

REVIEW ARTICLE

Addressing Inequity in Assistive Products Through Healthcare Systems in India: A Review

Ravinder Singh¹, Suman Badhal², Ashoo Grover³, Arvind Vashist²

¹Division of NCD, Indian Council of Medical Research, New Delhi, ²Department of Physical Medicine and Rehabilitation (PMR), Vardhman Mahavir Medical College; Safdarjung Hospital, New Delhi – 110029, ³Delivery Research Division, Indian Council of Medical Research New Delhi

CORRESPONDING AUTHOR

Suman Badhal, Department of Physical Medicine and Rehabilitation (PMR), VMMC & Safdarjung Hospital, New Delhi - 110029

Email: drsuman_badhal@yahoo.com

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ABSTRACT

Background: Assistive technologies (AT) are crucial for enhancing individuality, productivity, and quality of life for persons with functional impairments. Despite their proven profits, significant inequities persist in access to assistive products, particularly in low-and middle-income countries like India. **Objective:** This review scrutinizes the current landscape of assistive technologies establishment in India, evaluates economic and social returns on investment, and categorizes strategies to address inequities through healthcare system integration. **Results:** Evidence demonstrates substantial returns on investment for assistive products, with wheelchairs increasing economic productivity by 20-40%, spectacles showing benefit-cost ratios of 5:1, and hearing aids yielding ninefold returns per dollar invested. India has established institutional mechanisms including the National Centre for Assistive Health Technology (NCAHT) and the National List of Essential Assistive Products (NLEAP) to address access gaps. However, challenges remain in policy implementation, funding mechanisms, manufacturing capacity, and last-mile delivery. **Conclusion:** A multi-pronged approach combining strong policy frameworks, increased public funding, indigenous manufacturing, capacity building, and community engagement is essential to achieve equitable access to assistive technologies through India's healthcare system. Integration of AT into Universal Health Coverage represents a strategic pathway toward achieving Sustainable Development Goals 3 and 10.

KEYWORDS

Assistive Technology; Inequity in Assistive Technology; Healthcare Equity; Functional Impairment

INTRODUCTION

The global population requiring one or more assistive products is estimated at approximately 2.5 billion and the number of people with functional impairments, who are ageing and age-related functional restrictions or chronic health conditions is estimated to

rise to over 3.5 billion by 2050 (1-15). The term assistive technologies are broad-based on the number of devices, equipment, and systems that prevent or enhance functioning and independence of individuals with functional impairments, age related functional limitations or chronic health conditions (15). Although

most critically important, there is a critical lack of access to assistive products, especially in low- and middle-income countries (LMICs) where assistance to adequate assistive technologies is provided to only 3-5 per cent of the needy population (17,18).

In India the level of unmet need is high. According to the World Report on Disability, it is estimated that 15% of the world population experience some form of functional impairment and this means that in India alone, there are more than 200 million people with some kind of functional impairment (1). The difficulties to the usage of assistive technologies are complex, as they include cost limitations, lack of awareness, inaccessibility of healthcare facilities, shortage of trained experts, and social stigma (17). These impediments impact more on the marginalized groups like women, children, elderly, and the poor, thus contributing to the patterns of exclusion and poverty (14).

Assistive technologies one of the areas that healthcare systems can offer is not only a social welfare measure but a strategic economic measure that has proven returns at both individual, household and societal levels. The narrative review will summarize the evidence on the economic advantages of the assistive technology provision, analyse the institutional response of India to the provision of assistive products in terms of policy and programme efforts and suggest the overall strategies to realize equity in the provision of assistive products by strengthening the healthcare system.

2. Economic Case for Assistive Technology Provision

2.1 Wheelchairs: Increasing Economic and Mobility Engagement.

One of the most radical assistive technologies is wheelchairs, which is directly related to the mobility restriction and allows them to engage in education, work, and community life. Low-resource environments show that the provision of wheelchairs can boost the economic productivity of the beneficiaries by 20-40% (4). The outcome of this productivity is based on better access to workplaces, income

outcomes of work, and vocational training courses.

