist and hand injuries or pain because of their physical design, but by changing the width of the handles and the angle of the tools, these difficulties can be lessened *(244,245)*. For a person with visual difficulties, raised bumps on key letters and high contrasting letters on a keyboard can make products accessible. For someone with attention or concentration difficulties, the same high contrast letters and tactile cues on a keyboard may also be useful.

By partnering with the fashion industry, spectacle designers have changed certain products from being perceived as a medical device to being seen as a fashion item *(246)*. An inclusive line of boots features oversized double zippers, toggle-adjusted stretch laces, and rear pull tabs to make it easy to put them on. And a wristwatch, designed with universal design principles in mind (tactile cues for telling the time) has been produced by a designer in collaboration with people who have visual difficulties, creating a watch that everyone, regardless of their visual ability, can use and enjoy *(247)*.

Technology has been increasingly developed to be usable for as many people as possible. This can

delay the need for assistive technology or give an alternative to an assistive technology. For example, most computer and smartphone operating systems now come with accessibility features that narrate the interface for blind and visually impaired users. Similarly, text editors have text to speech as standard, and video conferencing platforms offer automatic subtitle captioning. While both the latter features have been created to enhance the accessibility of the products, it should be noted that this was not only for the benefit of persons with functional difficulties. Sometimes this might be situational, such as when automatic doors are helpful for a non-disabled person with their hands full.

A recent strategy to develop products that harnesses new technologies, users and interdisciplinary design teams in developing products, is the 'maker' movement *(248,249)*. In addition to using emerging additive technologies (i.e 3D printing), these interdisciplinary designers often put their designs on open source platforms for others to access and add to.

Built environment

The built environment comprises buildings, roads, transport networks, and indoor and outdoor settings, including schools, housing, medical facilities and workplaces. It can easily be taken for granted, but their designs influence accessibility. For example, doorknobs become difficult to use for those with arthritis, decreased strength or motion, or fine-motor difficulties. And the slope of a sidewalk – necessary to drain surface water – can cause wheelchairs to turn slightly, and to stay on course, wheelchair users experience shoulder forces that may contribute to injury. And obstacles are not just physical. Places can become inaccessible due to poor information availability or changing factors, such as crowds. In many countries, laws have been passed that mandate minimum accessibility guidelines for the built environment, but where these guidelines are not fully implemented *(250)*, physical and cognitive challenges remain.

To participate fully in the built environment, people must be able to perceive relevant information and make sense of it (cognitive function) and then act on it. For example, meeting a friend for a cup of coffee means navigating many physical, sensory, cognitive and digital challenges, including: getting dressed appropriately for the weather; finding how to get to the destination (and getting transport there); being able to arrive on time and find the friend; and choosing and paying for the refreshments. Some people might require specific assistive products to help with this activity. However, regardless of assistive product use there are elements of the environment that enable access to the activity and, by extension, elements of the environment that could prevent access. The importance of accessible infrastructure, information and services are illustrated in Box 6.2.

Box 6.2 Towards enabling city environments (India, Mongolia and United Kingdom)

To develop enabling city environments that are accessible and inclusive, recommendations based on experiences from India, Mongolia and United Kingdom highlight the need for integrating: a supportive legislative environment; participation of people with functional difficulties in planning, design and decision-making; positive cultural change; an accessible and inclusive environment; and access to assistive technology. It is important to find out what matters to people and establish a shared vision for an accessible and inclusive city among stakeholders. Stakeholders need to know that inclusive design benefits everyone and contributes to a culture of inclusion. Inclusive design is more than technical standards. It needs to consider user experiences and journeys, and to respond to local climate, culture and geography. Moreover, it needs to be embedded in the implementation of all essential infrastructures and services, such as streets and alleys, water and sanitation, health and social services, and education, so they can be accessed and used by users of different assistive products, such as tricycles that require sufficient space and interactive travel support that requires an internet connection. Integrating and budgeting for inclusive design from the start is effective. The start can be somewhere and gradually the enabling environment can be expanded to eventually cover the entire city.

Sources:

Patrick M, McKinnon I, Mishra S, Gupta S, Roy P, Choudhury U et al. Inclusive Design and accessibility of the built environment in Varanasi, India. AT2030 Inclusive Infrastructure Case Studies. Prepared by the Global Disability Innovation Hub and partners for the UK Foreign, Commonwealth and Development Office; 2021.

Patrick M, McKinnon I and Austin V. Inclusive design and accessibility in Ulaanbaatar, Mongolia. AT2030 Inclusive Infrastructure Case Studies. Prepared by the Global Disability Innovation Hub and partners for the UK Foreign, Commonwealth and Development Office; 2020. doi:10.13140/RG.2.2.26922.44485.

Inclusive design standards. Global Disability Innovation Hub (https://www.queenelizabetholympicpark.co.uk/-/media/inclusive-design-standards-low-res-final.ashx, accessed 20 April 2022).

People's home environments can facilitate or hinder functioning, and people may be forced to move to alternative accommodation if their homes cannot be modified. Guidance for accessible housing is largely based on homes in higher income contexts, which can be very different from homes in lower income contexts. In addition, national accessibility design standards may only address public areas.

Solutions

Cognitive accessibility

Cognitive standards (e.g. ISO 2100-800-1) can help those involved in designing and creating spaces ensure they are accessible. Examples of cognitive cues – good and bad – in the physical environment are shown in Figure 6.1.

Practical ways to improve the built environment for people with cognitive difficulties can be the use of pictures and symbols instead of text; the use of short, easy-to-read information such as floor plans in public facilities that make use of symbols and signs replicated within the public facility to aid recognition and orientation. Signage in buildings need to be accessible so that all people can find their way to the location they need to visit. Simple, easy-to-read fonts with international recognized pictograms are suggested for signage *(251)*. Sources to help design accessible information formats can be found online *(252)*.

Physical accessibility

Features that support physical access include ramps, automatic opening doors, dropped kerbs and elevators/lifts (Box 6.3).

Home modifications

When a person's home no longer supports their participation in everyday activities, it can be modified to better suit their needs *(253)*. There are numerous standardized assessment tools that can be used to assess home modification needs and recommend alterations or assistive products to enable people to stay in their homes *(254)*.

Figure 6.1. Good and bad cognitive cues

Sources:
Building for everyone: A universal design approach. Booklet 4 – Internal environment and services. Dublin: The Centre for Excellence in Universal Design, National Disability Authority (https://universaldesign.ie/Built-Environment/Building-for-Everyone/4-Internal-Environment-and-Services.pdf, accessed 20 April 2022). Imgur; 2014 (https://imgur.com/gEfpglb, accessed 20 April 2022).

Box 6.3 Accessibility in the Canadian Museum of Human Rights

Some of the features included in the design of the museum include universal keypads, which have simple tactile symbols and auditory output that can assist users with sensory or cognitive difficulties in finding their way around the museum and accessing information about its exhibits. Universal access points are small metal features that are numbered with the numbers in braille. These access points provide information about the museum in a variety of formats, and for those who cannot see them, a raised strip on the floor signals their location. Ramps connect all levels of the museum, so it is not necessary to take stairs to reach any of the galleries. Elevators are also available. And accessible washrooms are available throughout the museum. For visitors who are deaf or hard of hearing, a mobile app provided by the museum can be viewed in ASL or LSQ and includes additional sign-language content for several exhibitions. A final feature that makes exhibits and photographs accessible for all are tactile 3D renditions of some of the gallery's contents.

