Global report on assistive technology[1]

Section 4
Improving the assistive technology system

Key messages

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

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

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

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

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

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

Products

Increase assistive product supply

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

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

Invest in assistive product innovation

Increased investment in the research, development and commercialization of assistive products and parts is needed in the public and private sectors, and both nationally and globally. Including person-centred assistive product development and entrepreneurship training in college and university curricula could nurture new inventors and businesses to address unmet needs *(164)*. Leaders in the global assistive technology sector are

well-positioned to advance innovation that focuses on populations with the greatest unmet needs or people living in remote locations.

Most research and development in the assistive technology sector has focused on higher-income settings although the greatest unmet needs are in low- and middle-income countries. Unmet needs for assistive products that are identified by users and direct service providers can result in innovative designs suited to the local context (Box 4.1), *(161,165)*. Designing assistive products with local use and repairability in mind, and then testing products in the social and physical environment for which they are intended, is necessary to ensure uptake and sustained use *(166)*. Regulatory requirements must also match the environment to ensure product quality (e.g. durability and safety) and fit for purpose *(153)*.

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

Box 4.1 Increasing supply of wheelchairs (Tajikistan)

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

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

Utilize emerging technologies

The World Intellectual Property Organization (WIPO) report on developments in the field of assistive technology *(169)* presents an overwhelming number of advances in seven major emerging technology domains that will very likely have an impact on the field of assistive technology: artificial intelligence; human–computer interfaces; sensor technologies; robotics (Box 4.2); advances in computing and connectivity; additive manufacturing; and new materials.

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

Box 4.2 Robotics – an emerging technology

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

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

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

Sources:

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

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

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

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

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

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

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

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

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

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

Extend product lifespan

Extending an assistive product's life and value through repair and refurbishment can be quicker and more cost-effective than purchasing new products *(170)*. Abandoned products also generate waste. Reuse of assistive products through repair, refurbishment and repurposing materials has been proposed as a strategy to reduce environmental impact while bringing economic benefits to local communities where reuse activities are located (Box 4.3) *(171)*.

Meet Kimiko

Japan

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

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

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

Strengthen and harmonize product standards

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

The International Organization for Standardization (ISO) and its national affiliates establish technical assistive product standards to harmonize the sector globally, encompassing design, manufacture and testing. The 2016 ISO 9999 classification system for assistive products includes 945 product titles that are classified according to function (e.g. assistive technology for self-care activities). Countries have adapted ISO 9999 to match local context, relied on other global standards (Box 4.4) or developed their own product standards and classification system. For countries with existing regulatory infrastructure, establishing local product testing facilities and surveillance systems to monitor assistive product performance may be feasible.

Streamline regulatory procedures

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

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

Box 4.3 Refurbishment at assistive technology centres (Norway)

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

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

Box 4.4 Adaptation of WHO assistive product specification documents (China)

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

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

Build efficient and responsive supply chains

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

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

Improve functioning of the assistive technology market

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

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

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

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

As understanding of assistive technology demand grows, making it easier for all market actors to operate becomes paramount. Recommended strategies that facilitate market participation by key stakeholders along the supply chain (e.g. manufacturers, suppliers, dealers, regulators) include:

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

Provision

Improve information and referral systems

A well-designed information and referral system helps identify the best assistive technology access pathway (in terms of proximity, affordability and accessibility) to meet users' changing needs. Increasing coordination and cross-referral among health, education and social welfare ministries or local authorities, and the organizations providing assistive technology will help achieve this in the short term, while long-term

efforts are made to create a more integrated assistive technology system, preferably within universal health care. When there are multiple providers with diverse financing mechanisms for assistive technology within a country, the type of assistive products covered by each mechanism may vary. A well-coordinated approach is required to ensure universal access and prevent waste and duplication. A referral system can be designed to capture users' type of coverage (e.g. a specific medical aid plan) to refer them to the most affordable providers.