Along with the direct benefits to users, the provision of wheelchairs has other economic impacts at a broader household level. Enhanced mobility means that the family will not depend on the caregivers as much, allowing them to engage in employment instead of offering complete time care to them (4). This forms a snowball effect whereby one assistive appliance can increase the economic participation of many people in the household. The recommendations of the World Health Organisation on the provision of manual wheelchairs in less-resourced environments reinstate that proper selection, fitting and user training are necessary to fully exhaust the functional outcomes and assure prospective usage (19).

2.2 Spectacles: Fix Your Vision and Make More Product.

Refractive errors have been observed to affect approximately 2.6 billion individuals around the world with an uncorrected refractive error being one of the major causes of vision impairment (2). The case on economic benefits of providing spectacle has been found convincing, with systematic reviews indicating benefit-cost ratios of 5:1 (2,3), and a range of activities between the agricultural work and manufacturing sector as well as service sector jobs have been shown to benefit in terms of productivity.

With children, the payoff on spectacle provision is especially high in terms of better education results. The clear vision facilitates the positive involvement in classroom work, reading, and written assignments, which will be further converted into higher educational levels and an ultimate lifetime income level (10). Investment in eye health goes beyond the spectacles to include screening programs, treatment service and public health interventions with all showing favourable cost-effectiveness profiles (2).

2.3 Hearing Aids: Making Communication and Economic Integration Possible.

Approximately 1.5 billion people in the world have a hearing loss with 430 million individuals having a disabling hearing loss.(5). The cost of unmanaged hearing loss is significant and

includes both healthcare expenses, educational assistance requirements, productivity loss and societal expenses.(7). Hearing aid provision, on the other hand, has proven to yield excellent returns on investment with every dollar spent bringing about an average nine times returns in terms of earning power and less health care use (5,7). The improvement of hearing is known to boost communication skills and thus, performance at work, low rates of unemployment and social integration can be achieved by hearing (5). The World Report on Hearing states that the most important action is to identify and intervene as early as possible in order to maximize the result, especially when it comes to children whose language acquisition and education paths are heavily reliant on proper hearing. With such established advantages, hearing aid cover has not been well spread across the world as only 17 percent of those who are in need of hearing aid are the ones who use them (7).

2.4 Environmental Adaptations and Home Modifications.

Environmental barriers often deny the persons with disabilities the full life experience in their daily activities and community life. The installation of ramps, grab bars, accessible bathrooms and other adaptations among other home modification services greatly contribute to ability in the daily life of people who are ageing with disabilities as the services improve everyday life ability significantly (8). The financial analysis of the economic impact of government-based home adaptation programs has shown positive cost-effectiveness ratios especially taking into consideration the saved costs of institutionalisation and preserved independence (9).

2.5. Assistive Technology of Learning Disorders.

Its applications and technologies targeting learning disorder patients, such as dyslexia, have shown substantial improvement in the academic performance and future economic contributions (12). Parents that are early identified and offered adequate technological assistance can help learning differing students to succeed in the educational process in equal

measure to their cognitive abilities, saving the schools and economy the huge economic costs of school dropouts and under-employment (10).

3. India: Institutional Response: Initiatives and Infrastructure.

3.1 National Centre Assistive Health Technology (NCAHT).

The Indian Council of Medical Research (ICMR) has also started the National Centre of Assistive Health Technology (NCAHT) in several top institutions such as AIIMS-Delhi, IIT-Delhi, IIT-Madras and the National Institute of Speech and Hearing (NISH) in Trivandrum. NCAHT is also a site of research, innovation, and capacity-building in assistive technology that coordinates activities at the academic, healthcare and technology development centers.

3.2 National List of Essential Assistive Products (NLEAP).

The National List of Essential Assistive Products (NLEAP) has been established by ICMR as a prioritized system of meeting the needs that are critical and pertain to various types of disabilities and functional impairments (11). NLEAP facilitates the process of policy planning, procurement decisions, and resource allocation so that the interventions achieve the greatest possible impact on the population level and cost-effectiveness.

The main deliverable points of NLEAP
It is a list of important assistive products that are based on evidence and are meant to make things easier for people with functional impairments to get to.

It is a national guide for policy, purchasing, and service delivery, which helps make things more consistent, affordable, and of high quality.

NLEAP helps make the best use of resources, encourages local manufacturing, and makes sure that essential assistive technologies get to people who need them the most.