Source: Botelho FHF. Accessibility to digital technology: Virtual barriers, real opportunities. Assistive Technology. 2021;33(suppl1):27–34. doi:10.1080/10400435.2021.1945705.

Smart homes

Emerging digital technologies that make the physical environment more accessible such as smart homes and home automation – including the 'Internet of things' – use digital technology to control lighting, indoor temperatures, entertainment systems, appliances and home security (such as access control and alarm systems). A variety of options from voice control to remote control are available (Fig. 6.2).

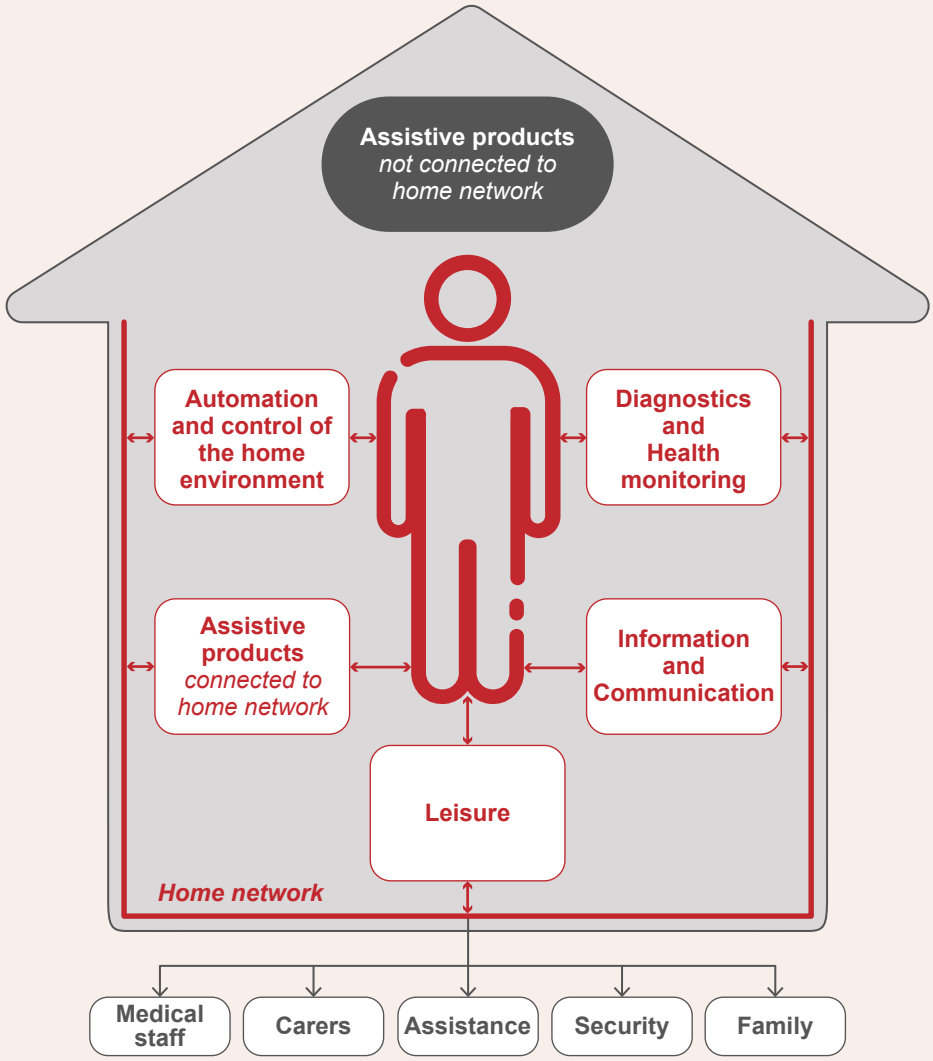
Legislation

Many countries have laws that include minimum requirements to make the built environment accessible to all (e.g. Australia's *Disability Discrimination Act*, India's *Disability and Equality Act*, and United States *Disabilities Act*).

Digital environment

The digital environment comprises two components: *(1)* hardware – comprising the tool/equipment that embodies the technology; and *(2)* software – consisting of an information base for the tool *(255)*. Hardware aspects of mobile phones and other digital devices present barriers to those with physical, sensory and cognitive difficulties (e.g. buttons that are too small to access and non-intuitive operations such as 'clicking' and 'swiping' that may not make sense to those with cognitive and cultural differences).

Figure 6.2. Smart home options



Source: Adapted from van Dijken F, van Hoof J, Kort HSM. Healthy buildings for older adults. In: E. de Oliveira Fernandes, M. Gameiro da Silva, J. Rosado Pinto (eds). HB2006: Proceedings of the 8th International Conference on Healthy Buildings (Volume III); 4–8 June 2006, Lisbon, Portugal.

Despite these challenges, where mainstream digital technology is more affordable and acceptable to use than assistive products, it is important that such devices are made accessible to all *(256)*.

Hardware

The hardware aspects of the digital environment can be challenging. An example of a common household device that can be challenging to use is remote controls. Figure 6.3 shows two remote controls: one that is more complex and has smaller buttons (a), which can be difficult to use for those with motor and/or sensory difficulties; panel (b) shows a simpler remote control design, with fewer, larger and more distinct buttons in high contrast colours.

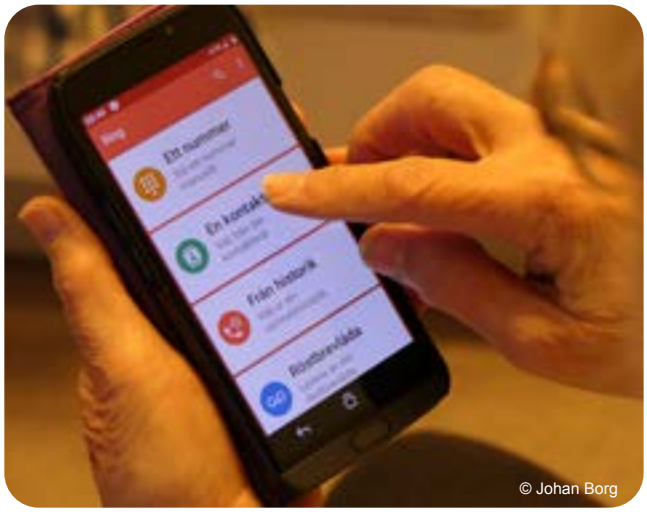
Figure 6.3. Examples of device controls

(a) more complex (b) less complex

Phones are another example of potentially challenging devices, and simplified interfaces have been developed to make this critical technology accessible (Fig. 6.4).

Less complex interfaces with larger text and symbols, fewer larger buttons, and requirements to confirm executions of commands are more accessible.

Figure 6.4. An example of accessible designs of phone interfaces



Software

There are many initiatives at the organizational, national and/or international levels that aim to make digital technology accessible to all (an example is provided in Box 6.5). Driven by market demand, common operating systems have in-built features that increase accessibility.