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

Expand provision coverage

For an assistive technology system to meet the assistive technology provision needs of a population (example in Box 4.5), its supply, facilities, and workforce capacity, including distribution, need to be planned accordingly. But it is not sufficient that the overall system can provide the required quantity of assistive products and accompanying services. To improve access, assistive technology needs to be affordable and available close to the community. Facilities should be as decentralized as possible beyond secondary and tertiary levels. Integrating simple assistive technology provision within the primary/community health care facilities will improve early identification and intervention, access and use *(153,179)*. Increasing the range of services (e.g. repairs) at primary/community health care facilities will have the greatest reach and impact.

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

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

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

Melanie (49), United Kingdom

Box 4.5 Annual provision of selected assistive products in Sweden through universal provision system

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

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

Improve services

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

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

For children, conducting assessments as early as possible is recommended, as assistive technology access can prevent secondary impairments (e.g. contractures or deformities), facilitate early childhood development and prepare the child for schooling and other activities. Even a year of missed education can have negative, long-term impacts on academic achievement and other developmental indicators. Compulsory screening for hearing and vision impairments in primary schools has been an effective approach to identify unmet needs. Designing services that are easily accessed by children at a young age may require collaborative assistive technology provision by ministries of education and health *(183)*.

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

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

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

Professionals, and the International Society of Prosthetics and Orthotics are examples of associations that maintain a network of thousands of country-level members for disseminating standards.

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

James (24), USA

Innovative provision models

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

Services can also be delivered outside hospital and health care facilities (e.g. at mobile clinics, by home- or community-based services, or via telemedicine or telerehabilitation approaches) and by a range of trained providers. Telehealth, telemedicine and telerehabilitation are growing areas for provision of rehabilitation and assistive technology and may help overcome geographical barriers. For example, to address hearing difficulty, telemedicine has been used for screening, diagnosis and hearing aid fittings *(186)*. Vision screening of students at a school used a smartphone app and those with visual impairments were then referred to eye care services *(187)*. The COVID-19 pandemic has accelerated the growth of virtual provision in health care and education while also highlighting disparities in digital access *(188)*. Advancement of digital health and greater access to mobile phones, coupled with enhanced digital literacy, bring new opportunities for developing innovative provision models. During the COVID-19 pandemic, when most rehabilitation or assistive technology centres were either closed or operating with reduced capacity, the need for digital health and remote service delivery models became more evident.

Implementation of national provision models takes time, government leadership and broad stakeholder collaboration, as the example of Norway's model of universal access to assistive technology demonstrates (Box 4.6)

Box 4.6 Universal access to assistive technology (Norway)

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

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

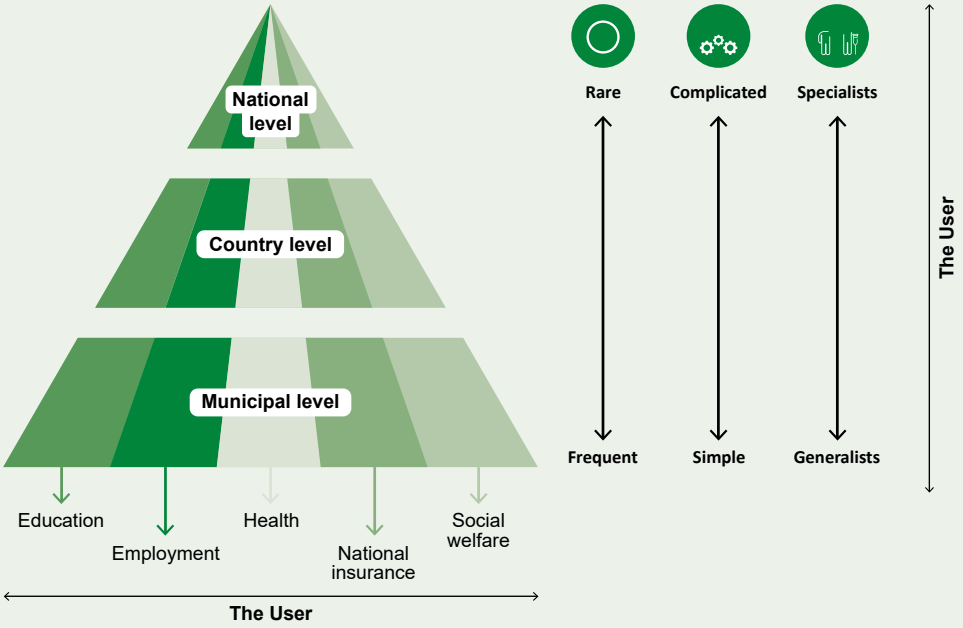
Today the system comprises 17 multidisciplinary assistive technology centres (one in each province), and the Ministry of Labour and Welfare Administration is responsible for funding, procurement and capacity building. Assistive technology is provided free of charge for people with disabilities and its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

