Global report on assistive technology[1]

Foreword

Ms Catherine M. Russell
UNICEF Executive Director

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 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

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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.

Dr Tedros Adhanom Ghebreyesus
WHO Director-General

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 peoplecentered, 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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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 relevant units within the Secretariat and in collaboration with all relevant stakeholders.

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

- presents a comprehensive dataset and analysis of current assistive technology access;
- draws the attention of governments and civil societies to the need for, and benefit of, assistive technology, including in relation to 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 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 devices 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 disability; 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 rises 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 domain-related 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 have been 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 from these countries 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 with the Human Development Index, a composite index of life expectancy, education, and per capita income indicators.

Seventy Member States responded to 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 fully or partly for assistive technology. 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 on 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, and 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 peoplecentred, 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 components: products, provision, personnel and policies. Where possible, assistive technology should be integrated within health and social care systems.

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 as needed by the individual considering 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 procured and provided, as well as the efficiency of delivered services, need to improve. Including assistive technology in universal health care and social care services is an important part of this.

Personnel: The workforce required to ensure access to assistive technology for everyone, everywhere 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 task-shifting, task-sharing and training of community level workers. Adaptive staffing models and good retention strategies are vital.

Policy: Policy is an overarching component of the previous three components. It also 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.

Preparing for assistive technology in humanitarian crises

Every crisis, especially war and conflicts, creates a greater demand for assistive technology, but its provision is still not a priority in emergency response. Approaches to reducing barriers to assistive technology in humanitarian settings include designing and producing assistive products that are appropriate for humanitarian settings, and including assistive products in catalogues and lists 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 medi-

cal or health care teams are triaging those in need, and that stakeholders involved in all stages of a humanitarian response – from community to international level, and from managers to staff and volunteers – are trained in inclusive policies and practices that incorporate assistive technology awareness 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 disabledfriendly, 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 to have an integrated or standalone assistive technology policy and plan of actions 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, not passive service recipients. Assistive technology services need to be organized around the person and the environment they live in, not the disease, impairment or the financing. Users and their family members or caregivers can be encouraged and trained to do simple repair, 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 evidencebased 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, 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 taskshifting can be adapted and translated rapidly. Integrated 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. Inter-

national cooperation is essential to reducing inequity and progressively achieving universal access to assistive technology – and leaving no one behind.

Introduction

Considering that a 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 need 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 policymakers, 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 profes-

sionals 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 Introduction 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 various 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 subnationally 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.

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 access assistive technology, 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 multistep 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 devices 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; 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 overcoming 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 selfcare, 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 selfmanagement, 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, development and maturation will mean 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.

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 having 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..."

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)*.

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 re-

habilitation, 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 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 in-

dependent 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 GDP 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 persons 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, 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.

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.

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)*.

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

Maximilian (23), Australia

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 moodtracking 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 persons with mental health difficulties *(66)*. The potential benefits of assistive products related to mental health include personcenteredness, 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)*.

Everyday activities

Assistive products support people with functional difficulties in everyday activities to increase their wellbeing, 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 impact 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[2] 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[3]. 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. psycholog-

[2] 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)*).

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

ical 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)*.

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 glasses a nd 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.

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)*.

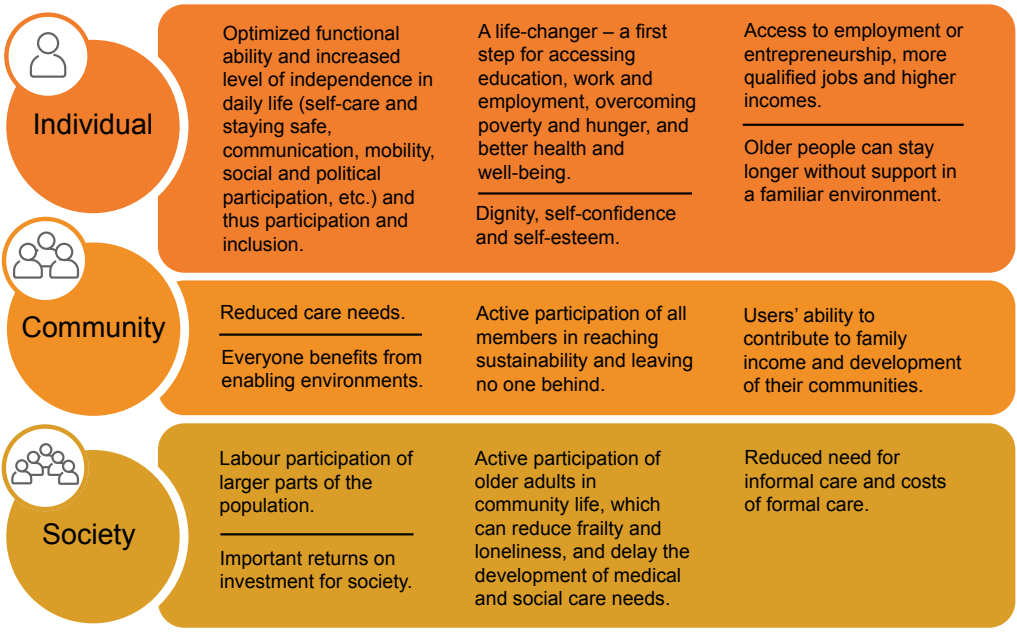
Enabling older persons to remain in their local community and maintain their social networks for as long as possible may bring significant financial advantages in terms of health care and welfare expenditure *(92)*. Compelling evidence suggests that investment in deploying assistive products in older 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).