Box 6.4 Enabling health care services

The right to enjoy health care without discrimination is specifically mentioned in Article 25 of the UN *Convention on the Rights of Persons with Disabilities (2)*. In addition to this international declaration, various countries have legislation that mandates that health care be accessible to all. For example, in the United States, the Americans with Disabilities Act mandates that all health care facilities must be accessible to all people regardless of difficulties they may experience. This includes hospitals, physician and dental offices, pharmacies and other places that people receive their health care *(257)*. Despite these international and national policies, problems accessing health care still exist. Examples of environmental barriers to health care include lack of knowledge of health care services, lack of accessible transportation to get to health care providers, cost of services, inaccessibility of equipment such as scales and examination tables, and negative attitudes of health care providers towards people with physical and mental difficulties *(258,259)*.

Creating enabling health care environments can be accomplished by addressing these barriers. First transportation must be available and accessible so health care recipients can get to the service they need. Then people need to be able to get into the building where the providers practices *(260)*. Signage in the buildings need to be accessible so that all people can find their way to the office they need to visit. Simple, easy-to-read fonts along with international recognized pictograms are suggested for signage *(261)*. Also, exams rooms need to be accessible to all people. Once in the exam room, examination products such as adjustable height exam tables and procedure chairs can allow people who have mobility difficulties to move from a wheelchair to the exam table or procedure chair instead of being examined or treated in their wheelchairs *(262)*.

There are also organizations that develop standards and training materials to encourage web accessibility for those who find difficulty using it (Table 6.1).

Despite these initiatives, not all countries have effectively enforced laws that require that all digital environments to be accessible (see Box 6.6). Digital accessibility is often inadequate even in essential services such as education, health and public information websites.

Solutions

Usability assessment

There are tools that can help individuals and entities assess the usability and extent to which their digital environments comply with recommended guidelines *(263)*.

Cognitive accessibility

International Organization for Standardization (ISO) guidelines for cognitive accessibility in digital/virtual environments advise on: how such environments can be customized for people with cognitive difficulties (e.g. the Zac web browser for use by children with autism); how pictures and symbols can be used to enable those with cognitive difficulties to navigate text-rich virtual environments (e.g. Symbolworld.org which uses both text and symbols to communicate its content, see Fig. 6.5); and support for completing tasks (e.g. ready-made sentences that can be inserted into emails *(264)* and autocomplete features when personal information is requested) *(265)*.

Table 6.1. Applicable examples of guidelines, policies or legislation on web accessibility

Initiative	Sources
International law and policy overview	www.w3.org/WAI/policies/
International web accessibility laws and policies	www.whoisaccessible.com/guidelines/international-web-accessibility-laws-and-policies/
The World Wide Web Consortium (W3C) is an international community that develops web standards.	www.w3.org/
Global Public Inclusive Infrastructure (GPII) aims to ensure that everyone who faces accessibility barriers can access and use the Internet	https://gpii.net/
WebAIM (Web Accessibility In Mind) provides comprehensive web accessibility solutions.	https://webaim.org/

Box 6.5 COVID-19 pandemic experiences of DATEurope

To enable access to digital assistive technology for all, the Digital Assistive Technology Industry Association Europe (DATEurope) works on raising awareness about digital assistive technology, influencing legislation for digital assistive technology, enabling industry networking opportunities, fostering emerging technologies and stimulating innovation. Their experience is that the COVID-19 pandemic emphasized the role and value of digital assistive and accessible technologies.

Digital technologies remained consistently available to people as distribution was through downloads and personal installation. As a result, the availability of digital products remained consistent. This allowed many people with functional difficulties to continue working, learning and connecting to family and friends when physical and face-to-face activity was limited.

DATEurope also noted that digital connectivity allowed the wider assistive technology ecosystem to be maintained and was a vital component of resilient services. Accessible technologies such as video conferencing, collaboration and assistance solutions facilitated training and capacity building, evaluations and recommendations to meet needs, post-sales and technical support and ongoing dialogue to develop policy and practice. At the same time, accessible consumer technologies and mobile technologies demonstrated their power to create more appropriate environments and impact every aspect of the lives of people with a functional difficulty.

Source: Digital Assistive Technology Industry Association Europe (DATEurope) (http://www.dateurope.com, accessed 20 April 2022).

Figure 6.5. Sample Symbolworld icons

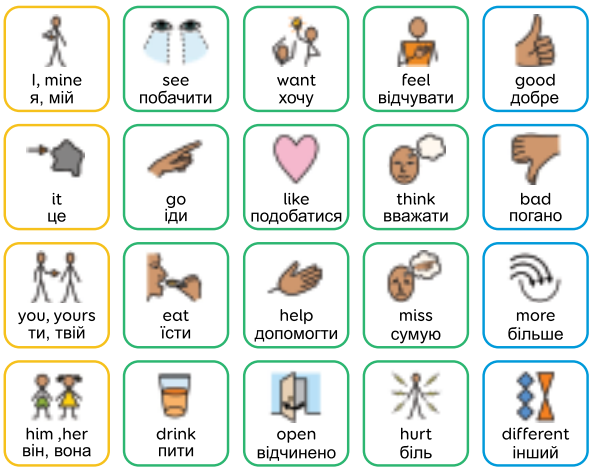


Figure 6.6. Sample screens with high and low contrast

Providing on-screen contrast options can also be a useful adaptation to promote focus in virtual environments (Fig. 6.6).

ISO guidelines also acknowledge that sensory difficulties can impact cognitive abilities *(266,267)*. Text-to-speech output can provide access to those with visual and cognitive difficulties *(268)*. Tactile or haptic input can also be useful for those with hearing and/or cognitive difficulty. For example, vibration is a useful accessibility feature for those who have hearing difficulties. This tactile feedback can be an effective reminder feature for those with memory difficulties *(269)*.

Legislation

Countries should institute and enforce laws requiring all digital environments to be accessible (including for essential services such as education, health and government websites). As digital technology is a dynamic field, legislation and other tools used to ensure universal access must include periodic revisions to match ongoing technical developments (see Fernando's story).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Meet *Fernando*

United States

Fernando is 51 years old and has lived in cities worldwide in his capacity as a policy advisor on assistive technology. He has held numerous internships and professional positions and appreciates the opportunity to continue learning and contributing to making a better world.

With his white cane, Fernando can go where he needs to, accessing public transport, which is often the most efficient and affordable way to get around in most highly dense urban centres. He has also used his white cane in all weather conditions – even rain or snow.

While Fernando uses his white cane to get around the physical environment, he uses screen readers in the digital world. He uses screen reading software on computers and smartphones to read books, navigate the web, use a range of software applications, and to write letters, articles and emails. He states, "It is fair to say that my screen reader has opened opportunities in the professional world just like my white cane has opened many paths in the cities where I have lived."

Despite Fernando's access to the best-quality screen readers, he still encounters inaccessible software programmes or websites that make it difficult to use his screen reader. Usability and accessibility challenges are common in the digital environment. For example, poorly structured websites are hard to navigate, and images and videos without alternative text or descriptions prevent full access to the content. When digital platforms are accessibly designed, he can operate efficiently and effectively in the virtual environment.

Upon reflection on the importance of assistive technology in his life, Fernando states, "Combined with training and hard work, assistive products have allowed me to enjoy family, a job, and wonderful friends. Thanks to assistive products, training, and my own efforts, I am blind, but not disabled."

Box 6.6 Access to technology among people with disabilities

"Considering the vast potential of technology to improve the lives of persons with disabilities and to contribute to the implementation of the Convention, as well as the role of persons with disabilities in designing, developing and producing ICTs, wider access to technology among persons with disabilities should be considered a priority. It is crucial to reduce the gaps in access to technology, digitalization and ICTs between persons with and without disabilities and to invest in assistive technology."

