THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 14 Issue 4

REVIEW ARTICLE

The Economic, Health, and Social Return on Investment in Assistive Technology: A Systematic Review

Prof. (Dr.) Suman Badhal[1*], Mr. Arvind Vashist[1], Dr. Ravinder Singh[2]

[1]Department of PMR, VMMC & SJH, New Delhi,
[2]ICMR (HQ), New Delhi

[*]drsuman_badhal@yahoo.com

OPEN ACCESS

PUBLISHED
30 April 2026

CITATION
Badhal, S., Vashist, A., Singh, R., 2026. The Economic, Health, and Social Return on Investment in Assistive Technology: A Systematic Review. Medical Research Archives, [online] 14(4).

ISSN
2375-1924

ABSTRACT

Objective: To synthesize global evidence on the return on investment (ROI) from assistive technology provision across economic, health, and social domains, demonstrating assistive technology as a strategic investment for achieving Universal Health Coverage and the Sustainable Development Goals.

Methods: We conducted a comprehensive systematic review integrating data from AT scale Global Partnership economic analysis (2020), World Health Organization cost-effectiveness assessments, national program evaluations from Rwanda, Pakistan, and the Philippines, and peer-reviewed literature from PubMed, Web of Science, and Google Scholar (2010-2024). We examined ROI at individual, household, organizational, and national levels, focusing on four priority assistive products (wheelchairs, hearing aids, prostheses, eyeglasses) in low- and middle-income countries. Economic modeling employed quality-adjusted life years, lifetime earnings projections, and macroeconomic multiplier analyses with 5% discount rate.

Findings: Providing sustained access to four priority assistive products for 900 million people in need would yield USD 10 trillion in economic benefits over 55 years, representing 9:1 return on investment against USD 730 billion required investment. Economic gains include USD 4 trillion from improved educational outcomes, USD 4.5 trillion from enhanced employment and productivity, and USD 1.9 trillion from increased caregiver workforce participation. Health benefits equivalent to 1.3 billion quality-adjusted life years would accrue through improved physical and mental health, reduced secondary complications, and enhanced healthcare access. Social returns include community integration, independence, reduced caregiver burden, and gender equality advancement.

Conclusion: Assistive technology represents a strategic investment with demonstrable 9:1 economic ROI and transformative health and social benefits, comparable to WHO Best Buys for noncommunicable disease prevention. Countries must integrate assistive technology within Universal Health Coverage packages and establish sustainable financing mechanisms.

Keywords: Assistive Technology, Return of Investment in Assistive Technology, Financial mechanisms in AT, Economic Models in AT.

Introduction

Assistive technology is a term that has been employed to refer to devices, equipment, instruments, software, and services that sustain or enhance abilities of individuals with impairments in their functioning in locomotor, visual, hearing, communication, cognitive, and self-care domains[1,2]. According to the World Health Organization (WHO), assistive products are simply the external products that have the sole aim of supporting or enhancing the functioning and self-sufficiency of an individual hence ensuring wellbeing[2]. Although assistive technology plays a critical role in facilitating participation, autonomy and dignity, 1 billion individuals worldwide cannot access the necessary assistive items, and the situation is severe in low and middle-income nations (LMICs), where only 5-15% of those in need can access the needed products adequately[3,4].

The magnitude of unmet assistive technology need represents both a human rights crisis and a significant impediment to sustainable development. Current global demand exceeds 2.5 billion people and is projected to reach 3.5 billion by 2050 due to population ageing, increased prevalence of noncommunicable diseases, and rising rates of chronic health conditions[5,6,13]. In LMICs specifically, the gap is most severe: only 3% of the need for hearing aids is met[14], only 5% of individuals requiring wheelchairs have access compared to 90% in high-income countries[15], and fewer than 20% of people needing eyeglasses receive them[16], Without access to assistive technology, individuals face systematic marginalization, reduced productivity, exclusion from education and employment, prolonged dependency on family caregivers, elevated risk of institutionalization, and substantially increased healthcare burden[9,17,18].

Assistive technology provision has historically been viewed as a social welfare spending instead of productive investment. Nevertheless, the emergent economic evidence illustrates that assistive technology results in high returns in terms of enhancement of workforce participation and productivity, better educational outcomes with long-term earnings impacts, lower healthcare costs due to prevention of subsequent complications, lessening of the burden on carers to participate in the economy, and macroeconomic growth through economic multiplier effects[19,20,21]. The recognition of assistive technology as an investment, not a cost, is a fundamental paradigm shift with far reaching health financing implications, development policy implications, and achievement of international development commitments[22].

There are various frameworks that have explicit commitments by the international community on assistive technology provision. Specifically, access to assistive technology is a right and responsibility of States Parties in the United Nations Convention on the Rights of Persons with Disabilities (CRPD) which has been ratified by 185 countries[17]. The 2030 Agenda of Sustainable Development and its 17 Sustainable Development Goals (SDGs) is committed to the goal of ensuring no one is left behind and that the furthest behind comes first, and disability is a cross-cutting issue, with 8 SDG targets and 11 indicators[22,23]. Other frameworks such as the Sendai Framework on Disaster Risk Reduction (2015), Addis Ababa Action Agenda (2015) and New Urban Agenda (2016) also mention disability inclusion and all implicitly imply the provision of assistive technologies[24,25,26]. Nevertheless, regardless of such commitments, global pledges have not been converted into adequate action, investment and quantifiable progress in bridging the assistive technology access gap[27].

In this review, the evidence is collected on a large scale, using various sources such as the AT scale Global Partnership economic analysis, WHO, national programs evaluation, clinical studies, and the scholarly literature to prove the economic, health, and social payback on investment through assistive technology provision. We specialize in making our case in four priority products (wheelchairs, hearing aids, prostheses and eyeglasses) that together will serve most of the unmet assistive technology need in the world and on which there is most compelling evidence[7] to make policy decisions about assistive technology integration in health systems, social protection programs, and development strategies.

Methods

STUDY DESIGN AND DATA SOURCES

We performed thorough systematic examination that summarized evidence concerning assistive technology return on investment in the economic, health, and social domains between January 2010

and December 2024. Primary sources of data were: (i) the 2020 investment case of AT scale Global Partnership that created an original economic model of the costs and benefits of scaled assistive technology provision in LMICs;[7] (ii) WHO reports such as the World Report on Disability (2011), Priority Assistive Products List (2016) and Global Report on Assistive Technology (2022);[5,28,29] (iii) national program assessments of Rwanda, Pakistan, and the Philippines documenting implementation approaches and outcomes;[10,11,12] and (iv) peer-reviewed literature identified through systematic searches.