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

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

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

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



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

Expand and improve procurement

National procurement mechanisms are powerful tools for reducing costs and increasing the range, quantity and quality of assistive products in each country. Technical product specifications, standards, types, quantities and services tend to determine assistive product availability for multiple years at a time.

Commonly needed spare parts for products can also be included in procurement specifications based on product lifecycles. Procurement guidelines may be unique to each country, in order to match the assistive technology needs and procurement mechanisms.

WHO and UNICEF procurement manuals and other similar resources could assist the buyers procure quality assistive products *(179)*. The development of procurement documents (e.g. ministry of health or social welfare tenders) generally involves technical experts, clinical experts, industry representatives, advocates and other stakeholders to ensure that the assistive technology procured meets standards and addresses unmet needs. Procurement committees that specialize in product categories (e.g. low vision or cognition) are then tasked with reviewing and updating procurement specifications to incorporate evolving standards, best practices, and product innovations. Well-designed tenders and robust standards can also address challenges within the procurement and provision system (e.g. through fair pricing guidelines that eliminate high price mark-ups). UN agencies can use their capacity and expertise to support governments and other relevant stakeholders in procurement (Box 4.7).

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

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

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

Improve product delivery

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

and vaccines in areas with poor transport infrastructure or during crisis situations *(192,193)*.

Assistive products available directly in the open market (e.g. physical or online retailers) do not require delivery through the health or other systems (Box 4.8). If direct buying information is available, users can choose to purchase a product (e.g. pill organizer or cane) closer to home (e.g. local pharmacy) instead of travelling further to the local health clinic. Technological advancements can also serve to reduce the complexity of service delivery (e.g. downloading a magnifier application to a smartphone or making the font bigger in tablets or phones).

Box 4.7 UNICEF and WHO call for global tenders on hearing aids and wheelchairs

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

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

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

Box 4.8 Over-the-counter assistive products

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

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

Conduct research to generate improvements in provision

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

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

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

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

Personnel

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

Figure 4.1. Assistive technology direct service personnel

Identifying and closing personnel gaps

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

1. Take stock of assistive technology staffing across all levels of the assistive technology provision system and validate that against the need. The WHO rapid Assistive Technology Assessment and Capacity Assessment tool can be used for this *(194)*.

2. Identify the ideal personnel composition, quantity and distribution required to move towards universal access to assistive technology.
3. Identify, implement and evaluate strategies to address short-term and long-term personnel gaps.
4. Use task-shifting and -sharing methods to engage other health care professionals in universal access to assistive technology (e.g. nurses, pharmacists and community health workers).

Health-related

Within the health sector, rehabilitation professionals (including occupational therapists, physiotherapists, prosthetists, rehabilitation technicians and speech and language therapists) provide a range of assistive products. Hearing and vision assistive products are typically provided by audiologists, audiometric technicians, and opticians, among others. In many countries, nurses and health workers with necessary training also provide simple assistive products such as canes, crutches, protective footwears, pill organizers and magnifiers.

Social welfare-related

Within the social welfare sector, social workers can provide a range of assistive products, especially for the home, such as canes, toilet chairs, pill organizers, personal alarms, social robots and robotic vacuum cleaners.

Education-related

Within public and private education at all levels, special education teachers and other disability and assistive technology specialists (e.g. Braille or sign language teachers) often provide assistive products and specialized services for students with a range of disabilities to facilitate equitable access to educational and learning opportunities (see Sukanya' story).