3.3 Rapid Assistive Technology Assessment (rATA)

ICMR is carrying out the Rapid Assistive Technology Assessment (rATA) study with joint efforts with the World Health Organisation to determine the availability, accessibility,

affordability, and use of assistive technologies among various communities in India. The rATA research approach offers policy-making and implementation plans evidence that reveals areas of coverage and use limitations by geographic location and subpopulations.

There is a need to raise awareness and reduce stigma among the general population through social media and media channels.

The partnering with the Central Health Education Bureau (CHEB) has enhanced the awareness campaigns by spreading information on the use of assistive technologies to the marginalized groups and striving to lessen the stigma that surrounds disability and the use of assistive devices. Such campaigns are essential in demand creation and making individuals with disabilities and their families know of the services and other entitlements available to them.

3.4 Capacity Building and Workforce Development.

Institutions such as the National Institute of Physical Medicine and Rehabilitation (NIPMR) in Thrissur have put a priority in training professionals in rehabilitation and provisioning of assistive technology. Developing such a strong workforce which understands the needs, prescribes the relevant devices, fits them properly and provides follow-up services is necessary to transform policy promises into enhanced access and outcomes.

3.5 Standards of Quality and Safety Rules.

ICMR works with the Bureau of Indian Standards (BIS) to work on and adopt elaborate standards and guidelines of assistive products (11,20). Standardisation promotes the quality, safety and interoperability of products and keeps away users of products of low quality or unsuitable products, it enhances market development and trade.

3.6 Indigenous Manufacturing and Innovation Ecosystems.

The promotion of local production is a strategic focus towards lowering cost, resiliency, and product differentiation to the conditions in India. Special economic zones like Andhra Pradesh MedTech Zone (AMTZ) are also promoting the local manufacture of assistive technologies. Partnerships with leading organisations like AIIMS, IITs, and government

agencies like the Department of Science and Technology (DST), Department of Biotechnology (DBT), Society for Applied Microwave Electronics Engineering and Research (SAMEER), Centre for Materials Electronics Technology (C-MET), and Centre for Development of Advanced Computing (C-DAC) have promoted state of the art research and development, and the development of cost efficient and user-friendly technologies (13).

4. Plans To Resolve the Inequality with healthcare systems.

4.1 Reinforcement of Policies and Financing Systems.

4.1.1 National Policy Framework

The AT policy framework in India should consider AT as a part of the health system that is indispensable and a legal right of every person with a functional impairment. It should guarantee access to relevant AT products and services across the lifelong by incorporating AT in universal health coverage, providing sustainable pooled funding, and linking services at the across all levels of care. There should be definite provisions in the framework to ensure that there is equal access to marginalized and underserved populations and that they are assisted by standardized protocols of needs assessment, service delivery, and follow-up. It will be important to increase domestic and quality-guaranteed supply chains and manufacturing, use digital health and telehealth information systems, purchases and remote support. Its implementation is going to involve cross-sectoral partnership between health, social welfare, education, labour, transport and digital areas in accordance with the disability rights legislation, the Sustainable Development Goals and the vision of "Viksit Bharat" by India (21). The accountability and user-centred service delivery are only possible with the help of strong governance, monitoring tools, and meaningful community participation. A number of flagship programmes, such as Ayushman Bharat, National Health Programmes, Digital India and the Accessible India Campaign already offer a platform through which one can enhance AT

access. The coordination of these efforts should be enhanced to create stable channels between identification and provision as well as follow-up care.

4.1.2 Public funding and Subsidies

The subsidies and public funding are to be used in the form of present-day provisioning is mainly based on the Ministry of Social Justice and Empowerment (MoSJE) schemes, specifically the Assistance to Disabled Persons to Purchase/Fit Aids and Appliances (ADIP) scheme and Rashtriya Vayoshri Yojana (RVY). But there is still little integration into the Ministry of Health and Family Welfare (MoHFW) programs and Ayushman Bharat. Universal coverage should be achieved by providing higher budgetary allocations and clearly incorporating assistive products in health insurance cover.

4.1.3 Increase in the Insurance Covers.

The early consultations with the private insurance companies are the steps to be made in changing the conditions in order to cover the assistive devices as the necessary health care. The experience of other countries shows that insurance coverage is a major step to better access spreading the costs throughout the risk pool instead of focusing the burden on financial companies and families.