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).

Figure 1.1. Benefits of assistive technology at different levels



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)

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.

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 virtually no services in other places. In some countries with extensive universal public health and wider welfare programmes, governments provide full or partial funding for assistive technology not only under health, 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 wishes. In a medical setting this will very often lead to a prescription, while in a social or educational setting budgets will be available and expenditure will have to be authorized. It is not uncommon that the actual provision of assistive products is 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).

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

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 get in touch with a health care or social worker who refers them to a rehabilitation facility, or a camp organized by an NGO or a local health care organization. In some countries assistive products are provided through

charitybased NGOs, but in other countries, products are typically supplied by a combination of government, nongovernment, private sector and organizations of persons with disabilities (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 eco-systems 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.

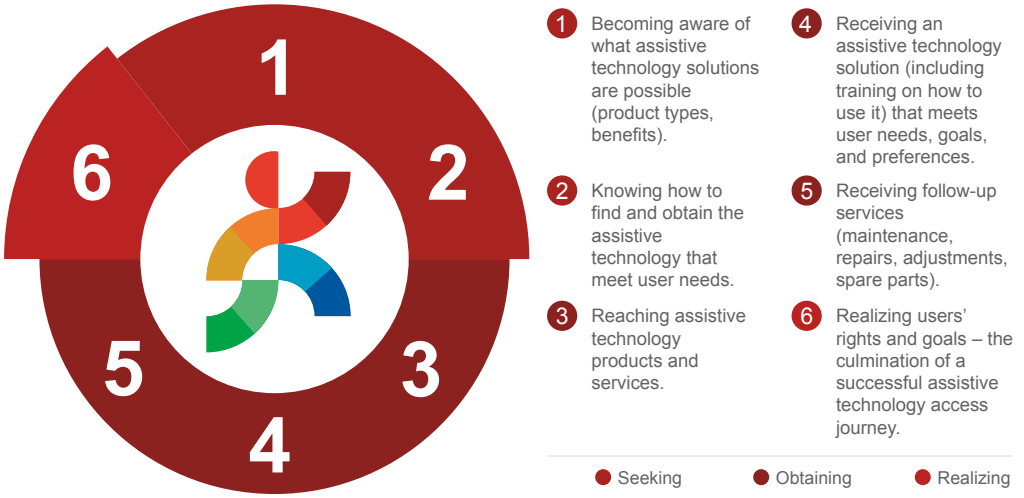
GDI Hub hosts the WHO's Collaborating Center on Assistive Technology at UCL engineering and was a founding partner of ATscale, and continues to work closely to share "what works" in order that it can be scaled. The collective mission is to transform assistive technology access for the billions of people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

Source: www.at2030.org

Whatever the situation, the person in need, or a family member, health care worker, school teacher, etc., must realize that assistive technology is a good solution to improve functional ability and participation, or that with new or additional assistive products and an enabling environment the situation can be improved. 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: seeking, obtaining and realizing (**Fig. 1.2**). A successful peoplecentred 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. Six steps (in three phases) of the assistive technology access pathway



Notes: Step 3: These should conform to the *International Classification of Functioning, Disability and Health* (ICF) principles of universality, parity and etiological neutrality, neutrality and physical and social environments *(6)*; Step 4: User needs are both physiological and environmental, and encompass: their capabilities, goals, preferences and psychosocial characteristics; expected assistive technology benefits; and contextual conditions *(98)*.

Many people search for information about assistive products themselves and directly purchase equipment from companies. Existing databases, such as those aggregated by EASTIN *(99)* (**Box 1.8**) and assistive technology user platform in Shanghai *(100)*, can help provide information. This route can be quick, 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: products, provision, personnel, and policy *(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 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'.

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)*.

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.