Source: Technology, digitalization and information and communications technology for the empowerment and inclusion of persons with disabilities. Note by the Secretariat. Conference of States Parties to the UN Convention on the Rights of Persons with Disabilities. Twelfth session; New York, 11–13 June 2019 (https://docslib.org/doc/11668246/convention-on-the-rights-of-persons-with-disabilities, accessed 20 April 2022).


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Services and systems

Accessible services and their related systems and policies *(6)* across various sectors (and at local, regional, national and international levels) can help users and caregivers in many areas of life. For a public service to be accessible, the buildings or online platforms that house them must be accessible, and the services must be designed inclusively, with staff receiving adequate disability equality and awareness training. For a service to be truly inclusive, everyone should be able to experience the service equally, without the need for 'special' treatment or provision.

A wide range of services, systems and policies relevant to users include those relating to the production of consumer goods, architecture and construction, open space planning, housing and utilities services, transport, communication, health, education, employment, and social security (see Box 6.7). While many local, national and international standards and policies exist to create inclusive services, lack of knowledge and practical application of these standards and policies creates barriers to inclusion. Added to this, awareness among service providers of the need for inclusive and accessible services can be low – the result of a lack of training and education on the topic.

Architects and urban planners who provide built environment services often receive little training in the concepts of accessibility and universal design, leading to their perception of accessibility being primarily about wheelchair access *(270)*. Similarly, those tasked with servicing and managing public open spaces may often not be aware of requirements to ensure spaces are accessible to all.

Box 6.7 Services, systems and policies: definitions

- *Services* provide benefits, structured programmes and operations, in various sectors of society, designed to meet the needs of individuals. Being public, private or voluntary, they can be established at different levels of society from local to international. An integral part of services are the people who provide them.
- *Systems* are administrative and organizational mechanisms designed to organize, control and monitor services. They can be established by governments at the local, regional, national and international levels, or by recognized authorities.
- *Policies* related to systems constitute the rules, regulations, conventions and standards established by governments at the local, regional, national and international levels, or by recognized authorities. Policies govern and regulate the systems *(6)*.

In the case of transport infrastructure and services, attitudinal barriers can be found in the shape of discriminatory practices or processes used by service staff and/or other service users.

Multiple factors impact the ability of those with functional difficulties to obtain housing, including affordability, accessibility and discrimination *(271)*. While national and international legislation protects people with functional difficulties from being discriminated against in housing, the problem of lack of access to affordable and accessible housing persists. For example, young adults with disabilities may live in nursing home facilities because they cannot find accessible supportive housing in the community. Additionally, those with mental health problems experience stigma, safety concerns, inaccessible design and lack of adequate caregiver support among the environmental factors, which jointly impact their ability to obtain community-based housing.

Creating inclusive digital services is promoted by two factors: 1) ensuring people have access to affordable digital devices; and 2) ensuring the physical digital products – and software that powers them – are accessible to users. By the end of 2020, 67% of the global population subscribed to mobile phone services, leaving over 30% without access to this vital technology *(272)*. Overall use levels are predicted to rise, but there remains a digital divide that leaves some excluded – especially those who have physical or cognitive difficulties, live in rural areas and/or are financially disadvantaged.

While improving, the inability to connect to the Internet varies across communities, presenting additional access issues. While government systems have committed to increasing communication access, there is still unequal distribution across countries *(273)*.

Solutions

Education and awareness-raising

Education and ongoing awareness campaigns on how to create accessible services at multiple levels are critical approaches to facilitate inclusion for all. Monitoring the practical application of policies is also needed to ensure that they are implemented across services and systems to provide access for all.

To address the need for service personnel education, there are multiple resources available that can be included in educational curricula and continuing education to provide this information. And the WHO *Age-friendly cities framework (271)* includes recommendations for making outdoor spaces accessible for people who have functional difficulties and can be useful to increase awareness at service, system and policy levels regarding how to make and maintain public and outdoor spaces that are accessible to all (see Box 6.8).

Knowledge of services and how to obtain them

Whether it is, for example, accessible voting booths available for political elections, or access to transportation services, people who need accessible services must know they exist and how to access them. Those providing the services need to have adequate disability equality and awareness training. And the service needs to be physically, sensorily and cognitively accessible to all who need it *(274)*.

Coordination and collaboration

To operate efficiently, systems need to collaborate and be coordinated, for example, when a service user is moving from an educational to a vocational setting. Including multiple stakeholders is a good strategy to ensure systems are accessible. Involving users in designing services to support their community-based living needs can also improve this experience *(275)*.

Box 6.8 Built environment panel and park accessibility (United Kingdom)

At Queen Elizabeth Olympic Park in London, a Built Environment Access Panel – formed of people with disabilities – provides expert guidance on the inclusive design of the park and surrounding areas. Inclusion is built into service contracts for partners, including: the requirement for staff to receive disability equality and awareness training; targets for inclusion of persons with disabilities as park employees; and requirements that park events must meet the park's inclusive design standards. The park also provides a park mobility service that supports visitors with functional difficulties with equipment, information, tours and sighted guide services.

Sources:

Inclusive Design Standards updated for 2019 [website]. London: Global Disability Innovation Hub, Queen Elizabeth Olympic Park and London Legacy Development Corporation; 2019 (https://www.disabilityinnovation.com/news/inclusive-design-standards-updated-for-2019, accessed 20 April 2022).

Park Mobility Service [website]. London: Queen Elizabeth Olympic Park (https://www.queenelizabetholympicpark.co.uk/the-park/plan-your-visit/accessibility/park-mobility-service, accessed 20 April 2022).

Establishing and enforcing adequate policies

While many policies exist that protect people with functional difficulties from discrimination, there is great variability across organizations and agencies about what is included in, and covered by, these policies. For standards and policies to be effective, mechanisms to ensure implementation and accountability are essential. Regular access audits can help governments to: monitor compliance with legislation; strengthen codes or standards; make recommendations to modify or improve a facility; develop an access handbook for buildings and other facilities management; or simply provide information on accessibility for building or service users. A survey conducted by the UN Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2017 found that, among its Member States, only 66.5% of government buildings in 15 countries and 59.8% of polling stations in national capitals in 18 countries were accessible *(276)*. Access audits are essential to provide such vital information, which can be used to support persons with functional difficulties to participate in public life.

Implementing national strategies and legislation at the local level

It is important that national strategies are supported by local action. Implementation of national policies often takes place at local levels, and so implementation challenges are common *(274)*. Participation and engagement with the public and civil society can support more enabling and inclusive infrastructures and service provision.

Support and attitudes

Support, relationships and attitudes are social aspects of the environment *(6)*. People or animals can offer practical physical or emotional support, nurturing, protection, assistance and relationships. This may influence the need for, and use of, assistive products in the home, school or place of work; at play; or in other daily activities. For example, in circumstances where human company may not be available or is unwanted, an assistive product in the form of a social animal robot (Fig. 6.7) may provide the desired relationship.