Workplace-/occupation-related

Occupational therapists, vocational rehabilitation professionals and other types of assistive technology practitioners are tasked with providing workplace accommodations such as adaptive computer hardware and software, and accessible workspaces.

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

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

is recommended that this cadre of assistive technology generalists be prioritized to increase the number of personnel and improve access *(195)*.

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

Recruiting and retaining workforce

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

Training the workforce

The pre-service training and continuing education requirements for direct services providers should align with users' assistive technology needs and contexts. Several globally recognized assistive technology training programmes that have been developed by professional associations can be applied and adapted to do this. Examples include the Rehabilitation Engineering and Assistive Technology Society of North America – Assistive Technology Professional certification *(199)* and the International Society for Prosthetics and Orthotics accreditation *(200)*.

Meet Sukanya

India

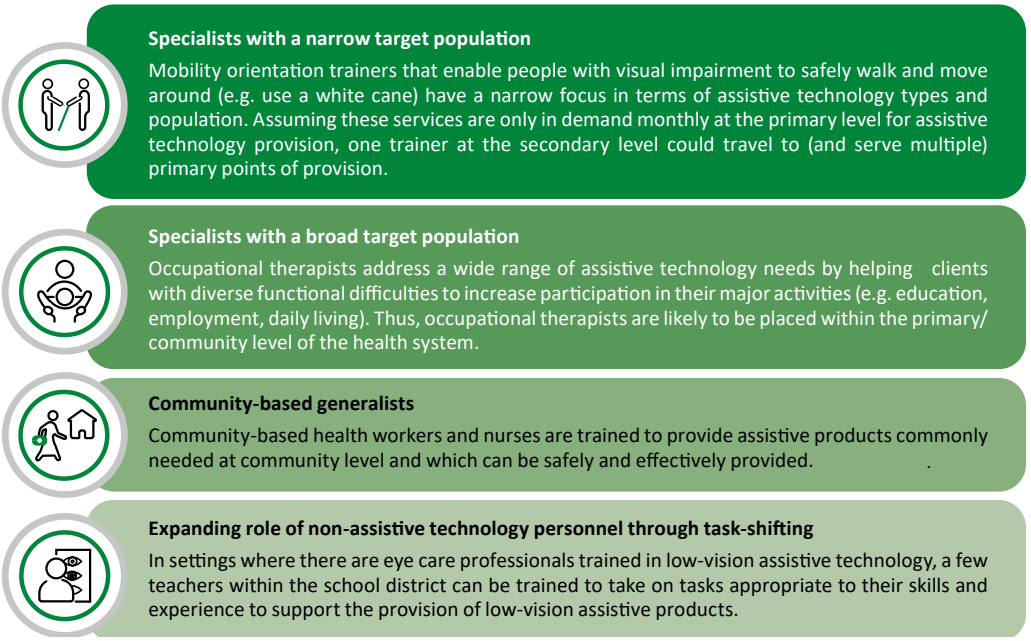
Sukanya, who was born with a vision impairment, lives in Andhra Pradesh, India, with her mother and two elder sisters. Sukanya began her education at a local school. However, the school could not meet her needs, and she joined a school with specialist teachers where she was introduced to a range of vision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

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

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

Ensuring training is relevant for staff serving rural and/ or hard-to-reach areas, or areas with diverse cultures and languages, requires ongoing evaluation to inform curriculum changes. For example, in settings where access to assistive technology is influenced by the gender of the staff, sufficient numbers of staff of each gender need be trained and employed to ensure equitable access. Training users and people from the community they serve can increase relevance (Box 4.9).