SEARCH STRATEGY AND STUDY SELECTION

We have searched PubMed, Web of Science, and the Google Scholar with such combinations of the following terms: assistive technology, assistive devices, assistive products, wheelchairs, hearing aids, prostheses, eyeglasses, and spectacles, the return on investment, cost-effectiveness, economic impact, cost-benefit analysis, quality-adjusted life years, QALYs, employment, productivity, education, and low- and middle-income countries. We searched peer-reviewed articles that were published in English in 2010- 2024 that reported quantitative data on an economic, health, or social outcome of assistive technology provision. Grey literature such as WHO reports, government reports, and technical reports of well-known organizations (AT scale, World Bank, ILO, UNICEF) were incorporated since the implementation evidence is not present in the peer-reviewed literature.

Based on database search, we selected and sifted through **55 peer-reviewed articles** that satisfied inclusion criteria, 15 grey literature reports and 3 national program evaluations. The inclusion criteria were as follows: (i) the study had to deal with one or more of the four priority assistive products in LMICs; (ii) the study had to report quantitative economic, health, or social outcomes (i.e., data); (iii) the study had to use rigorous methods (randomized controlled trial, cohort study, economic modeling, or program evaluation with pre-post measures); and (iv) the study had to be sufficiently detailed to extract the data. We also eliminated studies that dealt only with the high-income countries, qualitative studies that lacked the quantitative outcomes, and studies on assistive products that were not within our scope.

DATA EXTRACTION AND SYNTHESIS

Two reviewers collected data on study design, population characteristics, interventions, findings, and outcomes independently. In the case of economic results, we obtained information on the employment rates, productivity changes, earnings, education level, and time spent by caregivers. As health outcomes, we have drawn out QALY estimates, disability-adjusted life years (DALYs), quality of life scores, and healthcare utilization. In terms of social outcomes, we got data on the factors of community participation, independent variables and social inclusion variables. The inconsistencies were addressed by discussion. Since we have heterogeneity in the study design, populations and outcomes we employed narrative synthesis as opposed to meta-analysis.

Table 1. Characteristics of included studies and data sources by assistive product and outcome domain

Data source type	Number of sources	Assistive products covered	Outcome domains	Geographic scope	Key study designs
Peer-reviewed articles	55	Wheelchairs (18), hearing aids (13), eyeglasses (15), prostheses (9)	Economic (32), health (38), social (26)	LMICs (40), global (15)	RCTs (8), cohort studies (15), cross-sectional surveys (18), economic modeling (8), systematic reviews (6)
AT scale economic model	1	All four products	Economic, health, social	All LMICs	Economic modeling with lifetime projections
WHO reports	6	All products	Policy, epidemiology, service delivery	Global and LMICs	Epidemiological analysis, policy reviews, cost-effectiveness analysis
World Bank reports	4	Employment outcomes	Economic	LMICs and global	Economic analysis, household surveys
ILO reports	3	Workplace inclusion	Economic, social	Global	Labour market analysis

Data source type	Number of sources	Assistive products covered	Outcome domains	Geographic scope	Key study designs
National program evaluations	3	Eyeglasses (1) comprehensive AT (2)	Implementation, coverage, financing	Rwanda, Pakistan, Philippines	Program monitoring data, household surveys, policy analysis
UN documents	8	All products	Policy frameworks, rights	Global	International treaties, development frameworks
Other grey literature	16	Various	Economic, implementation, policy	Varied	Technical reports, policy briefs, working papers
Total	96	All four priority products	Economic, health, social	Global focus on LMICs	Mixed methods synthesis

{RCT = randomized controlled trial; LMIC = low- and middle-income country; AT = assistive technology; ILO = International Labour Organization}

SCOPE AND PRODUCT SELECTION

The products that are analysed as priority assistive products include wheelchairs, hearing aids, prostheses and eyeglasses. These products were chosen concerning: (i) size of unmet need, and all of them are addressing the need of almost 1 billion individuals in the LMICs; (ii) availability of outcome information based on clinical trials, program, and economic assessments; (iii) WHO Priority Assistive Products List; and (iv) areas of AT scale require intervention[28,32]. All LMICs according to the World Bank classification are included in the geographic scope[33]. The time horizon is 55 years long, which is an average life span of individuals that need assistive technology presently[7].

ECONOMIC MODELING APPROACH

Economic benefits were estimated using lifetime earnings projections incorporating: (i) educational returns for children receiving assistive technology, calculated using the established relationship of 10% earnings increase per additional year of schooling[34,35]; (ii) employment and productivity gains for adults, estimated through disability employment gap analysis and productivity studies[36,37]; (iii) extended working lifespan effects; and (iv) family caregiver workforce participation gains[38] All monetary values were calculated in 2020 US dollars with 5% annual discount rate[39].

Cost estimates included: (i) system strengthening investments estimated at USD 10 billion encompassing policy development, workforce training, supply chain infrastructure, and quality assurance mechanisms; and (ii) lifetime user costs including case-finding, initial assessment and fitting, product procurement, training, maintenance, and replacement over the user's remaining lifespan[7]. Product costs reflected estimated LMIC market prices accounting for procurement AT scale[40].

HEALTH IMPACT ASSESSMENT

The number of health benefits was measured by quality-adjusted life years (QALYs), a common unit of measurement, which is used to determine the quantity and quality of life, one QALY is one year of perfect health[41]. QALY weights based on published EQ-5D values prior to and following the access of every assistive technology product[42-45]. The data on pre- and post-intervention quality of life were based on program reviews, cohort studies, and clinical studies[7].

Findings

OVERALL ECONOMIC RETURN ON INVESTMENT

To satisfy the unmet demand of the four priority assistive products in LMICs would produce a total of greater than USD 10 trillion in real economic gains over the next 55 years that is equivalent to more than 1% of the total LMIC gross domestic product (GDP) over the same period. Opposite an estimated investment need of USD 730 billion (USD 10 billion to strengthen the system in case of failure and USD 720 billion to cover lifetime user costs) this returns 9:1[7].

This 9:1 ROI places the investments in assistive technology in a favourable position against other known health priorities in the world. The noncommunicable disease prevention through the use of the best buys offered by WHO have a ratio of ROI between 7:1 and 9:1[8]. Better childhood education has similar long-run economic payoffs, and estimates range between 7:1 to 10:1 depending on the situation[46]. Vaccination

programs in childhood can be proven to have ROI of about 16:1[47]. The ROI used in the calculation cannot reflect the actual returns since the economic model does not take into account a wide range of benefits that are hard to measure such as the lower cost of institutionalization, lower emergency healthcare use, less poverty cycle among families, greater invention capacity, and less social protection spending[48-50].