Attitudes – in particular how customs, practices, ideologies, values, norms, factual beliefs and religious beliefs etc. manifest themselves *(6)* – may influence individual behaviour and social life at various levels, from interpersonal relationships to community associations and political, economic and legal structures, and may motivate positive or negative practices, which may in turn lead to inclusion or exclusion. At the policy level, the attitudes of a society towards people with functional difficulties may be reflected in legislation related to their access to assistive technology.

Figure 6.7. Digital therapy cat

At the personal level, the presence or the design of assistive products may lead to stigmatization, marginalization or neglect of users, which may make users reluctant to use them. It is therefore important that assistive products are designed to reduce stigma.

Many users obtain information about and adopt assistive products based on information provided by family and caregivers. Attitudes and values towards assistive products among people with functional difficulties are also factors affecting its adoption and implementation, and related trust *(38)*. Ethics and privacy concerns are linked to this *(277)*. In cases where caregivers are knowledgeable and feel positive about assistive products, the use of assistive products has been shown to be acceptable and have positive health outcomes for users *(278)*. Positive attitudes of both users and caregivers towards assistive products are critical for successful adoption of these devices. Education and awareness about assistive products is therefore an important strategy to improve their uptake *(239)*.

Natural environment

Living and non-living elements of the natural environment, and components of that environment that have been modified by people, affect the use of assistive technology *(6)*. The accessibility for people with functional difficulties to physical geography – whether natural or human-made – can be improved, for example, by adapting and applying design recommendations for the built environment. This may include ensuring that slopes are not too steep, paths are sufficiently wide, and surfaces are

Box 6.9 Enabling education environments

The right to education has been documented in international, regional and national legal documents – including, Article 26 of the *Universal Declaration of Human Rights* and Article 24 of the UN *Convention on the Rights of Persons with Disabilities*. Despite all countries having ratified at least one treaty covering rights to education for all *(280)*, there are still access and equity barriers that prevent children with disabilities from obtaining an education. Barriers include disabling environments, difficulty accessing educational materials, inflexible education systems and attitudinal stigma and discrimination *(281)*. Principles of universal design have been applied to educational settings to ensure that a diverse group of students can participate in the educational process. Universal design promotes "the belief that the broad range of human ability is ordinary, not special. … [universal design] reduces stigma and provides benefits for all users" *(282)*. While the concepts of universal design have been applied both to the physical environment and adapted to make the educational curriculum accessible, access efforts reflect a narrow understanding of accessibility *(281)*.

To access education opportunities, it is critical that students are able to get to school, so accessible public transportation and school buses can be crucial. Transportation options are a challenge in remote rural villages and countries where travel to school may be dangerous or public transportation is not available. Creating community-based schools is one way to enable access to the school environment *(283)*.

The school environment must be inclusive as well. Applying the principles of universal design to school buildings and classroom design can create inclusive spaces. Entrances to and hallways in the school need to be wide enough to accommodate all students, and directional signs to classrooms and other school spaces must be visible and simple to read, with recognizable symbols.

In the classroom, seating near the front of the room may help students with visual, hearing or cognitive difficulties to better focus on the what the teacher is saying or writing on the board. Classrooms can have an overwhelming level of sensory stimulation. Reducing distracting noise by using earplugs or noise-cancelling headsets may help some students attend to what is going on in the classroom. Providing a variety of seating options such as floor pillows, seats and ball seats that fit various body sizes and shapes can make learning environments more inclusive *(284)*.

Using desktop cardboard privacy dividers can help focus attention of students who are easily distracted *(285)*. Slant boards – which allow a student to put reading or writing assignments at an angle on their desks, tables or laps – can promote healthy neck, shoulder and arm positions *(286)*.

Classroom products, such as writing tools, can also be designed with universal design principles in mind. Different sized writing implements to accommodate students' varying hand-grips and strengths can be made available. Local recycled materials can be useful for making classroom activities inclusive for all *(287)*.

It is suggested that governments ensure that schools have access to: (a) electricity; (b) internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities *(281)*. These features can support the devices and technologies that can help support students with difficulties accessing the curriculum to overcome the barriers they may experience.

Finally providing teachers with education on how to incorporate universal design and other inclusive principles into the classroom can help promote an understanding of how to use simple to high technology solutions to make educational environments enabling for all students *(288)*.

hard and smooth. In woodlands and national parks, accessible pathways can be provided. Ramps and matting on beaches can allow users to access popular recreational environments with friends and family *(279)*.

Animals and plants can act as barriers to participation of users, for example, by creating barriers for users of mobility devices or by being a fall hazard if they get underfoot.

Climate, such as temperature, humidity, rain, wind and seasonal variations, can affect the use of assistive products. For example, keeping paths free from rainwater or snow facilitates wheelchair use, while providing shelters can protect travellers from harsh weather when using public transport *(271,289)*. Moreover, weather protection at entrances is a universal design suggestion to protect people from the weather when entering and leaving their buildings *(290)*.

Natural events (e.g. earthquakes, tornadoes, hurricanes, typhoons, floods, forest fires, volcanos and ice-storms) and human-caused events (including events or conditions linked to conflict and wars, environmental disasters, and land, water or air pollution) can cause disruptions, alterations or disturbances in the physical environment. These events often increase the need for assistive technology, while at the same time hindering access to and use of it.

Box 6.10 Enabling environments in humanitarian crises

A humanitarian crisis can damage the physical and communication infrastructure, disrupt services and personal support networks, and alter the natural environment in ways that make accessing and using assistive technology more challenging, if not impossible. Enabling environments in humanitarian crises are necessary to reduce the need for, improve access to, and facilitate the use of assistive technology. Strategies that can be employed in preparing for humanitarian crises to improve assistive technology access include *(204)*:

- In emergency preparation planning, it is important to empower individuals and their support systems by engaging users in the development of emergency preparedness plans. These plans can include back-up resources or equipment, and alternative support necessary for managing environmental challenges.
- Humanitarian response efforts at all levels – local to international – can be prepared to address weaknesses in infrastructure and challenges in the natural environment. For example, adequate funding can be in place to provide accessible transportation to those with mobility limitations affected by a crisis.

During and after a crisis, strategies are needed to ensure users are not excluded from humanitarian assistance. Access to reliable information is of utmost importance during the acute phase. Communities require timely and accessible information to be aware of a crisis situation, and how and where to access support and services. Addressing the digital divide experienced by people with functional difficulties and marginalized groups is needed to ensure equal access to information during a crisis. Mobile phones offer access to information and a range of mobile-based technologies *(291)*. When life-saving decisions are made quickly by frontline humanitarian workers, people with disabilities and elderly have been left out when rationing of care is necessary. It is thus important to ensure that decision-making protects rights of vulnerable groups and is not influenced by prevalent biases (e.g. ageism) *(292)*. In cases where communities must evacuate and temporarily relocate, humanitarian facilities, housing, latrines, paths, supports and services can be designed to ensure accessibility. For example, waiting in line for long periods to receive food may not be possible for everyone, so alternative methods to deliver food are needed. Numerous humanitarian situations are long-term, such as long-standing refugee camps that provide ongoing housing and a range of services. Inclusive environments can be achieved through:

- Raising awareness about assistive technology and inclusive attitudes among broader refugee community and humanitarian staff *(293)*.
- Ensuring that assistive products provided are suitable within the local environment *(294)*.
- Ensuring physical facilities and environments are accessible (e.g. latrines *(295)*, shelters *(296)*).