4.2 Universal Health coverage and the Assistive Products.

4.2.1 Integration in Primary Care

It is important to make sure that assistive products are regarded as an indispensable healthcare service at all levels, especially on the primary health center, in order to identify and intervene early. The models to be considered should focus on integration with the available screening programs, maternal and child health services, geriatric services as well as management of noncommunicable diseases.

4.2.2 Distribution Networks in the public.

The creation of supply chains of assistive devices by government hospitals and primary health centers must be done in collaboration with the private manufacturers, logistics and quality assurance systems. There is a continuing discussion with the private partners and AMTZ to come up with the sustainable distribution models.

4.3 Local creativity and production

4.3.1 Make-in-India Initiatives

The costs, availability, and job opportunities can be minimized by supporting indigenous manufacturing with incentives, incubation centers, and startup ecosystems. Ceres, in partnership with AMTZ, AIIMS, IITs, state governments, and entrepreneurial networks, is leveraging innovation through more affordable assistive technologies that address Indian contexts.

Research and development partnerships focus on the growth of a company by partnering with other firms possessing assets to carry out their activities.

4.3.2 Research and Development Partnerships

By working with universities, research institutions, including the Biotechnology Industry Research Assistance Council (BIRAC), and other organisations, development of assistive technologies that are affordable and of local use can be achieved. The Global Cooperation on Assistive Technology (GATE) innovation snapshot methodology offers systems of sharing innovations and replication of successful interventions.(13).

4.4 Establishing Capacity among Healthcare Providers.

4.4.1 Training Programs

The systematic training programs are needed to equip healthcare workers with knowledge to be able to evaluate the needs, prescribe the required devices, make sure they fit well, and provide after-use support. Partnerships with NIPMR, CHEB, IITs, AIIMS and St. Johns hospital are developing capacity at the professional cadre.

4.4.2. Awareness and Sensitisation.

Engagement of healthcare providers regarding the need of assistive devices in disadvantaged population and the rights-based approach to disability is key to person-centered and respectful care. Attitudinal barriers are being taken care of through awareness campaigns with AIIMS, IIT, NISH, Saksham, Initiative for Disability and Accessibility (IDEA), AMTZ, and other partners.

4.5 Increasing Accessibility and Community Awareness.

4.5.1 Community Outreach Programs.

Demand generation and uptake is highly important by conducting awareness programs to educate communities on available assistive products, application processes and benefits. The best community-based rehabilitation strategies involve the participation of the local health workers, self-help groups, and disabled persons organisations.

4.5.2 Availability of Channels of Distribution.

The telehealth systems and mobile units can be used in rural and remote locations where the provision of tertiary care facilities is scarce. New models of provision strategies introduced by the Goa Government and AMTZ prove their possible nature as decentralized ones.

4.6 Stakeholder Engagement and User-Centered Design.

4.6.1 Participatory Design Processes.

The information on persons with functional impairments in design and testing of assistive products is crucial because it guarantees that technologies are based on real needs and are acceptable to the end consumers. Partnerships with the AIIMS, IIT, NISH, Saksham, IDEA, and AMTZ focus on co-creation strategies.

4.6.2 Multi-Sectoral Collaborations.

Partnership with non-governmental organisations, corporate social responsibility programs and international organisations increases access and utilizes varied expertise and resources. There are certain organisations, such as Saksham and IDEA, that can be very helpful to close the policy-implementation gaps.

4.7 Reaching Marginalized and Vulnerable Populations.

4.7.1 Designing Equity-Based Programs.

It is important that the schemes be designed for women, children, elderly people, and economically disadvantaged to make sure that those who are subject to multiple forms of marginalisation do not get left behind. Intersectional methods are needed to identify compounding vulnerabilities.

4.7.2 Subsidized and free provision.

Assistive products are offered at zero or low charge to those needing them through such programs as ADIP, RVY, and NGO programs, which decreases financial barriers. It has been suggested that small co-payments can be insurmountable to the poorest households.

4.8 The provision of monitoring, accountability and impact assessment is among the.

4.8.1 Tracking and Data Systems

ICMR is also coming up with databases to track distribution and utilisation of assistive devices so that they are able to manage the programs in real time and identify the gaps in coverage. Evidence-based decision-making is based on strong information systems.