Figure 4.2. Examples of ways to address personnel gaps



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

Box 4.9 Training in priority assistive products package

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

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

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

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

- **System-wide awareness-raising:** Basic assistive technology awareness-raising is needed across the broader assistive technology and general health care workforce (in terms of the range of products, potential users and benefits). Anyone in a position likely to refer a user to an assistive technology access pathway can be informed about how to use a referral system. Personnel who make decisions in the procurement process must understand product standards and the scope of assistive technology.
- **Competency-based approaches:** Identifying the knowledge, skills, attitudes and other professional competencies required for assistive technology roles within different levels of service can be used to shape job descriptions, and recruitment and retention strategies for generalist and specialist positions. These competencies can be used in planning and certifying training and education standards as well as programmes (Box 4.10) *(195)*.
- **Identifying and applying best practices:** Research and data systems that monitor user outcomes are useful in identifying best practices and staffing models. Sharing platforms and learning from communities of practice can facilitate the widespread application of well-documented best practices, such as:

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

Centralized resource centres can help produce and disseminate assistive technology evidence, training resources and information to a broad range of assistive technology professionals (Box 4.11). Information needs of both assistive technology specialists and generalists may include:

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

Replicate training models

Effective curriculum and training programmes in different assistive technology disciplines or categories have been developed at national and international levels (see Box 4.12 for examples).

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

International or global umbrella organizations – for example the Global Alliance of Assistive Technology Organizations (GAATO) and its national affiliates (national professional organizations) – play a role in sharing effective training models and resources. Annual conferences for assistive technology professionals and national accreditation programmes can also be a starting point for training and education in other countries. National professional associations are often affiliated with international bodies tasked with harmonizing training and practice standards, among other roles.

Box 4.10 Core competencies for the eye-health workforce in the WHO African region

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

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

Box 4.11 The Rehabilitation Reference Centre (Brazil)

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

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

Box 4.12 Replicating training models nationally and internationally

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

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

Sources:

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

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

Build capacity of users and their support networks

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

- **Awareness and referral:** Increasingly, people are developing awareness about assistive technology, but this needs to be accelerated. Potential users and their support networks need to know what types of assistive products will assist them most, and how and from where they can access them. Necessary information in local languages and accessible formats needs to be available in the local community or health centres can direct them to the best assistive technology access pathways, from local to referral systems.
- **Provision:** For many product types, adequate training, tools and support enables users to identify needs and adjust, maintain and repair assistive products. Out of necessity, users are continually creating solutions to daily living challenges. Capturing and sharing assistive products developed by users is another avenue to increase provision, particularly in areas where formal assistive technology provision is absent.
- **Advocacy:** Users and potential users are the best advocates to improve access to assistive technology. Understanding the broader assistive technology system, legal rights to assistive technology, and avenues to advocate for increased and improved access are important parts of user engagement. Advocacy organizations and networks worldwide have and will continue to play a major role in advancing the rights of persons with disabilities and older people, including the right to accessing assistive technology. Community- based rehabilitation and civil society organizations including organizations of persons with disabilities and older people can be the main provider of information, services and support.
- **Assistive technology careers:** Many users are making significant contributions to advance assistive technology – for example as policy- makers, designers, providers, educators, etc. Professional or community training programmes can develop outreach and recruitment strategies that target users who are interested in pursuing a professional career in the sector. Engaging the skills, experience and aspirations of users will likely yield effective and relevant solutions.

Policy

Leverage global policy instruments

Global policy instruments (see Section 1) and regional frameworks (see Box 4.13) can be used to place assistive technology high on national health, social welfare, education and development agendas.

Box 4.13 Framework for improving access to assistive technology, WHO African region

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

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

Develop and implement national assistive technology policies

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

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

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

Meet Shona

South Africa

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

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

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

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

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

Developing action plans

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

- Engaging relevant stakeholders: The first step to develop a national action plan is to connect stakeholders from across the assistive technology, health, education and social welfare sectors, such as international organizations, governments, academia, providers, standardization bodies and civil society organizations, especially organizations of persons with disabilities, older people, women and other vulnerable or minority groups. Stakeholder mapping exercises can help identify relevant stakeholders.
- Conducting a national assistive technology situation assessment: Assessing the needs (e.g. quantity and types of assistive products needed), access and capacities of the assistive technology and health sector is often the second step towards developing a national or regional policy (Box 4.14). These data inform action plan activities such as prioritizing populations with the greatest unmet assistive technology needs. This assessment can be used to identify existing assistive technology initiatives (e.g. Rehabilitation 2030) and programmes (e.g. eye or vision care) that need to be aligned and coordinated within national approaches to reduce redundancy and save cost.