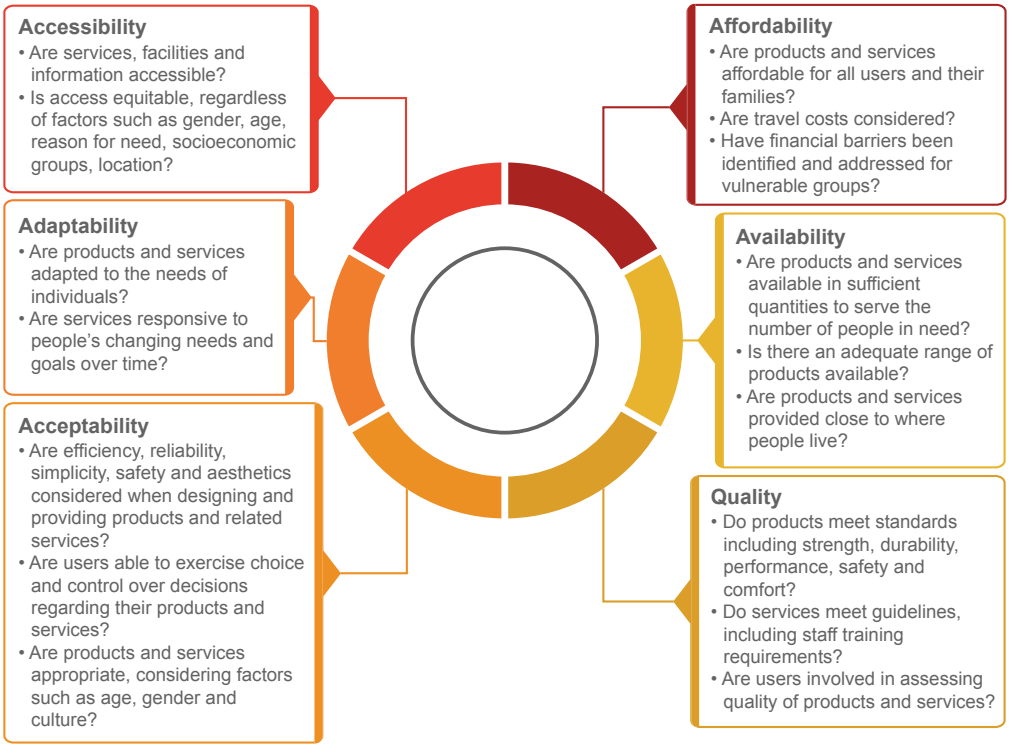
Examples of the active engagement of users and potential users across the components of the assistive technology system include:

- **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, provided.
- **Personnel** – direct service personnel receive training in how to be responsive to user preferences when conducting assessments and selecting products.
- **Policy** – users are the key stakeholders in policy-making, raising demand and supply, implementation, monitoring and in providing feedback.

Principles of assistive technology access

Answering questions related to 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 experienced along the assistive technology access pathway. These principles are woven within all assistive technology system components. 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.

Figure 1.4. Principles of assistive technology access



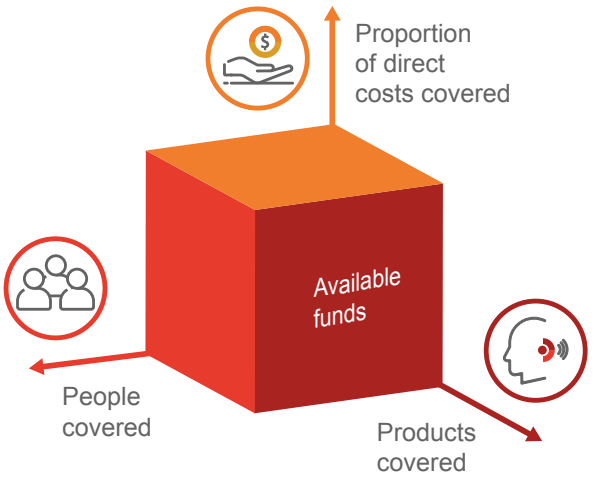
Source: Joint position paper on the provision of mobility devices in less-resourced settings: a step towards implementation of the Convention on the Rights of Persons with Disabilities related to personal mobility. Geneva: World Health Organization; 2011 *(2)*.

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 waste of public resources and also needs not being optimally met.

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 partic-

ipation. 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 persons 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 Convention on the Rights of the Child

The *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)*.

Figure 1.6. United Nations Sustainable Development Goals

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.

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.
  - » More than 50% of people found their assistive products were suitable for different environments and activities, and were satisfied with the related services.
- 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 signing or ratifying the UN *Convention on the Rights of Persons with Disabilities*, and the existence of legislation, policies and public budgets, the population need for assistive products was far from being fully met in most countries. Further attention and improvements are required to make assistive technology affordable and accessible for everyone in need.

Data are essential to formulate and implement evidence-based policy and programmes. In relation to assistive technology, data on population needs and access, barriers to access and system preparedness for provision are important 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 measure access to assistive technology 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 us-

ing findings from a government survey.[4] Available evidence published in relevant literature and reports are discussed to complement the understanding of access to assistive technology in different scenarios.