4.8.2 Continuous Assessment and Quality Enhancement.

Appraising programs to achieve fair results should be in partnership with the organisations such as the Small Industries Development Bank of India (SIDBI), Health Technology Assessment in India (HTA-DHR) and the Comptroller and Auditor General (CAG). Impact assessments need to look beyond coverage indicators and also look at functional outcomes, user satisfaction as well as continued use of the device.

5. Goal congruency with the Sustainable Development Goals.

The direct delivery of assistive technologies to the healthcare systems will lead to the realisation of the Sustainable Development Goals of India, namely SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities).⁽¹⁶⁾ The availability of assistive products will allow person with functional impairments to be able to engage in economic, social, and civic life fully, overcoming the exclusion, which contributes to poverty and marginalisation.

Assistive technology provision can be seen to have economic benefits that are not only to the users individually but also to the workforce participation, healthcare cost reduction and also the development of human capital (6). India can create a more inclusive and equitable healthcare system that meets unmet needs in scalable and cost-effective interventions, leads to economic growth, and supports the dignity of individuals with health conditions and functional impairments.

6. Difficulties and Future-Perspectives.

Nonetheless, even though there is a lot of progress, the implementation of assistive technologies in India on a universal basis is still

facing enormous challenges. Divided funding systems, where funding is mainly provided through social welfare and not health systems form lapses in coverage and co-ordination. The fact that assistive products were not fully integrated in Ayushman Bharat and mainstream health insurance is a lack of systematic scale-up opportunity.

The level of manufacturing assistive products is still low and heavily dependent on importation which makes the products very expensive and inaccessible. Although efforts such as AMTZ are encouraging, large contributions towards research, development and production facilities are required to satisfy the needs on the population level.

The number and geographical distribution of assistive technology workforce, such as rehabilitation professionals, prosthetists and orthotists, audiologists, and optometrists, is also inadequately large. The rural and remote locations are especially under served and they need innovative service delivery models and task-shifting.

The barriers are social and attitudinal such as stigma related to functional impairment and usage of assistive devices which still hinder uptake even where products are accessible and affordable. The advocacy of a positive shift in attitudes that will result in the inclusion of disability among the population requires a long-term education campaign and community involvement.

Future directions must be strengthened in terms of providing assistive technology as part of Universal Health Coverage, enhancing insurance coverage, improving supply networks, investing in local manufacturing and innovation, cultivating workforce, and stringent monitoring and evaluation to achieve fair results.

CONCLUSION

The fact is indisputable, the strategic investment that has significant economic, social, and health returns is the provisioning of assistive technologies via healthcare systems. Wheelchairs make people more mobile and productive, spectacles make vision clear and educational and work results better, hearing aids make communicating and integrating

economically possible, and environmental modification allows people to live independently.

Through NCAHT, India has built the necessary critical institutional infrastructure, through NLEAP, prioritisation frameworks have been created, through rATA, evidence has been created and through innovation ecosystems, academia, industry and government have been connected. Nevertheless, to convert these initiatives into universal access, policies need to be reinforced, people have to be funded to provide universal access, manufacture has to be scaled up, the labour force has to be developed and the commitment towards equity must be maintained.

These need to be a multi-pronged strategy of having strong policy frameworks, proper financing, local innovation, capacity development, community involvement, and a stringent accountability system. With the assistive technology provision as a central part of the healthcare system, as opposed to a marginal social welfare issue, India can fulfil the two key objectives of the better population health and fewer disparities, and help progress in the direction of the Sustainable Development Goals.

Provision of assistive technology should be evaluated on patient, clinical and community levels continuously and make sure that the provided intervention is responsive to the needs of the users and that it delivers the expected results. Through sustained political will, proper resource mobilisation and joint efforts by all sectors of government, civil societies, private sector and communities, it is possible to have equal access to assistive technologies and change lives and create a more inclusive India.

AUTHORS CONTRIBUTION

RS & SB conceptualized the study and provided the core idea of the manuscript, along with support in writing and overall guidance. AV was primarily responsible for drafting the manuscript, data interpretation, and preparing revisions and amendments. AG conducted the final review of the manuscript and provided critical inputs.

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

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