- Developing strategies, including monitoring, to achieve the progressive realization of universal access to assistive technology: Action plans can include a variety of approaches to develop and strengthen assistive technology systems at the national level. Specific strategies will depend on current system capacity, population needs, stakeholder engagement and levels of political commitment and resources. As shown in Box 4.15, ministries of health within multiple countries have developed priority lists of assistive products as one approach to increase the availability of assistive technology. National priority lists are adapted from the WHO *Priority assistive products list (113)* that includes 50 priority assistive products – the list can serve as a starting point for the progressive realization of universal access to assistive technology.

Box 4.14 Rapid assessment of assistive technology provision: WHO Eastern Mediterranean region

In 2017, data were collected from 17 of the 22 countries in the WHO Eastern Mediterranean region using the WHO assistive technology capacity assessment tool (ATA-C). It covers five key components of delivery of assistive technology services: policy and financing; information and research; products; personnel; and service provision. Assessment results were used to develop plans to improve assistive technology access.

Sources:

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

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

Box 4.15 Developing assistive technology priority lists (Ethiopia and Tajikistan)

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

Sources:

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

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

Establish permanent implementation structures

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

- **National assistive technology agencies:** A dedicated national entity devoted to increasing assistive technology access can provide the leadership, coordination and information to facilitate system-wide strengthening. Such entities can take many forms (e.g. an institute, department or committee) and serve a range of functions. The main aim is to have a central body at the national level that is responsible for designing and realizing assistive technology policies and programmes *(110)*. Functions of this national entity may include:
  - increasing awareness about assistive technology needs and benefits among policy- makers and other key stakeholders;
  - creating awareness among users, potential users and their families and caregivers about assistive technology, their rights to access assistive technology and the means to realize such rights;
  - facilitating development of ongoing improvements to assistive technology policies and programmes including database and information system;
  - engaging users in developing and implementing assistive technology policies and programmes;
  - advocacy for addressing needs (e.g. personnel, financing, etc.);
  - intersectoral and inter-ministerial coordination, and aligning existing assistive technology programmes;
  - resource sharing to promote best practices in production, procurement and provision;
  - providing technical assistance to implementing ministries or other organizations.
- **Coordination platforms:** Robust and well- designed information systems and resources are needed to facilitate coordination and coherence, build networks, reduce duplication, and share solutions across all levels of assistive technology provision, sectors and ministries. Examples include:
  - information and referral systems that simplify access (see also *Provision: Improve information and referral systems*);
  - centralized information for evidence-based resources on improving different components (e.g. human resources) or key strategies (e.g. delivery to remote areas) within the assistive technology system;
  - national working groups tasked with harmonizing assistive technology standards and practices;
  - initiatives that bring together diverse actors across the assistive technology and allied sectors to share evidence and to identify and solve common problems (e.g. a national conference on assistive technology access).
- **Regulatory bodies and mechanisms:** Regulations and enforcement are needed to support access to affordable, safe and effective assistive products and related services. Standards are needed for products and procurements, training and education, and trade and economic policies. For example, reduction or elimination of

tariffs and fees on imported assistive products and introducing fair pricing policy for assistive products and associated services to limit and restrict price mark-up (i.e. by manufacturers or during transactions along the supply chain).

When establishing governance models for assistive technology is important to consider interdisciplinarity, leadership and oversight (Box 4.16).

Introduce financing mechanisms

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

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

Nafla, Iraq

Box 4.16 Establishing governance models that are compliant with the UN Convention on the Rights of Persons with Disabilities

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

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

and sectors should be promoted, developed and maintained in order to deliver cost-effective integrated services.