Table 2. Economic, health, and social return on investment by assistive product for LMICs

Assistive product	Users in need (millions)	Economic benefits (USD billions)	Health benefits (million QALYs)	Key economic pathways	Key health outcomes	Key social outcomes
Eyeglasses (reading + prescription)	850 (720 reading, 130 prescription)	5,300 (user: 3,600, family: 740, multiplier: 960)	970 (children: 1.8 QALYs each, adults: 1.1 QALYs each)	Educational attainment (+2.5 years), productivity gains (22% for presbyopia), employment increase (25-35%)	Reduced accidents and injuries, improved mental health, enhanced healthcare access	School participation, workplace inclusion, independence in daily activities, reduced social isolation
Wheelchairs	60 (10 children, 50 adults)	1,400 (user: 1,000, family: 140, multiplier: 260)	120 (children: 2.7 QALYs each, adults: 1.8 QALYs each)	Employment increase (30-50%), reduced caregiver burden (4-6 hrs/day), educational access	Prevention of pressure ulcers and secondary complications, improved cardiovascular health, reduced pain	Community participation, enhanced mobility and independence, social engagement, recreation access
Hearing aids	54 (4 children, 50 adults)	300 (user: 200, family: 70, multiplier: 30)	22 (children: 0.6 QALYs each, adults: 0.4 QALYs each)	Educational outcomes (language development), employment (30% increase), productivity gains (25-40%)	Reduced dementia risk (27% reduction), improved mental health, fall prevention	Communication ability, reduced social isolation, family relationships, civic participation
Prostheses (lower limb)	35 (5 children, 30 adults)	1,500 (user: 1,200, family: 110, multiplier: 190)	240 (children: 8.9 QALYs each, adults: 5.2 QALYs each)	Employment probability increase (40-60%), educational completion, income gains (35-50% increase)	Physical activity maintenance, cardiovascular health, reduced comorbidities, mental wellbeing	Mobility restoration, dignity and self-esteem, community integration, recreation and sports participation
System strengthening investment	N/A	Cost: 10	N/A	Policy development, workforce training (60,000 personnel), supply chain infrastructure, quality assurance	N/A	Service delivery models, user involvement mechanisms, awareness campaigns
Lifetime user costs (all products)	900	Cost: 720	N/A	Assessment and fitting, product procurement, training,	N/A	N/A

Assistive product	Users in need (millions)	Economic benefits (USD billions)	Health benefits (million QALYs)	Key economic pathways	Key health outcomes	Key social outcomes
				maintenance, replacement over lifetime		
Total investment required	900	Cost: 730	N/A	System (10) + Users (720)	N/A	N/A
Total benefits generated	900	8,500 (direct user and family gains) + 1,440 (multiplier effects) = 9,940 ≈ 10,000	1,352	Education (4,000), employment and productivity (4,500), family caregivers (1,900), economic multipliers (1,440)	Improved physical health, mental health, reduced secondary complications, enhanced healthcare access [5,42-45,79-83]	Community participation, independence, reduced isolation, gender equality, dignity [58-62,70,71,84-86]
Return on Investment (ROI)	N/A	9:1 (USD 10 trillion benefit / USD 730 billion cost)	Cost per QALY: USD 540	Highly cost-effective (<1x GDP per capita)	Comparable to WHO Best Buys	Transformative social inclusion

{QALY = quality-adjusted life year; LMIC = low- and middle-income country; N/A = not applicable
Note: Economic values in 2020 USD with 5% discount rate over 55-year timeframe. Multiplier effects reflect broader economic impacts through increased consumer spending and economic circulation. Cost per QALY of USD 540 is well below the WHO cost-effectiveness threshold of one time GDP per capita for LMICs (average ~USD 5,000).}

EDUCATIONAL OUTCOMES AND LIFETIME EARNINGS FOR CHILDREN

Economic returns are large in the long run as a result of access to assistive technology in childhood due to better educational performance. The higher the number of years spent at school, the higher the future income, with the difference between the country being between 8 and 12 years in the LMIC context[34,35,51]. Nowadays, disabled children are severely disadvantaged in terms of education. Meta-analyses conducted on 51 countries indicate that children with disabilities have a 10-60% poorer likelihood of attending school than children without disabilities with the LMICs reporting higher disparities and girls with disabilities having the highest disparities[52,53]. Among the attending people, children with disabilities have a lower chance to complete primary school by about a third[54,55].

Assistive technology handles various barriers to education at the same time. The transportation barriers are overcome through mobility tools like wheelchairs and prostheses[56,57]. Hearing aids and eyeglasses allow a greater contribution to the classroom and enhance the learning[58,59]. Research has recorded that the administration of the right assistive technology will lead to a rise in school attendance by 50-80, academic achievement by 30-50, and a drop-out rate decrease by 40-60%[60-62].

The total impact is cumulative, equivalent to greater, on average, additional lifetime income of more than USD 100,000 per child getting assistive technology equal to about 25% of the additional lifetime income potential across LMICs[7]. In the case of the estimated number of 39 million children in LMICs that are in need of assistive technology now, the cumulative returns on education -related economic benefits of their working life would be more than USD 4 trillion[7]. There are also intergenerational benefits that come with enhanced education with educated parents having a higher chance of investing in the education and health of their children[63,64].

EMPLOYMENT, PRODUCTIVITY, AND EXTENDED WORKING LIFESPAN

In the case of adults, the provision of assistive technology brings economic benefits in the form of high levels of employment, improved productivity at work and longevity of employment. WHO in an analysis of 51 countries concluded that a very small percentage of men with disabilities of 53 percent

of men with disability are working compared to 65 percent of men without disability[5]. In the case of women, inequalities are even worse: women with disabilities have one out of five employed compared to 3 out of five women without disabilities[5,65].

Persons with disabilities are more likely to work in informal sectors, part time, and low-paid jobs[19,65]. The wage inequality experienced in various LMICs is between 10 and 30 percent following education, experience and occupation[66].

Assistive technology helps in securing employment in several ways. Research indicates that adults with corrected vision or hearing impairments have a higher probability of being employed, by 25-40% relative to adults with uncorrected sensory weaknesses[68,69]. Wheelchairs well designed enhance the chances of employment by 30-50%[70,71].

Another essential economic advantage is that of productivity gains. According to the economic model, the assistive technology enhances average productivity of users by about 16%[7]. Other reports record productivity gains of 15-25% of office workers with the right visual correction, 20-30% of manual labourers with the right mobility aids and 25-40% with workers with hearing loss with the right hearing aids[73-75].

Its aggregate impact on all adult users creates about USD 4.5 trillion of incremental lifetime earnings in terms of employment, productivity and long working life trajectories integrated together[7].

FAMILY ECONOMIC IMPACT AND GENDER EQUALITY

The application of assistive technology creates huge benefits to the providers of family support. In LMICs, non-paid full-time support of people in need of assistive technology is disproportionately offered by family members, mostly women[5]. Assistive technology facilitates transition of family caregiver to paid work by enabling more autonomy among the users. According to economic modeling, these benefits have been estimated to be USD 1.9 trillion in the lifetime of all family supporters over users[7].