Population access to assistive technology

Methodology for measuring population access to assistive technology

Needs for and access to assistive technology are influenced by many factors, including a person's functional ability, level of awareness, socioeconomic status, living context, and interaction with the environment. Fully understanding the need in the population and identifying the key barriers to accessing assistive products are key 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 data on self-reported access to assistive technology.[5] Selfreporting is a feasible and valid survey method, especially in resource-limited contexts. The 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:[6]

- Prevalence of need: the sum of the prevalence of met need and the prevalence of 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

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

[5] 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.

[6] As the definitions of indicators may be different from that used by individual countries or institutes, the presented estimates may not be the same as a country's official estimates for the same indicator.

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.[7]

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**.

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)
Mobility	12.1% (5.9%–21.6%)
Seeing	20.9% (8.5%–64.3%)
Hearing	4.8% (2.7%–11.5%)
Communication	2.4% (0.7%–7.9%)
Cognition	6.4% (1.4%–24.8%)
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,[8] 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: canes and crutches; chairs

[7] 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.

[8] 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.

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[9] in the surveyed countries.

Assistive product need and access

The prevalence of need for assistive products including spectacles[10] ranged from 9.9% to 68.9% (median: 24.7%) and increased in countries with higher Human Development Index (HDI) scores,[11] 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**). 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 prevalence of need for and access to assistive products in surveyed countries with low, medium, high and very high human development status are summarized in the **Table 2.3**.

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

Assistive products	Prevalence of need (%)			Access (%)
	min	median	max	median
Spectacles	4.60	18.5	65.1	53.7
Canes	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

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

[10] Given that spectacles are the assistive product most predominantly in need in most countries, the same indicators were analysed including and excluding spectacles.

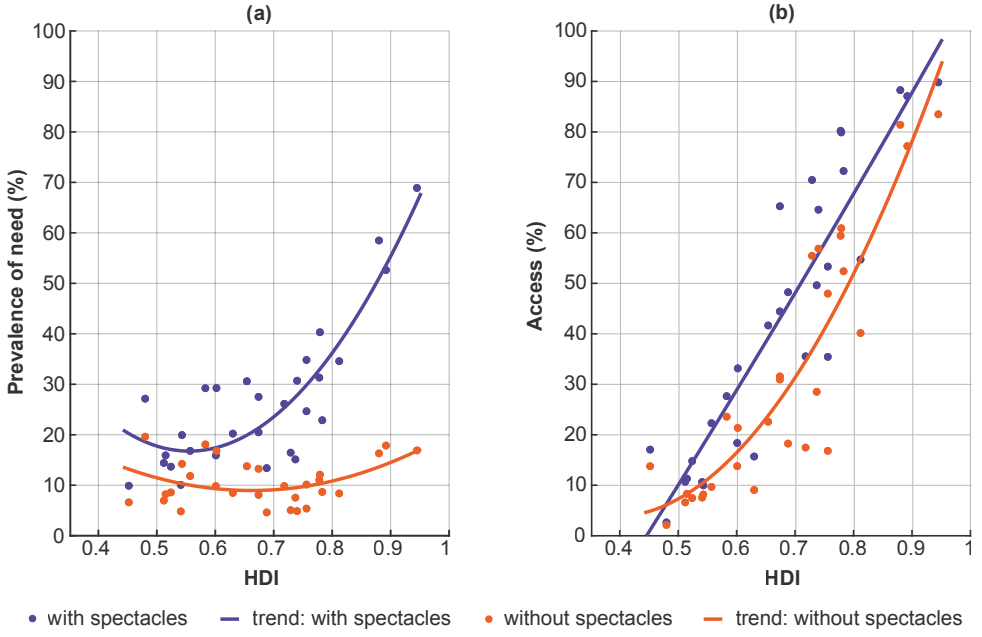
[11] The Human Development Index (HDI) is a statistical composite index of life expectancy, education (mean years of schooling completed and expected years of schooling upon entering the education system), and per capita income indicators. A higher HDI score indicates longer lifespan, higher level of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

Assistive products	Prevalence of need (%)			Access (%)
	min	median	max	median
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
Alarm signalers	0.00	0.08	1.76	0.61
White canes	0.00	0.09	1.38	16.7
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

Assistive products	Prevalence of need (%)			Access (%)
	min	median	max	median
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.

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.