Section 7

Moving forward

While assistive technology enables the enjoyment of human rights and changes the lives of those with access to it, this report reveals that improving access to assistive technology is long overdue for hundreds of millions of people. However, while knowledge gaps exist, there is sufficient evidence and normative guidance for action to strengthen sustained provision of adequate quantities of safe, effective and affordable assistive products to achieve universal access to assistive technology.

Box 7.1 Regional and global collaborations on the development of recommendations

In September and October 2021, regional consultations were organized by WHO in African, American, Eastern Mediterranean, European, South-East Asian and Western Pacific[i] regions, followed by a two-day global consultation. Government and other stakeholder representatives from 99 countries[ii] participated in the regional consultations. In total, 291 participants representing users, academia, professionals, providers, international organizations and policy-makers – involved in all aspects of assistive technology – participated in the global consultations. The consultations informed participants about key findings on access to assistive technology at global and country levels from the surveys and research work during the global report development. Thematic group discussions engaged participants to validate, challenge and suggest improvements of the recommendations, especially from regional and country perspectives. The consultations did not only lead to the final recommendations to be presented in the current report but also provided the opportunity for governments and stakeholders to reflect on their responsibilities, prioritize actions,[iii] and outline the way forward.

[i] The WHO Western Pacific Regional Office deployed an online platform to present a video tutorial on global report key findings and to collect feedback and inputs to the draft recommendations. The platform was open for two weeks for government representatives in the region to participate in the consultation.

[ii] Participating countries and territories: Afghanistan, Andorra, Armenia, Aruba, Australia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Belarus, Benin, Bermuda, Bhutan, Bolivia (Plurinational State of), Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burundi, Chad, Chile, Costa Rica, Cuba, Czechia, Democratic Republic of the Congo, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Georgia, Germany, Guatemala, Guyana, Haiti, Hungary, Iceland, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Israel, Italy, Jordan, Kenya, Latvia, Lebanon, Liberia, Libya, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mexico, Morocco, Myanmar, Nepal, New Zealand, Niger, Pakistan, occupied Palestinian territory, Papua New Guinea, Peru, Poland, Portugal, Qatar, Republic of Moldova, Romania, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Slovakia, Spain, Sri Lanka, Sudan, Suriname, Sweden, Switzerland, Syrian Arab Republic, Tajikistan, United Republic of Tanzania, Thailand, Tunisia, Turkmenistan, Ukraine, United Arab Emirates, United States of America, Uzbekistan, Venezuela, Viet Nam.

[iii] In the regional consultation in the WHO European Region, participating countries consented to priority actions through voting.

Recommendations

Every country has its own context to be considered to plan and develop the best path to improve access to assistive technology. Through the development of the current report, consultations at regional and global levels were organized to create platforms for exchanging knowledge, experience, practices and lessons learned among different countries and stakeholders (Box 7.1). These exchanges identified synergies and fostered collaborative thinking towards co-created meaningful, relevant and actionable recommendations that are owned by countries and stakeholders.

The following ten overarching recommendations are intended to guide countries and other stakeholders progressively in their work to improve access to assistive technology, in accordance with their commitments under the UN *Convention on the Rights of Persons with Disabilities (2)* and to achieve the Sustainable Development Goals (SDGs).

Recommendation 1: Improve access to assistive technology within all key development sectors

A national strategy and plan of action to progressively improve access to assistive technology should ensure that no one is left behind irrespective of age, gender or functional difficulty. An integrated approach to assistive technology provision involves all key development sectors – particularly health, education, labour and social services – ensuring that the needs of all users and potential users are met. Such provision can be included into essential health services (for example, ear and hearing care, rehabilitation, and services for older people and people with communicable and noncommunicable diseases, including neglected tropical diseases) and education at all levels.

A broad range of stakeholders including government ministries, organizations that represent users and their families, professional groups, NGOs and the private sector should be involved in developing, implementing and monitoring the national assistive technology strategy, which could either stand alone or be integrated into a complementary national strategy. Based on a situational analysis, the strategy should establish priorities with measurable outcomes. The strategy should be operationalized in a planned, phased manner, and specify concrete actions, targets, timelines and responsible agencies. Necessary resource allocations, including availability of trained personnel to support implementation of the national assistive technology strategy, should be ensured. Responsibilities for coordination, decision-making, financing, monitoring and reporting, and control of resources, should be explicit.

Recommendation 2: Ensure that assistive products are safe, effective and affordable

Ensuring that assistive products are safe and effective requires that: necessary regulatory systems and standards are in place; designers, manufacturers and providers are competent; and users and their families are trained on use and maintenance. As this often increases the costs for providing assistive products, consideration should be given to: cost-minimizing designs, manufacturing, business models and service delivery; reduced taxes and duties on assistive products and required materials; effective procurement processes; and health and social insurance coverage or other cost-reducing programmes. As affordability also depends on costs for travelling and loss of income for users and their families in accessing the services, adequate measures to reduce such indirect costs should be considered. UN agencies can use their procurement capacity and expertise to ease these barriers via international tendering accessible to governments and other relevant stakeholders to ensure that quality standards are upheld globally and drive best value for money.

Recommendation 3: Enlarge, diversify and improve human resource capacity

Knowledge, skills and attitudes of people working in all related sectors are important for improving access to assistive technology. Similarly, the knowledge and skills of professionals involved in all aspects of assistive technology are critical. Where needed, special efforts should be made to go beyond a focus on traditional assistive technology professionals, to build the capacity of available human resources at municipal, community and/or primary health care levels – this includes nurses and midwives, pharmacists, health workers, community-based rehabilitation workers, other allied workforces, and expert users and family members. Human resource

Incontinence products are essential for my child's independence, relationships and self-esteem.

George, Democratic Republic of Congo

capacity at all levels may be re-assessed periodically and can be enlarged and improved through education, training, recruitment, staff retention and task-shifting. Training on provision of assistive technology in humanitarian crises should be included where appropriate. The WHO Training on Assistive Products (TAP) and other similar materials can be used for training of the workforce.

Recommendation 4: Actively involve users of assistive technology and their families

Users should be seen as partners in assistive technology service provision, not passive service recipients. Users of assistive technology and their families often have unique insights about particular needs and their situation. Hence, they should be consulted and actively involved in every aspect at all levels of assistive technology. Sometimes users and their families or caregivers are good resources for minor repair, adjustments and maintenance of assistive products. Users and their families or caregivers can also spread the word about the benefits of assistive technology provision, and can provide regular feedback that is useful for upgrading and updating the products used.

Recommendation 5: Increase public awareness and combat stigma

Ensure policy-makers are aware of the need for – and benefit of – assistive technology, including its return on investment. Awareness about assistive technology and its uses and benefits should be raised to increase public understanding and political support, and to reduce stigma. Governments, users' organizations, professional associations, media, social and cultural associations (especially in sports) are examples of actors that can run campaigns to change negative attitudes towards the use of assistive products. Successful users, including para-athletes, are good role models for mitigating stigma and improving access.