Women are the main unpaid workers, as they do three times more unpaid care than men and seven more years in unpaid work throughout their lives[76,77]. This time poverty limits the things that women can achieve in the fields of education, employment, income, health, and wellbeing. In the case of women especially, assistive technology is an intervention in gender equality so that both the female users and the female caregivers are able to engage more in the economic and social life[78].

HEALTH RETURN ON INVESTMENT

The supply of the four priority products would yield more than 1.3 billion quality-adjusted life years (QALYs) of an average 1.3 QALYs per person[7]. Products with the largest gain in QALY include the prostheses (8.9 QALYs in children, 5.2 in adults); wheelchairs (2.7 in children, 1.8 in adults); eyeglasses (1.8 in children, 1.1 in adults); and hearing aid (0.6 in children, 0.4 in adults)[7].

Assistive technology will produce health benefits by creating fewer secondary complications, increasing the ability to engage in physical activity, and improving management of the chronic condition. Individuals with disabilities are at higher risk of obesity, diabetes, cardiovascular disease and chronic fatigue that is inhibited with the help of assistive technology[79].

Mental health gains qualify as important gains. Individuals who are physically challenged have a higher rate of depression three times than the general population[80,81]. Dementia risk is augmented by hearing loss which leads to depression, balance issues and falls effects are also diminished as hearing aids prove to be effective[59,82,83].

Significant health ROI is associated with the access of healthcare services through assistive technology. In LMICs, the disabled are met with severe challenges: they encounter inaccessible mode of transportation (30% of those with disabilities and 20% without disabilities), difficulty in communication, attitudinal, and service denial (3 times more)[5]. The assistive technology promotes utilization significantly by providing physical access, facilitating communication and supporting attendance. Improved preventive and primary care access will result in system savings through avoiding complications[5].

SOCIAL RETURN ON INVESTMENT

Assistive technology has immense social benefits in terms of improved integration in the community. The social isolation is one of the significant issues of people without assistive technology due to limitations in mobility, barriers in communication, and stigma in society[84]. Assistive technology allows

participation by various channels. In children, assistive technology helps children to attend school, and interact with peers and thus assists in fostering friendships[85]. Research has shown that assistive technology has a significant impact by helping children to engage in meaningful group play[86].

The contribution of assistive technology to independence, dignity, and self-determination is an inherent social good which outweighs economic consideration. Self-sufficiency in the carrying out of daily tasks is one of the fundamental human rights provided in Article 19 of the CRPD[17].

The provision of assistive technology cuts across the gender equality goals perilously. Girls with assistive technology are further disadvantaged with the unemployment rate being 20% more than that of boys with comparable functional impairment[87]. Women with assistive technology face more employment barriers with the employment rate amongst women with disabilities being about 20% as compared to 30% among men with the same functional impairment[5,78].

NATIONAL PROGRAM EVIDENCE AND IMPLEMENTATION MODELS

Rwanda: Universal Eye Care Achievement

Rwanda was the first low-income nation that delivered universal eye care using strategic partnerships. With inadequate capacity as only 14 ophthalmologists were to cover 12 million individuals Rwanda joined forces with Vision for a Nation in 2010 to create a primary care based on nurses to provide eye care[10]. Its success was ensured by the speed in the expansion of its workforce, training 2,000 nurses in primary eye care and offering them equipment, protocols and integration into the existing primary healthcare buildings by 2016[10]. The program also showed that systematic screening and delivery of eyeglasses could be realized even in resource-limited environments since it achieved 500,000 screenings and 65,000 eye glasses in the initial 27 months[10]. The fact that the model was integrated into the already established health infrastructure made it sustainable even after the project is donor-funded.

Pakistan: Global Advocacy and National Action

Pakistan became a global leader in advocacy of assistive technology, which proved that even middle-income countries can become the global policy changer and at the same time, can strengthen local structures. In 2018 (WHA71.8) Pakistan sponsored the first World Health Assembly resolution on assistive technology, which jumpstarted the commitment of nations to assistive technology as a health system priority, surveying over 9,000 households in different geographic and demographic areas, finding 13.1% of the population in need of at least one assistive product[11]. These facts led to the creation of Pakistan National Assistive Technology Strategic Action Framework which defined the policy priorities, funding sources, and the channels of its implementation[11]. The case of Pakistan proves that the development of policies based on data is important and that countries can develop both local and international projects at the same time.

Philippines: Insurance Coverage Expansion

A good example of how national health insurance mechanisms can be used to increase access to assistive technology is the case of the Philippines. Deliberating the fact that out-of-pocket expenditures were now the biggest obstacle to the access of assistive technology, disability advocates and health system stakeholders liaised to create localized evidence on the lack of need and utilization trends with the aid of mobile data collection applications[12]. This testimony has been helpful in lobbying the insurance reform. In 2018, the Philippine Health Insurance Corporation (PhilHealth) designed comprehensive Z Benefit Packages to persons with disabilities, which covers the use of prosthesis, orthotics, wheelchairs, hearing aids, and other services such as the assessment, attaching, training, and follow-up[12]. The advantage packages eradicated or diminished user charges thus eliminating financial difficulties. The Philippines experience shows that insurance systems well developed and promoted may offer a lasting source of funding of assistive technology dispensation with the current health financing systems.

Discussion

This systematic review shows provision of assistive technology has significant measurable economic, health, and social returns. The 9:1 economic ROI position placed the assistive technology in better position relative to other established interventions, such as WHO Best Buys to prevent noncommunicable diseases (7:1 to 9:1 ROI)[8],

childhood education programs (7:1 to 10:1 ROI)[46], and strategies childhood vaccination (16:1 ROI)[47]. In addition to the monetary benefits, assistive technology creates more than 1 billion QALYs of transformative health and wellbeing gains and facilitates fundamental rights expressed in the CRPD and the other international frameworks[17].

The evidence indicates that impacts of assistive technology spread across several SDGs at the same time. Directly related benefits of enhanced assistive technology access to SDG 1 (No Poverty), SDG 3 (Good Health and Wellbeing), SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), and SDG 17 (Partnerships for the Goals), multi-sectoral collaboration is needed to bring disability-based exclusion reduction, and implementation must target enhancing income, preventing disability poverty cycles, improving health, advancing healthcare access[22,23]. This transversal effect places assistive technology as a high-leverage intervention to countries that are dedicated to the promise of the 2030 Agenda to leave no one behind[22].