Table 2.3. 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 in the population including spectacles** (median and range)	**Access to assistive products among population in need 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 in the population excluding spectacles** (median and range)	**Access to assistive products among population in need 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%)

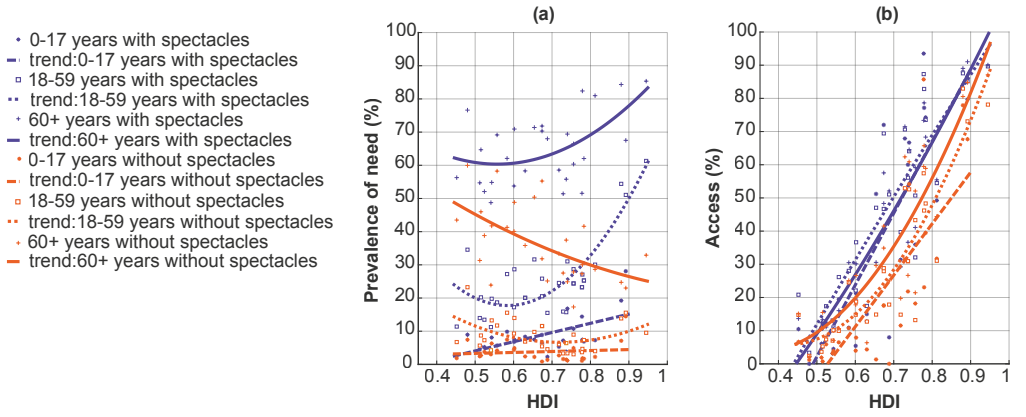
Notes: HDI classifications are based on HDI fixed cutoff points, which are derived from the quartiles of distributions of the component indicators. The cut off-points are HDI of less than 0.550 for low human development, 0.550–0.699 for medium human development, 0.700–0.799 for high human development 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).

The prevalence of 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 different age groups increased in countries with higher HDI (**Fig. 2.2b**).

The differences in the prevalence of need for assistive products between males and females were examined by the ratio between the difference in prevalence to the mean prevalence. The ratios of the difference in need including spectacles varied from 0.4% to 70.9% and from 0.4% to 63.1% excluding spectacles, respectively. Females had a higher prevalence of need including spectacles than males in most surveyed countries (**Fig. 2.3a**). There was a tendency that males had higher access

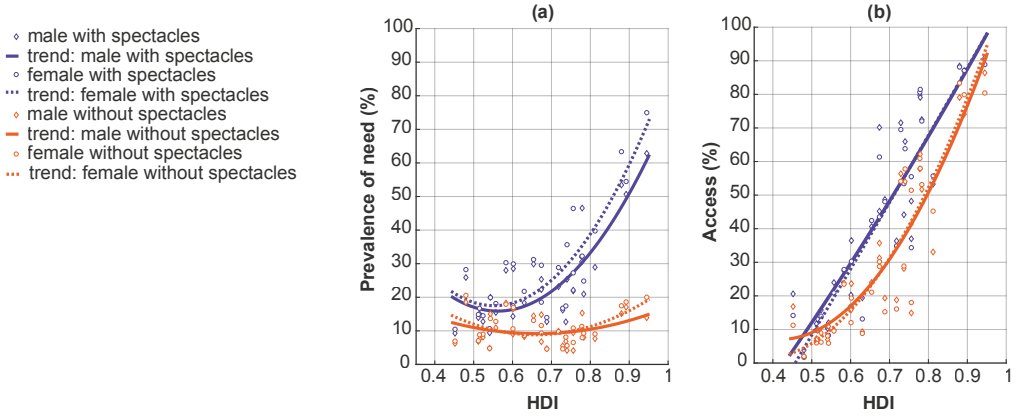
including spectacles in most surveyed countries (**Fig. 2.3b**). This tendency increased in countries with lower HDI.[12]

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.

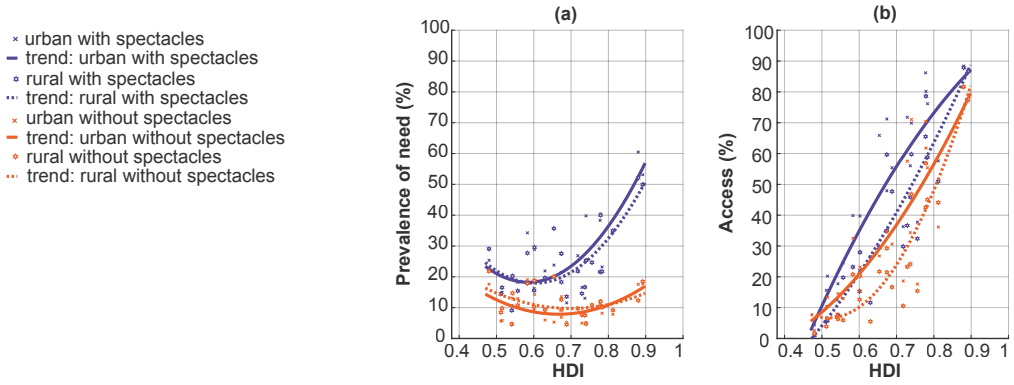
Figure 2.3. Prevalence of need for (a) and access to (b) assistive products, by sex



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

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.