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

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

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

Sources:

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

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

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

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

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

Budgeting and allocation

- *Ministries responsible for assistive technology.* How assistive technology budget decisions are made is critical to ensuring adequate financing. Within many ministries, assistive technology is often included under broader budgets (e.g. social welfare, health care, rehabilitation or educational technology) and not as a discrete category. Earmarked budgets for assistive products and related services are needed so that it is not subsumed into broader product or service categories *(153)*. Prioritizing assistive technology when deciding on budgets, and earmarking assistive technology budgets when allocated, are strategies that can be used by all ministries or government authorities involved in procuring assistive technology. Using data on needs and unmet needs for assistive technology will assist in budgeting decisions.
- *Public and private health insurance.* Assistive technology funding is inconsistent across public and private health insurance plans. If assistive technology is within the scope of covered health products or services, parameters may include preferred suppliers, products, maximum prices, and a product replacement schedule. 'Minimum benefits' for assistive technology funding can be established and enforced by regulatory bodies within each country *(201)*. External and internal advocacy is necessary to expand minimum benefits to include a range of assistive products and related services within public and private health insurance.
- *Expanding robust funding models.* Within each country there is likely to be more comprehensive public or private assistive technology funding (i.e. maximum price, product options, services included) for specific product categories or populations (see Box 4.17 for an example). More robust elements within the national assistive technology landscape can serve as models for expanding funding. Other ways that assistive technology financing can be more comprehensive include:
  - coverage of multiple assistive products (e.g. if a person needs an electric wheelchair for outdoors and a manual wheelchair for indoors);
  - warranties paired with a replacement cycle (if funding mechanisms only allow for products to be replaced every five years but products may need replacing before five years, warranties would enable users to get repairs or replacement when needed) *(202)*.

Box 4.17 Prosthetic and orthotic coverage for landmine victims (Cambodia)

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

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

Box 4.18 Dedicated revenue stream for assistive technology (Argentina and South Africa)

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

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

Generating revenue and covering costs

- *General revenue.* Governments use taxes and levies to fund health, education and other public goods and services, including assistive technology. In countries with weaker economies, the tax base is often inadequate to cover health products and services such as assistive technology, and thus contributions from external funders can serve to supplement assistive technology budgets *(201)*.
- *Dedicated assistive technology revenue.* Levies or taxes can be specifically dedicated to assistive technology provision (Box 4.18).
- *User cost-sharing.* Various cost-sharing methods have been applied for public and private health financing of assistive technology, such as a co- payment, deductible or percentage of coverage (e.g. 90% coverage so user pays 10% out-of- pocket). Balancing the need to recover a portion of costs and facilitate efficient consumption, while ensuring affordable and equitable access, can be challenging *(201)*.
- *Public–private–public partnerships.* Public, private and public partnerships share responsibility for funding and contributing other resources to increase assistive technology provision (Box 4.19).

Box 4.19 National spectacle programme (Timor-Leste)

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

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

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

Strengthen research, monitoring and evaluation

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

- **Effective approaches to improve access.** There is minimal evidence on the effectiveness of specific approaches to strengthen the assistive technology system – as a whole and within each of the products, provision, personnel and policy components – and on how these interventions are implemented and maintained *(203)*. From national-level policies to ground-level operations, building the evidence base on effective strategies towards achieving universal access to assistive technology is critical to its advance.
- **Level of unmet need.** Data on population-level needs for assistive technology is scarce but is critical for policy-making and resource allocation. In many countries there is a gap between need and access, and between need and demand.
- **Level of access.** Collecting reliable data on access is the most important exercise for developing evidence-informed policy and programmes.
- **Impact and outcomes.** Evidence is needed on the impact and outcomes of accessing and using assistive products by populations and product types. Solely measuring the percentage of people who have access to assistive technology will not capture the benefits to the user or broader community. A better metric to capture user outcomes may be the percentage of people who need assistive technology that reach Step 6 of the access pathway: "I realize my rights and goals" (see Fig. 1.2). In addition, evaluating clinical and other outcomes informs practice and procurement standards, and coverage policies of other key actors (e.g. health insurance companies).

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

Engaging the international community

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

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

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

Miriam (67), Venezuela