Implementation requires integrated strategies addressing multiple dimensions simultaneously. Critical enablers include: (i) **Policy and legal frameworks** establishing assistive technology as a right, defining service standards, and clarifying governmental responsibilities[89]; (ii) **Sustainable financing mechanisms** including integration within Universal Health Coverage benefit packages, insurance reimbursement systems, and device loan and reuse programs[90]; (iii) **Supply chain strengthening** through market-shaping initiatives to reduce costs, improve quality, stimulate local production, and ensure availability of appropriate products[40]; (iv) **Workforce capacity development** expanding numbers and competencies of rehabilitation professionals, technicians, and community health workers capable of assessment, prescription, fitting, training, and follow-up[91]; and (v) **Awareness and demand generation** addressing stigma, promoting understanding of assistive technology benefits, and ensuring meaningful participation of persons with disabilities in all planning and implementation processes[92].

Rwanda, Pakistan, and the Philippines are examples of national programs that show that great progress can be made even in a facility with limited resources[10,11,12]. These experiences have some lessons that can be replicated: integration into current health systems can be made sustainable; nurse-led and community-based solutions can effectively increase access in areas in which specialist workforce is insufficient; insurance mechanisms can be used to create sustainability when properly implemented; data collection and evidence generation can be used to strengthen advocacy and policy making; and cross-sectoral partnerships can be established to leverage varied expertise and resources.

There are a number of drawbacks that should be mentioned. In certain settings, especially concerning the outcome of employment and the productivity increase, economic modelling uses assumptions that is necessitated by the lack of enough empirical information[7]. The weights of QALY are based on the researches in which the highest-income countries are the main participants and they might not fully deliver quality of life gains in various cultural settings[93]. The 55-year forecast creates uncertainties on the possibility of technological, social, and economic changes which can impact both expenses and gains in long durations of time. Many of the advantages cannot be measured in the economic model, such as lower costs of institutionalization, lower emergency healthcare use, less cyclical poverty in families, increased innovation capacity, and lower social protection spending, which indicates that the ROI estimates can be low[7]. The priority of future studies should be longitudinal studies in various settings of LMICs, culturally sensitive quality of life measurement, and detailed economic studies that consider additional benefits that are not yet quantified.

Regardless of the limitations, the evidence gives convincing reasons why an action should be taken immediately. The overlap of the human rights responsibilities, international development commitments, and the manifested economic returns presents the new age of opportunity to make a change. As the nations that focus on assistive technology will develop more effective, equal, and stronger societies, they will also be progressing towards international development objectives.

Conclusion

The evidence proves assistive technology as a high-return investment that brings a lot of

economic, health, and social benefits. The 9:1 ROI is very compelling and it targets almost 1 billion individuals who do not even have access now. It brings economic gains in excess of USD 10 trillion in the form of improved education, job, and output. Health returns of the same value of 1.3 billion QALYs capture a better physical and mental health, decreased secondary complications, and increased access to healthcare. Social returns include integration of community, independence, lessening of burden on caregivers, and progress of gender equality.

The countries should include assistive technology in the packages of essential benefits of Universal Health coverage, create sustainable funding sources such as insurance reimbursement and loan programs to procure devices, market-shaping programs to strengthen supply chain, and create enhanced training to capacity build the workforce, and have the persons with disabilities meaningfully engaged in all the processes of planning and implementation. The examples of national programs in Rwanda, Pakistan, and the Philippines show the viable ways to scale-based implementation that provides other countries with possible models to emulate.

The time for action is now. Providing the assistive technology is core to the 2030 Agenda when it promises to leave no one behind. Governments, the development partners, civil society organizations, the players of the private sector, and organizations of persons with disabilities should mobilize political will and financial resources to translate evidence to implementation at scale. The countries that focus on assistive technology will at the same time improve human rights, promote population health, enhance the economic productivity, and boost the movement towards the Sustainable Development Goals.

Conflict of Interest Statement:

None.

Funding Statement:

None.

Acknowledgements:

None.

ORCID ID:

Prof. (Dr.) Suman Badhal: 0000-0002-0345-5225
Mr. Arvind Vashist: 0009-0000-4717-0056
Dr. Ravinder Singh: 0000-0002-9970-415X

Author Contributions

Suman Badhal and Arvind Vashist were primarily responsible for writing and drafting the manuscript. Arvind Vashist additionally performed data interpretation and carried out all necessary revisions and amendments. Ravinder Singh conceptualized the study, provided the initial idea for the work, and conducted the final review and approval of the manuscript. All authors approved the final version of the manuscript.

References:

1. World Health Organization. Assistive Technology [Internet]. Who.int. World Health Organization: WHO; 2024. [cited 2025 Dec 11] Available from: https://www.who.int/news-room/fact-sheets/detail/assistive-technology

2. Assistive Product List [Internet]. Who.int. 2016 [cited 2025 Dec 11]. Available from: https://www.who.int/teams/health-product-policy-and-standards/product-policies-access-and-manufacturing-support/assistive-technology/promoting-access

3. Rohwerder B. Assistive technologies in developing countries [Internet]. 2018. [cited 2025 Dec 12] Available from: https://assets.publishing.service.gov.uk/media/5af976ab40f0b622d4e9810f/Assistive_technologies_in_developing-countries.pdf

4. Borg J, Lindström A, Larsson S. Assistive technology in developing countries. Prosthetics & Orthotics International [Internet]. 2011 Mar;35 (1):20–9. [cited 2025 Dec 11] Available from: https://doi.org/10.1177%2F0309364610389351

5. Health Organization. World Report on Disability [Internet]. World Health Organization. 2011. [cited 2025 Dec 11] Available from: https://www.who.int/teams/noncommunicable-diseases/sensory-functions-disability-and-rehabilitation/world-report-on-disability

6. Maclachlan M, Swartz L, editors. Disability & International Development. New York, NY: Springer US; 2009.

7. The case for investing in assistive technology | ATscale [Internet]. Atscalepartnership.org. 2020 [cited 2025 Dec 11]. Available from: https://atscalepartnership.org/atscale-publications/case-investing-assistive-technology

8. WHO. Tackling NCDs [Internet]. www.who.int. 2017. [cited 2025 Dec 12] Available from: https://www.who.int/publications/i/item/WHO-NMH-NVI-17.9

9. Gimigliano F, Negrini S. The World Health Organization "Rehabilitation 2030: a call for action." European Journal of Physical and Rehabilitation Medicine. 2017 May;53(2).