The ratio of the difference in the prevalence of need among populations living in rural or urban areas across surveyed countries was between 0.1% and 55.9% including spectacles and ranged from 1.0% to 116.1% when excluding spectacles. 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**). 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 surveyed countries with lower HDI.[13]

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 highincome 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,

[13] 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: $\rho = 0.53$, $p = 0.007$).

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[14] 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 to 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 the 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**).

Global estimates of needs for assistive technology

Based on the presented, 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 other or more assistive products than spectacles. About two thirds of the global population of age 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**).

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

[14] 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.

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."

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.[15] 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,[16] 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 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; selfperceived functional abilities being one. It is therefore reasonable that

[15] 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.

[16] 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).

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.

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 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**).

Table 2.4. 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)

A rATA survey in September 2019 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 products found mostly in need were for vision (57%, Sierra Leone) and for speaking and communicating (42%, Indonesia).

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 age between 2 to 17 years, 51% among people between 18 to 59 years older, and 85% among those aged 60 years and older, respectively.

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

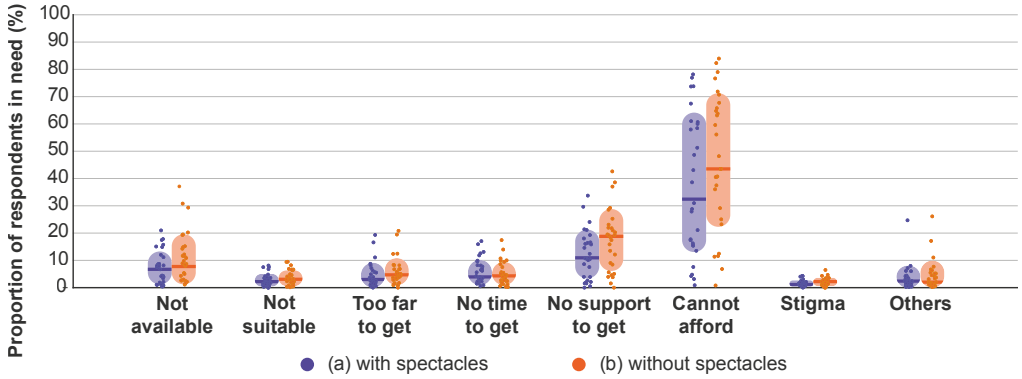
A rATA survey carried out with users of outpatient rehabilitation services provided by the public health care system in São Paulo, Brazil revealed that of the 929 surveyed participants: 50% of the survey respondents needed assistive products excluding spectacles, among which 22% reported a need for hearing 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%), canes (14%) and lower limb orthoses (10%).

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.

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

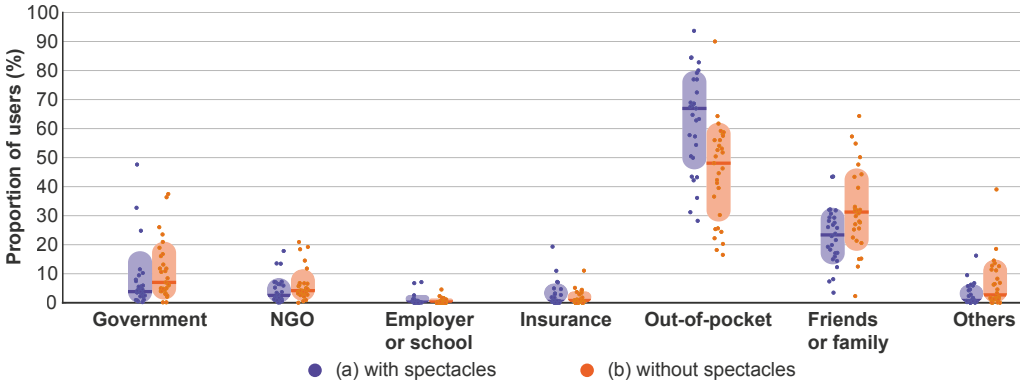


Notes: The proportions of responses in each surveyed country are represented by individual markers. The medians and the 25th and 75th percentiles of the proportions are represented by horizontal lines and vertical bars. Survey respondents can choose multiple answers. Data from Pakistan do not include 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**).