Recommendation 6: Invest in data and evidence-based policy

Knowledge is essential to raise public and political awareness about assistive technology and to allocate adequate funding to improve access to it. Every country should have data on need, and on the demand and supply of assistive technology to understand the gaps and trends. To this end, the WHO assistive technology assessment tools can be used to get real data on the national assistive technology situation and context. To develop evidence-based legislation and strategies, and to plan, monitor and evaluate comprehensive programmes, it is necessary to invest in, collect and analyse relevant population-based data. Important, broad areas for study include: outcomes in terms of human rights and quality of life for users, their families and the community or country at large; affordability and availability of assistive technology; service delivery models; financing models; cost-benefits and cost-effectiveness of assistive technology from the perspectives of users, programmes and countries; enabling environments; and assistive technology in humanitarian crises. Establishing a mechanism for sharing experiences, information and evidence can support policy decision-making across sectors and countries.

Recommendation 7: Invest in research, innovation and an enabling ecosystem

The assistive technology sector is changing rapidly due to technological advances and evolving needs. Advanced materials science, artificial intelligence, digital technologies and new service provision models are creating new opportunities for the assistive technology sector to become more effective in reaching everyone, everywhere. New start-ups to support research and innovation in terms of products, services and solutions are opening doors for the assistive technology sector, and while this attracts investment, an enabling ecosystem is required to ensure that new assistive products reach the market and benefit users. It is essential to link users, researchers, innovators, universities and industries within and between countries, providing mutual learning, research and innovation opportunities. All research, innovation, and enabling ecosystem policies and programmes should be people-centred.

Recommendation 8: Develop and invest in enabling environments

The outcomes of assistive technology depend largely on the existence of enabling environments. Such environments are critical for everyone's independence, comfort and participation. Assistive technology and enabling environments complement each other, and access to one is often a prerequisite for using the other. Enabling environments are not only about accessible and inclusive physical and virtual environments, but also services and systems, support, relationships and attitudes. Stakeholders in all relevant sectors need to develop and invest in the environments they are responsible for to ensure that they are enabling for all people. Investment in enabling environments is a key prerequisite to optimize the purpose of assistive technology provision – to enable people to live independently and safely with dignity, participating fully in all aspects of life. It is important that users are actively engaged in developing enabling environment policy and programmes.

Recommendation 9: Include assistive technology in humanitarian responses

Ensuring access to assistive technology during humanitarian crises is a challenging task, but efforts must be made to ensure that users in crisis settings are not further disadvantaged and that new potential users can access the assistive technology they need. Assistive technology has the potential to mitigate the consequences of fragility, conflict and violence. In the context of humanitarian crises, access to assistive technology improves the quality of life, safety and protection of people with newly inflicted or pre-existing functional difficulties. Evidence suggests that the provision of assistive technology during conflict – and inclusive humanitarian responses – will increase community ownership, stability, and support peace-building processes in post-conflict situations. All stakeholders responsible for humanitarian responses, including governments, aid agencies, development organizations and civil society, should therefore include assistive technology provision in humanitarian plans and responses within and outside their countries. Active engagement of users must be sought from the planning phase.

Recommendation 10: Provide technical and economic assistance through international cooperation to support national efforts

International cooperation to support efforts to improve access to assistive technology is essential to reducing inequality and progressively achieving universal access to assistive technology, and is mandated in the UN *Convention on the Rights of Persons with Disabilities* (Article 32). Access to assistive technology should therefore be an integral part of international cooperation. It must involve governments, international or regional organizations, the private sector and civil society, and especially organizations representing users and potential users. Measures of cooperation should include technical or economic assistance in areas such as research, policies, regulations, fair pricing, market shaping, product development, technology transfer, manufacturing, procurement, supply, service provision and human resources.

Actors

The implementation of the overarching recommendations and the following actions require the involvement of different sectors and determined action from a range of stakeholders. While national governments have the most significant role, a non-exhaustive list of other stakeholders includes: users and their families or caregivers; organizations representing people with disabilities or older people, or people living with chronic conditions; service providers, professionals and their associations; designers and engineers; manufacturers; suppliers; academic institutions; communities; local authorities; public services; the private sector (including information, communication and technology companies); donors, funding agencies and investors; media organizations; NGOs and faith-based organizations; and UN agencies and development organizations.

UN agencies and development organizations must include assistive technology and enabling environments in their programmes; exchange information and coordinate actions; provide technical and financial assistance to build capacity and strengthen policies, systems and services for assistive technology and enabling environments; and collect and publish related data.

Actions

Recommendations can be operationalized by the following actions, ensuring that they are adapted to specific situations and contexts, and undertaken in feasible ways to progressively achieve universal access to assistive technology. Actions that are limited by human, technical or financial resources can be included in international cooperation (see Recommendation 10).

People

All stakeholders can work to:

- Engage users and their families in developing and evaluating actions in all areas of the assistive technology system and enabling environments.
- Educate the public and raise awareness about assistive technology, its uses and benefits, and the right to access assistive technology; support early identification of needs; improve access; increase acceptability; and reduce stigma and exclusion.
- Empower, develop the capacity of and engage users and their families in development and implementation of awareness raising; policies and provision; design and testing of assistive products; workforce training; and planning and undertaking research.
- Empower and develop the capacity of potential users and their families to identify assistive technology needs; to find and access services; to be involved in the service and product selection process; to use and maintain assistive products; and to follow-up and evaluate them to determine realized benefits and need for changes.
- Empower, develop the capacity of and engage users and their families in designing and evaluating enabling environments.

Policy

Policy actions are the responsibility of the whole of government, even if one or more ministries or agencies has a coordinating role and other stakeholders are actively involved. Key actions are to:

- Establish or assign one or more ministries or agencies to lead and coordinate work to improve access to assistive technology in the country.
- Collect data at regular intervals using the WHO rapid Assistive Technology Assessment (rATA) tool to understand the needs, as well as the demand and supply situation.
- Conduct a situational analysis to map the current assistive technology gaps, provision capacity, and to develop a national assistive technology roadmap.
- Recognize assistive technology as comprising essential health products and services, and as an integral component of universal health coverage.
- Develop and adopt a national assistive technology strategy and plan of action, together with all relevant stakeholders (including users) to progressively achieve universal access to assistive technology.

- Develop, strengthen, enforce and implement legislation, policies, regulations on assistive technology and enabling environments, including universal and barrier-free design.
- Adopt and regularly review a national essential or priority assistive products list based on population needs.
- Establish a regulatory system that ensures production, procurement and provision of effective, safe and affordable assistive products, including a surveillance system.
- Establish a regulatory system that ensures environments are enabling.
- Invest in provision of assistive technology and enabling environments, taking into consideration human rights and long-term benefits, and ensuring adequate funding to sustainably meet collective and individual needs for assistive technology and enabling environments.
- Implement effective and sustainable financing mechanisms for assistive technology, considering loans, instalments, rebates, vouchers and subsidies to increase affordability.
- Reduce or eliminate tariffs and taxes on internationally and locally produced and procured assistive products to increase affordability.
- Strengthen data collection and information management systems to ensure accurate estimation of population need, met need, and outcomes and impact, while monitoring assistive technology provision.
- Stimulate regional and international collaboration in research, innovation and learning.

Products

Designers, engineers, manufacturers, academic institutions, governments, users and their families, professional associations, service providers and investors can all act to:

- Develop an essential assistive products list based on the model WHO *Priority assistive products list*.
- Analyse manufacturing capacity to determine what assistive products can be manufactured in-country or imported. Invest in manufacturing where possible.
- Establish and regularly review standards that ensure assistive products are safe, secure and effective, including functional and technical specifications.
- Leverage resources and empower existing systems to increase innovation, design, manufacturing and repair capacity in relation to safe, effective, affordable and contextually appropriate assistive products.
- Consider aesthetics, gender and preference of different age groups in the design of assistive products to increase acceptability and reduce stigma and exclusion.
- Ensure secure connectivity and compatibility between digital assistive products and surrounding digital environments.
- Promote quality assurance mechanisms for assistive products, such as supporting the role of standards in design and manufacturing.