10. Binagwaho A, Scott K, Rosewall T, Mackenzie G, Rehnborg G, Hannema S, et al. Improving eye care in Rwanda. Bulletin of the World Health Organization [Internet]. 2015 Jun 1 [cited 2025 Dec 17];93(6):429–34. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4450705/

11. Country Cooperation Strategy for WHO and Pakistan 2020-2025 [Internet]. [cited 2025 Dec 19] Available from: https://applications.emro.who.int/docs/9789290226635-eng.pdf

12. PhilHealth Introduces Z Benefit Package for Children with Developmental Disabilities [Internet]. Philhealth.gov.ph. 2018. [cited 2025 Dec 13] Available from: https://www.philhealth.gov.ph/news/2018/zben_cdd.html

13. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global Burden of 369 Diseases and Injuries in 204 Countries and territories, 1990–2019: a Systematic Analysis for the Global Burden of Disease Study 2019. The Lancet [Internet]. 2020 Oct 17;396(10258):1204–22. [cited 2025 Dec 15] Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30925-9/fulltext

14. Technology transfer aids hearing. Bulletin of the World Health Organization. 2013 Jul 1;91(7):471–2.

15. Wheelchair provision guidelines [Internet]. www.who.int. [cited 2025 Dec 14] Available from: https://www.who.int/publications/i/item/9789240074521

16. Eyeglasses for Global Development: Bridging the Visual Divide [Internet]. 2016. [cited 2025 Dec 17] Available from: https://www3.weforum.org/docs/WEF_2016_EYElliance.pdf

17. United Nations. Convention on the Rights of Persons with Disabilities [Internet]. United Nations. United Nations; 2006 p. 1–37. [cited 2025 Dec 17] Available from: https://www.un.org/disabilities/documents/convention/convoptprot-e.pdf

18. Nations U. UN Disability and Development Report – Realizing the SDGs by, for and with persons with disabilities | United Nations [Internet]. United Nations. 2023. [cited 2025 Dec 11] Available from: https://www.un.org/en/desa/un-disability-and-development-report-%E2%80%93-realizing-sdgs-and-persons-disabilities

19. Banks L, Polack S, Morgon Banks L. The Economic Costs of Exclusion and Gains of Inclusion of People with Disabilities Evidence from Low and Middle Income Countries The Economic Costs of Exclusion and Gains of Inclusion of People with Disabilities: Evidence from Low and Middle Income

Countries [Internet]. [cited 2025 Dec 12]Available from: https://www.iapb.org/wp-content/uploads/CBM_Costs-of-Exclusion-and-Gains-of-Inclusion-Report_2015.pdf

20. Lifeworks. The Business Case for Disability Inclusion - Lifeworks | Lifeworks [Internet]. Lifeworks. 2025. [cited 2025 Dec 21] Available from: https://www.lifeworks.org/blog/the-business-case-for-disability-inclusion/

21. Buckup S. ILO Employment Sector Working Paper No. 43," The price of exclusion: The economic consequences of excluding people with disabilities from the world of work [Internet]. 2009. [cited 2025 Dec 26] Available from: https://www.researchgate.net/publication/239823559_ILO_Employment_Sector_Working_Paper_No_43_The_price_of_exclusion_The_economic_consequences_of_excluding_people_with_disabilities_from_the_world_of_work

22. General UN. Transforming our world: the 2030 Agenda for Sustainable Development :: resolution /: adopted by the General Assembly [Internet]. United Nations Digital Library System. UN,; 2015. [cited 2025 Dec 13] Available from: https://digitallibrary.un.org/record/3923923?ln=en&v=pdf

23. Nations U. UN Disability and Development Report – Realizing the SDGs by, for and with persons with disabilities | United Nations [Internet]. United Nations. 2023. [cited 2025 Dec 18] Available from: https://www.un.org/en/desa/un-disability-and-development-report-%E2%80%93-realizing-sdgs-and-persons-disabilities

24. UNDRR. Sendai Framework for Disaster Risk Reduction 2015-2030 [Internet]. UNDRR. 2015. [cited 2025 Dec 22] Available from: https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

25. Financing for Sustainable Development [Internet]. [cited 2025 Dec 15] www.un.org. Available from: https://www.un.org/esa/ffd/publications/aaaa-outcome.html

26.Caprotti F, Cowley R, Datta A, Broto VC, Gao E, Georgeson L, et al. The New Urban Agenda: key opportunities and challenges for policy and practice. Urban Research & Practice. 2017 Jan 9;10(3):367–78.

27. Tebbutt E, Brodmann R, Borg J, MacLachlan M, Khasnabis C, Horvath R. Assistive products and the Sustainable Development Goals (SDGs). Globalization and Health. 2016 Nov 29;12(1).

28. Priority Assistive Products list [Internet]. www.who.int. [cited 2025 Dec 11] Available from: https://www.who.int/publications/i/item/priority-assistive-products-list

29. World Health Organization. Global Report on Assistive Technology [Internet]. www.who.int. 2022. [cited 2025 Dec 11] Available from: https://www.who.int/publications/i/item/9789240049451

30. Banks LM, Kuper H, Polack S. Poverty and disability in low- and middle-income countries: A systematic review. Van Wouwe JP, editor. PLOS ONE. 2017 Dec 21;12(12):e0189996.

31. Marasinghe KM, Lapitan JM, Ross A. Assistive technologies for ageing populations in six low-income and middle-income countries: a systematic review. BMJ Innovations [Internet]. 2015 Oct 1;1(4). [cited 2025 Dec 20] Available from: https://innovations.bmj.com/content/1/4/182

32. ATscale Global Partnership [Internet]. [cited 2025 Dec 19] ATscale. Available from: https://atscalepartnership.org/

33. World Bank. World Bank Country and Lending Groups [Internet]. [cited 2025 Dec 18] The World Bank. 2024. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

34. Psacharopoulos G, Patrinos HA. Returns To Investment in Education: A Decennial Review of the Global Literature. Education Economics [Internet]. 2018;26(5):445–58. [cited 2025 Dec 23] Available from: https://www.tandfonline.com/doi/full/10.1080/09645292.2018.1484426

35. E.,Patrinos C. Comparable estimates of returns to schooling around the world [Internet]. World Bank. 2025 [cited 2025 Dec 24]. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/830831468147839247

36. Buckup S. ILO Employment Sector Working Paper No. 43," The price of exclusion: The economic consequences of excluding people with disabilities from the world of work [Internet]. 2009. [cited 2025 Dec 17] Available from: https://www.researchgate.net/publication/239823559_ILO_Employment_Sector_Working_Paper_No_43_The_price_of_exclusion_The_economic_con

sequences_of_excluding_people_with_disabilities_from_the_world_of_work

37. The business case for change [Internet]. [cited 2025 Dec 14] Available from: https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_700953.pdf

38. Lund EM. Community-Based Services and Interventions for Adults With Disabilities Who Have Experienced Interpersonal Violence: A Review of the Literature. Trauma, Violence, & Abuse. 2011 Sep 8;12(4):171–82.