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

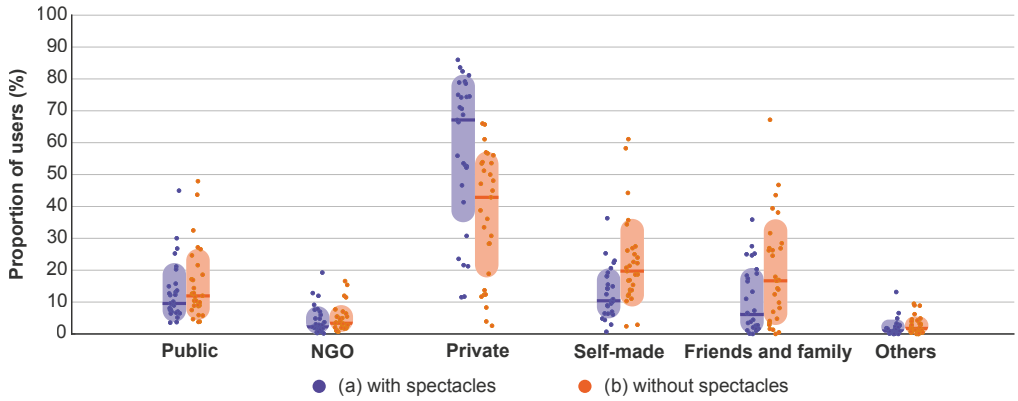


Notes: Respondents could choose multiple answers. Data from Pakistan did not include response options of "Friends or Family" and "Other".

Private shops, clinics or pharmacies were the source 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 private sector as the source decreased (median: 42.9%) and self-made products and products provided by friends and families[17] increased (**Fig. 2.7**).

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

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

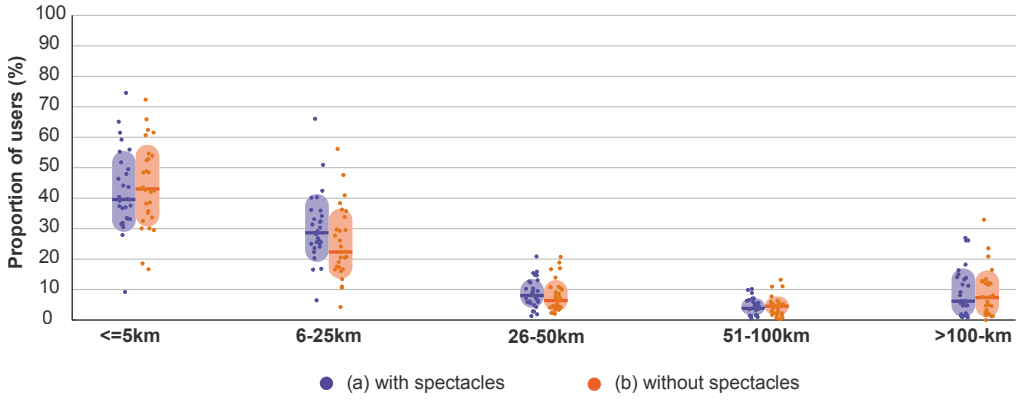


Notes: Respondents could choose multiple answers.

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**).

Sufficient funding and easily accessible sources are fundamental for improving access.

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

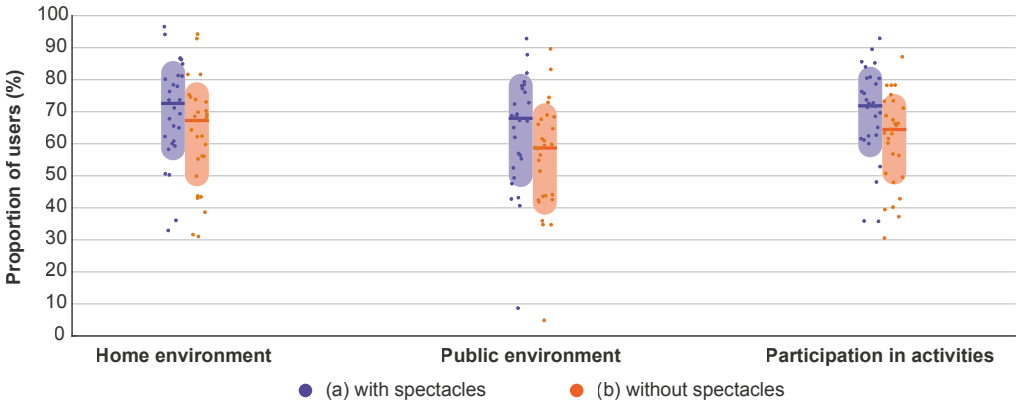


Users' experience of assistive products and related services

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**). The majority of the users in surveyed countries were satisfied with their products (median with spectacles: 80.2%; without specta-

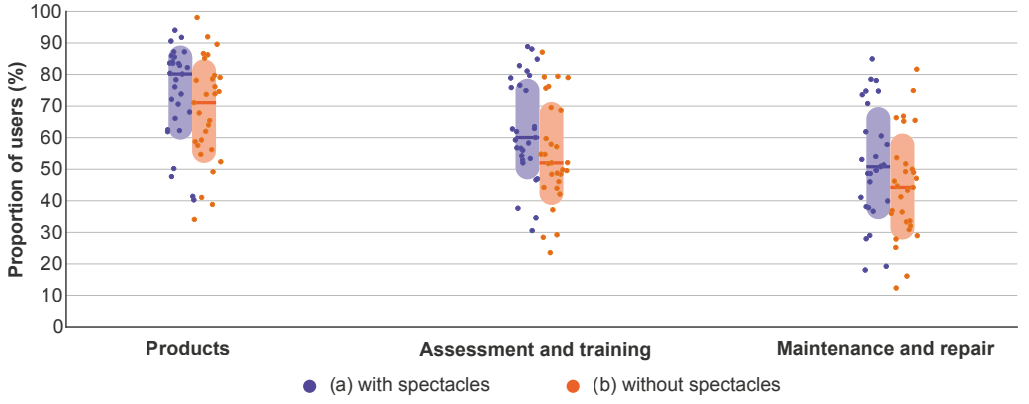
cles: 71.1%). Satisfaction was reported with the services related to assessment and training, and was lower with those related to maintenance or repair (**Fig. 2.10**).