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- Develop and invest in innovative and emerging manufacturing and delivery strategies, such as mass production of components supplemented by additive or local parts, or customization.
- Aggregate demand by considering pooled procurement mechanisms to source safe and effective materials, parts and assistive products at optimal prices and to stabilize supply.

Provision

Provision varies across countries and involves different stakeholders, but overall it should aim to:

- Develop and strengthen coordination and referral networks and mechanisms across sectors (e.g. health, social, education, employment, etc.).
- Develop, adopt and promote quality standards or guidelines for services and procurement.
- Develop or strengthen effective national, regional or global procurement mechanisms to improve supply, quality, availability and affordability of assistive products.
- Ensure that contextually appropriate assistive technology is accessible and affordable in all geographic areas and available at all levels, especially at the primary/community level, including establishing or integrating provision facilities at appropriate locations and considering a one-stop-shop approach with services that can meet complex user needs.
- Establish or integrate alternative service delivery models (such as, mobile, tele-based or online services, and online distribution) to improve access and affordability.
- Develop and invest in effective emerging technologies, including secure digital technology, for affordable service provision.
- Ensure availability of safe, effective and affordable assistive products (including spare parts) at the point of provision and with sufficient quantity and range to meet demand.
- Ensure that facilities and services are accessible and inclusive for all users, regardless of type of functional difficulty, age, gender or any other social or personal characteristics.
- Ensure that services include assessment, fitting, user training, and follow-up; repairs and maintenance; and feedback from service users throughout the provision process.
- Engage peer-users in coaching and training users.

- Refurbish assistive products that can be reused to reduce costs and improve sustainability.
- Establish an information system to coordinate services and facilitate follow up for users, and to support maintenance of assistive products.
- Monitor and evaluate programmes for assistive technology provision.

Personnel

As appropriate, all stakeholders can work to:

- Identify required competencies, skills and number of personnel at different levels to adequately undertake tasks related to assistive technology.
- Develop and adopt a strategy and plan of action for enlarging and improving their human resource capacity, including education, training, recruitment, staff retention and task-shifting.
- Develop, adopt and promote standards for training programmes.
- Develop and conduct continuous capacity building, including face-to-face, online and hybrid training and education, mentoring, peer support, and job-shadowing, on all aspects of assistive technology for people in different roles.
- Expand the assistive technology workforce at all levels, especially in primary health care and/or at community level, to include cadres such as nurses, pharmacists, community-based rehabilitation workers, community health workers and teachers.
- Consider task-shifting where appropriate, from highly specialized to less specialized personnel to broaden access to assistive technology for users, while providing training and strengthening supportive infrastructure to maintain the quality of services.
- Train the assistive technology workforce at all levels to be flexible and agile, and able and capable of adapting to new assistive products and models of provision that include remote services.

Enabling environments

Although governments are responsible for ensuring that environments are enabling, all stakeholders can take important actions to:

- Develop and implement an action plan to create enabling environments, including products and equipment; the built environment; the virtual environment; the natural environment and human-made changes to the environment; services and systems; as well as support, relationships and attitudes.


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- Establish standards, guidelines, regulations or bylaws that ensure that environments are truly enabling, welcoming and can be used by all people, to the greatest extent possible, without the need for adaptation or specialized designs.
- Regularly review standards and guidelines to ensure that they match ongoing technical developments, especially in the areas of digital and emerging technologies.
- Analyse environments and the extent to which they enable functioning and prevent functional difficulties or injuries.
- Create enabling environments to ensure that people with functional difficulties have access to the physical environment, health care, education, transport, information and communications (including information and communication technologies and systems) and to other facilities and services open or provided to the public, regardless of where they live.

Humanitarian crises

In addition to previous actions, humanitarian stakeholders can undertake to:

- Establish or assign a multi-stakeholder taskforce to address assistive technology in humanitarian crises.
- Develop and conduct training to raise awareness of humanitarian crises among assistive technology professionals, and to help humanitarian actors understand assistive technology.

- Develop a global assistive technology-inclusive humanitarian response action plan.
- Develop and integrate an assistive technology provision and coordination framework for humanitarian crises across all concerned sectors.
- Include provision of assistive technology within national humanitarian action plans, or emergency preparedness and response plans.
- Ensure funding is adequate to implement humanitarian action plans, emergency preparedness and response plans, including ring-fencing humanitarian and development funding for provision of assistive technology in humanitarian crises.
- Include need for and access to assistive technology in needs assessments for humanitarian crises.
- Develop an essential assistive products list for humanitarian settings.
- Expand supply catalogues for humanitarian crises to include safe, effective and affordable assistive products.
- Develop assistive products and service delivery methods intended to meet assistive technology needs in humanitarian crises.
- Establish coordination systems to facilitate information, referral, procurement and delivery of assistive products in humanitarian crises.
- Link provision of assistive technology in humanitarian crises to national systems to ensure long-term sustainability and equity between affected populations and others.
- Strengthen national assistive technology systems so they are responsive to the needs of all people who may be affected by humanitarian crises, including displaced people.
- Ensure that all aspects of the environment are enabling.
- Include indicators on access to, and use and outcomes of, assistive technology in monitoring frameworks for humanitarian response.
- Undertake research in humanitarian crises to identify key gaps in, and specific actions to improve, access to assistive technology.

My child is able to learn and send messages on her smartphone and do other activities.

Pramod (51), India

Annex

Method for modelled estimates of prevalence of need for assistive technology

Generalized linear regression models were used to estimate the prevalence of need for countries based on the independent variables: HDI (2019) and its components, median age of the population (2020), the employment to population ratio (2019) and the ratio of population living in areas classified as urban (2019) provided by Human Development Data Center, Human Development Report (http://hdr.undp.org/en/data, accessed September 2021). Population structure data (2020) was provided by the United Nations' Department of Economic and Social Affairs Population Dynamics (https://population.un.org/wpp/Download/Standard/Population/, accessed February 2022). The models were based on a subset of independent variables using stepwise feature selection and the measured prevalence of need as the dependent variable from the national and subnational representative self-reported population surveys presented in the report. HDIs of the subnational representative population surveys refer to the regions where the survey took place. The prevalence of need for assistive products in the whole population and in the populations of different age groups was estimated by the weighted mean prevalence adjusted to the population sizes of countries. The uncertainty limits were estimated as the weighted mean of the upper and lower bounds of the 95% confident intervals for the estimated prevalence for each country. Confidence intervals of the prevalence of need at 95% significance was calculated using Sheffe's method. The statistical modelling was conducted with the 2021b version of Matlab (MathWorks). Due to the availability of the data at the time of the report development, limitations of the modelled estimates could have been attributed to the following: a) the small number of surveyed countries providing measured prevalence of need for model training; b) the measured prevalence of need of several surveyed countries did not represent the whole national population; and c) the independent variables (i.e. the HDI, median age of the population, etc) and the dependent variable (i.e. the measured prevalence of need) were from close but different years.

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