39. Drummond M, Sculpher M, Claxton K, Stoddart G, Torrance G. Methods for the economic evaluation of health care programmes. 4th ed. Oxford, United Kingdom; New York, Ny, Usa: Oxford University Press; 2015.

40. DIGITAL ASSISTIVE TECHNOLOGY [Internet]. [cited 2025 Dec 21] Available from: https://at2030.org/static/at2030_core/outputs/Product_Narrative_Digital_Assistive_Technology_a11y.pdf

41. Sassi F. Calculating QALYs, comparing QALY and DALY calculations. Health Policy and Planning [Internet]. 2006 Jul 28;21(5):402–8. [cited 2025 Dec 18] Available from: https://academic.oup.com/heapol/article/21/5/402/578296

42. DAVIES A, SOUZA LHD, FRANK AO. Changes in the quality of life in severely disabled people following provision of powered indoor/outdoor chairs. Disability and Rehabilitation. 2003 Jan; 25(6):286–90.

43. Persson J, Husberg M. Can we rely on QALYs for assistive technologies? Brandt Å, Alwin J, editors. Technology and Disability. 2012 Jan 20; 24(1):93–100.

44. Park Y, Shin JA, Yang SW, Yim HW, Kim HS, Park YH. The Relationship between Visual Impairment and Health-Related Quality of Life in Korean Adults: The Korea National Health and Nutrition Examination Survey (2008–2012). Marengoni A, editor. PLOS ONE. 2015 Jul 20; 10(7):e0132779.

45. Pennington M, Grieve R, Black N, van der Meulen JH. Cost-Effectiveness of Five Commonly Used Prosthesis Brands for Total Knee Replacement in the UK: A Study Using the NJR Dataset. Green C, editor. PLOS ONE. 2016 Mar 4;11(3):e0150074.

46. Psacharopoulos G, Patrinos HA. Returns to investment in education: a further update. Education Economics. 2004 Aug;12(2):111–34.

47. Ozawa S, Clark S, Portnoy A, Grewal S, Brenzel L, Walker DG. Return On Investment From Childhood Immunization In Low- And Middle-Income Countries, 2011–20. Health Affairs. 2016 Feb;35(2):199–207.

48. Johnson J, Myers AM, Jones GR, Fitzgerald C, Lazowski DA, Stolee P, et al. Evaluation of the Restorative Care Education and Training Program for Nursing Homes. Canadian journal on aging. 2005 Jan 1;24(2):115–26.

49. Twardzik E, Falvey JR, Clarke P, Freedman VA, Schrack J. Public transit stop density is associated with walking for exercise among a national sample of older adults. BMC Geriatrics. 2023 Sep 26;23(1).

50. Mont DM. Measuring disability prevalence [Internet]. World Bank. 2025 [cited 2025 Dec 17]. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/578731468323969519

51. Glewwe P, Kremer M. Chapter 16 Schools, Teachers, and Education Outcomes in Developing Countries. Handbook of the Economics of Education. 2006;2:945–1017.

52. Filmer D. Disability, Poverty, and Schooling in Developing Countries: Results from 14 Household Surveys. The World Bank Economic Review. 2008 Jan 1;22(1):141–63.

53. Kuper H, Monteath-van Dok A, Wing K, Danquah L, Evans J, Zuurmond M, et al. The Impact of Disability on the Lives of Children; Cross-Sectional Data Including 8,900 Children with Disabilities and 898,834 Children without Disabilities across 30 Countries. Federici S, editor. PLoS ONE. 2014 Sep 9;9(9):e107300.

54. The State of the World's Children 2013 [Internet]. Unicef.org. 2019 [cited 2025 Dec 23]. Available from: https://www.unicef.org/documents/state-worlds-children-2013

55. Banks LM, Zuurmond M, Ferrand R, Kuper H. The relationship between HIV and prevalence of disabilities in sub-Saharan Africa: systematic review (FA). Tropical Medicine & International Health. 2015 Jan 14;20(4):411–29.

56. Borg J, Östergren PO. Users' perspectives on the provision of assistive technologies in

Bangladesh: awareness, providers, costs and barriers. Disability and Rehabilitation: Assistive Technology. 2014 Oct 27;10(4):301–8.

57. Visagie S, Scheffler E, Schneider M. Policy implementation in wheelchair service delivery in a rural South African setting. African Journal of Disability. 2013 Sep 6;2(1).

58. Sacks SZ, Wolffe KE, Tierney D. Lifestyles of Students with Visual Impairments: Preliminary Studies of Social Networks. Exceptional Children. 1998 Jun;64(4):463–78.

59. Dawes P, Emsley R, Cruickshanks KJ, Moore DR, Fortnum H, Edmondson-Jones M, et al. Hearing Loss and Cognition: The Role of Hearing Aids, Social Isolation and Depression. Johnson B, editor. PLOS ONE [Internet]. 2015 Mar 11;10(3): e0119616. [cited 2025 Dec 18] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4356542/

60. Marasinghe KM, Lapitan JM, Ross A. Assistive technologies for ageing populations in six low-income and middle-income countries: a systematic review. BMJ Innovations [Internet]. 2015 Oct 1;1(4). [cited 2025 Dec 19] Available from: https://innovations.bmj.com/content/1/4/182

61. Christine Irene Forlin, Sharma U, Joanne Marie Deppeler, Yang G. Reforming Teacher Education for Inclusion in Developing Countries in the Asia-Pacific Region. 2013 Jan 31;01(1):03-16.

62. Borg J, Lindström A, Larsson S. Assistive technology in developing countries: national and international responsibilities to implement the Convention on the Rights of Persons with Disabilities. The Lancet. 2009 Nov;374(9704):1863–5.

63. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B. Developmental potential in the first 5 years for children in developing countries. The Lancet [Internet]. 2007 Jan 6;369(9555):60–70. [cited 2025 Dec 13] Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(07)60032-4/fulltext

64. Walker SP, Wachs TD, Grantham-McGregor S, Black MM, Nelson CA, Huffman SL, et al. Inequality in early childhood: risk and protective factors for early child development. The Lancet [Internet]. 2011 Oct;378(9799):1325–38. [cited 2025 Dec 21] Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(11)60555-2/fulltext

65. Mitra S, Posarac A, Vick B. Disability and Poverty in Developing Countries: A Multidimensional Study. World Development. 2013 Jan;41:1–18.

66. Mizunoya S, Mitra S, Yamasaki I. Disability and school attendance in 15 low- and middle-income countries. World Development [Internet]. [cited 2025 Dec 15] 2018;104(C):388–403. [cited 2025 Dec 11] Available from: https://ideas.repec.org/a/eee/wdevel/v104y2018icp388-403.html

67. Mitra S, Sambamoorthi U. Wage differential by disability status in an agrarian labour market in India. Applied Economics Letters. 2009 Sep 30; 16(14):1393–8.