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.

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



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

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 of the public health care System in Sao 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 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%).

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

System preparedness for providing assistive technology

Methodology for measuring system preparedness for providing assistive technology

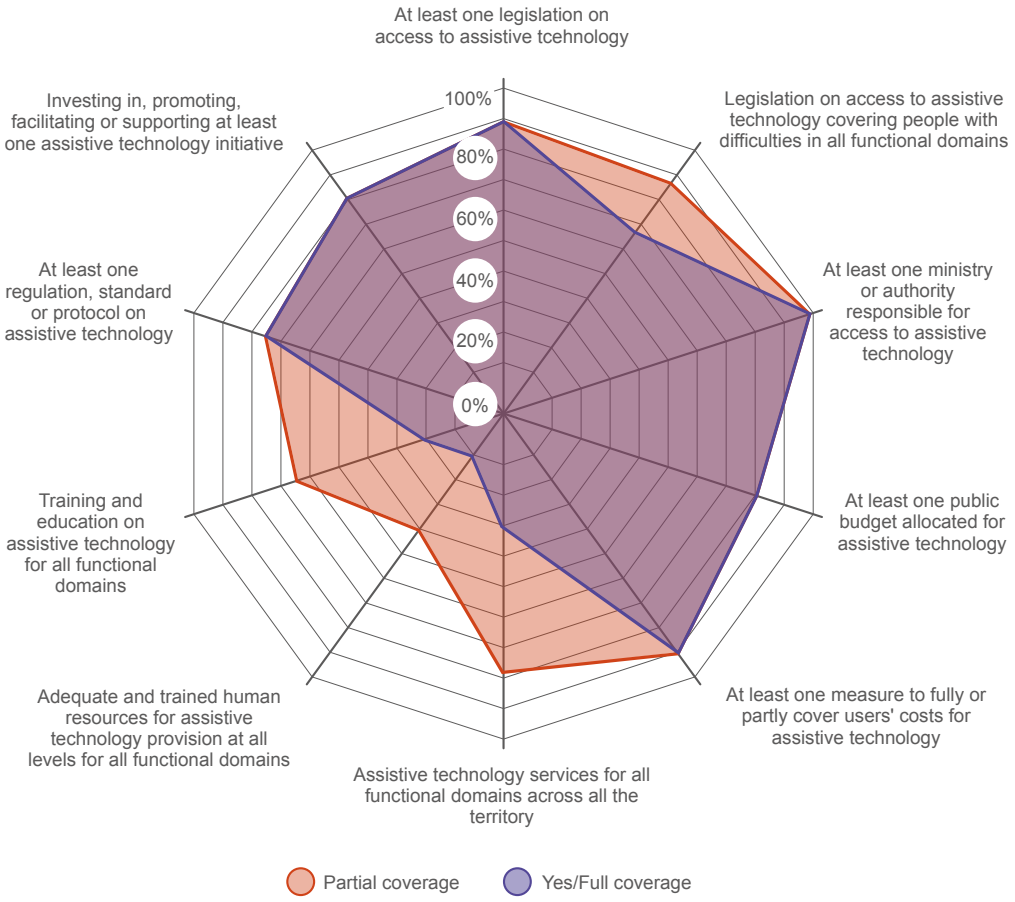
In response to the request in World Health Assembly Resolution WHA71.8, WHO developed a set of indicators[18] to measure Member States' progress in improving access to assistive technology up to 2030. The progress indicators measure system preparedness in terms of: governance; legislation; public budget; 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[19] had completed the survey through the focal points in ministries of health or other relevant ministries and/or government agencies.

[18] For the set of indicators for data collection in 2021, see https://apps.who.int/iris/bitstream/handle/10665/354084/WHOMHP-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.

[19] 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 2.11. 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.

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%) of 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 a 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.

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/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 barrierfree 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, such as service delivery capacity (41 countries, 59%), product procurement (40 countries, 57%), information to users and families (38 countries, 54%), collection of data on populationbased 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%).

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 need 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 in 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.

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 assistive technology service availability 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 of the 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 cover 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**).

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 guar-

antee 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.

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 selfreported 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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