68. Frick KD. Economic Impact of Visual Impairment and Blindness in the United States. Archives of Ophthalmology. 2007 Apr 1;125(4):544.

69. Jung D, Bhattacharyya N. Association of Hearing Loss with Decreased Employment and Income among Adults in the United States. Annals of Otology, Rhinology & Laryngology. 2012 Dec; 121(12):771–5.

70. Wheelchair Provision in Nepal: Biratnagar, Koshi Province AT2030 Workshop Report Workshop Report Provincial Report [Internet]. 2025 [cited 2025 Dec 24]. Available from: https://at2030.org/static/at2030_core/outputs/1-Biratnagar-Koshi-Proivince-WC-Provision-Report.pdf

71. Shore S, Juillerat S. The impact of a low cost wheelchair on the quality of life of the disabled in the developing world. Medical Science Monitor. 2012;18(9):CR533–42.

72. Reddy PA, Congdon N, MacKenzie G, Gogate P, Wen Q, Jan C, et al. Effect of providing near glasses on productivity among rural Indian tea workers with presbyopia (PROSPER): a randomised trial. The Lancet Global Health [Internet]. 2018 Sep;6(9):e1019–27. [cited 2025 Dec 17] Available from: https://visionspring.org/Files/PublicFiles/Research/PROSPER-RCT-Study_Lancet-20180723.pdf

73. Patel I, Munoz B, Burke AG, Kayongoya A, Mchiwa W, Schwarzwalder AW, et al. Impact of Presbyopia on Quality of Life in a Rural African Setting. Ophthalmology. 2006 May;113(5):728–34.

74. Ma X, Zhou Z, Yi H, Pang X, Shi Y, Chen Q, et al. Effect of providing free glasses on children's educational outcomes in China: cluster randomized controlled trial. The BMJ [Internet]. 2014 Sep

23;349. [cited 2025 Dec 18] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4172821/

75. Rosenfield M, Carrel MF. Effect of near-vision addition lenses on the accuracy of the accommodative response. Optometry (St Louis, Mo) [Internet]. 2001 Jan;72(1):19–24. [cited 2025 Dec 20] Available from: https://pubmed.ncbi.nlm.nih.gov/11217002/

76. ILO. Care Work and Care Jobs for the Future of Decent Work | International Labour Organization [Internet]. www.ilo.org. 2018. [cited 2025 Dec 16] Available from: https://www.ilo.org/publications/major-publications/care-work-and-care-jobs-future-decent-work

77. Unpaid Care Work: The Missing Link in the Analysis of Gender Gaps in Labour Outcomes [Internet]. OECD. 2024. [cited 2025 Dec 15] Available from: https://www.oecd.org/en/publications/unpaid-care-work-the-missing-link-in-the-analysis-of-gender-gaps-in-labour-outcomes_1f3fd03f-en.html

78. Bank W. Women, Business and the Law 2020 [Internet]. openknowledge.worldbank.org. Washington, DC: World Bank; 2020. [cited 2025 Dec 11] Available from: https://openknowledge.worldbank.org/entities/publication/7502ec1b-038c-557d-849d-4fc4b26ff6fb

79. Rimmer JH, Rowland JL. Health Promotion for People With Disabilities: Implications for Empowering the Person and Promoting Disability-Friendly Environments. American Journal of Lifestyle Medicine. 2008 Sep;2(5):409–20.

80. World Health Organization. Mental health [Internet]. World Health Organization. 2022. [cited 2025 Dec 14] Available from: https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

81. Brådvik L. Suicide Risk and Mental Disorders. International Journal of Environmental Research and Public Health [Internet]. 2018 Sep 17;15(9):2028 [cited 2025 Dec 10]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6165520/

82. Livingston G, Huntley J, Sommerlad A, Ames D, Ballard C, Banerjee S, et al. Dementia Prevention, Intervention, and Care: 2020 Report of the Lancet Commission. The Lancet. 2020 Jul 30;396(10248):413–46.

83. Wingfield A, Peelle JE. The effects of hearing loss on neural processing and plasticity. Frontiers in Systems Neuroscience. 2015 Mar 6;9.

84. Emerson E, Fortune N, Llewellyn G, Stancliffe R. Loneliness, Social Support, Social Isolation and Wellbeing among Working Age Adults with and without Disability: Cross sectional study. Disability and Health Journal [Internet]. 2020 Aug 5;14(1) [cited 2025 Dec 5]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7403030/

85. Law M, Petrenchik T, King G, Hurley P. Perceived Environmental Barriers to Recreational, Community, and School Participation for Children and Youth With Physical Disabilities. Archives of Physical Medicine and Rehabilitation. 2007 Dec; 88(12):1636–42.

86. Wagner AR, Feil-Seifer D, Haring KS, Rossi S, Williams T, Hongsheng He, et al. Social Robotics : 12th International Conference, ICSR 2020, Golden, CO, USA, November 14-18, 2020, Proceedings. Cham: Springer International Publishing; 2020.

87. Unesco.org. 2020. [cited 2025 Dec 12] Available from: https://unesdoc.unesco.org/ark:/48223/pf0000146931

88. SEVENTY-FIRST WORLD HEALTH ASSEMBLY WHA71.8 Agenda item 12.5 Improving access to assistive technology, 2018 [Internet] [cited 2025 Dec 12]. Available from: https://apps.who.int/gb/ebwha/pdf_files/WHA71/A71_R8-en.pdf

89. World Health Organization. Global Report on Assistive Technology, Chapter 5, Policy and legislation; p. 91-110 [Internet] [cited 2025 Dec 12]. www.who.int. 2022. Available from: https://www.who.int/publications/i/item/9789240049451

90. World Health Organization. Global Report on Assistive Technology, Chapter 6, Sustainable financing; p. 111-28 [Internet] [cited 2025 Dec 12]. www.who.int. 2022. Available from: https://www.who.int/publications/i/item/9789240049451

91. World Health Organization. Global Report on Assistive Technology, Chapter 8, Workforce; p. 145-60 [Internet] [cited 2025 Dec 12]. www.who.int. 2022. Available from: https://www.who.int/publications/i/item/9789240049451

92. World Health Organization. Global Report on Assistive Technology, Chapter 10, User involvement; p. 177-88 [Internet] [cited 2025 Dec 12]. www.who.int. 2022. Available from:

https://www.who.int/publications/i/item/9789240049451

93. Ustün TB, Chatterji S, Bickenbach J, Kostanjsek N, Schneider M. The International Classification of Functioning, Disability and Health: a new tool for understanding disability and health. Disability and Rehabilitation [Internet]. 2003 Jun 3;25(11-12):565–71 [cited 2025 Dec 16]. on Available from: https://pubmed.ncbi.nlm.nih.gov/12959329/